

Why Cleanups Do Not Work: Accumulation and Re-accumulation of Cigarette Butts on Runoff-Contributing Surfaces Near Storm Water Inlets

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Background

- Cigarette butts are the most littered item in the world. They leach toxic substances like nicotine, heavy metals, and microplastic into the environment as they degrade.⁴
- Storm drain runoff from Pacific Beach flows south into northern Mission Bay, which contain 40-acres of protected wetlands.
- Previous research detected has tobacco chemicals (nicotine) in the water and soil near stormwater outlets in the neighboring Kendall-Frost Mission Bay Marsh Reserve.¹
- Previous research done in San Diego showed tobacco product waste can re-accumulate to baseline levels after a cleanup within 1-2 months.³

Our Goal

- Determine the rate of cigarette butt accumulation and re-accumulation in the drainage area of Pacific Beach.
- Demonstrate the rate of removal necessary to achieve a significant reduction in waste levels.

Methods

- City maps and ArcGIS Pro were used to map the drainage area of Pacific Beach and identify storm drain inlets that flow into the two outlets located in the Reserve. A stratified random sample (n=29) of storm drain inlets were selected.
- Survey area boundaries were set from the middle of the street to the inside edge of the curb strip from the left and right of each storm drain to the nearest cross street. (See **Figure S2** for diagram)
- A repeated measures design was used, with 6 tobacco product waste survey and pickup events scheduled around 4 rain events (≥ 6mm rain). See **Figure 1** for timing of rounds and rain events.
- Trained research staff and student assistants followed standardized sampling protocols to record and collect tobacco product waste.

Cigarette butts are littered at a rate that outpaces frequent cleanups, pointing to the need for prevention-focused solutions.

Cigarette Butts Returned (% of Steady State)	Time Since Last Cleanup
10% returned	After 2 days
30% returned	After 7 days
50% returned	After 2 weeks
90% returned	After 2 months

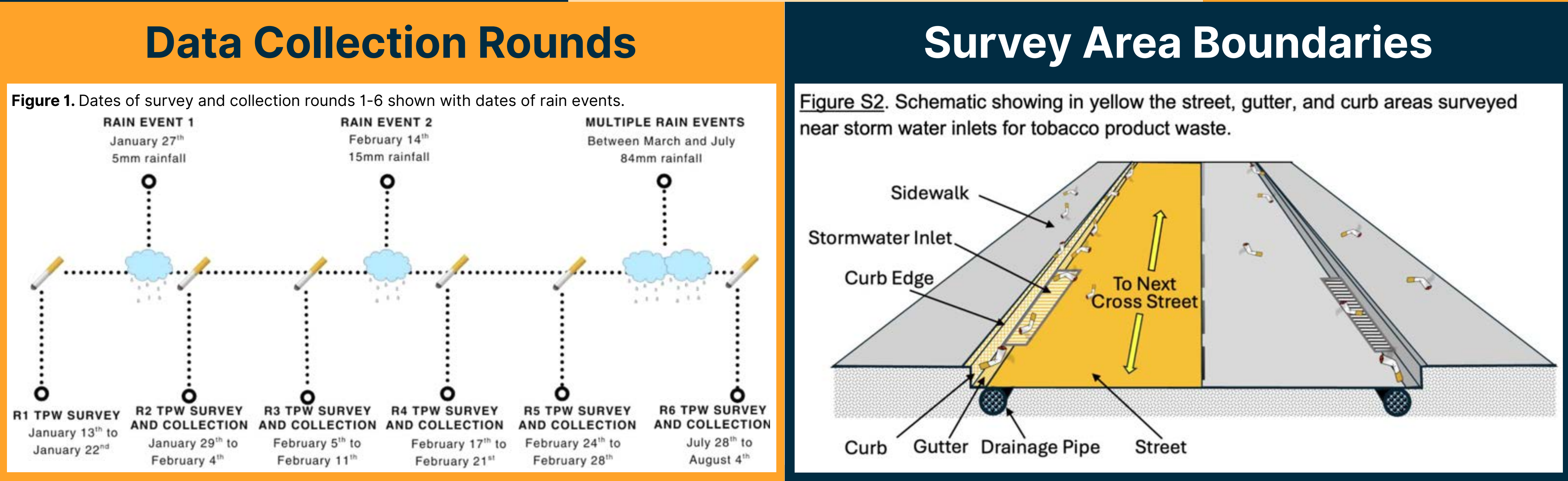
To keep discarded cigarette butts down to just 10% of prior levels, cleanups would need to happen **every other day.**

~1,500 cigarette butts make up the “steady state” of pollution near the 29 storm drains of the study area at any given time.

~80 cigarette butts are estimated to be discarded near the 29 storm drains each day in the study area.

That's ~29,000 butts discarded each year!

Rain events did not significantly impact the “steady state” of pollution in the study area.



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References

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Access the full article² in ACS ES&T Water.

Results

Steady State of Cigarette Butt Pollution

A first-order accumulation model showed that ~80 butts accumulated per day and 5% were “removed” per day. An estimated 29,073 butts are discarded each year.

At this rate, the “steady state” of cigarette butt pollution in the drainage area is estimated to be ~1,500 cigarette butts at any given time. (See Fig 3)

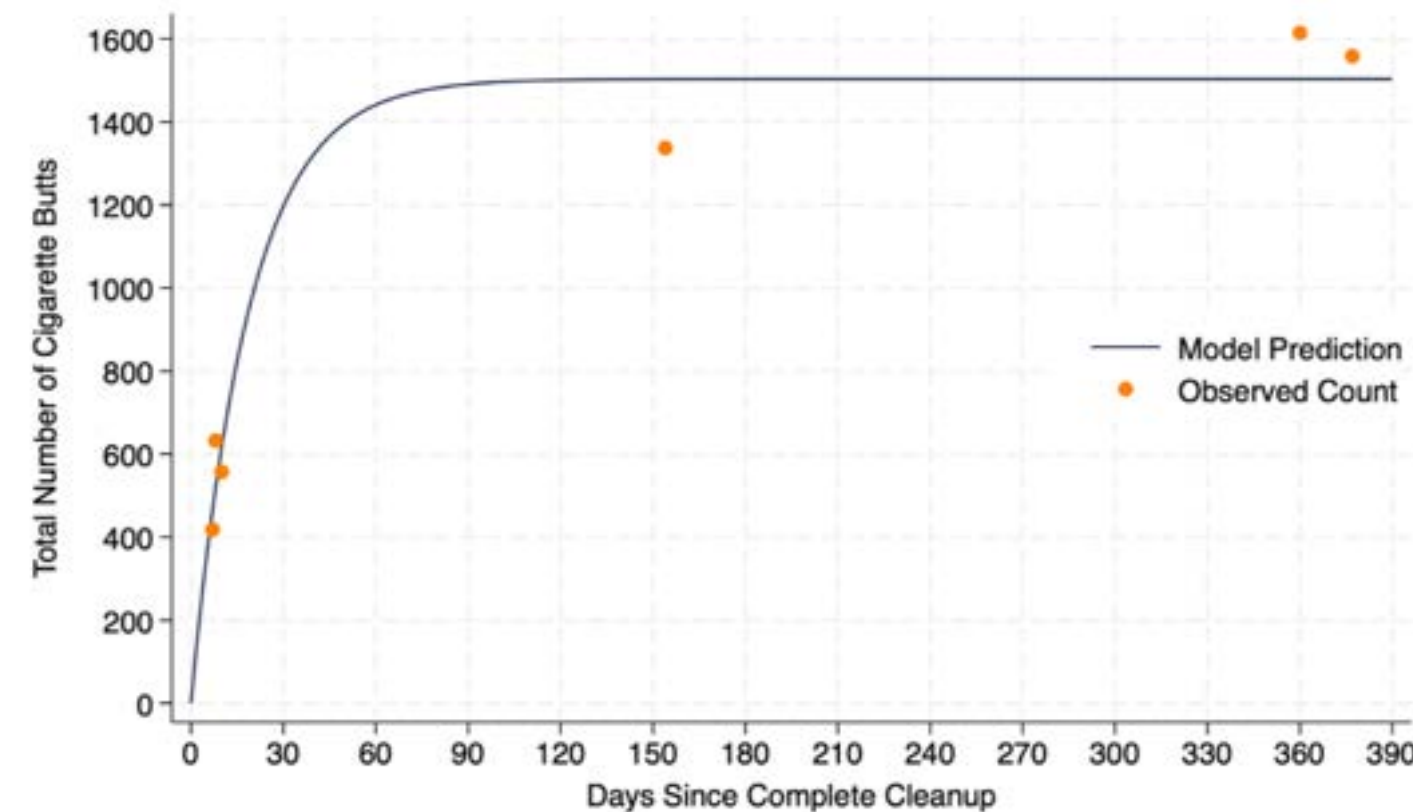


Figure 3. Total number of cigarette butts observed (orange dots) and estimated to accumulate (blue line) near the 29 storm drains as a function of the number of days since the last cleanup.

Cigarette Butts Per Inlet Over Time

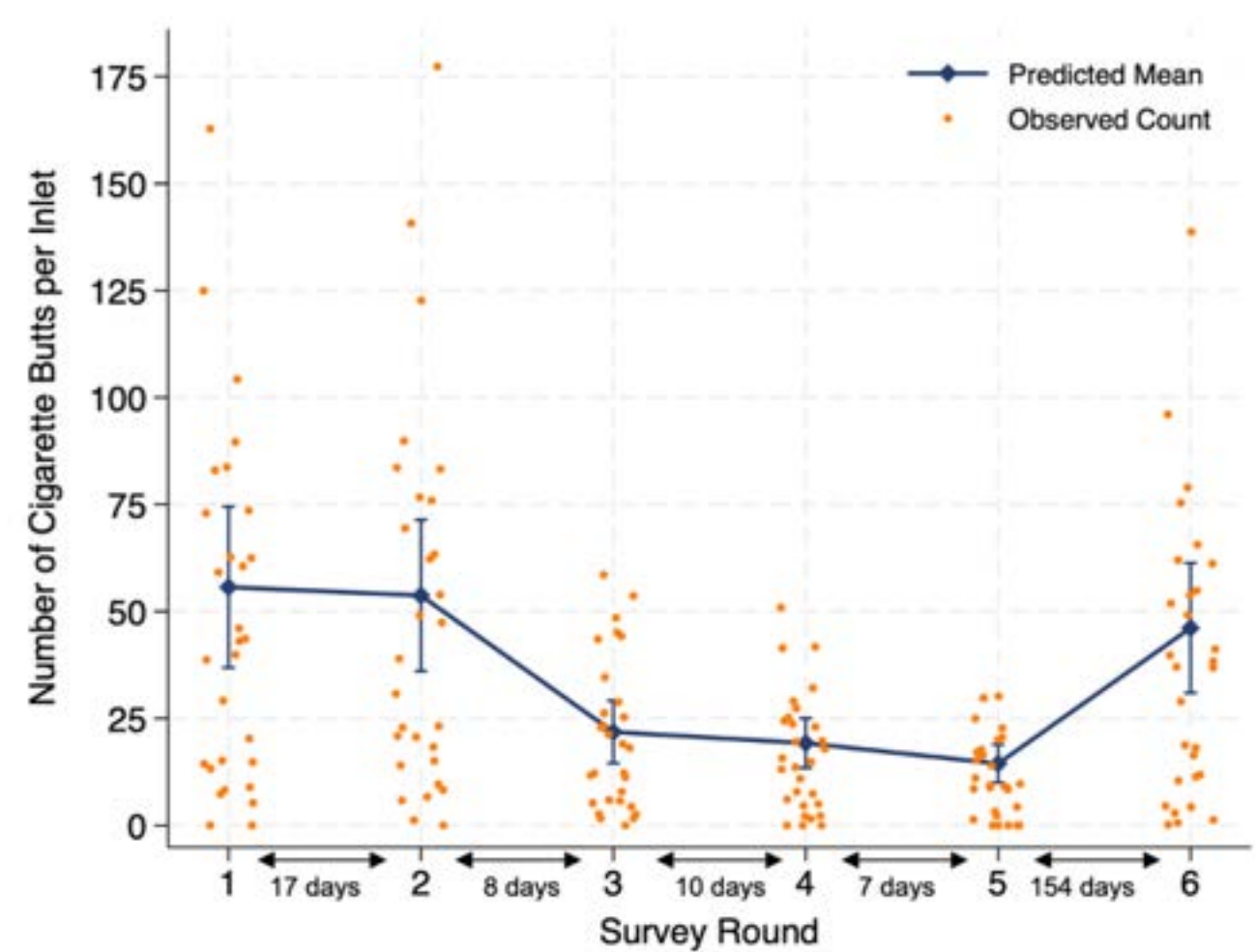
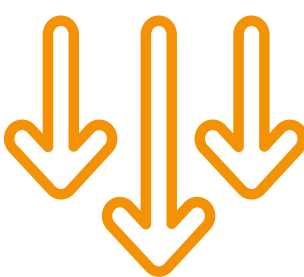


Figure 2. Observed counts (orange dots) and estimated mean cigarette butts (blue dots) per storm drain inlet with 95% confidence interval based on six surveys. CBs were removed in survey rounds 2 to 6. Rain events occurred between Round 1 and 2, 3 and 4, and 5 and 6.

Mean cigarette butt counts between Rounds 2 & 3 (57.3 vs 21.8; $\chi^2(1)=70.9$, $p<0.001$) and Rounds 4 & 5 (19.2 vs. 14.4; $\chi^2(1)=7.45$, $p=0.0063$) revealed statistically significant reductions.



The number of days between collections here was the shortest, with 2 and 3 occurring 8 days apart, and 4 and 5 occurring 7 days apart. (See Fig 2)

Conclusion

- Continuous cigarette butt accumulation near storm drains in Pacific Beach likely contributes to chronic microplastic and chemical pollution in the protected northern Mission Bay wetlands year-round.
- To reach a 90% reduction in cigarette butt pollution in the Pacific Beach to Reserve drainage areas, complete cleanups would need to be performed every other day. This type of “downstream” intervention is unrealistic and cost-prohibitive for municipal governments, businesses, or volunteer organizations.
- Cleanups on their own, while symbolically important, are ineffective in preventing the continuous environmental pollution from cigarette butts.
- Prevention-focused, “upstream” solutions are needed to reduce the rate at which cigarette butts are discarded in the first place. This includes eliminating the sale of filtered cigarettes, restricting outdoor tobacco use, reducing the density of tobacco retail outlets, and stronger educational and behavioral interventions to reduce cigarette butt and other tobacco product environmental pollution.



Policy Research Center for Tobacco and the Environment