Pilot Study to Identify Trash Sources and Management Measures at an In-stream Trash Accumulation Area

San Mateo County, California

San Mateo Countywide Stormwater Pollution Prevention Program

August 2005

SUMMARY

At the recommendation of San Francisco Bay Region Water Board staff, all Bay area urban creeks, lakes and shorelines were placed on the State Water Resources Control Board 2002 "Monitoring List" due to the potential of trash to impair water quality. In response, STOPPP initiated a program to begin identifying and addressing trash in urban water bodies in San Mateo County. The program is initially focusing on urban creeks.

The trash pilot study was a follow-up to STOPPP's FY 2003/04 survey on existing municipal trash management practices and known trash problem areas. The objective was to attempt to identify trash sources and management measures at a selected in-stream trash accumulation area. The methodology included applying a Rapid Trash Assessment protocol developed by Water Board staff in conjunction with research on adjacent and upstream land uses, sources and transport pathways. A reach of San Mateo Creek in Gateway Park in the City of San Mateo was selected for the pilot study.

Assessments using the Rapid Trash Assessment protocol were performed at the study site during three different hydrologic periods: the dry season, in mid-winter between rainstorms, and in the spring. Assessment dates were October 7, 2004, January 20, 2005, and May 16, 2005. In addition, City of San Mateo staff was interviewed regarding adjacent and upstream land uses, potential trash sources and transport pathways, and current municipal trash management activities. Principal findings of the pilot study included:

- Trash was removed during each assessment but persistently accumulated at the site, though levels and types of trash varied during each assessment. Potential causes of this temporal variation include varying public use of Gateway Park, varying rainfall patterns, occasional site cleanups by the City of San Mateo Parks Department, and site conditions intermittently interfering with the assessment (e.g., abundant algal growth interfered with visually sighting pieces of trash below the creek waterline during the May 2005 assessment).

- Field reconnaissance in the vicinity of the site and interviews with City of San Mateo staff indicated that littering at Gateway Park and nearby upstream bridges and occasional dumping from the bridges were the most likely sources of trash to the site, rather than accumulation from further upstream sources or discharges from storm drains in the vicinity of the site. This conclusion was supported by the results of the trash assessment fieldwork performed by STOPPP, based on the types of trash observed by field staff, evidence of littering at the site, and lack of indications of waterborne trash accumulating on the creek bed or banks.

- The results of the pilot study suggested that applying the Rapid Trash Assessment protocol, in conjunction with research on adjacent and upstream land uses, sources and transport pathways, is potentially a useful methodology for addressing trash in San Mateo County creeks. More specifically, this methodology may help identify trash sources and inform the selection of trash management measures at in-stream trash accumulation sites. However, further confirmation of the utility of the methodology would require additional pilot testing at a variety of trash sites.

The City of San Mateo may wish to implement measures to help mitigate littering and dumping at Gateway Park and the nearby upstream bridges. Potential measures include erecting signs prohibiting dumping and littering. The effectiveness of such signs would potentially be

enhanced by including educational messages about the value of San Mateo Creek as a natural and community resource.

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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 of trash to impair water quality. In response, the San Mateo Countywide Stormwater Pollution Prevention Program (STOPPP) initiated a program to begin identifying and addressing trash issues in urban water bodies in San Mateo County. The program is initially focusing on urban creeks.

This FY 2004/05 trash pilot study was a follow-up to STOPPP's FY 2003/04 survey on existing municipal trash management practices and known trash problem areas. The objective of the pilot study was to attempt to identify trash sources and management measures at a selected in-stream trash accumulation area. The methodology included applying a Rapid Trash Assessment protocol developed by Water Board staff in conjunction with research on adjacent and upstream land uses, sources and transport pathways, in accordance with the study work plan (STOPPP 2004).

Rapid Trash Assessment

During 2002, Water Board staff developed a Rapid Trash Assessment methodology as a tool to monitor trash levels in creeks and potentially help inform efforts to identify sources and controls. STOPPP subsequently developed a work plan to pilot-test this procedure (STOPPP 2002). STOPPP 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 Rapid Trash Assessment procedure might be useful for:

- measuring baseline levels of trash,
- identifying and prioritizing trash problem areas,
- identifying potential sources of trash, and
- identifying Best Management Practices (BMPs) that target trash and evaluating their effectiveness.

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

Water Board staff has continued to apply the Rapid Trash Assessment in Bay Area watersheds monitored through the statewide Surface Water Ambient Monitoring Program (SWAMP).

FY 2003/04 Survey

In June 2003, STOPPP 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. STOPPP 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 STOPPP's municipalities.

The completed survey report (STOPPP 2004) summarizes 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 discusses municipal organizational structure in relation to trash management and how municipalities evaluate the success of their trash management activities. Finally, the report documents trash accumulation/dumping areas reported by municipal staff, including the location of each area, the origin of the trash, and the source of information about the area. Most of the reported accumulation/dumping areas were not within creeks.

METHODS

Site Selection

STOPPP General Program staff initially narrowed potential pilot study locations to three in-stream creek sites, based on the results of the FY 2003/04 survey and discussions with STOPPP's Trash Control Work Group. The sites were locations on San Pedro, San Mateo and Redwood Creeks where trash accumulates. A reach of San Mateo Creek in Gateway Park was

selected (Figure 1) based on the following factors:

- the study site was identified in STOPPP's FY 2003/04 survey on existing municipal trash problem areas,
- City of San Mateo staff was available to assist with the fieldwork and land use research,
- prior year data were available from the Water Board's Surface Water Ambient Monitoring Program (SWAMP), which also employed the Rapid Trash Assessment protocol, and
- the study site was accessible and not located on private property.

Research on Land Use, Sources, Pathways and Management Activities

General Program staff interviewed City of San Mateo Public Works and Parks and Recreation staff regarding adjacent and upstream land uses, potential trash sources and transport pathways, and current municipal trash management activities. City staff also accompanied General Program staff on a drive-by reconnaissance of the study site and vicinity on October 20, 2004.

Trash Field Assessments

The pilot study incorporated Version 8 of the Rapid Trash Assessment protocol (Appendix A). The protocol is applied at a 100-linear foot section of creek. The study assessment site was located along San Mateo Creek adjacent to a condominium complex in Gateway Park in the City of San Mateo (Appendix B contains photographs of the study site). Two landmarks identified the ends of the assessment site – a small willow tree on the south bank of the creek marked the downstream end and a dead Eucalyptus stump on the north bank marked the upstream end. Assessments were performed during three differing hydrologic periods: the dry season, in mid-winter between rainstorms, and in the spring. Assessment dates were October 7, 2004, January 20, 2005, and May 16, 2005. Field staff attempted to collect all of the trash at the assessment site during each assessment episode. Water Board and General Program staff performed the initial October assessment; City of San Mateo staff assisted General Program staff to perform the assessments in January and May. The initial assessment was performed jointly with Water Board staff to ensure that the assessment site was identical to the SWAMP location and that STOPPP applied the protocol consistently to the SWAMP.

RESULTS AND DISCUSSION

Research on Land Use, Sources, Pathways and Management Activities

The field reconnaissance revealed that an upstream, accessible section of San Mateo Creek in Arroyo Court Park accumulated natural woody debris but little trash. This park is located in a residential neighborhood. City of San Mateo staff believes that trash accumulation in the creek is generally less of a problem in the mainly residential areas west of El Camino Real than east

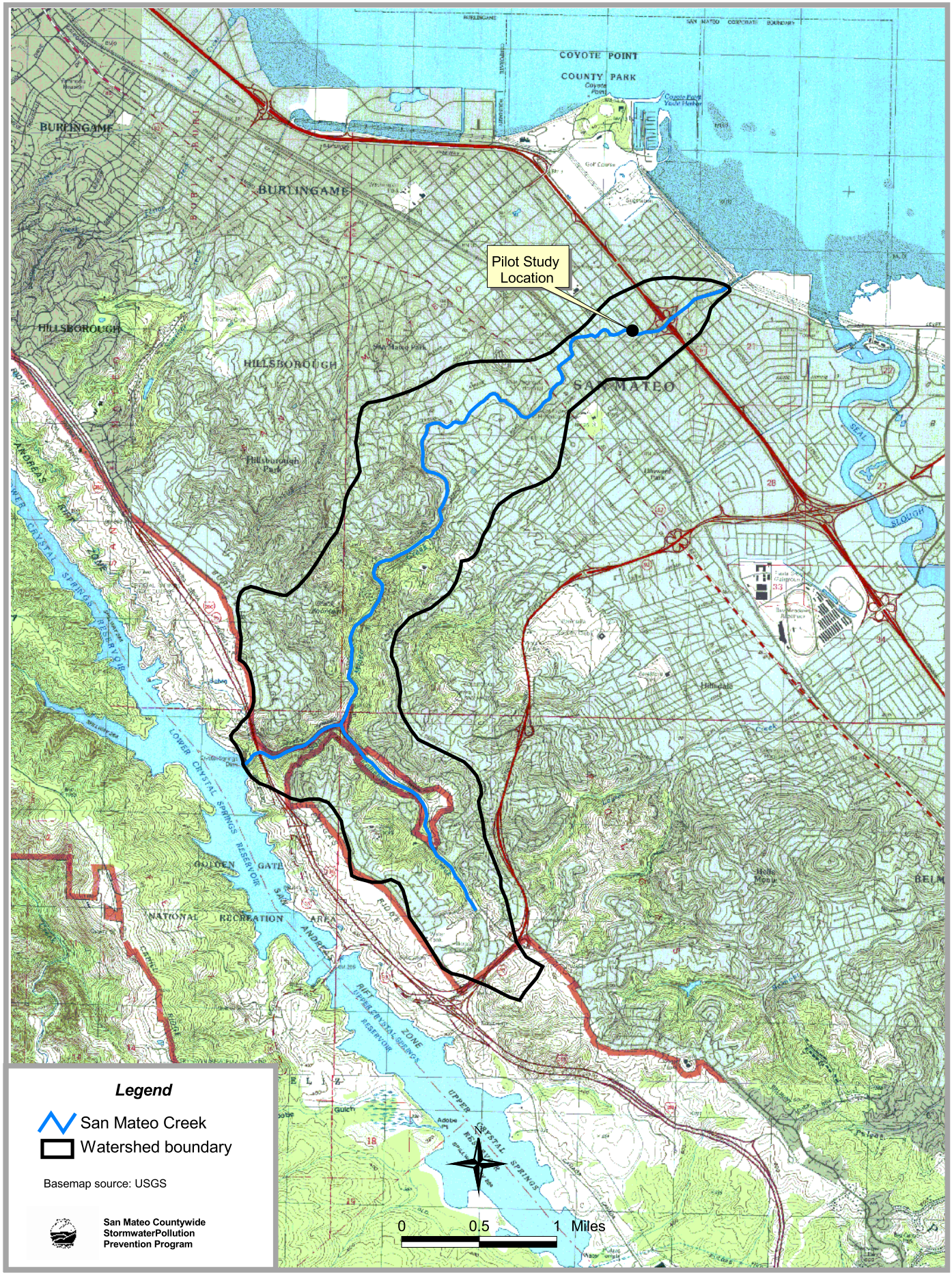


Figure 1. Pilot Study location.

of this roadway. City staff identified the following potential trash sources to the study site:

- Littering at Gateway Park.
- Littering and occasional dumping from bridges upstream and nearby to the study site. The bridges are the Fremont Street crossing over San Mateo Creek on the western end of Gateway Park and a small pedestrian bridge in Gateway Park downstream of the Fremont Street bridge. Dumping from the bridges was inferred based on the presence of bags of trash on the creek bank beneath the bridges.
- Litter from downtown commercial areas transported by storm drains that discharge to San Mateo Creek upstream of the study site.
- Homeless encampments along a section of San Mateo Creek that is adjacent to the railroad station at Main Street. This relatively inaccessible reach is fenced off and has steep banks.

City staff identified littering at Gateway Park and the nearby upstream bridges and occasional dumping from the bridges as the most likely sources of trash to the study site. City staff also identified the following trash management activities at Gateway Park and upstream:

- Parks Department staff indicated that workers remove easily retrievable trash items from the creek in Gateway Park as frequently as once per week. Workers perform a more thorough cleanup of the creek in Gateway Park every one to two months, which includes using waders to remove more difficult to reach trash items.
- Juvenile work crews clean up the creek and banks at the railroad station site.
- The City has erected fences at the Fremont Street and 2nd Avenue bridge and the railroad station site to prevent illegal dumping from vehicles.

Trash Field Assessments

Tables 1 and 2 and Figures 2, 3 and 5 summarize the results of STOPPP's three episodes of applying the Rapid Trash Assessment protocol during the pilot study. It should be noted that the results from STOPPP's third assessment (May 16, 2005) might understate levels of trash. Abundant algal growth on the surface of the water interfered with visually sighting pieces of trash below the creek waterline during this assessment. Figures 2 - 4 summarize earlier data gathered by Water Board staff during the SWAMP using similar methods at the same site.

Table 1. Trash Item Tally for STOPPP Trash Pilot Assessments

Date	Plastic	Bio-hazard	Construc-tion Debris	Misc	Metal	Large	Toxic	Biode-gradable	Glass	Fabric and Cloth	Total Pieces of Trash
10/7/04	68	1	6	46	16	0	0	26	39	3	205
1/20/05	29	0	12	35	18	0	0	9	58	1	162
5/16/05	13	1	0	15	24	0	0	5	32	2	92

Table 2. Parameter Scores[1] for STOPPP Trash Pilot Assessments

Date	Level of Trash (Qualitative)	Number of Trash Items	Threat to Aquatic Life	Threat to Human Health	Illegal Dumping/ Littering	Accumulation of Trash	TOTAL
10/7/04	11	4	4	9	10	15	53
1/20/05	17	5	6	5	9	15	57
5/16/05	14	6	8	10	12	15	65

[1]Each parameter is scored from 0 to 20. Higher parameter scores indicate better conditions (i.e., lower qualitative and quantitative levels of trash, lower potential impacts to aquatic life and human health, and less illegal dumping, littering and trash accumulation).

Based on the trash tallies and parameter scores, the levels and types of trash at the study site varied considerably. For the STOPPP assessments, total trash tallies and parameters scores (Figure 2) indicated higher trash levels in the fall (October 7, 2004) and lower levels in the late spring (May 16, 2005).[1] The earlier SWAMP data (Figure 2) showed a different pattern, with lower trash levels in the fall (October 20, 2003) and higher levels in the winter (February 13, 2004) and preceding spring (March 21, 2003). SWAMP data were collected at several different locations on San Mateo Creek in 2003 and 2004 and each location showed the same trend of higher trash levels during periods with higher flows (spring and winter) and lower levels in the relatively dry summer and fall seasons.

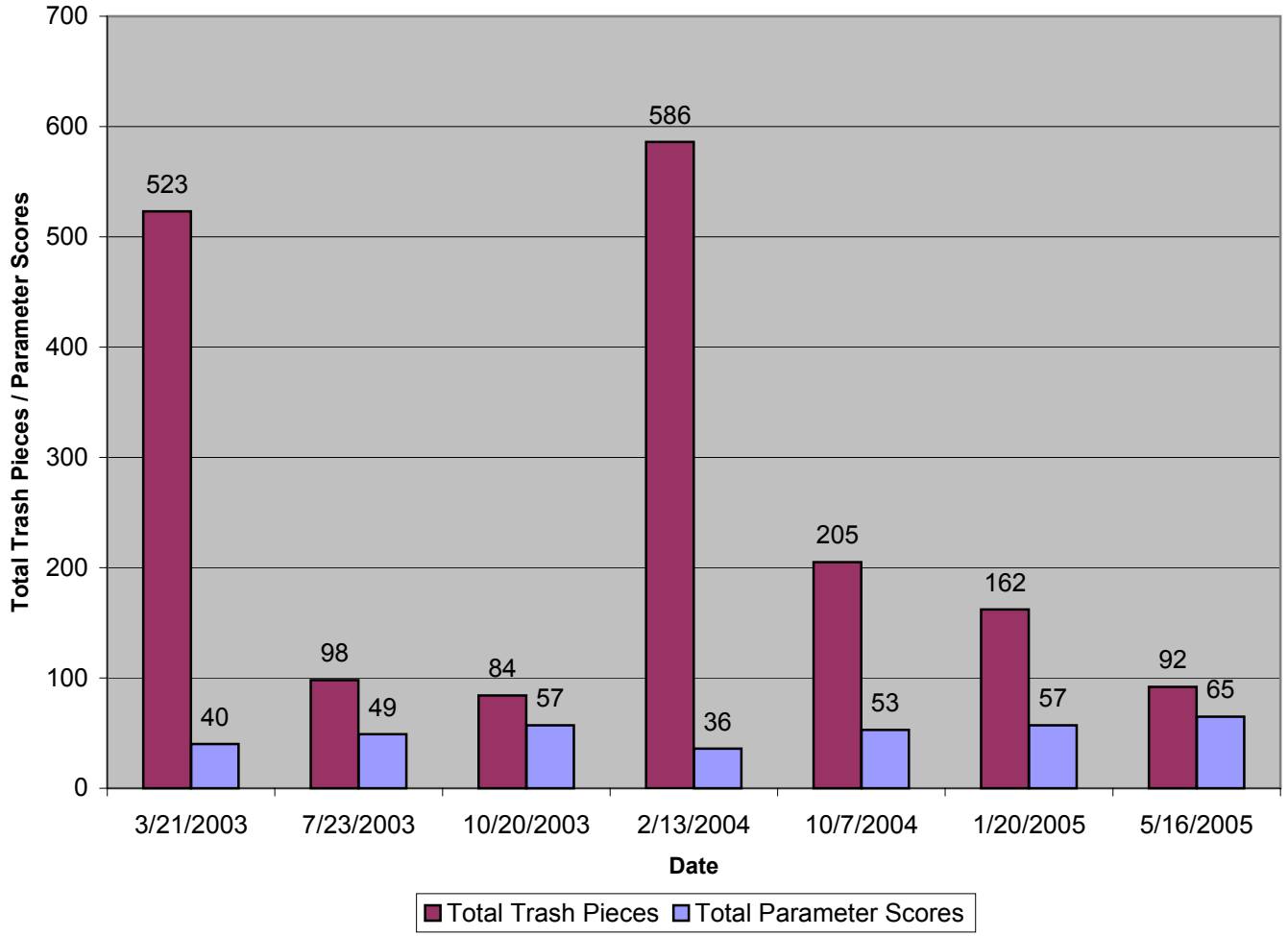
Potential causes of the temporal variation in trash levels and types include varying public use of Gateway Park, varying rainfall patterns, occasional site cleanups by the City of San Mateo Parks Department, and site conditions intermittently interfering with the assessment (e.g., abundant algal growth, as described previously). Trash was removed during each of STOPPP's assessments but persistently accumulated at the site.

Figures 4 and 5 show the relative proportions of trash types found during the SWAMP and STOPPP assessments, respectively. Most notable was the high proportion of glass, particularly during the SWAMP assessments (about 68% of all pieces collected). In general, STOPPP field staff observed relatively large amounts of heavier, non-floatable materials on the creek bed, such as glass, pottery shards and hard plastic. Large amounts of glass found during some assessments appeared consistent with littering during intermittent social gatherings at the site (e.g., drinking parties) or occasional illegal dumping. Other indications of littering at the site included cigarette butts surrounding a park bench located immediately adjacent to the creek within the 100-foot assessment site.

The SWAMP data point toward accumulation from upstream sources, based on higher levels of trash during the rainy season and corresponding accumulation parameter scores (Figure 3). However, the more recent STOPPP assessments yielded accumulation scores (Figure 3) consistent with STOPPP field staff observing little evidence of waterborne accumulation of trash from upstream sources. Such evidence may include floatable trash (e.g., paper products) accumulating along the creek bank near the waterline or caught on vegetation (e.g., roots) within the creek.

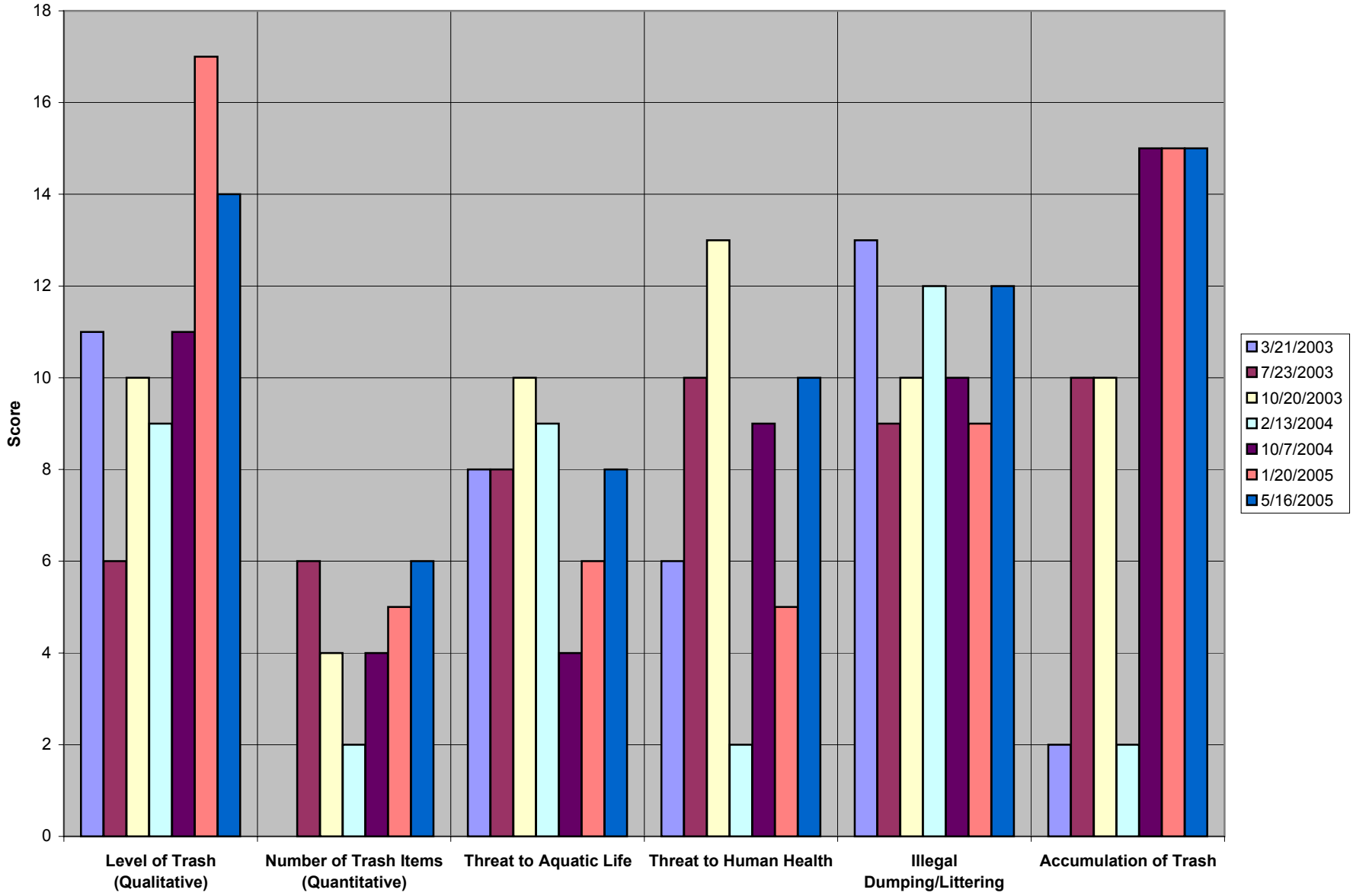
[1]Parameter scores are generally inversely proportional to trash tallies.

Figure 2
San Mateo Creek at Gateway Park Trash Assessment
Total Parameter Scores and Tallies



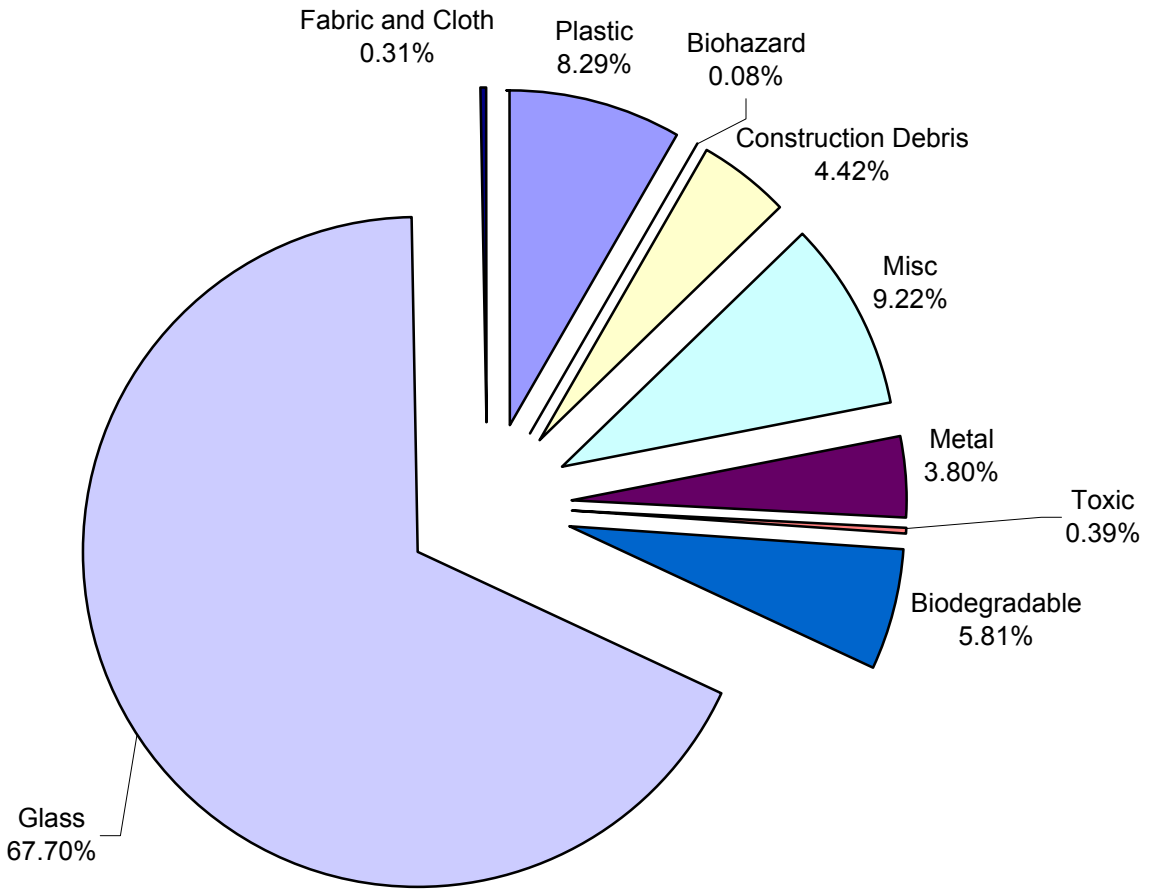
1. 2003 and Feb 04 are SWAMP data provided by Water Board staff, Oct 04 and 2005 are STOPPP data.
2. Total parameter scores are the sum of 6 individual trash parameter scores, each scored from 0 to 20. Higher scores indicate better conditions.

Figure 3
San Mateo Creek at Gateway Park Trash Assessment
Individual Parameter Scores



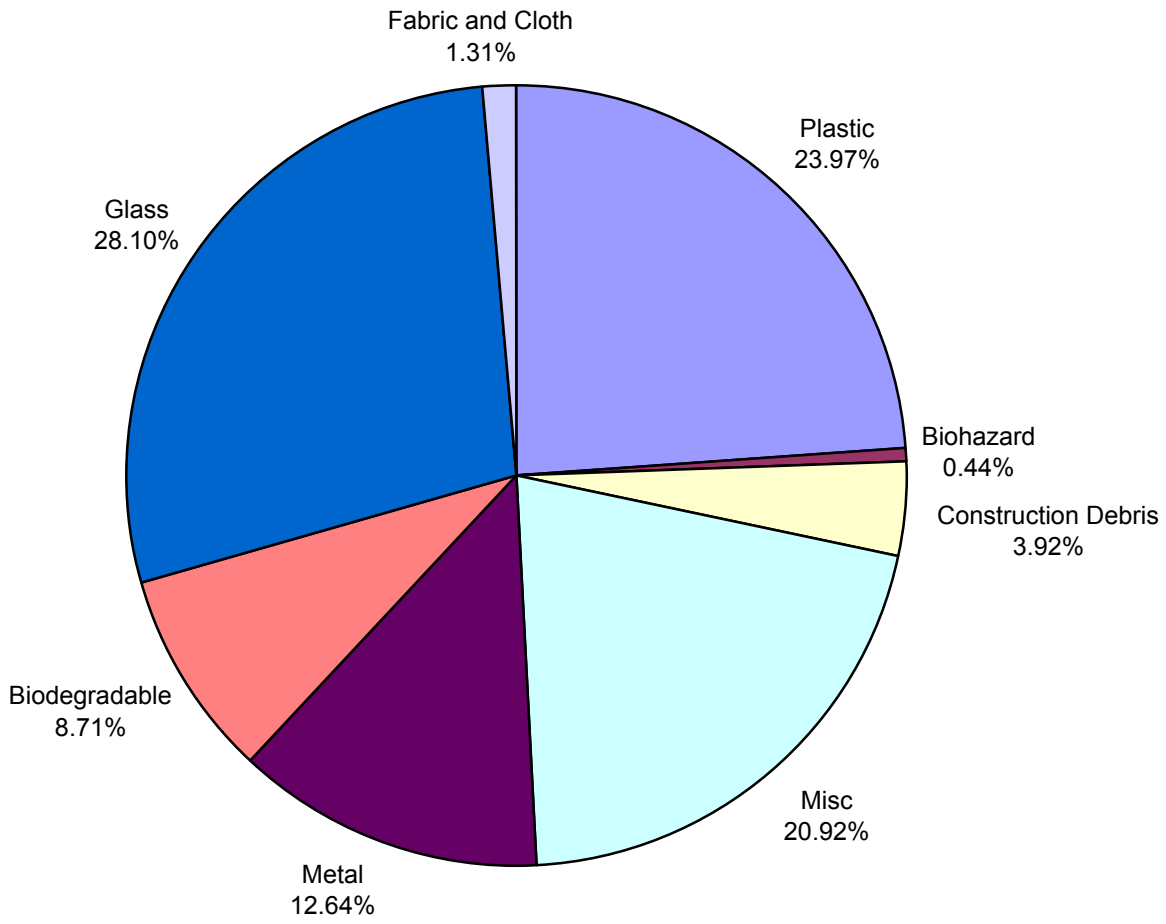
Notes:
1. The following dates are SWAMP data provided by Water Board staff: 3/21/03, 7/23/03,10/20/03 and 2/13/04.
2. The following dates are STOPPP data: 10/7/04, 1/20/05 and 5/16/05.

Figure 4
San Mateo Creek at Gateway Park Trash Assessment
Types of Trash Collected during SWAMP Assessments



Source: SWAMP March 2003 - February 2004 data provided by Water Board staff.

Figure 5
San Mateo Creek at Gateway Park Trash Assessment
Types of Trash Collected during STOPPP Assessments



FINDINGS

Principal findings of the pilot study included:

- Trash was removed during each assessment but persistently accumulated at the site, though levels and types of trash varied during each assessment. Potential causes of this temporal variation include varying public use of Gateway Park, varying rainfall patterns, occasional site cleanups by the City of San Mateo Parks Department, and site conditions intermittently interfering with the assessment (e.g., abundant algal growth interfered with visually sighting pieces of trash below the creek waterline during the May 2005 assessment).

- Field reconnaissance in the vicinity of the site and interviews with City of San Mateo staff indicated that littering at Gateway Park and nearby upstream bridges and occasional dumping from the bridges were the most likely sources of trash to the site, rather than accumulation from further upstream sources or discharges from storm drains in the vicinity of the site. This conclusion was supported by the results of the trash assessment fieldwork performed by STOPPP, based on the types of trash observed by field staff, evidence of littering at the site, and lack of indications of waterborne trash accumulating on the creek bed or banks.

- The results of the pilot study suggested that applying the Rapid Trash Assessment protocol, in conjunction with research on adjacent and upstream land uses, sources and transport pathways, is potentially a useful methodology for addressing trash in San Mateo County creeks. More specifically, this methodology may help identify trash sources and inform the selection of trash management measures at in-stream trash accumulation sites. However, further confirmation of the utility of the methodology would require additional pilot testing at a variety of trash sites.

RECOMMENDATION

The City of San Mateo may wish to implement measures to help mitigate littering and dumping at Gateway Park and the nearby upstream bridges. Potential measures include erecting signs prohibiting dumping and littering. The effectiveness of such signs would potentially be enhanced by including educational messages about the value of San Mateo Creek as a natural and community resource.

ACKNOWLEDGEMENTS

STOPPP would like to acknowledge assistance provided during this project by Water Board and City of San Mateo staff, which greatly contributed to the success of the project. Water Board staff assisted STOPPP General Program staff in the field with the initial field assessment of the pilot study site. City of San Mateo staff assisted with the subsequent assessments and also helped General Program staff identify potential trash sources, transport pathways and management measures.

REFERENCES

SCVURPPP and STOPPP 2003. *SCVURPPP and SMSTOPPP Pilot Implementation and Testing of RWQCB Rapid Trash Assessment*. Santa Clara Valley Urban Runoff Pollution Prevention Program and San Mateo Countywide Stormwater Pollution Prevention Program. March 1, 2003.

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STOPPP 2003. *FY 2003/04 Trash Control Work Plan.* San Mateo Countywide Stormwater Pollution Prevention Program. June 2003.

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APPENDIX A

RAPID TRASH ASSESSMENT PROTOCOL
Surface Water Ambient Monitoring Program
California Regional Water Quality Control Board, San Francisco Bay Region

Monitoring Design. The rapid trash assessment can be used for a number of purposes, such as ambient monitoring, evaluation of management actions, determination of trash accumulation rates, or comparing sites with and without public access. Ambient monitoring efforts should provide information at sites distributed throughout a waterbody, and several times a year to characterize spatial and temporal variability. Additionally, the ambient sampling design should document the effects of episodes that affect trash levels such as storms or community cleanup events. Pre- and post-project assessments can assist in evaluating the effectiveness of management practices ranging from public outreach to structural controls, or to document the effects of public access on trash levels in waterbodies (e.g., upstream/downstream). Such evaluations should consider trash levels over time and under different seasonal conditions. Revisiting sites where trash was collected during previous assessments enables the determination of accumulation rates. This methodology was developed for sections of wadeable streams, but can be adapted to shorelines of lakes, beaches, or estuaries. Ultimately, the monitoring design will strongly affect the usefulness of any rapid trash assessment information.

Site Definition. Upon arrival at a designated monitoring site, a team of two people or more defines or verifies a 100-foot section of the stream or shoreline to analyze, associated with a sampling location or station. When a site is first established, it is recommended that the 100-foot distance be accurately measured. The length should be measured not as a straight line, but as 100 feet of the actual stream or shore length, including sinuous curves. Where possible, the starting and ending points of the survey should be easily identified landmarks, such as an oak tree or boulder, and noted on the worksheet ("Upper/Lower Boundaries of Reach"), or documented using a global positioning system (GPS), so that future assessments are made at the same location. The team should confer and document the upper boundary of the banks to be surveyed, based on evaluation of whether trash can be carried to the water body by wind or water (e.g., an upper terrace in the stream bank). The team documents the location of the high water line based on site-specific physical indicators, such as a debris line found in the riparian vegetation along the stream channel. If the high water line cannot be determined, it is suggested that bankfull height be documented, noting that the high water line could not be determined. Trash located below the high water line can be expected to move into the streambed or be swept downstream during the next winter season. Visually extend all boundaries in order to encompass the 100' section. Defining site characteristics will facilitate the comparison of trash assessments conducted at the same site at different times of the year.

Survey. It is highly recommended that all trash items within an assessed site be picked up, so that the site can be revisited and re-assessed for impairment and usage patterns. A survey, including notes and scoring, will take approximately one to two hours based on how trash-impacted the site is and how many people are working together. The first time a site is assessed, the process will generally take longer than on subsequent visits. Begin the survey at the downstream end of the selected reach so that trash can be seen in the undisturbed stream channel. Tasks can be divided according to the number of team members. In one scenario of a team with two members, one team member begins walking along the bank or in the water (wear waders) at the edge of the stream or shore, looking for trash on the bank up to the upper bank boundary, and above and below the high water line. This person picks up trash and tallies the items on the trash assessment worksheet as either above or below the high water line based on the previously determined boundary. The other person walks in the streambed and up and down the opposite bank, picking up and calling out specific trash items found in the water body and on the opposite bank both above and below the high water line, for the tally person to mark down appropriately on the trash assessment sheet. All team members pick up the trash items as they are found. Keep in mind that the person tallying will not be able to pick up nearly as much trash as the other team members. All team members make sure to avoid injuries by using gloves. Avoid touching trash with unprotected hands!

The person tallying the trash indicates on the sheet whether the trash was found above the high water line on the bank, or below the high water line either on the bank or in the stream (i.e., tally dots or circles (•) for above high water line, tally lines (|) for below). If it is evident that items have been littered, dumped, or accumulated via downstream transport, make a note in the designated rows near the bottom of the tally sheet - this will help when

assessing scores. A trash grabber, metal kitchen tongs, or a similar tool should be used to help pick up trash. Be sure to look under bushes, logs, and other plant growth to see if trash has accumulated underneath. The ground and substrate should be inspected to ensure that small items such as cigarette butts and pieces of broken glass or Styrofoam are picked up and counted. The tally count is an important indicator of trash impairment and should be used in conjunction with the total score to assist in site comparisons. It is important not to miss items that can affect human health such as diapers, fecal matter, and needles; these items can strongly affect the total score.

Once the team is finished with the tallying, use the tally sheet margins to count up two totals for each trash item line, one total for items found above the high water line, and one total for items found below the high water line. Now sum the totals of above and below for each trash category, and write in next to each trash category. Be sure to complete the worksheets before leaving the site while everything is still fresh in the memory. The team should discuss each parameter and agree on a score based on a discussion of the condition categories. Discuss and document possible influential factors affecting trash levels at the site, such as a park, school, or nearby residences or businesses. Within each trash parameter, narrative language is provided to assist with choosing a condition category. The worksheet provides a range of numbers within a given category, allowing for a range of conditions encountered in the field. For instance, trash located in the water leads to lower scores than trash above the high water line. Not all specific trash conditions mentioned in the narratives need to be present to fit into a specific condition category (e.g., "site frequently used by people"), nor do the narratives describe all possible conditions. Scores of "0" should be reserved for the most extreme conditions. Once the scores are assigned for the six categories, sum the final score and include specific notes about the site at the end of the sheet. A site should be assessed several times in a given year, during different seasons, to characterize the variability and persistence of trash occurrence for water quality assessment purposes.

Trash Assessment Parameters. The rapid trash assessment includes a range of parameters that capture the breadth of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the second two parameters estimate actual threat to water quality, and the last two parameters represent how trash enters the water body at a site, either through on-site activities or downstream accumulation.

1. **Level of Trash.** This assessment parameter is intended to reflect a qualitative "first impression" of the site, after observing the entire length of the reach. Sites scoring in the "poor" range are those where trash is one of the first things noticeable about the waterbody. No trash should be obviously visible at sites that score in the "optimal" range.

2. **Actual Number of Trash Items Found.** Based on the tally of trash along the 100-foot stream reach, total the number of items both above and below the high water line, and choose a score within the appropriate condition category based on the number of tallied items. Where more than 100 items have been tallied, assign the following scores: 5: 101-200 items; 4: 201-300 items; 3: 301-400 items; 2: 401-500 items; 1: 501-600 items; 0: over 600 items. Use similar guidelines to assign scores in other condition categories.

   Sometimes items are broken into many pieces. Fragments with higher threat to aquatic life such as plastics should be individually counted, while paper and broken glass, with lower threat and/or mobility, should be counted based on the parent item(s). Broken glass that is scattered, with no recognizable original shape, should be counted individually. The judgment of whether to count all fragments or just one item also depends on the potential exposure to downstream fish and wildlife, and waders and swimmers at a given site. Concrete is trash when it is dumped, but not when it is placed. Consider tallying only those items that would be removed in a restoration or cleanup effort.

3. **Threat to Aquatic Life.** As indicated in the technical notes, below, certain characteristics of trash make it more harmful to aquatic life. If trash items are persistent in the environment, buoyant (floatable), and relatively small, they can be transported long distances and be mistaken by wildlife as

food items. Larger items can cause entanglement. Some discarded debris may contain toxic substances. All of these factors are considered in the narrative descriptions in this assessment parameter.

4. **Threat to Human Health.** This category is concerned with items that are dangerous to people who wade or swim in the water, and with pollutants that could accumulate in fish in the downstream environment, such as mercury. The worst conditions have the potential for presence of dangerous bacteria or viruses, such as with medical waste, diapers, and human or pet waste.

5. **Illegal Dumping and Littering.** This assessment category relates to direct placement of trash items at a site, with "poor" conditions assigned to sites that appear to be dumping or littering locations based on adjacent land use practices or site accessibility.

6. **Accumulation of Trash.** Trash that accumulates from upstream locations is distinguished from dumped trash by indications of age and transport. Faded colors, silt marks, trash wrapped around roots, and signs of decay suggest downstream transport, indicating that the local drainage system facilitates conveyance of trash to water bodies, in violation of clean water laws and policies.

Technical Notes on Trash and Water Quality

Trash is a water pollutant that has a large range of characteristics of concern. Not all litter and debris delivered to streams are of equal concern to water quality. Besides the obvious negative aesthetic effects, most of the harm of trash in surface waters is imparted to aquatic life in the form of ingestion or entanglement. Some elements of trash exhibit significant threats to human health, such as discarded medical waste, human or pet waste, and broken glass. Also, some household and industrial wastes may contain toxic substances of concern to human health and wildlife, such as batteries, pesticide containers, and fluorescent light bulbs that contain mercury. Larger trash such as discarded appliances can present physical barriers to natural stream flow, causing physical impacts such as bank erosion. From a management perspective, the persistence and accumulation of trash in a waterbody are of particular concern, and signify a priority area for prevention of trash discharges. Also of concern are trash "hotspots" where illegal dumping, littering, and/or accumulation of trash occur.

Rapid Trash Assessment. Trash assessment includes a visual survey of the waterbody (e.g., streambed and banks) and adjacent areas from which trash elements can be carried to the waterbody by wind, water, or gravity. The delineation of these adjacent areas is site-specific and requires some judgment and documentation. The rapid trash assessment worksheet is designed to represent the range of effects that trash has on the physical, biological, and chemical integrity of water bodies, in accordance with the goals of the Clean Water Act and the California Water Code. The worksheet also provides a record for evaluation of the management of trash discharges, by documenting sites that receive direct discharges (i.e., dumping or littering) and those that accumulate trash from upstream locations.

Trash Characteristics of Concern. For aquatic life, buoyant (floatable) elements tend to be more harmful than settleable elements, due to their ability to be transported throughout the waterbody and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent, even though they are not biodegradable, because wave action and rusting can cause them to break into smaller pieces. Natural rubber and cloth can degrade but not as quickly as paper (U.S. EPA, 2002). Smaller elements such as plastic resin pellets (a by-product of plastic manufacturing) and cigarette butts are often more harmful to aquatic life than larger elements, since they can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life such as sea turtles, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation. Floating debris that is not trapped and removed will eventually end up on the beaches or in the ocean, repelling visitors and residents from the beaches and degrading coastal and open ocean waters.

Trash in water bodies can threaten the health of people who use them for wading or swimming. Of particular concern are the bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can then expose a person's bloodstream to microbes in the stream's water that may cause illness. Also, some trash items such as containers or tires can pond water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile virus.

Leaf litter is trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive levels due to human influence can cause nutrient imbalance and oxygen depletion in streams, to the detriment of the aquatic ecosystem. Clumps of leaf litter and yard waste from trash bags should be treated as trash in the water quality assessment, and not confused with natural inputs of leaves to streams. If there is a question in the field, check the type of leaf to confirm that it comes from a nearby riparian tree. In some instances, leaf litter may be trash if it originates from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs. Other biodegradable trash, such as food waste, also exerts a demand on dissolved oxygen, but aquatic life is unlikely to be adversely affected unless the dumping of food waste is substantial and persistent at a given location.

Wildlife impacts due to trash occur in creeks, lakes, estuaries, and ultimately the ocean. The two primary problems that trash poses to wildlife are entanglement and ingestion. Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of floatable debris. Many of the species most vulnerable to the problems of floatable debris are endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds that can lead to infections or loss of limbs; it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, or in difficulty in moving, finding food, or escaping predators (U.S. EPA, 2001).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (i.e., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (U.S. EPA, 2001).

Common settled debris includes glass, cigarettes, rubber, construction debris and more. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination. Larger settleable items such as automobiles, shopping carts, and furniture can redirect stream flow and destabilize the channel.

In conclusion, trash in water bodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration, thus the trash assessment methodology was designed to reflect a range of trash impacts to aquatic life, public health, and aesthetic enjoyment. When considering the water quality effects of trash while conducting a trash assessment, remember to evaluate individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife. Utilize the narratives in the worksheet, refer to the technical notes and trash parameter descriptions in the text as needed, and select your scores after careful consideration of actual conditions.

References:
U.S. Environmental Protection Agency, 2001. Draft Assessing and Monitoring Floatable Debris.

U.S. Environmental Protection Agency, 2002. The Definition, Characterization and Sources of Marine Debris. Unit 1 of Turning the Tide on Trash, a Learning Guide on Marine Debris.

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

WATERSHED/STREAM: _____ DATE/TIME: _____
MONITORING GROUP, STAFF: _____ SAMPLE ID: _____
SITE DESCRIPTION (Station Name, Number, etc.): _____

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Level of Trash	On first glance, no trash visible. Little or no trash (<10 pieces) evident when streambed and stream banks are closely examined for litter and debris, for instance by looking under leaves.	On first glance, little or no trash visible. After close inspection small levels of trash (10-50 pieces) evident in stream bank and streambed.	Trash is evident in low to medium levels (51-100 pieces) on first glance. Stream, bank surfaces, and riparian zone contain litter and debris. Evidence of site being used by people: scattered cans, bottles, food wrappers, blankets, clothing.	Trash distracts the eye on first glance. Stream, bank surfaces, and immediate riparian zone contain substantial levels of litter and debris (>100 pieces). Evidence of site being used frequently by people: many cans, bottles, and food wrappers, blankets, clothing.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Actual Number of Trash Items Found	0 to 10 trash items found based on a trash assessment of a 100-foot stream reach.	11 to 50 trash items found based on a trash assessment of a 100-foot stream reach.	51 to 100 trash items found based on a trash assessment of a 100-foot stream reach.	Over 100 trash items found based on a trash assessment of a 100-foot stream reach.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Threat to Aquatic Life	Trash, if any, is mostly paper or wood products or other biodegradable materials. Note: A large amount of rapidly biodegradable material like food waste creates high oxygen demand, and should not be scored as optimal.	Little or no (<10 pieces) transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. Presence of settleable, degradable, and non-toxic debris such as glass or metal.	Medium prevalence (10-50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts Larger deposits (< 50 pieces) of settleable debris such as glass or metal. Any evidence of clumps of deposited yard waste or leaf litter.	Large amount (>50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, balloons, Styrofoam, cigarette butts; toxic items such as batteries, lighters, or spray cans; large clumps of yard waste or dumped leaf litter; or large amount (>50 pieces) of settleable glass or metal.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Threat to Human Health	Trash contains no evidence of bacteria or virus hazards such as medical waste, diapers, pet or human waste. No evidence of toxic substances such as chemical containers or batteries. No ponded water for mosquito production. No evidence of puncture and laceration hazards such as broken glass or metal debris.	No bacteria or virus hazards or sources of toxic substances, but small presence (<10 pieces) of puncture and laceration hazards such as broken glass and metal debris. No presence of ponded water in trash items such as tires or containers that could facilitate mosquito production.	Presence of **any one** of the following: hypodermic needles or other medical waste; used diaper, pet waste, or human feces; any toxic substance such as chemical containers, batteries, or fluorescent light bulbs (mercury). Medium prevalence (10-50 pieces) of puncture hazards.	Presence of **more than one** of the items described in the marginal condition category, or high prevalence of any one item (e.g. greater than 50 puncture or laceration hazards).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
5. Illegal Dumping	D: No evidence of illegal dumping. No bags of trash, no yard waste, no household items placed at site to avoid proper disposal, no shopping carts.	D: Some evidence of illegal dumping. Limited vehicular access limits the amount of potential dumping, or material dumped is diffuse paper-based debris.	D: Presence of **one** of the following: furniture, appliances, shopping carts, bags of garbage or yard waste, coupled with vehicular access that facilitates in-and-out dumping of materials to avoid landfill costs.	D: Evidence of chronic dumping, with **more than one** of the following items: furniture, appliances, shopping carts, bags of garbage, or yard waste. Easy vehicular access for in-and-out dumping of materials to avoid landfill costs.
Illegal Littering	L: Any trash is incidental litter (< 5 pieces) or carried downstream from another location.	L: Some evidence of litter within creek and banks originating from adjacent land uses (<10 pieces).	L: Prevalent (10-50 pieces) in-stream or shoreline littering that appears to originate from adjacent land uses.	L: Large amount (>50 pieces) of litter within creek and on banks that appears to originate from adjacent land uses.
D-SCORE	10 9	8 7 6	5 4 3	2 1 0
L-SCORE	10 9	8 7 6	5 4 3	2 1 0
6. Accum-ulation of Trash	There does not appear to be a problem with trash accumulation from downstream transport. Trash, if any, appears to have been directly deposited at the stream location.	Some evidence (<10 pieces) that litter and debris have been transported from upstream areas to the location, based on evidence such as silt marks, faded colors or location near high water line.	Evidence that (10 to 50 pieces) trash is carried to the location from upstream, as evidenced by its location near high water line, siltation marks on the debris, or faded colors.	Trash appears to have accumulated in substantial quantities at the location based on delivery from upstream areas, and is in various states of degradation based on its persistence in the waterbody. Over 50 items of trash have been carried to the location from upstream.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Total Score _____

SITE DEFINITION:
UPPER/LOWER BOUNDARIES OF REACH: _____
HIGH WATER LINE: _____
UPPER EXTENT OF BANKS OR SHORE: _____
_____

NOTES:
_____
_____
_____
_____
_____
_____
_____

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

TRASH ITEM TALLY (Tally with (•) if found above high water line, and (|) if below)

PLASTIC # Above___ # Below____	**METAL** # Above___ # Below____
Plastic Bags	Aluminum Foil
Plastic Bottles	Aluminum or Steel Cans
Plastic Bottle Caps	Bottle Caps
Plastic Cup Lid/Straw	Metal Pipe Segments
Plastic Pipe Segments	Auto Parts (specify below)
Plastic Six-Pack Rings	Wire (barb, chicken wire etc.)
Plastic Wrapper	Metal Object
Soft Plastic Pieces	**LARGE (specify below)** # Above___ # Below____
Hard Plastic Pieces	Appliances
Styrofoam cups pieces	Furniture
Styrofoam Pellets	Garbage Bags of Trash
Fishing Line	Tires
Tarp	Shopping Carts
Other (write-in)	Other (write-in)
BIOHAZARD # Above___ # Below____	**TOXIC** # Above___ # Below____
Human Waste/Diapers	Chemical Containers
Pet Waste	Oil/Surfactant on Water
Syringes or Pipettes	Spray Paint Cans
Dead Animals	Lighters
Other (write-in)	Small Batteries
CONSTRUCTION DEBRIS#Above___#Below__	Vehicle Batteries
Concrete (not placed)	Other (write-in)
Rebar	**BIODEGRADABLE** # Above___ # Below____
Bricks	Paper
Wood Debris	Cardboard
Other (write-in)	Food Waste
MISCELLANEOUS # Above___ # Below____	Yard Waste (incl. trees)
Synthetic Rubber	Leaf Litter Piles
Foam Rubber	Other (write-in)
Balloons	**GLASS** # Above___ # Below____
Ceramic pots/shards	Glass bottles
Hose Pieces	Glass pieces
Cigarette Butts	**FABRIC AND CLOTH** # Above___ # Below____
Golf Balls	Synthetic Fabric
Tennis Balls	Natural Fabric (cotton, wool)
Other (write-in)	Other (write-in)
Total pieces Above: **Below:**	**Grand total:**
Tally all trash in above rows; make notes below as needed to facilitate scoring.	
Littered:	
Dumped:	
Downstream Accumulation:	

SPECIFIC DESCRIPTION OF ITEMS FOUND:_____

_____

_____

APPENDIX B

Trash Pilot Study Site. San Mateo Creek at Gateway Park in the City of San Mateo.

Trash Pilot Study Site. Pedestrian bridge in background is located nearby and upstream to the assessment site.