Quantifying Water Quality Impacts of Tobacco in Litter

Author: Walter Yu, P.E.

Abstract

The State Water Resources Control Board (SWRCB) is in process of adopting its Trash Amendments which prohibit trash discharge to Waters of the State to minimize environmental impacts. One major component of trash is cigarette butts and tobacco products which are a form of non-biodegradable litter. In addition, this litter contains tobacco which may lead to health impacts when incorporated into discharged runoff. The National Institute of Health (NIH) published an article in 2009 which outlines these impacts and recommendations for reducing them. As a result, this study evaluates methods to quantify potential water quality and health impacts of tobacco incorporated into litter.

Introduction

This study was developed as part of the 2018 CA Trash Data Dive which was organized by the SWRCB and hosted by the San Francisco Estuary Institute. It analyzes trash characterization data from the Bay Area Stormwater Management Agencies Association (BASMAA) street sweeping and curb inlet screen evaluation study and the CalEnviroScreen dataset provided by the CA Environmental Protection Agency (CalEPA).

Quantifying the impacts of tobacco in litter would help with develop public policy and shifting public opinion, so this study address the questions listed below with data analysis and visualization:

1. Which publicly available datasets would be useful in quantifying water quality impacts?
2. If so, then what are some effective methods for analyzing them?
3. What are some observations and next steps from this study?

Data Exploration

Publicly available datasets were selected for analysis so that results could be shared and reproduced easily; relevant portions of each dataset were used as follows:

1. BASMAA Study: Data includes trash characterization for all materials collected as part of its study. Monitoring sites shown in Figures 2.3, 2.4 and 2.5 were reproduced in Excel and merged with monitoring data shown in Appendix B. The data was cleaned and imported into Google Earth.
2. CalEPA CalEnviroScreen: Data includes environmental health scores statewide. Scores were filtered for each zip code of each BASMAA monitoring site, and the data was cleaned and imported into Google Earth.

Assumptions and Limitations

The scope of this study is limited to method for quantifying water quality impacts and do not attempt to demonstrate or correlate them since doing so requires additional study. It proposes a cost and time-effective method for quantifying efforts, although other methods may also be effective or required to demonstrate potential causes for these effects.

In addition, this study and datasets have the following limitations:

1. BASMAA Trash Characterization: Study focused on street sweeper and inlet screen evaluation, so monitoring sites are located based on inlet and roadway geometry. In addition, sites were located within only 3 cities (Fremont, Oakland and San Jose) so additional sites with a focus on cigarette butt and tobacco product litter would be required for more accurate data.
2. CalEPA CalEnviroScreen: The dataset and its methodology are robust; however, additional study is required to demonstrate any cause or correlation between tobacco in litter and potential health impacts. Environmental impacts are validated since cigarette butts were quantified in the BASMAA study within inlet screens which would have otherwise discharged into the Waters of the State; however, potential health impacts are unclear.

Data Analysis and Visualization

The BASMAA and CalEnviroScreen datasets were analyzed and visualized in Google Earth as follows:

1. BASMAA Trash Characterization: Dataset includes cigarette butt volume collected at 3 monitoring sites in 2015; as a result, the site locations and volume data were summarized in Excel then imported into Google Earth for visualization.
2. CalEPA CalEnviroScreen: Dataset includes potential health impacts due to groundwater and drinking water risk; as a result, scores within the same zip code as the BASMAA monitoring sites in Excel then imported into Google Earth for visualization.
3. BASMAA and CalEnviroScreen Visualization: Both datasets were compared in Google Earth to demonstrate the effectiveness of this approach to quantifying water quality impacts. The CalEnviroScreen data was visualized as data points and GIS layers as shown in Appendices A and B.

Tools and Process

The tools and process listed below were used to analyze data and provide recommendations:

1. Excel and CSV Files - Exploratory data analysis and data cleaning were completed in Excel and CSV.
2. Google Earth - Data visualization was completed by importing BASMAA and CalEnviroScreen CSV data.
3. Machine Learning (Next Step) - Additional analysis may be used to compare data features.

Recommendations

Data analysis and visualization appear to be an effect method of quantifying and evaluating potential water quality impacts. This study provides the methodology and process for continuing similar analysis with other datasets such as pilot study results or other public datasets. Additional analysis is recommended to study specific effects. The questions posed by this study were addressed as follows:

1. ***Which publicly available datasets would be useful in quantifying water quality impacts?***
   Based on literature review completed during this study, the BASMAA evaluation study and CalEPA CalEnviroScreen datasets were such useful datasets. In addition, the CA Open Data [website](#) provides additional tobacco-related datasets available for analysis.

2. ***If so, then what are some effective methods for analyzing them?***
   Data analysis using pivot tables in Excel and visualizing using Google Earth were effective methods; however, additional statistical or machine learning analysis may provide additional insights.

3. ***What are some observations and next steps from this study?***
   Causation and correlation of health impacts and pollution are a large topic; as a result, additional study is required to provide any such conclusions. Next steps include additional statistical or machine learning analysis, pilot studies or comparison with other public datasets.

Conclusion

This study demonstrates the benefit of analyzing public datasets to quantify (and hopefully minimize) the water quality impacts of tobacco in litter. Although health and environmental impacts caused by pollution are a wide topic, small steps may be taken to start support of policy and public opinion for minimizing negative impacts.

Appendix A - BASMAA Monitoring Sites and CalEnviroScreen Data Visualization

Figure A.1 - Monitoring Site in Fremont (FR-01) with Nearby CalEnviroScreen Data Points
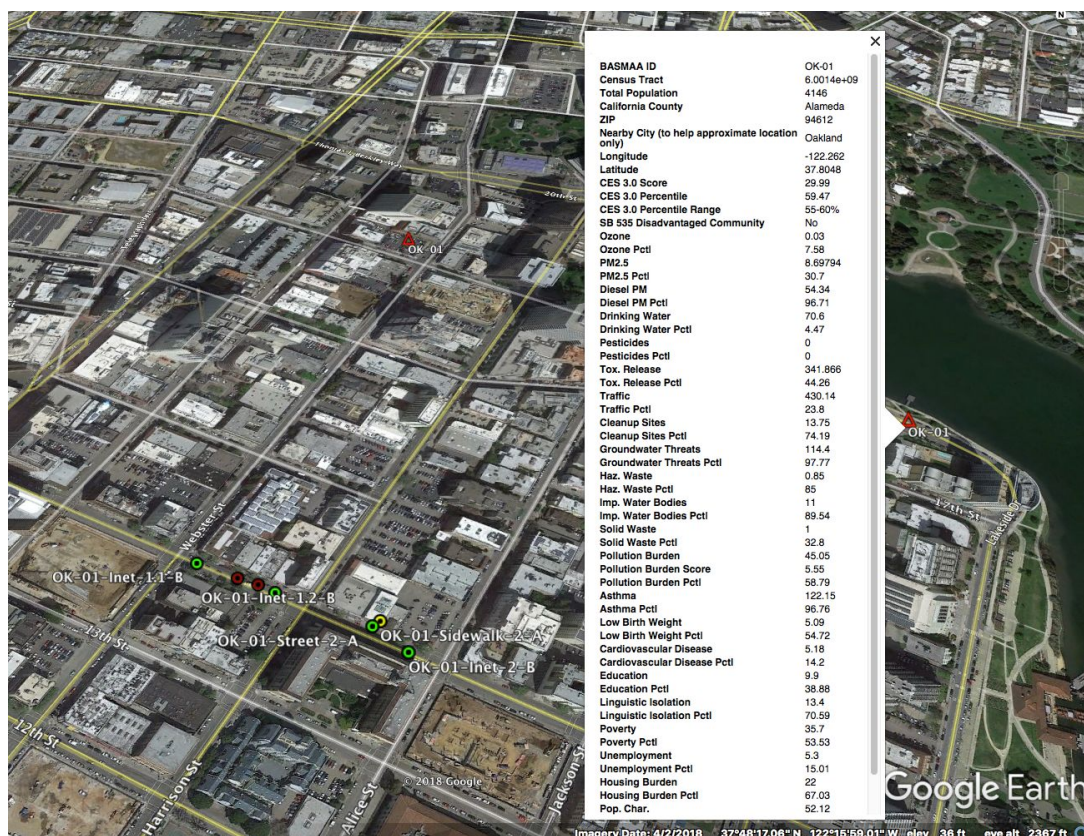

Figure A.2 - Monitoring Site in Oakland (OK-01) with Nearby CalEnviroScreen Data Points

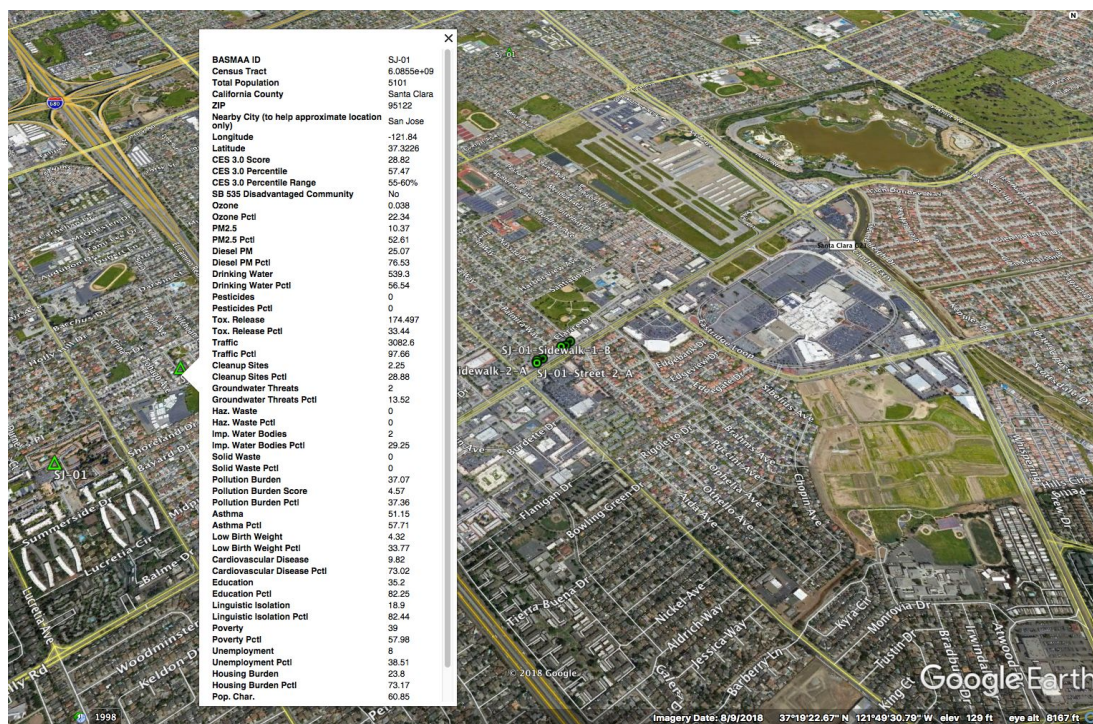# Appendix A - BASMAA Monitoring Sites and CalEnviroScreen Data Visualization

Figure A.3 - Monitoring Site in San Jose (SJ-01) with Nearby CalEnviroScreen Data Points

Appendix B - BASMAA Monitoring Sites and CalEnviroScreen Data Visualization

Figure B.1 - Monitoring Site in Fremont (FR-01) and CalEnviroScreen GIS Layer
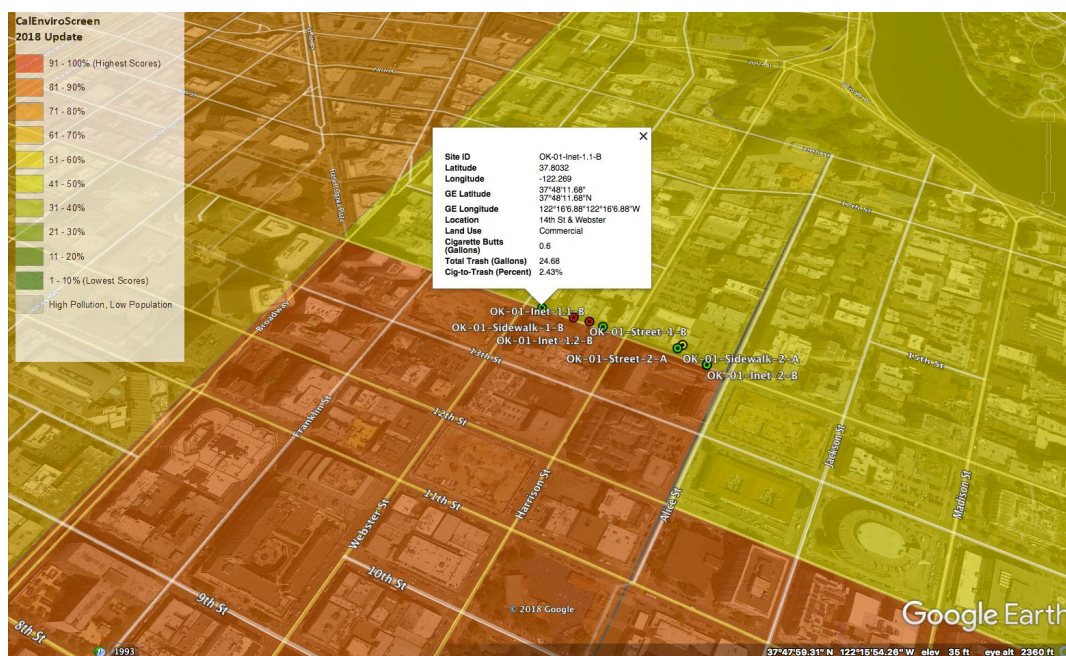

Figure B.2 - Monitoring Site in Oakland (OK-01) and CalEnviroScreen GIS Layer

Appendix B - BASMAA Monitoring Sites and CalEnviroScreen Data Visualization
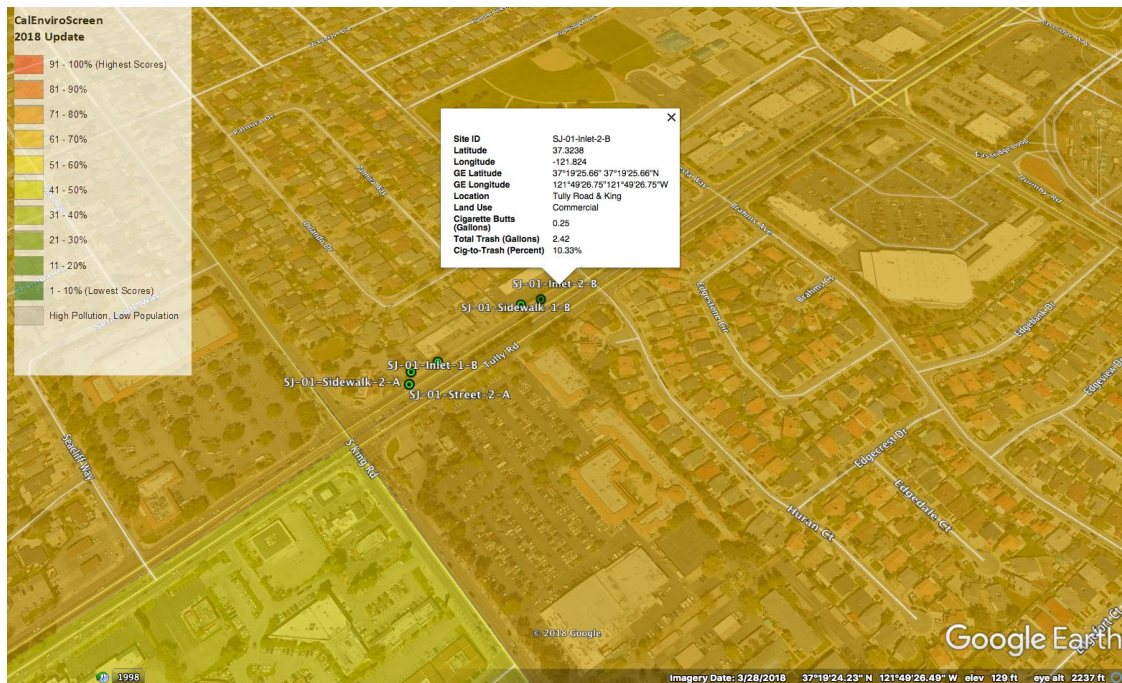

Figure B.3 - Monitoring Site in San Jose (SJ-01) and CalEnviroScreen GIS Layer