SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community

TRASH ASSESSMENTS IN SIX WATERSHEDS IN SAN MATEO COUNTY, CALIFORNIA

1.0 INTRODUCTION

California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) staff has indicated that trash potentially impairs water quality in all Bay Area surface waters (SFBRWQCB 2001). At the Water Board's recommendation, all Bay area urban creeks, lakes and shorelines were placed on the State Water Resources Control Board 2002 "Monitoring List" due to the potential for trash to impair water quality. In response, the Watershed Assessment and Monitoring (WAM) component of the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) initiated a program to begin identifying and addressing trash problem areas in urban creeks in San Mateo County. Most recently, the WAM component conducted trash assessments in six San Mateo County watersheds. This report documents the methodology used and results of these trash assessments and provides recommendations for future activities to address trash in the county's urban creeks. The primary objectives of this study included:

- Identifying trash-impacted sites in six urban creek watersheds in San Mateo County;
- Evaluating the status and condition with respect to trash of selected impacted creek sites, including establishing a baseline against which to track future trends;
- Identifying primary trash sources and transport pathways at selected impacted sites;
- Identifying Best Management Practices (BMPs) for potential implementation at selected impacted sites; and
- Collecting data that will inform development of an overall strategy to address trash in urban creeks in San Mateo County.

It should be noted that Water Board staff is currently developing specific trash-related provisions for the Bay Area stormwater NPDES Municipal Regional Permit (MRP). The MRP will replace existing countywide NPDES permits held by San Francisco Bay Area Phase I stormwater programs, including SMCWPPP. It is anticipated that these provisions will include requirements for assessing trash in urban creeks using similar methods to those used in this study.

2.0 BACKGROUND

Addressing trash became a higher priority in the Bay Area with the release of a Water Board report in 2001 that described how trash potentially impairs water quality in all Bay Area urban creeks (SFBRWQCB 2001). The following sections describe some of the trash-related activities performed since that time in the Bay Area by the Water Board, SMCWPPP and other organizations.

2.1 Rapid Trash Assessment

Beginning in 2001, Water Board staff developed a Rapid Trash Assessment (RTA) methodology as a tool to monitor the amount and types of trash in creeks and inform efforts to identify sources and controls. SMCWPPP subsequently developed a work plan to pilot-test this procedure (STOPPP 2002). SMCWPPP implemented the work plan during September 2002 in collaboration with the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). The pilot study (SCVURPPP and STOPPP 2003) concluded that the RTA procedure might be useful for:

- Measuring baseline levels of trash;
- Identifying and prioritizing trash problem areas;
- Identifying potential sources of trash; and
- Identifying BMPs that target trash and evaluating their effectiveness.

The study concluded that implementing the RTA at all urban creeks in jurisdictions the size of San Mateo and Santa Clara Counties would be infeasible; rather, priority should be given to evaluating known accumulation and dumping areas. The study also recommended modifications to the RTA that would increase its usefulness in municipal trash control programs. Water Board staff subsequently released updated versions of the RTA that incorporated some of the pilot study's recommended modifications.

2.2 Surface Water Ambient Monitoring Program

Between 2001 and 2004, Water Board staff conducted trash assessments using the RTA as part of the Surface Water Ambient Monitoring Program (SWAMP). Eighty-five trash assessments were conducted at 27 stream locations throughout the San Francisco Bay region (SFBRWQCB 2007).

2.3 Municipal Survey

In June 2003, SMCWPPP submitted a FY 2003/04 trash control work plan (STOPPP 2003) to the Water Board. The work plan tasks included surveying San Mateo County municipalities regarding known trash accumulation/dumping areas and existing municipal trash management efforts. SMCWPPP also convened a trash control work group to oversee the survey and generally assist efforts to assess and manage trash in San Mateo County. The work group included maintenance, parks and recreation, code enforcement and recycling program staff from the SMCWPPP's municipalities.

The completed survey report (STOPPP 2004) summarized activities carried out by most San Mateo County municipalities that fall under three general categories of municipal trash management practices:

- Local government services to collect and cleanup trash, including routine trash collection, street sweeping, storm drain facility maintenance, recycling programs, trash cleanup services by municipal staff or contractors, and facilitation of volunteer creek/shoreline cleanup events.

- Enforcement procedures to discourage littering, dumping, and discharge of trash, including the use of code enforcement staff to enforce municipal ordinances related to trash, inspection of construction sites and source control conditions of approval for trash/recycling areas at new developments.

- Incentive and education programs, such as anti-littering campaigns, community recognition programs, and outreach at community events regarding litter control.

The survey report also discussed municipal organizational structure in relation to trash management and how municipalities evaluate the success of their trash management activities. Finally, the report documented trash accumulation/dumping sites reported by municipal staff, including the location of each site, the origin of the trash, and the source of information about the site. Most of the reported accumulation/dumping sites were not within creeks.

2.4 Pilot Study

During FY 2004/05, the SMCWPPP initiated a pilot study to identify trash sources and management measures at a selected in-stream trash accumulation area. The methodology included assessing trash condition at a downstream location of an urban watershed and evaluating potential trash sources and transport pathways that may impact the site. A reach of San Mateo Creek in Gateway Park in the City of San Mateo was selected for the pilot study. Version 7.0 of the Water Board's RTA was used at the study site during three different hydrologic periods: the dry season, wet season, and in the spring. In addition, City of San Mateo staff was interviewed to identify potential trash sources and transport pathways, and current municipal trash management activities.

Trash assessment results from the pilot study showed that trash persistently accumulated at the site despite removal of trash during each assessment. Littering and illegal dumping at the site and nearby upstream bridges were identified as likely trash sources impacting the site. Although the trash assessment results were useful in identifying trash sources and potential trash management measures at Gateway Park, further confirmation in the utility of the methodology would require additional pilot testing at a variety of trash sites.

2.5 Urban Rapid Trash Assessment

During FY 2005/06, the SCVURPPP revised the Water Board's RTA protocol to increase its utility in evaluating trash conditions at highly impacted sites in urban watersheds. The revisions were intended to enhance the ability of municipal staff to use this tool to identify, prioritize and evaluate trash management activities in urban creeks. The revised protocol is referred to as the Urban Rapid Trash Assessment (URTA). Version 1.0 of the URTA incorporates new trash categories and parameter thresholds to characterize trash conditions.

3.0 METHODS

3.1 Identification of Creek Sites Impacted by Trash

SMCWPPP conducted creek walks during October and November 2006 in six San Mateo County watersheds using the Unified Stream Assessment (USA) protocol (CWP

2004). Assessments were conducted within urbanized reaches of Belmont Creek, Cordilleras Creek, Laurel Creek, Pulgas Creek, San Mateo Creek and San Pedro Creek. SMCWPPP (2007) provides complete results of the USA assessment.

One component of the USA is to document creek areas impacted by trash. General characteristics were documented at each of the sites including types of trash, sources (i.e., littering,[1] illegal dumping,[2] and accumulation from upstream sources) and adjacent land uses. In general, two of the relatively highly trash-impacted sites identified in each watershed during the USA were selected for more detailed assessments using the URTA. If the USA identified less than two appropriate and accessible trash-impacted sites in a watershed, additional sites were identified for the purposes of this study so that a total of two sites from each watershed were selected for the URTA.

It is important to note that the sites selected for more detailed assessments were not intended to represent trash conditions throughout the watershed. Instead, relatively impacted sites were selected to identify and prioritize major trash sources and to begin to identify specific management actions to address these sources. Furthermore, information from these assessments of relatively impacted sites will inform development of an overall strategy to address trash in San Mateo County creeks.

3.2 Trash Assessments at Impacted Sites

The URTA protocol (Version 1.0) was used to evaluate trash conditions at two locations within each of the six study watersheds, for a total of 12 sites. The URTA was conducted twice at each site, once during fall 2006 and a second time during spring 2007, for a total of 24 assessments. The URTA was applied at a defined 100-foot section of creek. Where possible, the starting or end points of the assessment reach were marked by easily identifiable landmarks (e.g., bridge crossing, storm drain culvert). The upper and lower boundaries of the stream banks were also defined to distinguish location of trash items found on creek banks (i.e., above the high water line) versus within the creek channel. Trash was enumerated using tally sheets and removed from the site.

The URTA includes six condition parameters that relate to a range of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the next two parameters evaluate specific types of trash items relevant to water quality and the last two parameters assess how trash enters the creek site (i.e., littering, illegal dumping or accumulation from upstream sources). Appendix A contains further documentation on the URTA.

4.0 RESULTS

4.1 Location and Characteristics of Creek Sites Impacted by Trash

A total of seventeen sites impacted by trash were identified during the USA in the six

[1]Littering refers to when individual(s) leave trash behind in the course of other activities at a creek site (e.g., walking, picnicking).
[2]Dumping refers to when individual(s) in a premeditated action dispose of a relatively large quantity of trash onto the creek bank or bed.

study watersheds. Three additional trash sites were identified for the URTA analysis - two sites in Pulgas Creek and one site in Cordilleras Creek. These sites were either out of the USA study area or were more accessible than the sites identified during the USA. Table 1 gives the locations and general characteristics of the trash-impacted sites identified during the USA and the sites assessed in more detail using the URTA. Figure 1 shows the site locations.

Table 1. Location and general characteristics of twenty creek sites in six San Mateo County Watersheds documented as impacted by trash during USA and/or assessed in greater detail using the URTA.

Site ID	Watershed	Location	USA Site	URTA Site	Trash Source[1]	Adjacent Land Use
B-1	Belmont	Below Maywood Dr	X	X	TA	Residential
B-2	Belmont	Behind Carlmont Shopping Mall	X	X	L, ID	Commercial
C-1	Cordilleras	Between Industrial and Stafford	X		TA	Industrial, residential
C-2	Cordilleras	Below Stafford Rd		X	L	School, residential
C-3	Cordilleras	Parking lot at Laurel and Eaton	X	X	L, ID	Commercial, residential
C-4	Cordilleras	Cordilleras Rd	X		ID	Residential
L-1	Laurel	Footbridge at Hillsdale Shopping Mall	X	X	L, ID	Commercial, park
L-2	Laurel	Below footbridge at Hillsdale apartments	X	X	ID	Residential apartments, park
L-3	Laurel	Laurelwood Dr	X		TA, ID	Residential, park
P-1	Pulgas	Old County Rd		X	TA	Commercial, industrial
P-2	Pulgas	Below Alameda de las Pulgas		X	TA	Residential
P-3	Pulgas	Cambridge and Molton	X		L, TA	Residential
SM-1	San Mateo	Above Fremont	X		TA, ID	Residential
SM-2	San Mateo	Below Delaware	X		TA, ID	Residential
SM-3	San Mateo	Below Claremont	X	X	L, ID	Residential apartments
SM-4	San Mateo	Above Caltrain Bridge	X	X	L, ID	Commercial, transportation
SM-5	San Mateo	Roblar and El Cerrito	X		ID	Residential
SM-6	San Mateo	Crystal Springs Rd	X		L, ID	Open space
P-1	San Pedro	Below Peralta Ave	X	X	TA	Residential
P-2	San Pedro	Below North Fork Culvert	X	X	TA	Residential, commercial

[1] Littering (L); Illegal Dumping (ID); Trash Accumulation (TA)

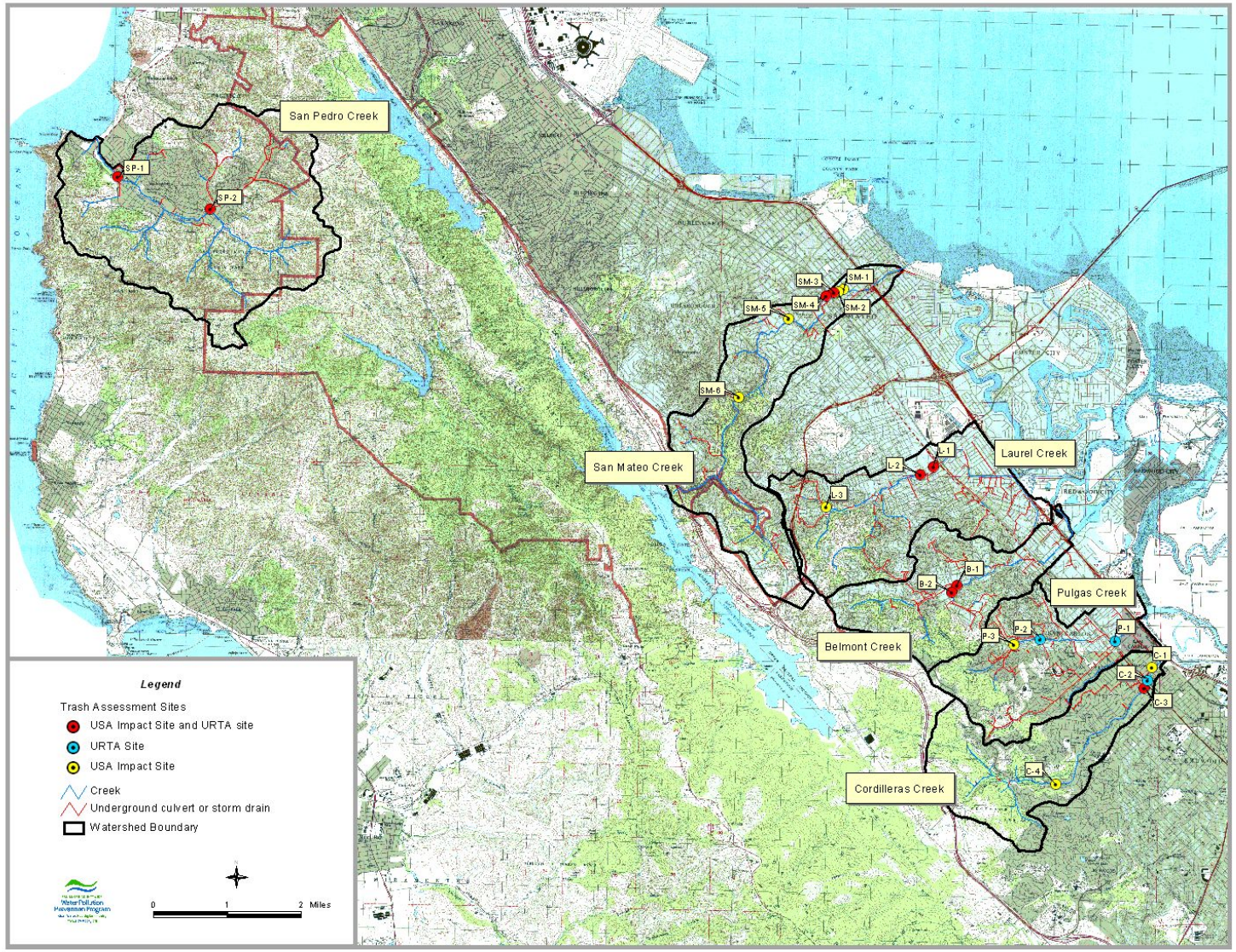

Figure 1. Impacted trash sites identified during the USA and sites assessed using the URTA in six San Mateo County watersheds.

The majority of the trash-impacted sites found in the five Bay-side watersheds were located in close proximity to major transportation corridors and commercial land uses, including eight sites near El Camino Real and three sites near Alameda de las Pulgas. Trash sources at sites in these areas tended to be littering and/or illegal dumping. At sites adjacent to primarily residential land uses, trash impacts were generally associated with trash accumulation from upstream sources or illegal dumping of yard waste. Minimal amounts of trash were observed in the creek areas west of El Camino Real adjacent to primarily residential land uses, with the exception of Belmont Creek which has both commercial and residential areas between El Camino Real and Alameda de las Pulgas.

A different pattern was observed in the San Pedro Creek watershed compared to the Bay-side watersheds. Two trash-impacted sites were observed. The largest trash impact occurred in the upper reaches of the mainstem; the trash at this site primarily originated from the North Fork outfall. The lower impacted site was close to the mouth of the creek at Pacifica State Beach. At both sites trash primarily accumulated from upstream sources. Relatively small amounts of trash were also observed in the mainstem of San Pedro Creek below the North Fork confluence, primarily at locations with a high density of vegetation in the channel.

4.2 Urban Rapid Trash Assessments

4.2.1 Status and Condition of Trash-impacted Sites

Table 2 presents the URTA scores given to the twelve creek sites during assessments in the fall and spring seasons (n=24). The scores ranged between 18 and 99. Scores of 0 to 30 suggest poor conditions, 31 to 60 suggest marginal conditions, 61 to 90 suggest suboptimal conditions and 91 to 120 suggest optimal conditions. The three lowest scores were received by the two sites in San Mateo Creek and the lower site in Laurel Creek during the fall season. These three sites also had the highest total number of trash items. The four highest scores were received by the upper site in Pulgas Creek and the lower site in Cordilleras Creek during both seasonal periods. These two sites also had the lowest total number of trash items.

Figure 2 is a frequency histogram of the fall URTA scores, which represent the baseline trash condition at the twelve sites. Baseline scores do not include the spring assessments since trash removal during the fall assessments may have influenced the spring scores. Approximately 33% of the sites were characterized as suboptimal (n=4), 42% were characterized as marginal (n=5) and 25% were characterized as poor (n=3).

Baseline URTA assessment scores for the upstream and downstream assessment sites within each watershed are shown on Figure 3. The combined upper and lower site scores were lowest in the San Mateo and Laurel Creek watersheds. There was no trend in scores with respect to watershed location (i.e., scores were lower at the downstream site for three watersheds and higher at the downstream sites for the other three).

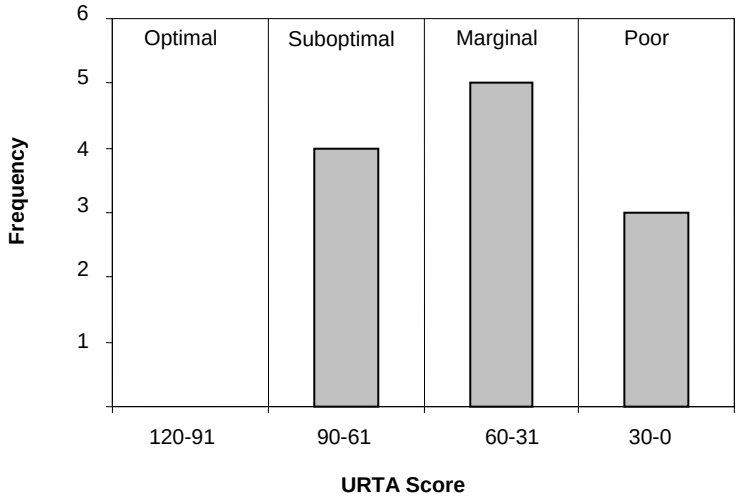

Figure 2. Frequency histogram of baseline URTA scores for 12 sites in six San Mateo County watersheds.

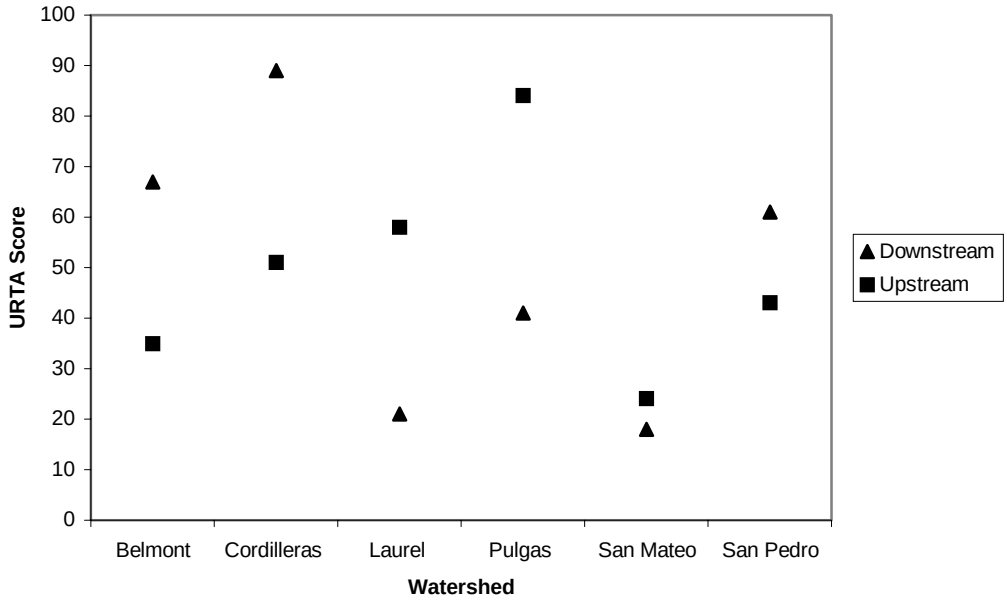

Figure 3. URTA scores from trash assessments conducted during fall 2006 at two sites in six San Mateo County watersheds.

Table 2. Total and individual parameter scores and total number of trash items documented during trash assessments conducted at 12 creek locations during fall 2006 and spring 2007.

Watershed	Site	Date	1 Qual-itative Trash Level	2 Quan-titative Trash Level	3 Trans-portable Items	4a Hazar-dous Items	4b Access	5a Dumping	5b Litter	6 Accum-ulation	Total Score	Total Trash Items
Belmont Creek	Maywood Drive	Oct-06	10	13	8	5	7	10	10	4	67	188
	Maywood Drive	Apr-07	13	8	2	8	7	8	10	2	58	368
	Shopping Center	Oct-06	5	9	4	5	1	5	1	5	35	302
	Shopping Center	Apr-07	8	7	2	8	1	2	1	8	37	467
Cordilleras Creek	Stafford Ave	Oct-06	16	17	13	9	3	10	5	16	89	65
	Stafford Ave	Apr-07	15	14	11	6	3	9	5	15	78	154
	Laurel and Eaton	Oct-06	6	8	6	5	2	5	3	16	51	356
	Laurel and Eaton	Apr-07	6	2	2	5	2	2	1	15	35	616
Laurel Creek	Hillsdale Shopping Mall	Nov-06	3	2	3	2	1	1	1	8	21	1036
	Hillsdale Shopping Mall	Apr-07	4	4	2	2	1	6	1	13	33	651
	Hillsdale Apartments	Nov-06	9	9	8	8	3	3	3	15	58	289
	Hillsdale Apartments	Mar-07	14	14	11	9	3	4	7	12	74	126
Pulgas Creek	El Camino Real	Nov-06	7	2	0	8	3	10	10	1	41	594
	El Camino Real	Apr-07	1	4	2	5	3	10	8	0	33	530
	Alameda de las Pulgas	Nov-06	18	15	10	8	9	7	9	8	84	108
	Alameda de las Pulgas	Apr-07	19	17	14	9	9	9	10	12	99	67
San Mateo Creek	Claremont Ave	Nov-06	3	2	1	2	2	0	0	8	18	666
	Claremont Ave	Mar-07	5	6	3	3	2	1	1	7	28	499
	Caltrain Crossing	Nov-06	2	0	1	2	1	0	3	15	24	885
	Caltrain Crossing	Mar-07	8	7	5	2	1	5	1	8	37	447
San Pedro Creek	Peralta Ave	Oct-06	14	13	9	4	3	5	5	8	61	152
	Peralta Ave	Mar-07	15	13	8	10	3	5	7	5	66	159
	North Fork Outfall	Oct-06	7	4	2	8	4	8	7	3	43	521
	North Fork Outfall	Mar-07	5	4	2	5	4	5	9	2	36	558

Spring 2007 URTA scores were higher than fall 2006 scores at 58% of the sites (n=7) but were lower for the remaining 42% of the sites (n=5). These changes resulted in some changes to the distribution among categories (Figure 4).

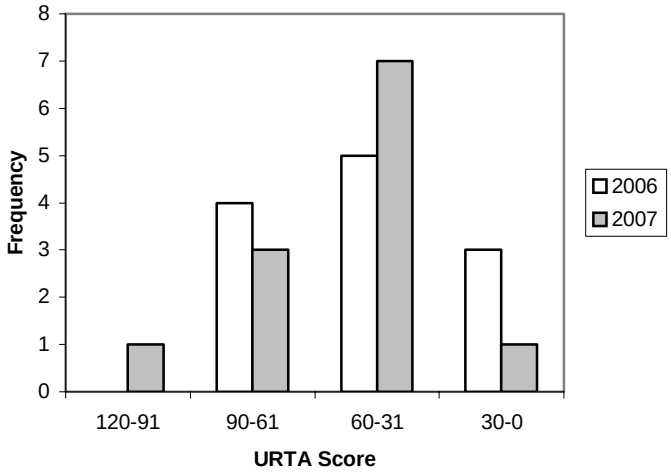

Figure 4. URTA scores from trash assessments conducted during fall 2006 and spring 2007 at twelve sites in six San Mateo County watersheds.

4.2.2 Trash Characteristics

A total of 9,804 items of trash were documented during the 24 assessments (Table 3). The number of trash items was smaller during the spring assessment at three sites, but larger for the other three. The variation in number of trash items between the two seasons was largely caused by changes in the total amount of plastic and biodegradable items. Plastic was the most common item collected during the assessments, representing over 60% of all trash. Biodegradable, metal, miscellaneous and glass items were the next most common trash items, representing about 35% of the trash.

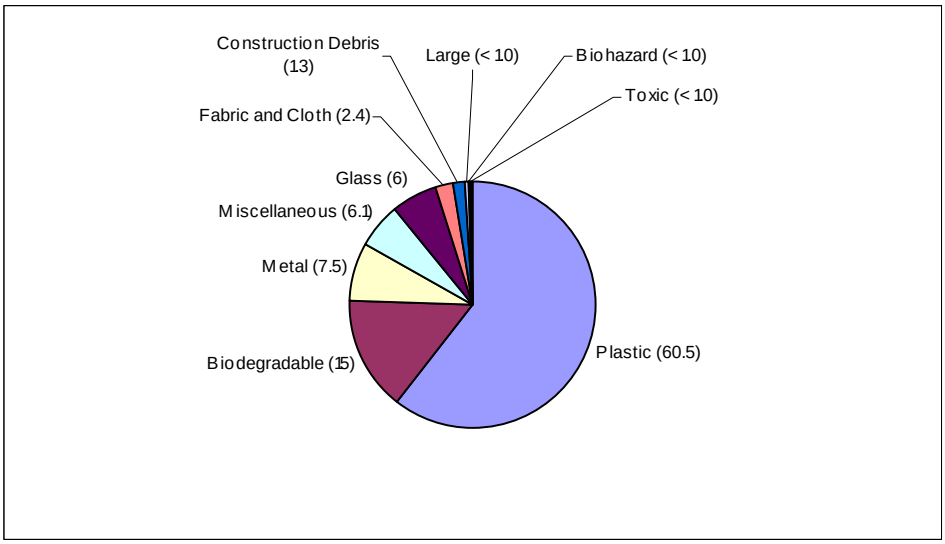

Figure 4. Percent of types of trash items enumerated at 12 creek sites over two seasons.

URTA Parameters 3 and 4 evaluate trash items that likely have the greatest impact to water quality. Plastic (e.g., bags, wrappers, bottles) and miscellaneous items (e.g., cigarette butts, rubber balls) were grouped and totaled to evaluate URTA Parameter 3: transportable, persistent buoyant litter. The average score for this parameter across all sites was 5.4 out of a total of 20 possible points (a score of 20 would indicate none of these trash items was observed), which suggests marginal conditions in relation to this parameter.

Hazardous objects (e.g., diapers, batteries, glass and metal) were grouped and totaled to evaluate URTA Parameter 4a: biohazard, toxic and sharp objects. The average score for this parameter across all sites was 5.8 out of total of 20 possible points, which also suggests marginal conditions in relation to this parameter. Glass and metal objects generally caused this relatively low average score as toxic and biohazardous items were relatively uncommon. URTA Parameter 4b (accessibility) averaged 3.3 out of 20 possible points, indicating that on average the sites with hazardous objects were relatively accessible.

4.2.3 Trash Sources and Pathways

URTA Parameters 5 and 6 evaluate potential trash sources and pathways. On average, the most common trash sources identified during the 24 assessments were littering and illegal dumping with average scores of 4.9 and 5.4, respectively (total possible combined score of 20 points). The lowest scores for littering (indicating high levels of littering) occurred at the two sites near shopping centers and one site behind an apartment complex. The lowest scores for illegal dumping (indicating high levels of illegal dumping) occurred adjacent to an apartment complex, footbridges at a Caltrain station and a park near a shopping center. Littering and dumping were often observed at the same site.

Trash associated with upstream sources (i.e., trash accumulation) was also relatively common during the assessments with an average score of 8.6 (total possible score of 20 points). The lowest scores for trash accumulation (indicating high levels of accumulation) occurred below a Caltrain crossing in a low gradient channel with dense vegetation on the lower reaches of Pulgas Creek. Other sites with high accumulation were located below large outfalls (e.g., North Fork of San Pedro Creek and Belmont Creek at Maywood Drive).

In general, littering from adjacent land uses was the predominant source of trash at sites that had larger proportions of trash on the banks compared to the creek channel. Larger trash items (construction materials, furniture) were found on both banks and in the creek channel at sites with good access (i.e., footbridges or road crossings). Relatively high levels of trash in the creek channel generally originated from upstream sources. These sites tended to be directly below outfalls or in areas where trash is deposited (e.g., areas with dense vegetation that can capture trash conveyed by flowing water).

Table 3. Total number and type of trash items documented in six watersheds during fall 2006 and spring 2007.

Trash Category[1]	Belmont Cr.		Cordilleras Cr.		Laurel Cr.		Pulgas Cr.		San Mateo Cr.		San Pedro Cr.		Total Items
	Fall 2006	Spring 2007	Fall 2006	Spring 2007	Fall 2006	Spring 2007	Fall 2006	Spring 2007	Fall 2006	Spring 2007	Fall 2006	Spring 2007	
Biodegradable	38	80	101	206	279	178	42	34	295	156	27	32	1468
Biohazard	5	0	3	1	3	1	0	0	4	2	14	1	34
Construction Debris	10	3	2	20	14	15	9	13	15	9	7	10	127
Fabric and Cloth	5	7	1	8	21	21	6	21	62	37	22	24	235
Glass	11	9	5	23	124	50	5	9	181	137	16	17	587
Large	1	3	0	1	8	1	0	0	26	11	4	5	60
Metal	19	19	19	35	129	45	86	70	152	66	40	56	736
Miscellaneous	48	49	62	78	115	59	43	28	27	31	20	40	600
Plastic	353	665	228	397	622	405	510	421	785	494	523	532	5935
Toxic	0	0	0	1	10	2	1	1	4	3	0	0	22
Total Items by Site	490	835	421	770	1325	777	702	597	1551	946	673	717	9804

[1]See the Appendix for more information on the trash categories.

5.0 FINDINGS

The principal findings of this study are summarized as follows:

- Continuous creek walk protocols such as the USA are a valuable tool for identifying and prioritizing areas within urban creeks that are impacted by trash. The results of the USA showed that the majority of the trash-impacted sites in the five Bay-side study watersheds were located in close proximity to major transportation corridors (e.g., El Camino Real) and commercial land uses. The trash impacts in the upper reaches of these watersheds consisted primarily of yard waste behind private residences or illegal dumping sites near roadways. In contrast, in San Pedro Creek the largest trash impact occurred in the upper reaches of the mainstem and primarily originated from the North Fork outfall.

- URTA scores suggested that nearly 70% of the sites initially assessed during fall 2006 had poor or marginal conditions with respect to trash. There was no apparent trend in trash condition with elevation (i.e., lower elevation sites had lower scores in only three of the six study watersheds). Sites in lower reaches of watersheds with relatively low levels of trash tended to have site characteristics that did not favor trash deposition and accumulation (e.g., such sites lacked a high density of vegetation in the channel). Site characteristics were thus an important factor influencing URTA scores.

- Compared to the initial fall assessment, 58% of the sites (n=7) received similar or lower trash assessment scores (i.e., score was lower or if higher, within 10%) during the second assessment in the spring. This suggests a persistent ongoing source of trash at these sites, since trash was removed during the fall assessment.

- Plastic comprised 60% of the total items removed during the trash assessments. Biodegradable, metal, miscellaneous, and glass materials comprised 35% of the remaining items. Average scores for the parameters most closely associated with threats to water quality suggested marginal conditions due to high quantities of plastic, metal and glass items.

- Littering from adjacent land uses was the predominant source of trash at sites that had larger amounts of trash on creek banks (i.e., above the high water line) than within creek channels. Larger trash items (construction materials, furniture) were found on both banks and in the creek channel at sites with good access (i.e., footbridges or road crossings). Relatively high levels of trash in the creek channel generally originated from upstream sources. These sites tended to be directly below outfalls or areas where trash is deposited and accumulates (e.g., areas with dense vegetation that can capture trash conveyed by flowing water).

6.0 RECOMMENDATIONS

Based upon the results of this study the following is recommended:

- Implement USA creek walks in other San Mateo County watersheds and identify the location of additional trash impacted areas, with higher priority given to lower reaches of each watershed and areas near major transportation corridors and commercial land uses.

- Conduct URTA assessments at selected locations identified during the USA creek walks to gather data that will inform identifying and prioritizing trash BMPs and developing an overall strategy to address trash in urban creeks in San Mateo County. Long-term monitoring sites may also be established to determine status and trends. URTA assessments may be used to evaluate the effectiveness of BMPs where trash sources are in close proximity to the impacted site. The URTA is less useful for evaluating BMP effectiveness at trash accumulation sites where trash originates from multiple upstream sources.

- Begin to develop an overall "trash control strategy" that will assist SMCWPPP's municipalities to 1) assess trash in and near urban creeks; 2) identify priority trash problem areas, pathways and sources; 3) select and implement appropriate BMPs at priority problem areas; and 4) assess the effectiveness of the BMPs. The trash control strategy should build upon SMCWPPP's past trash-related accomplishments and trash-related work performed by other programs (e.g., SCVURPPP and SWAMP).

7.0 REFERENCES

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