

## APPENDIX A: TRASH BACKGROUND

### I. Beneficial Uses Impacted by Trash

The final Trash Amendments are directed toward achieving the highest water quality consistent with the maximum benefit to California. Beneficial uses, as defined by Porter-Cologne section 13050, are the uses of surface water and groundwater that may be protected against water quality degradation. The Water Boards are charged with protecting these uses from pollution and nuisance that may occur as a result of waste discharges. Beneficial uses of surface waters, ground waters, marshes, and wetlands serve as a basis for establishing water quality objectives and discharge prohibitions to attain these goals and are defined in the basin plans for each regional water board and the Ocean Plan.

There are many beneficial uses in California, defined in the basin plans for each regional water board and the Ocean Plan, which can be impacted by trash. This section discusses the impacts of trash to beneficial uses associated with aquatic life and public health (Figure 27).

Trash is a threat to aquatic habitat and life as soon as it enters state waters. Mammals, turtles, birds, fish, and crustaceans are threatened following the ingestion or entanglement of trash (Moore et al. 2001, U.S. EPA 2002). Ingestion and entanglement can be fatal for freshwater, estuarine, and marine life. Similarly, habitat alteration and degradation due to trash can make natural habitats unsuitable for spawning, migration, and preservation of aquatic life. These negative effects of trash to aquatic life can impact twelve beneficial uses. A summary of specific impacts associated with each aquatic life beneficial use are presented in Table 13.



**Figure 27.** Trash Impacting Beneficial Uses (NOAA Marine Debris Program, Algalita Marine Research Institute, California Coastal Commission, and LA County Flood Control District).

### Impacts of Trash to Aquatic Habitat and Life

Regardless of the method trash reaches waterways, trash is a threat to aquatic habitat and life as soon as it enters state waters. Mammals, turtles, birds, fish, and crustaceans are threatened following the ingestion or entanglement of trash (Moore et al. 2001, U.S. EPA 2002). Ingestion and entanglement can be fatal for freshwater, estuarine, and marine life. Similarly, habitat alteration and degradation due to trash can make natural habitats unsuitable for spawning, migration, and preservation of aquatic life. These negative effects of trash to aquatic life can impact several beneficial uses. A summary of specific impacts associated with each aquatic life beneficial use is presented in Table 13.

**Table 13.** Trash-Related Impacts to Aquatic Life Beneficial Uses.

Beneficial Use	Impact of Trash to Specific Aquatic Life Beneficial Use
Warm Freshwater Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish or wildlife (including invertebrates).</li> <li>Freshwater habitat alteration or degradation.</li> <li>Interference with ecosystem function, including interference with benthic communities.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Cold Freshwater Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish or wildlife (including invertebrates).</li> <li>Saline water habitat alteration or degradation.</li> <li>Interference with ecosystem function, including interference with benthic communities.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Inland Saline Water Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish or wildlife (including invertebrates).</li> <li>Saline water habitat alteration or degradation.</li> <li>Interference with ecosystem function, including interference with benthic communities.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Estuarine Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish or wildlife (including estuarine mammals, waterfowl, and shorebirds).</li> <li>Ingestion of toxic compounds (including shellfish) associated with trash.</li> <li>Estuarine habitat alteration or degradation.</li> <li>Interference with ecosystem function, including interference with benthic communities and shellfish.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Marine Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish or wildlife (including marine mammals, birds, and turtles).</li> <li>Ingestion of toxic compounds (including shellfish) associated with trash.</li> <li>Marine habitat alteration or degradation, including alterations to kelp habitat.</li> <li>Interference with ecosystem function, including interference with benthic communities, shellfish and kelp.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Wildlife Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by wildlife (including mammals, birds, reptiles, amphibians, and invertebrates).</li> <li>Terrestrial habitat alteration or degradation, including alterations to wildlife water and food sources.</li> <li>Interference with ecosystem function.</li> <li>Transportation of invasive species from floating trash.</li> </ul>
Preservation of Biological Habitats	<ul style="list-style-type: none"> <li>Habitat alteration and degradation, including alterations to established refuges, parks, sanctuaries, and ecological reserves.</li> <li>Interference with ecosystem function.</li> <li>Transportation of invasive species from floating trash, potentially leading to species displacement.</li> </ul>

Beneficial Use	Impact of Trash to Specific Aquatic Life Beneficial Use
Preservation of Areas of Special Biological Significance	<ul style="list-style-type: none"> <li>Habitat alteration or degradation of marine life refuges, ecological reserves, and designated Areas of Special Biological Significance.</li> <li>Interference with ecosystem function, including interference with kelp propagation.</li> <li>Transportation of invasive species from floating trash, potentially leading to species displacement.</li> </ul>
Rare, Threatened, or Endangered Species	<ul style="list-style-type: none"> <li>Ingestion and entanglement by plant or animal species listed as rare, threatened or endangered.</li> <li>Alteration or degradation of habitat that supports plant or animal species listed as rare, threatened or endangered.</li> <li>Interference with ecosystem function.</li> <li>Transportation of invasive species from floating trash, potentially leading to species displacement.</li> </ul>
Migration of Aquatic Organisms	<ul style="list-style-type: none"> <li>Alteration or degradation of habitat that supports migration or other temporary activities by aquatic organisms.</li> <li>Interference with ecosystem function.</li> </ul>
Spawning, Reproduction, and/or Early Development	<ul style="list-style-type: none"> <li>Alteration or degradation of habitat that is suitable for reproduction and early development of fish.</li> <li>Interference with ecosystem function.</li> </ul>
Wetland Habitat	<ul style="list-style-type: none"> <li>Ingestion and entanglement by fish, invertebrates, and insects.</li> <li>Ingestion of toxic compounds (including shellfish) associated with trash.</li> <li>Natural or man-made wetland ecosystem alteration or degradation.</li> <li>Interference with ecosystem function, including interference with benthic communities and shellfish.</li> <li>Transportation of invasive species from floating trash.</li> </ul>

## Effects of Trash on Aquatic Habitat

Trash that settles to a riverbed, bottom of a bay, or ocean floor can interfere with normal ecosystem functions and have immediate and long-term effects on the aquatic habitat. Settled trash is a problem for bottom feeders and dwellers and can contribute to sediment pollution. Settled trash can smother the growth of aquatic vegetation, disrupt nurseries and spawning areas, and disturb benthic communities (United Nations Environment Program 2009). Trash can alter the aquatic habitat and impact the aquatic biodiversity as it introduces hard surfaces for colonization as well as provides increased places of refuge for mobile species. Hard surfaces may attract hard-substratum sessile species that may have been previously limited and, consequently, displace soft bottom species due to competition and predation (Katsanevakis et al. 2007). Serious alterations, such as hypoxia and anoxia conditions, can result when the gas exchange between the overlying waters and pore waters of the sediments is prohibited by the accumulation of trash, specifically plastic trash (Goldberg 1994). Settled trash can also disturb benthic communities by mechanical scouring as trash twists and moves with flow, currents, and tides, damaging the bottom fauna (United Nations Environment Program 2009). Furthermore, aquatic life can be threatened by trash when it causes increased siltation and turbidity resulting in blocking of essential sunlight or smothering of sea grass species.

Trash is found settling in the deep-sea to depths of 13,028 feet. Specifically in the Monterey Canyon, trash is most abundant where aggregation and downslope transport of trash from the continental shelf are enhanced by canyon dynamics (Figure 28). Based on 1,149 video records over a 22-year time period, the majority of trash was plastic (33%) and metal (23%) with relatively high number of observations of trash in the deep-sea environment (Schlining et al. 2013). Thus, submarine canyons can function to transport trash from coastal to deep-sea habitats.



**Figure 28.** A Discarded Tire in Monterey Canyon (Monterey Bay Aquarium Research Institute).

Trash that does not settle can float and be suspended for great distances. Floating trash, specifically plastic trash, is capable of carrying and distributing potentially harmful, non-native species of animals and plants to foreign aquatic habitats (Winston 1982, Highsmith 1985, Minchin 1996, Barnes 2002, Masó et al. 2003). Trash is found to more than double the rafting opportunities for biota at 30 remote islands across subtropics locations and higher latitudes (Barnes 2002). Trash drifting on ocean currents eventually becomes home to entire communities of encrusting and attached organisms. Aquatic life that uses trash as transport includes bryozoans, barnacles, polychaete worms, hydroids, and mollusks (Barnes 2002). Plastics are not readily biodegradable, but travel slowly in oceans, making them a more effective invasive species dispersal mechanism than vessels or ballast water (Barnes 2002). Although plastics constitute the larger percentage of floating trash, other common anthropogenic floating objects include polystyrene, wooden items, and fishing gear (Barnes and Milner 2005). While these studies have largely focused on trash in marine waters, similar conditions are expected to occur in estuarine, freshwater, and saline systems.

Not only can trash serve as a vessel for aquatic life, but trash, particularly plastic trash, can serve as a transport medium for pollutants and sorb persistent organic pollutants in the marine environment (Carpenter et al. 1972, Mato et al. 2001, Derraik 2002). Although the quantities and effects of these contaminants have yet to be fully determined, plastic trash in the marine environment, including resin pellets, plastic fragments have been found to contain organic contaminants, including polychlorinated biphenyls, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, phthalate ester plasticizers, polybrominated diphenylethers, and alkylphenols and bisphenol- A (Giam et al. 1978, Teuten et al. 2009; DG Europe 2011). Some of these compounds are added during plastic manufacture (e.g., nonylphenol, bisphenol- A, and polybrominated diphenylethers), while others (e.g., polychlorinated biphenyls and DDT) are sorbed from the surrounding seawater (Mato et al. 2001, Moore et al. 2005, Teuten et al. 2009, Hirai et al. 2011). Although plastic

trash may have the capacity to sorb toxins, there is limited research on the extent of toxic exposure from plastic vectors compared to other exposure pathways such as atmospheric deposition and ocean currents (Gouin et al. 2011). Microplastics are unlikely to be an important global geochemical reservoir for historically released persistent organic pollutants such as polychlorinated biphenyls, dioxins, and DDT, and it is not clear if microplastics play a larger role as chemical reservoirs on smaller scales (NOAA 2008b).

Persistent organic pollutants found in or carried by trash may present potential threats in aquatic environments as they can leach from surface of trash to state waters. Leaching and degradation of plasticizers, polymers, and other plastic additives are complex phenomena dependent on environmental conditions and the chemical properties of each additive (Teuten et al. 2009). Persistent organic pollutants, however, have a high affinity for plastic in seawater, which may elevate POP concentrations on microplastic particles but reduce their bioavailability (NOAA 2008b).

### **Effects of Trash Ingestion on Wildlife, Freshwater, Estuarine, and Marine Aquatic Life**

Many species, including mammals, birds, turtles, and fish, have been reported to ingest several different forms of trash. Ingestion of trash may occur either because of misidentification of trash items or accidental consumption during feeding and normal behavior. The effects of trash ingestion include starvation, suffocation, and internal injuries and infections. Ingested items can block air passages, prevent breathing, and be fatal (U.S. EPA 1992; 2002). In addition, some trash (e.g., diapers, medical and household waste, and chemicals) can be a source of bacteria, viruses, and toxic substances that can impact aquatic life. As described below, many studies have been completed on the impact of trash ingestion in marine environments; the effects of trash ingestion are expected to be the same in freshwater, saline, and estuarine environments.

For birds, ingestion of small plastic fragments and preproduction plastic pellets floating at the water surface pose a significant threat. At least 50 species of seabirds are known to ingest plastic debris (Day et al. 1985). Birds confuse these plastic fragments and preproduction plastic pellets with normal prey items, such as fish eggs or larvae, which are similar in both size and color.

Ingestion of trash by marine mammals has been reported to cause fatalities. In 2008, the ingestion of floating trash was fatal to two large sperm whales that were found stranded along the northern California coast (Jacobsen et al. 2010).

Sea turtles are especially prone to ingestion of marine trash, particularly plastics. Sea turtles, mistaking them for food, swallow plastic bags that block the turtle's digestive tract and lead to starvation (U.S. EPA 1992). Trash items that have been found in digestive tracts of turtles include plastic bags, tar, fishing lines, ropes, polystyrene, rubber, fishing hooks, charcoal, aluminum cans, aluminum foil, cardboard, net fragments, cloth, plastic spherules, strings, wood, cigarette filters, cellophane, bottles, vinyl films, pieces of latex balloons, and beer crown corks (Balazs 1985, Gramentz 1988, Plotkin and Amos 1990, Bjorndal et al. 1994, Tomás et al. 2002). Numerous studies that have reported high incidence of trash ingestion include:

leatherback turtles (30.3%) (Sadove and Morreale 1990); 19 of 32 sea turtles (59.4%) (Duronslet et al. 1991); 25 of 51 sea turtles (49%) (Bjorndal et al. 1994), and 23 of 38 green turtles (60.5%) (Bugoni et al. 2001). Even small quantities of trash can be fatal as seen by the death of two sea turtles where the trash represented only 4.6 and 5.8 percent of wet mass and 3.2 and 9.8 percent of volume of gut contents of the two turtles, respectively (Bjorndal et al. 1994).

Ingestion of trash can be particularly detrimental to aquatic life when trash contains or carries toxic compounds. Trash, particularly plastic trash, has plastic additives and can sorb contaminants ambient in state waters such as polychlorinated biphenyls and DDT. These contaminants can be assimilated by aquatic life through ingestion. Ryan et al. (1988) found that the mass of ingested plastic in birds was positively correlated with polychlorinated biphenyls in their fat tissue and eggs. Also, Teuten et al. (2007) found that a priority pollutant, phenanthrene, was transmitted to a lugworm by plastic that was mixed into the sediments inhabited by the worm. Phenanthrene is not a plastic additive, but was sorbed by the plastic from the ambient water.

Although there is limited research on the bioaccumulation of toxic compounds associated with plastics, a preliminary experiment demonstrating the transfer of contaminants from plastics to higher trophic level organisms was performed by Endo et al. (2005). The results of this study suggest that plastic-derived polychlorinated biphenyls are transferrable to biological tissue of birds after ingestion, especially lower-chlorinated congeners commonly found in plastic resin pellets. Since lower-chlorinated congeners are easily metabolized and cannot be biomagnified through the food chain, their presence in animal tissue is indicative of plastic ingestion. This phenomenon was also demonstrated by Yamashita et al. (2011), which found that the mass of ingested plastic in short-tailed shearwaters in the North Pacific Ocean was positively correlated with concentrations of lower-chlorinated congeners. Given the limited research of the biological uptake and bioaccumulation of toxics from plastics, plastic trash is not a significant vector of toxics relative to other exposure processes, such as atmospheric deposition and ocean currents (Gouin et al. 2011). Using lungfish and North Sea cod as model species, Koelmans et al. (2014) determined the potential leaching of nonylphenol and bisphenol A in the intestinal tracts from plastic ingestion. They found that plastic ingestion will make a negligible contribution to the transfer of additive as compared to other routes of exposure. However, salinity has been shown likely to have a strong effect on the sorption of contaminants, especially polymers, on plastic (Velzeboer et al. 2014). The transport and movement of contaminants by plastic particles in the aquatic environment are greatly influenced by local conditions. The transport of pollutants, such as DDT and polyaromatic hydrocarbons, is from freshwater and estuarine to fully marine conditions (Bakir et al. 2014). Overall, while the uptake and bioaccumulation of pollutants from plastics has been shown to occur, there is limited understanding of the significance in comparison to other modes of pollutant transfer in the environment.

Ingestion of toxic compounds and aquatic fatalities in freshwater, estuarine, and marine water systems negatively impact beneficial uses of aquatic life. Fatalities induced by trash ingestion or toxicity can affect aquatic life in warm and cold freshwater, inland saline water, estuarine, marine, wetland, and terrestrial habitats. Beneficial uses can be

impacted when the ingestion of trash causes aquatic life fatalities or physiological stress in ASBS, and mortality or physiological stress in rare, threatened, or endangered species. See Table 13 for a summary of specific impacts of trash ingestion associated with each aquatic life beneficial use.

### Effects of Trash Entanglement on Wildlife, Freshwater, Estuarine, and Marine Aquatic Life

In addition to ingestion, entanglement can result when an animal becomes encircled or ensnared by trash. Entanglement can cause wounds and associated infections, strangulation or suffocation, and impair the ability of an animal to swim, fly, find food, and escape predators (Figure 29; U.S. EPA 1992). Once entangled, animals have trouble eating, breathing or moving, all of which can be fatal. Similar to the discussion on trash ingestion, the studies describing effects of trash entanglement in marine environments also apply to freshwater and estuarine environments since the impacts are the same, regardless of the aquatic habitat.



**Figure 29.** Trash Entanglement (NOAA Marine Debris Program 2013).

According to the US Marine Mammal Commission, 136 marine species have been reported in entanglement incidents, including six species of sea turtles, 51 species of seabirds, and 32 species of marine mammals (Marine Mammal Commission 1996). Marine animals, particularly seals and sea lions, become entangled because of the natural curiosity and tendency to investigate unusual objects in the environment. Between 1982 and 2006, 268 entanglements of the endangered monk seal were documented in the Northwestern Hawaiian Islands. Additionally, many birds, including ducks geese, cormorants, and gulls have been found entangled in six-pack rings (U.S. EPA 1992), and nearly one million seabirds are thought to die from entanglement or ingestion of floatable material each year (U.S. EPA 2002).

Although entanglement is considered a serious mortality factor, the mortality rate due to entanglement is difficult to quantify. Many species vulnerable to entanglement are oceanic or migratory and are scattered across wide areas. Animals that become entangled and die either quickly sink or are consumed by predators, eliminating them from potential detection (Laist 1987). For these reasons, the estimated mortality rates and the effects of trash entanglement may actually be underestimated.

Fatalities induced by entanglement can affect aquatic life in warm and cold freshwater habitats, as well as inland saline water, estuarine, marine, wetland, and terrestrial habitats. Aquatic life fatalities in these habitats impact the beneficial when entanglement causes aquatic life fatalities in preserved areas of biological significance and fatalities of rare, threatened, or endangered species. See Table 13 for a summary

of specific impacts associated with trash entanglement on each aquatic life beneficial use.

### Impacts of Trash on Public Health

Trash in state waters can impact humans by means of jeopardizing public health and safety and posing harm and hindrance to recreational, navigational, and commercial activities. Trash can also affect the traditional and cultural rights of indigenous people or subsistence fishers to waters of the state. Specific impacts associated with each public health beneficial use are presented in Table 14.

**Table 14.** Trash-Related Impacts to Public Health Beneficial Uses.

Beneficial Use	Impact of Trash to Specific Public Health Beneficial Use
Municipal and Domestic Supply	<ul style="list-style-type: none"><li>Alterations or degradation to waters that are used for community, military, or individual water supply systems (including drinking water).</li><li>Health hazards due to ingestion of water where diseases were transported by trash.</li></ul>
Navigation	<ul style="list-style-type: none"><li>Safety hazards (including hazards to boats, rafts or other vessels used for shipping, travel, or transportation by private, military or commercial vessels).</li></ul>
Water Contact Recreation	<ul style="list-style-type: none"><li>Health and safety hazards (including hazards from bacteria, viruses, toxic substances, mosquito production, and injuries).</li><li>Health hazards due to consumption of fish with diseases transported by trash or ingestion of water where diseases were transported by trash.</li><li>Safety hazards (including hazards to boats, rafts or other recreational vessels).</li><li>Alterations or degradation to waters that support contact water recreation.</li></ul>
Non-Contact Water Recreation	<ul style="list-style-type: none"><li>Safety hazards (including hazards to boats, rafts or other recreational vessels).</li><li>Alterations or degradation to waters that support non-contact water recreation.</li></ul>
Commercial and Sport Fishing	<ul style="list-style-type: none"><li>Safety hazards (including hazards to boats, rafts or other commercial or recreational vessels).</li><li>Health hazards due to consumption of fish, shellfish, or other aquatic species with diseases transported by trash.</li><li>Alterations or degradation to waters that support commercial and sport fishing.</li></ul>
Aquaculture	<ul style="list-style-type: none"><li>Health hazards due to consumption of aquatic plants or animals with diseases transported by trash.</li><li>Alterations or degradation to waters that support aquaculture.</li></ul>
Shellfish Harvesting	<ul style="list-style-type: none"><li>Safety hazards (including hazards to boats, rafts or other commercial or recreational vessels).</li><li>Health hazards due to consumption of filter-feeding shellfish with diseases transported by trash.</li><li>Alterations or degradation to waters that support shellfish harvesting.</li></ul>
Native American Culture	<ul style="list-style-type: none"><li>Health hazards due to consumption of fish or shellfish with diseases transported by trash.</li><li>Elimination/reduction of native fish or shellfish populations that support the cultural and/or traditional rights of indigenous people.</li><li>Alteration or degradation to the habitat of or death to aquatic life that support the cultural beliefs of indigenous people.</li><li>Alterations or degradation to waters that support Native American culture.</li></ul>
Subsistence Fishing	<ul style="list-style-type: none"><li>Health hazards due to consumption of fish or shellfish with diseases transported by trash.</li><li>Alterations or degradation to waters that support subsistence fishing.</li></ul>

Beneficial Use	Impact of Trash to Specific Public Health Beneficial Use
Note: Not all kinds of trash impact the specific human life beneficial uses.	

## Effects of Trash on Public Health

Trash poses health and safety hazards for the safety of fishermen, recreational boaters, and children playing in the waterways and beaches. Items such as broken glass, medical waste, rope, and fishing line pose immediate risks to human safety. Injuries incurred by incisions from glass and metal can expose a person's bloodstream to microbes in the stream's water that may cause illness (Los Angeles Water Board 2010). Swimmers, divers, and snorkelers can become entangled in submerged or floating trash such as rope or fishing line. Some trash (e.g., diapers and medical and household waste) can be a source of bacteria, viruses, and toxic substances (Musmeci et al. 2010). Medical and personal hygiene trash, for instance, can indicate the presence of pathogenic contaminants such as streptococci, fecal coliform, and other bacterial contamination. Consumption or contact with water contaminated with these pathogens could result in infectious hepatitis, diarrhea, bacillary dysentery, skin rashes, and even typhoid and cholera. Also, some debris, such as containers or tires, can collect water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile Virus (Los Angeles Water Board 2010). Trash, specifically plastic waste, has a potential to expose humans to chemicals, such as bisphenol A and phthalates (DG Europe 2011).

Trash in state waters can pose serious risks to recreational users including incisions and exposure to disease. Because of these health and safety hazards, trash may be an immediate threat to public health depending on the type of trash, where there is bodily contact with water, and where ingestion of water is reasonably possible. Therefore, waters designated with the beneficial use water contact recreation (Table 14) can be negatively impacted by the presence of trash. In addition, beneficial uses associated with the human consumption of water, shellfish, aquatic plants and animals, and commercial and sport fish, may be impacted by trash. Specifically, the ingestion of water or food that may be contaminated by bacteria, viruses, or toxic compounds found in trash poses a significant public health concern.

## Effects of Trash on Contact & Non-Contact Water Recreation, Commercial and Sport Fishing, and Navigation

Beyond the immediate health and safety hazards caused by trash, the presence of trash in state waters can also affect beneficial uses of waters where there is less bodily contact with water. Damage to boats, rafts, and other recreational vessels through entanglement of equipment and propellers can lead to potentially hazardous and perhaps fatal situations for boaters (Figure 30). For these circumstances, trash present in waters designated for recreational activities and for transportation can impact the beneficial uses of non-contact water recreation and navigation, respectively.



**Figure 30.** Entangled Propeller (NOAA Marine Debris Program).

### **Effects of Trash on Native American Culture**

Some waters within the jurisdiction of the North Coast Water Board are protected by the beneficial use, Native American Culture. This beneficial use describes waters that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving, jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses. Trash affects this use by reducing the numbers of fish and/or shellfish, and/or by introducing toxic compounds to the waters making the waters too dangerous or unsuitable for this beneficial use. The North Coast Water Board also has a subsistence fishing beneficial use that protects the use of waters for subsistence fishers. Many people living near freshwater or marine areas depend on food from their nearby water bodies for survival. Similar to the Native American Culture use, trash affects the subsistence fishing use if waters are void of fish and/or shellfish or if toxic compounds associated with trash impact the aquatic life. The effect on these uses is similar to the aquatic life and public health impacts of trash described above.

## **II. Trash in the Environment**

The presence of trash in surface waters, especially in coastal and marine waters, is a serious issue in California. According to California's 2008-2010 Integrated Report, there are 73 water bodies listed as having impaired water quality due to the presence of large amounts of trash. Trash discarded on land is frequently transported through storm drains and to waterways, shorelines, the seafloor, and the ocean. Statewide and local studies have documented the presence of trash in state waters and the accumulation of land-based trash in the ocean. Street and storm drain trash studies conducted in regions across California have provided insight into the composition and quantity of trash that flows from urban streets into the storm drain system and out to adjacent waters (Figure 31).



**Figure 31.** Don't Trash California (Caltrans).

### **Composition of Trash**

Since 1986, the California Coastal Commission and the Ocean Conservancy have organized the Coastal Cleanup Day to collect trash from beaches, inland waterways, coastal waters, and underwater annually through voluntary efforts at sites around the world (Figure 32). In 2012, volunteers removed 854,496 pieces of trash totaling 1,444,546 from 2,023 miles of Coastal Cleanup sites throughout California. The top ten items collected from 1989-2012 were: (1) cigarette butts; (2) bags (paper and plastic); (3) food wrappers and containers; (4) caps and lids; (5) cups, plates, forks, knives, and spoons; (6) straws and stirrers; (7) glass beverage bottles; (8) plastic beverage bottles; (9) beverage cans; and (10) building materials. These items made up nearly 90 percent of the items removed and cataloged by Coastal Cleanup Day events. These data generated by the Coastal Cleanup Day efforts provide valuable information on the sources of debris, as well as the types and quantity of debris in California.

In addition to the dominance of consumer products in the waste stream, preproduction plastics pellets are a particular concern when the raw material is improperly disposed and reaches a water body. A 1998 study, conducted in Orange County by Moore et al., found the most abundant debris items on beach sites were preproduction plastics, foamed plastics, and hard plastics. A 2009 collaborative baseline study conducted by the Southern California Coastal Water Research Project and the State Water Board estimated that preproduction plastic made up 95 percent of the debris on California's beaches, and other plastic debris items made up an additional 4.6 percent (Moore et al. 2013). The densest distribution of debris was found in the San Diego, Orange, Los Angeles and San Francisco County Regions, and appears to correlate with the more densely populated coastal watersheds in California.

Plastic, the largest component and among the longest of life spans of trash materials, is an increasingly local and global threat to aquatic and marine life and environments. Although plastics are one of the most common forms of trash and may have lasting and deleterious impacts, all forms of trash are a threat to state waters.

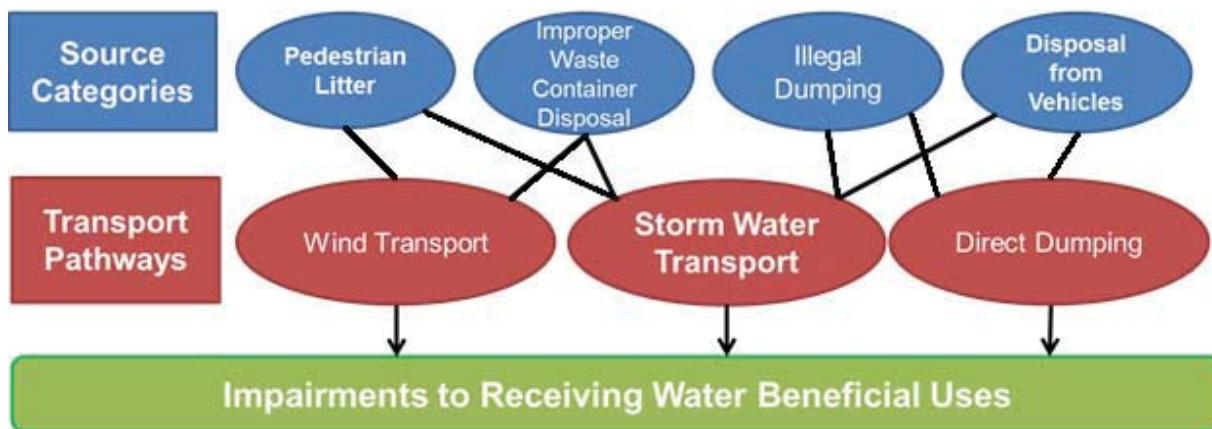


**Figure 32.** California Coastal Cleanup Day Advertisements (California Coastal Commission).

### Transport of Trash in the Environment

Trash in state waters is related to the direct and indirect activities of inhabitants inland, along coastal shorelines, and offshore (NOAA 2008a). A major source of trash is either intentionally or accidentally improperly discarded waste, thrown or deposited on land and in water bodies. If trash occurs on land, it is commonly transported to nearby water bodies by wind and/or rain or dry weather runoff. The five primary sources and transport mechanisms for trash to state waters are (Figure 33):

1. Littering by the public on or adjacent to waterways;
2. Storm events draining watersheds and carrying trash originating from littering, inadequate waste handling or illegal dumping via the storm drain system to receiving waters;
3. Wind-blown trash, also originating from littering, inadequate waste handling or illegal dumping;
4. Illegal dumping into or adjacent to water bodies, and;
5. Direct disposal (overboard disposal and/or dumping) of trash into water bodies from vessels involved in commercial, military, fishing or recreational activities.



**Figure 33.** Transport of Trash to Waters of the State.

Littering is commonly the first route for trash to enter the environment. It is considered as a land-based source of trash and frequently accumulates in the vicinity of shopping centers, car parking lots, fast food outlets, railway and bus stations, roads, schools, public parks and gardens, garbage bins, landfill sites, and recycling depots. Results of trash generation studies conducted in Los Angeles County and City of Los Angeles in 2001 and 2004 concluded that high trash generation rates occur at highly populated and highly visited areas that attract vehicular and pedestrian traffic. Objects that can be easily transported by wind, such as plastic and paper trash, are a particular problem because they can become floatable trash even when originally disposed of in an appropriate manner. Uncontained trash can be blown directly into inland surface waters (including rivers, lakes, estuaries, and drains), enclosed bays, and the ocean, or it can be transported to the ocean if blown into a river, stream, or enclosed bay that empties to coastal waters (U.S. EPA 2002, San Diego CoastKeeper 2010).

Storm water can also wash trash into drainage systems, where it is able to travel via the storm water systems, streams, rivers, lakes, and estuaries until it eventually reaches coastal waters (Armitage and Rooseboom 2000, Richmond and Clendenon 2011).

Trash will accumulate in areas of generation until the local authority either removes it or it is transported by wind and/or storm water runoff to nearby drainage systems and water bodies (Armitage and Rooseboom 2000). During storms and other periods of high winds or high waves, almost any kind of trash (including glass, metal, wood, and medical waste) can be deposited into the waters of the state (U.S. EPA 2002). A significant contribution from runoff has been shown in recent studies monitoring the density of marine trash before and after storm events. A study conducted on the Los Angeles and San Gabriel Rivers found the greatest abundance of plastic trash occurred after a rain event (Moore et al. 2011). A study conducted off the Southern California coast found trash increased after a storm event, reflecting inputs from land-based runoff and re-suspended matter (Lattin et al. 2004).

According to NOAA, it is estimated that 80 percent of marine trash comes from land-based sources (1999). Evidence of floating trash and trash on the seafloor suggests that trash from land-based sources can travel and impact waters downstream, along coastal shores, and in marine waters of the state. Trash that ends up on California beaches is indicative of trash accumulated from upstream sources, as well as other

sources such as visitor littering, poor management of waste containers, and recreational water activities. The transport of trash from land-based sources is not unique to California; the transport of trash is occurring globally. For example, the Danube River in Austria is reported to have a net flow rate of 4.2 tons of trash per day, with industrial raw materials accounting for over 70 percent of the reported items (Lechner et al. 2014). In the Tamar Estuary in London, plastics accounted for 82 percent of the trash found and the tidal cycle was a factor in the transport of trash (Sadri et al. 2014).

Illegal dumping and direct disposal of trash can take place in both fresh and marine waters. Trash is directly deposited into surface waters from accidental loss, improper waste management or by illegal disposal. Sources may include commercial fishing vessels; merchant, military and research vessels; recreational boats; cruise ships; and offshore petroleum platforms and associated supply vessels; beach recreation; and illegal encampments adjacent to waterways and water bodies. Trash deposition associated with recreational boating (Richmond and Clendenon 2001) also contributes to the problem, a majority of which is found to be plastic trash (Milliken and Lee 1990). One study that assessed trash generation along the shorelines of Orange County, suggested that water-based sources, such as overboard disposal were more significant than littering or wind deposition at these locations (Moore et al. 2001). While there are laws regulating the dumping of trash from boats and vessels in rivers, streams, marinas and seas, the global nature of trash, the inability to confine trash within territorial boundaries and the complexity of identifying trash sources have made laws difficult to develop and even harder to enforce.

### **Trash Assessment Studies**

Potential sources of trash have been identified in trash assessment studies performed in the San Francisco Bay Region, Los Angeles River watershed and in Santa Clara County. Collectively, these trash assessments have identified the following as potential sources: direct littering and dumping, downstream transport and accumulation, recreational land-uses, industrial land-uses, urban runoff, pedestrians, vehicles, and improper management of waste containers (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007, Surface Water Ambient Monitoring Program 2007, U.S. EPA 2012b).

Over the 2003-2005 monitoring period, the San Francisco Bay Region Rapid Trash Assessment study found that over 50 percent of the trash collected in urban streams was composed of plastic items. Glass (19%) and biodegradable items (10%) were also commonly found. Direct littering and dumping as well as downstream transport and accumulation were the two major transport mechanisms identified as responsible for the trash in streams in this region (Surface Water Ambient Monitoring Program 2007). High trash deposition rates were generally associated with wet weather, which reflects accumulation from upstream sources. As for dry season deposition, elevated deposition rates were primarily associated with localized littering and dumping, wind-blown trash from nearby sources, and, at certain sites, accumulation from upstream sources due to dry season runoff. Overall, trash levels generally increased in a downstream direction from headwaters to the mouth of the watershed. Other sources of trash near creek channels were identified as parks, schools, roads, or poorly kept commercial facilities.

In the Los Angeles River Watershed, the U.S. EPA and Los Angeles Water Board staff performed Rapid Trash Assessment in the lakes, along lakeshores, near fences and at the outlet of storm drains to document the impairment of Los Angeles area lakes. Rapid Trash Assessment site visits evaluated different land use types surrounding the lakes such as recreational use, industrial businesses, and urban runoff (U.S. EPA 2012b). The study suggests that trash in recreational areas surrounding the lake is likely transported from people littering in the area and from uncovered trash cans. In recreational areas, trash problems were primarily caused by overflowing trash cans and littering of small trash items, such as cigarette butts. Facilities in recreational areas, such as bathrooms and parking lots, were also identified as key hotspots for trash. Although industrial sites surrounding Peck Road Park Lake were too steep to appropriately conduct a quantitative trash assessment, items observed from a distance included plastic bags, milk jugs, a tire, a cooler, metal cable, and industrial scraps. Lastly, an inlet to Peck Road Park Lake was assessed to evaluate trash derived from urban runoff. This area demonstrated heavy accumulation of trash and evidence of trash dumping. Specific items found in the inlet of the lake included semiconductors, pepper sprays, spray paint cans, cigarette butts, large furniture items, foamed polystyrene, and plastic pieces (U.S. EPA 2012b).

Based on urban creek trash assessments in Santa Clara County, four source categories of trash have been identified by Santa Clara Valley Urban Runoff Pollution Prevention Program: pedestrians, vehicles, waste containers, and illegal dumping (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007). Pedestrian locations are likely the greatest source of trash that ends up in local water bodies. Areas most affected by trash include high foot traffic locations (e.g., shopping plazas, convenience stores, and parks), transition points (e.g., bus stops, train stations, and entrances to public buildings), and special event venues (e.g., concerts, sporting events, and fairs). Drivers and passengers are also responsible for trash when they litter directly from vehicles or do not adequately cover their vehicles when transporting trash. Land areas that may accumulate trash from vehicles include roads, highways, and parking lots. Waste containers that are overflowing or uncovered and the improper handling of trash during curbside collection may also contribute to the problem. Illegal dumping of trash may occur within a watershed or directly into a waterway. High occurrences of illegal dumping often are by illegal encampments near or within riparian areas (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007).

### **Land-Based Generation Studies**

Studies show that trash is predominantly generated on land and then transported to a receiving water body. The main transport pathway of trash to receiving water bodies is through storm water transport. Several studies have been conducted to determine the sources of land-based trash generation and the rates of trash generation areas. The land areas evaluated in these studies typically included the following: high density residential, low density residential, commercial services, industrial, public facilities, education institutions, military institution, transportation, utilities, mixed urban, open space, agriculture, water, and recreation land uses.

In 2001, the City of Los Angeles Watershed Protection Division performed a geographical analysis of trash generation in the City of Los Angeles. The study showed

that trash is most severe in Central City (Downtown LA) and nearby communities where commercial, industrial, and residential land uses are predominant (City of Los Angeles 2002). According to the 2004 Trash Baseline Monitoring results in Los Angeles County, the highest trash-generating land-uses were high-density residential, mixed use urban, commercial, and industrial land uses in the Ballona Creek and Los Angeles River Watershed, respectively (County of Los Angeles Department of Public Works 2004a; 2004b). The results indicate that high generation of trash is commonly found at highly populated and highly visited areas that attract high vehicular and pedestrian traffic.

BASMAA worked collaboratively with the permittees of the San Francisco Bay Area's Regional Stormwater Permit to develop a regionally consistent method to establish baseline trash loads from their municipality. The project, BASMAA Baseline Trash Generation Rates Project, assisted the permittees in establishing a baseline by which to demonstrate progress towards trash load reduction goals. The project assessed the baseline trash generation rates at 137 monitoring sites at nine different land uses, determined that the four land uses with the highest trash generation rates are (1) retail and wholesale, (2) high-density residential, (3) K-12 schools, and (4) commercial/services and industrial, and developed a conceptual model for trash generation rates (EOA, Inc. 2012a). The project provided a scientifically-sound method for developing trash generation rates that can be adjusted, based on permittee/site specific conditions, and used to develop baseline loading rates and loads (EOA, Inc. 2012a). Baseline loads form the reference point for comparing trash load reductions achieved through control measure implementation (EOA, Inc. 2012b).

### **Outfall and Storm Drain Monitoring**

Outfall and storm drain monitoring results are useful in determining the types of trash that is transported to receiving waters from inland locations. Paper, plastics, cigarette butts, and vegetation are common forms of trash collected in the outfalls and storm drains by Caltrans and municipalities such as Fresno and Stockton.

The Litter Management Pilot Study conducted in 1998 through 2000 by Caltrans identified that trash collected during outfall monitoring in the Los Angeles area consists of paper, plastic, wood, cigarette butts, foamed polystyrene, metal, and glass (Caltrans 2000). Further evaluation of the Litter Management Pilot Study data indicated that smoking- and food-related trash accounted for 20-30 percent of the trash by weight and volume and that approximately 90 percent of the trash collected at the storm drain outfall is floatable (Caltrans 2000). The high percentage of floatable trash can be indicative of the short residence time in the drainage system. Though plastics are one of the more common forms of trash in receiving waters (Moore et al. 2001, Moore et al. 2005; 2011), the Litter Management Pilot Study showed that non-plastics represent 67 percent of trash composition by weight, 57 percent by volume and 66 percent by count (Caltrans 2000). Caltrans reported that polystyrene items represented 5 percent by weight and 15 percent by volume. Plastic film including bags represented 7 percent by weight and 12 percent by volume.

During the 2001-2002 monitoring season, the Caltrans Public Education Litter Monitoring Study collected storm water trash data at Caltrans highway sites in Fresno and Stockton, California. The majority of material collected was vegetation. Trash,

however, as defined as manufactured items greater than 5 millimeters, ranged from 5 to 18 percent by weight and 11 to 43 percent by volume (Caltrans 2004).

### **Street and Storm Drain Trash Audits**

Street and storm drain trash audits characterize trash that can be transported to surface waters by wind, runoff, or storm water collection systems. Trash audits reveal the composition of littered products depicting the materials (paper, plastic, metal, and glass), type of product (bottle, cup, can, and cigarette butt), and sometimes the land-based sources of littered items. In California, two studies that have collected and assessed trash for brands and identifiable sources are the Source Reduction Pilot Project in the San Francisco Bay area and the storm drain trash audit of the City of Oxnard. A street trash audit was conducted in San Francisco, but the sources of the trash were not identified.

In 2010-2011, Clean Water Action coordinated a Source Reduction Pilot Project in which trash was characterized at isolated sites in four jurisdictions: Oakland, Richmond, San Jose, and South San Francisco. The results of the project identified that cigarette butts were the most common item found in trash. The leading quantifiable type of trash on city streets was food and beverage packaging (67%) (Clean Water Action 2011a). Altogether, 81 percent of trash collected originated from food establishments, including fast food, cafes, grocery stores, and convenience food stores. The results of this study suggest that businesses that sell “take-out” food and beverages are the largest sources of trash after cigarette smokers. These studies are instructive because businesses and institutions that decide to purchase packaged and disposable products influence the quantity of potential material that is available to become littered, dumped, improperly disposed, and thus potentially transported to nearby waters.

In 2005, the City of Oxnard completed a study of trash in the open channel storm drain system. According to the Stormdrain Keeper program, the most common trash items collected were plastic, cellophane, paper products, and foamed polystyrene (Pumford 2005). While much of the trash removed from the storm drain open channel was unmarked, key contributors of marked trash were fast food businesses and markets.

A street trash audit was conducted in San Francisco in April 2007 and April 2008. Within this study, trash was classified as “large” for items over four square inches or as “small” for items smaller than four square inches. For both monitoring periods, the most significant type of large trash observed was paper products, followed by plastic materials. Plastic materials include plastic packaging, wrap, plastic bags, and beverage containers. As for small trash observations, the most significant type of small trash was chewing gum, followed by glass pieces (City and County of San Francisco 2007, City of San Francisco 2008).

### **III. Current Efforts to Address Concerns Related to Trash in California Waters**

Regulations and policies are currently implemented in California to address trash in state waters. These efforts are discussed in the following sections.

## **State Laws and Local Ordinances**

Statewide laws and local ordinances have been adopted in California to address trash. For instance, California prohibits littering where such litter “creates a public health and safety hazard, a public nuisance, or a fire hazard” (Penal Code § 374.4). The California Vehicle Code provides that no one may throw or trash, including cigarettes onto highways and adjacent areas (§ 23111 and 23112).

In 2006, California passed Assembly Bill (AB) 2449, the Plastic Bag Recycling Law. This law requires certain retail establishments (grocery stores and pharmacies) that make plastic bags available at checkout to set up in store recycling programs to accept plastic bags. AB 2449 restricted the ability of cities and counties to regulate single-use plastic grocery bags through the imposition of a fee on plastic bags. In 2012, Senate Bill (SB) 1219 repealed the provisions that preempted local regulatory action, and extended recycling requirements for large supermarkets that distribute plastic bags to collect them for recycling until 2020.

California is the leader in implementing local ordinances with goals of reducing trash, specifically plastics. The two types of ordinances passed by local governments focus on addressing single-use disposable items: expanded polystyrene foam and single-use plastic bags. At least 65 jurisdictions have either banned expanded polystyrene foam food containers completely or have prohibited use by government agencies or at public events. A few jurisdictions that have banned or partially banned polystyrene for takeout food packaging include San Francisco, Los Angeles County, Sonoma County, Malibu, and Berkeley (Clean Water Action 2011b).

In 2006, the City of San Francisco passed a ban on single-use plastic bags in grocery stores and pharmacies. Since then, at least 72 local jurisdictions have adopted city and county ordinances for single-use plastic bags (Environment California Research and Policy Center 2011). In 2013, the City of Los Angeles became the largest city in the United States to adopt a single-use carryout bag ordinance. Most ordinances have a paper bag fee as well as a ban on plastic due to the desire to promote reusable bags as the bag of choice. Some large retailers also offer a five cent credit or other discounts for bringing a reusable bag. Statewide, several attempts have been made to pass plastic bag ban bills over the past several years, including AB 1998 in 2010 and SB 405 in 2013, although none have been passed in the State Legislature (West Coast Governors’ Alliance on Ocean Health 2013).

On September 30, 2014, Governor Edmund G. Brown Jr. signed the nation’s first statewide ban on single-use plastic bags—Senate Bill 270 (Sen. Padilla)(2014 Stat. Ch. 850)(adding Chapter 5.3 to Part 3 of Division 30 of the Public Resources Code). Senate Bill 270 aligns state law with the ordinances passed by local governments in California to reduce plastic waste. The new law prohibits grocery stores and pharmacies that have a specified amount of sales in dollars or retail floor space from providing single-use carry-out plastic bags as of July 1, 2015, and enacts the same ban for convenience stores and liquor stores on or after the following year. The legislation prohibits stores from selling or distributing a recycled paper bag or compostable bags at the point of sale for at a cost of less than \$0.10.

The proposals to ban plastic bags and polystyrene food containers could result in the use of alternative materials with a variety of potential impacts. Data from the City of San Francisco's Streets Litter Re-Audit report confirmed that eliminating all food-related polystyrene would simply change the type of litter found on our streets and in our waterways, and result in an increase in the non-polystyrene related litter items, thus, showing no overall reduction in litter (or trash to the waterways) (City of San Francisco 2008). Without a ban on all plastic and paper carryout bags, a ban on only plastic bags would simply cause a shift back to paper. According to some lifecycle data, which did not look at end-of-life impacts, greenhouse gas emissions would double due to releases associated with paper bag production and use (Boustead Consulting & Associates Ltd. 2007). In addition, some studies show that policies which force consumers to switch from plastic bags to paper will double energy use and quadruple the amount of waste generated. Similarly, bans on polystyrene food containers would cause a shift to materials with other significant environmental impacts (University of California at San Diego 2006).

### No Existing Trash-Specific Water Quality Objectives

Each regional water board has adopted narrative objective(s) for pollutants in its basin plan (Table 15). These narrative objectives refer to trash-related pollutants and other pollutants such as foam and sediment in general terms (i.e., floatable, suspended, and settleable material), but do not specifically refer to trash as a specific pollutant. The Ocean Plan also has similar floatable, suspended, and settleable material objectives, but no specific mention of trash as a pollutant. As summarized in Table 15, there is variability among the existing narrative objectives in the basin plans and the Ocean Plan. Additionally, the ISWEBE Plan lacks a trash-related water quality objective.

**Table 15.** Trash-Related Water Quality Objectives.

Basin Plan / Ocean Plan	Water Quality Objective
North Coast	<p><i>For inland surface waters, enclosed bays and estuaries</i></p> <p><u>Floating Material:</u> Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Suspended Material:</u> Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Settleable Material:</u> Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.</p>
San Francisco Bay	<p><i>For all surface waters except the Pacific Ocean</i></p> <p><u>Floating Material:</u> Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Suspended Material:</u> Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Settleable Material:</u> Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.</p>

Basin Plan / Ocean Plan	Water Quality Objective
Central Coast	<p><i>For all inland surface waters, enclosed bays and estuaries</i></p> <p><u>Floating Material:</u> Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Suspended Material:</u> Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Settleable Material:</u> Waters shall not contain settleable material in concentrations that result in deposition of material that causes nuisance or adversely affects beneficial uses.</p>
Los Angeles	<p><i>For inland surface waters and enclosed bays and estuaries (including wetlands)</i></p> <p><u>Floating Material:</u> Floating materials can be an aesthetic nuisance as well as provide substrate for undesirable bacterial and algal growth and insect vectors. Waters shall not contain floating materials, including solids, liquids, foams and scum, in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Solid, Suspended, or Settleable Materials:</u> Surface waters carry various amounts of suspended and settleable materials from both natural and human sources. Suspended sediments limit the passage of sunlight into waters, which in turn inhibits the growth of aquatic plants. Excessive deposition of sediments can destroy spawning habitat, blanket benthic (bottom dwelling) organisms, and abrade the gills of larval fish. Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.</p>
Central Valley Sacramento and San Joaquin Basins	<p><i>All surface waters in the basin</i></p> <p><u>Floating Material:</u> Water shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses.</p> <p><u>Settleable Material:</u> Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.</p> <p><u>Suspended Material:</u> Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.</p>
Central Valley Tulare Lake Basin	<p><i>For inland surface waters</i></p> <p><u>Floating Material:</u> Waters shall not contain floating material, including but not limited to solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.</p> <p><u>Settleable Material:</u> Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.</p> <p><u>Suspended Material:</u> Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.</p>

Basin Plan / Ocean Plan	Water Quality Objective
Lahontan	<p><i>For all surface waters</i></p> <p><u>Floating Materials</u>: Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses. For natural high quality waters, the concentrations of floating material shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.</p> <p><u>Settleable Materials</u>: Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. For natural high quality waters, the concentration of settleable materials shall not be raised by more than 0.1 milliliter per liter.</p> <p><u>Suspended Materials</u>: Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affects the water for beneficial uses. For natural high quality waters, the concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.</p> <p><i>Specific to Pine Creek Watershed</i></p> <p><u>Settleable Material</u>: The concentration of settleable material shall not be raised by more than 0.2 milliliter per liter (maximum) and by no more than an average of 0.1 milliliter per liter during any 30-day period.</p>
Colorado River	<p><i>All surface waters</i></p> <p><u>Aesthetic Qualities</u>: All waters shall be free from substances attributable to wastewater of domestic or industrial origin or other discharges which adversely affect beneficial uses not limited to:</p> <ul style="list-style-type: none"> <li>- Settling to form objectionable deposits;</li> <li>- Floating as debris, scum, grease, oil, wax, or other matter that may cause nuisances; and</li> <li>- Producing objectionable color, odor, taste, or turbidity.</li> </ul> <p><u>Suspended Solids and Settleable Solids</u>: Discharges of wastes or wastewater shall not contain suspended or settleable solids in concentrations which increase the turbidity of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in turbidity does not adversely affect beneficial uses.</p> <p><i>Specific to New River (has Trash TMDL)</i></p> <p>The waters of the River shall be essentially free from trash, oil, scum, or other floating materials resulting from human activity in amounts sufficient to be injurious, unsightly, or to cause adverse effects on human life, fish, and wildlife. Persistent foaming shall be avoided.</p>

Basin Plan / Ocean Plan	Water Quality Objective
Santa Ana	<p><i>For enclosed Bays and estuaries</i></p> <p><u>Floatables</u>: Floatables are an aesthetic nuisance as well as a substrate for algae and insect vectors. Waste discharges shall not contain floating materials, including solids, liquids, foam or scum, which cause a nuisance or adversely affect beneficial uses.</p> <p><u>Solids, Suspended and Settleable</u>: Settleable solids are deleterious to benthic organisms and may cause anaerobic conditions to form. Suspended solids can clog fish gills and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development. Enclosed bays and estuaries shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.</p> <p><i>For inland surface waters</i></p> <p><u>Floatables</u>: Floatables are an aesthetic nuisance as well as a substrate for algae and insect vectors. Waste discharges shall not contain floating materials, including solids, liquids, foam or scum, which cause a nuisance or adversely affect beneficial uses.</p> <p><u>Solids, Suspended and Settleable</u>: Settleable solids are deleterious to benthic organisms and may cause anaerobic conditions to form. Suspended solids can clog fish gill and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development. Inland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.</p>
San Diego	<p><i>For all inland surface waters, enclosed bays and estuaries, coastal lagoons and ground waters</i></p> <p><u>Floating Material</u>: Floating material is an aesthetic nuisance as well as a substrate for algae and insect vectors. Waters shall not contain floating material, including solids, liquids, foams, and scum in concentrations which cause nuisance or adversely affect beneficial uses.</p> <p><u>Suspended and Settleable Solids</u>: Suspended and settleable solids are deleterious to benthic organisms and may cause the formation of anaerobic conditions. They can clog fish gills and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development. Waters shall not contain suspended and settleable solids in concentrations of solids that cause nuisance or adversely affect beneficial uses.</p>

Basin Plan / Ocean Plan	Water Quality Objective
Ocean Plan	<p><i>Objectives</i></p> <ol style="list-style-type: none"> <li>1. Floating particulates and grease and oil shall not be visible.</li> <li>2. The discharge of waste shall not cause aesthetically undesirable discoloration of the ocean surface.</li> <li>3. Natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste.</li> <li>4. The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.</li> </ol> <p><i>Implementation Provisions</i></p> <p>Waste discharged to the ocean must be essentially free of:</p> <ol style="list-style-type: none"> <li>1. Material that is floatable or will become floatable upon discharge.</li> <li>2. Settleable material or substances that may form sediments which will degrade benthic communities or other aquatic life.</li> <li>3. Substances which will accumulate to toxic levels in marine waters, sediments or biota.</li> <li>4. Substances that significantly decrease the natural light to benthic communities and other marine life.</li> <li>5. Materials that result in aesthetically undesirable discoloration of the ocean surface.</li> </ol>
ISWEBE Plan	No water quality objective applicable to trash.

## Current NPDES Permits and Existing Trash TMDLs

The CWA establishes the NPDES permit as the primary mechanism for achieving water quality standards in navigable waters. NPDES permits are issued to point source dischargers and include effluent and receiving water limitations. Effluent limitations are based on the water quality objectives in the applicable basin plan and are designed to attain and maintain water quality standards in the receiving waters. Currently, existing NPDES permits, such as MS4 Phase I, MS4 Phase II, and Caltrans, have some existing requirements for trash reduction in the form of institutional controls, such as street sweeping and educational programs. These existing requirements can be applicable to multiple types of urban storm water pollutants, including trash.

For those waters that do not attain water quality standards even after NPDES permits are issued to point sources with the effluent limitations described above, the CWA requires states to adopt TMDLs for the pollutants causing the impairment in a water body. TMDLs are designed to restore water quality by controlling the pollutants that cause or contribute to such excursions. A TMDL assigns waste load allocations for specific pollutants to point sources discharging effluent pursuant to the terms and conditions of NPDES permits. A TMDL also assigns load allocations to nonpoint source discharges. Attainment of all load and waste load allocations would, in most cases, result in compliance with the water quality standards within a reasonable time period.

Additionally, discharges not subject to NPDES permits are regulated under Porter-Cologne through WDRs, waivers of WDRs, and prohibitions of discharge. WDRs are

issued by regional water boards and are issued individually for a specific discharge or generally to cover a category of discharges. WDRs may include effluent limitations or other requirements designed to implement applicable water quality control plans, and they may specify when and where a discharge of waste will not be permitted.

The presence of trash in California waters has resulted in a number of waters listed as impaired on the CWA section 303(d) list of Water Quality Limited Segments over the past several listing cycles. According to California's 2008-2010 section 303(d) list of impaired waters, there are 73 listings due to trash in California waters. These impairments will ultimately require some action to address the listing (e.g., TMDLs or other actions). According to the 2010 Integrated Report, 73 water bodies have approved TMDLs for impairments due to trash and debris. Although listings occur in four Regions (San Francisco Bay, Los Angeles, Colorado River Basin, and San Diego), TMDLs have only been developed to date in the Los Angeles Region and the Colorado River Basin Region. In the Colorado River Basin, a TMDL for trash was adopted for the New River (at the international boundary) that included a numeric target of zero trash (Colorado River Basin Water Board 2006). In the Los Angeles Region, fifteen TMDLs were adopted for trash and debris by either the Los Angeles Water Board or U.S. EPA: San Gabriel River East Fork, Ballona Creek, Los Angeles River Watershed, Revolon Slough, Beardsley Wash, Ventura River Estuary, Malibu Creek Watershed, Lake Elizabeth, Munz Lake, Lake Hughes, Legg Lake, Machado Lake, Santa Monica Bay Nearshore and Offshore, Peck Road Park Lake, Echo Park Lake, and Lincoln Park Lake (Table 16; Los Angeles Water Board 2000; 2004; 2007a; 2007b; 2007c; 2007d; 2007e; 2007f; 2008g; 2010, U.S. EPA 2012a).

The Los Angeles Water Board's trash and debris TMDLs set the numeric target for trash in the applicable water bodies to zero, as derived from the water quality objective in the basin plans. The TMDLs have all also defined trash to be "man-made litter," as defined by the California Government Code (§ 68055.1(g)). Implementation plans vary slightly but are mostly based on phased percent reduction goals that can be achieved through discharge permits, BMPs, and structural controls.

**Table 16.** Existing Trash and Debris TMDLs.

TMDL Name (Year TMDL Effective)	Numeric Target	Implementation
<b>Los Angeles Water Board</b>		
Santa Monica Bay Near and Offshore (2012)	0 (zero) trash and plastic pellets	For trash, the TMDL recommended implementation of full capture systems, MFAC program, or nonstructural BMPs (e.g., trash collection, public education, and bans on certain non-degradable items). For plastic pellets, industries must comply with the Statewide Industrial Permit or other general or individual industrial permits, which require a Stormwater Pollution Prevention Plan.
Peck Road, Lincoln Park, and Echo Park Lakes (2012)	0 (zero) trash	Recommended implementation of full capture systems, MFAC program, or nonstructural BMPs (e.g., trash collection, public education, and bans on certain non-degradable items).

TMDL Name (Year TMDL Effective)	Numeric Target	Implementation
Malibu Creek Watershed (2009)	0 (zero) trash	100% reduction, 8 years from effective date of TMDL using full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Lake Elizabeth, Munz Lake, and Lake Hughes (2008)	0 (zero) trash	10% reduction after third year and 20% per year thereafter using full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Legg Lake (2008)	0 (zero) trash	100% reduction, 8 years from effective date of TMDL using full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Los Angeles River (2008)	0 (zero) trash	40% reduction after first year and 10% per year thereafter using any combination of full/partial capture systems or institutional controls
Machado Lake (2008)	0 (zero) trash	Full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Revolon Slough and Beardsley Wash (2008)	0 (zero) trash	100% reduction, 8 years from effective date of TMDL Full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Ventura River (2008)	0 (zero) trash	100% reduction, 8 years from effective date of TMDL using full capture systems or MFAC program for point sources; MFAC or appropriate alternative program for nonpoint sources
Ballona Creek (2005)	0 (zero) trash	Phased reduction of 10% per year over a 10-year period using capture systems (e.g., catch basin inserts, structural vortex separation system, end of pipe nets) and/or institutional measures (e.g., street sweeping, enforcement of litter laws)
San Gabriel River East Fork (2001)	0 (zero) trash	Litter prevention, trash sweeps, patrol staff enforcing litter laws, trash receptacles and signs
<b>Colorado River Basin Water Board</b>		
New River (2007)	0 (zero) trash	75% reduction within 2 years from effective date of TMDL; 100% reduction within 3 years.

The San Francisco Bay Water Board uses provisions in the San Francisco Bay MRP to address trash in the 27 303(d) listed water bodies in the Region (Order R2-2009-0074). The San Francisco Bay MRP applies to 76 large, medium and small municipalities and flood control agencies in the San Francisco Bay Region. The San Francisco Bay MRP prohibits the discharge of “rubbish, refuse, bark, sawdust, or other solid wastes into surface waters or at any place where they would contact or where they would be eventually transported to surface waters, including flood plain areas.” The trash-related receiving water limitations identified in the San Francisco Bay MRP do not place numeric targets on trash but use narrative language to prohibit trash discharges. In the San Francisco Bay MRP, trash is as defined in the California Government Code section 68055.1(g).

Compliance with the discharge prohibition and trash-related Receiving Water Limitations is met through a timely implementation of control measures, BMPs, and any trash reduction ordinances or mandatory full trash capture devices to reduce trash loads from MS4s by set percent reductions (San Francisco Water Board 2009). The San Francisco Bay MRP requires that permittees reduce trash from their storm sewer systems by 40 percent by July 1, 2014. The San Francisco Bay MRP permittees are developing and implementing a Short-Term Trash Load Reduction Plan. The implementation of the Short-Term Trash Load Reduction Plan includes a mandatory minimum level of trash capture systems, cleanup and abatement progress on a mandatory minimum number of Trash Hot Spots<sup>22</sup>, and implementation of other control measures and BMPs, such as trash reduction ordinances, to prevent or remove trash loads from MS4s to attain a 40 percent reduction in trash loads by July 1, 2014 (City of Cupertino 2012, City of San Jose 2012).

### **State Policy Efforts**

In response to the increasing problem of trash within the state, particularly plastic trash, policymakers have initiated efforts such as the California Ocean Protection Council's Resolution on Reducing and Preventing Marine Debris (2007) and subsequent Implementation Strategy for Reducing Marine Litter (2008). These policies respectively call for target reductions of trash within a set timeline, and prioritize state efforts for source reduction of "worst offender" plastic trash, such as cigarette butts, plastic bottle caps, plastic bags, and polystyrene. The Implementation Strategy also prioritizes extended producer responsibility for packaging waste, which has already been embraced in Canada, the EU, and other countries (California Ocean Protection Council 2007; 2008). Neither the California Ocean Protection Council Resolution nor the Implementation Strategy details methodologies for decreasing trash in the context of NPDES storm water permitting or other federal and state clean water laws.

In 2013, the West Coast Governor's Alliance on Ocean Health introduced a Marine Debris Strategy. The objectives of the Strategy are to prevent marine debris from entering the ocean or littering beaches; maximize recovery of marine debris in the ocean or on shore; reduce and prevent the negative impacts of marine debris; and enhance existing efforts through communication and collaboration among interested parties on the West Coast. The Strategy provides a toolbox of key actions that may be implemented collaboratively or individually by western states at its discretion and allows for the successful achievement of target milestones through various reduction methods.

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<sup>22</sup> Trash Hot Spots are to be cleaned up to a level of "no visual impact" at least one time per year for the term of the permit. Trash Hot Spots shall be at least 100 yards of creek length or 200 yards of shoreline length.