Sweep Smart Public Site Final Report

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1. Goals

Street sweeping parking violations incur most of the tickets in the city of Oakland annually. In 2019, street sweeping parking violations composed 57% of total tickets issued by the Oakland Department of Transportation.

The Oakland government is working towards reducing street sweeping parking violations by improving street sweeping schedules and increasing the public awareness of street sweeping. To accomplish the second goal, we helped the government build this information visualization website to: 1) inform the residents about the work done by the street sweeping unit, 2) explain the reason for the high number of violation tickets; 3) introduce channels for people to communicate with the government.

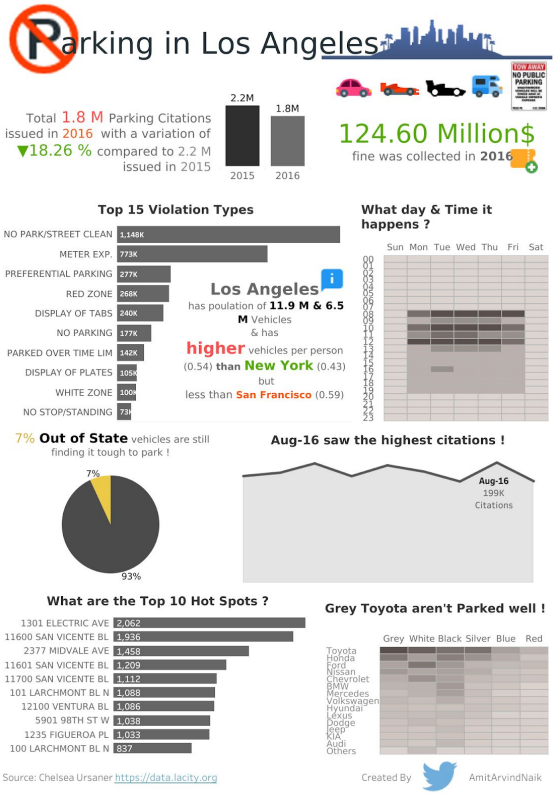
2. Related Work

2.1. Anna

Street sweeping violations on its own is a somewhat niche topic, but we were able to find various sources that explored relevant topics. We found several sources related to parking and traffic in general, and there are also many map-oriented visualizations aimed at depicting trends or patterns over geographic regions.

One source we drew some inspiration from in the early stages or exploratory data analysis for our project were other tableau projects. One in particular was a project about parking citations in Los Angeles, available publicly through Tableau. This visualization

includes several key statistics regarding parking citations, and we considered this a good reference for material that people might be interested in, as we ourselves had become fairly familiar with the topic and wanted to keep an open mind towards aspects of parking citations that people might not be familiar with and that we should be sure to include in our report.

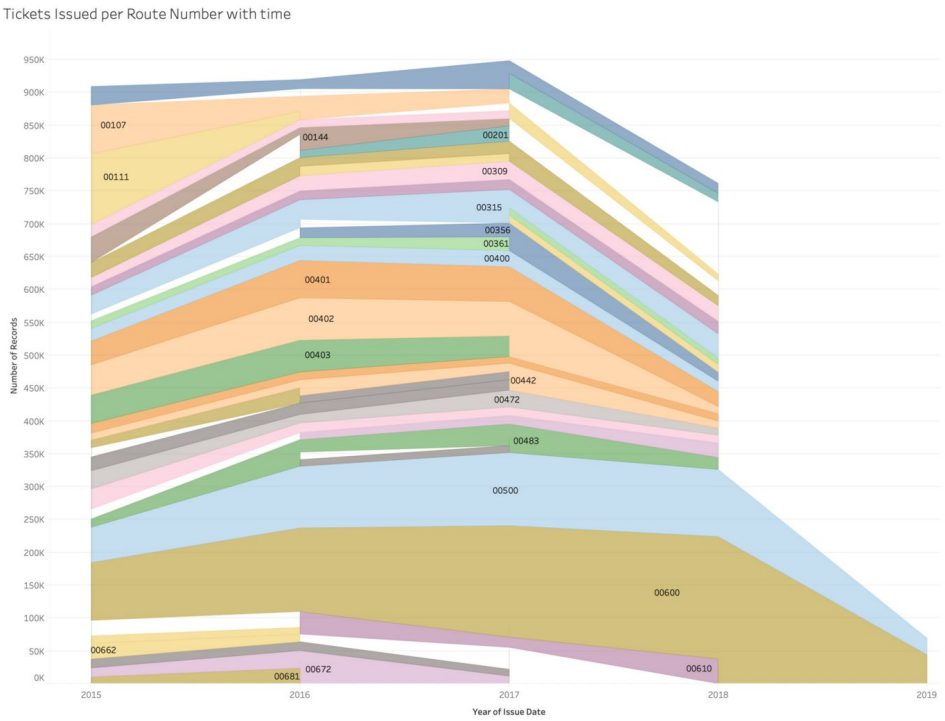


Parking in Los Angeles[1]

We also referenced another Los Angeles parking violation article available on Medium. While this was largely a written report, it included several interesting visualizations, including the one shown below. This was a novel method of showing the change in ticketing patterns over time in relation to the ticketing routes themselves - it becomes very clear which routes seem to pick up more tickets over times and which routes seem to be discontinued. Our data similarly has a large focus on the difference in routes and

[1] Image source: https://public.tableau.com/profile/amit.n6941#!/vizhome/ParkinginLosAngeles2016/Dashboard1

their own schedules, and though this ended up not resulting in interesting visualizations with our data, it was an interesting area to explore when we did our preliminary analysis.

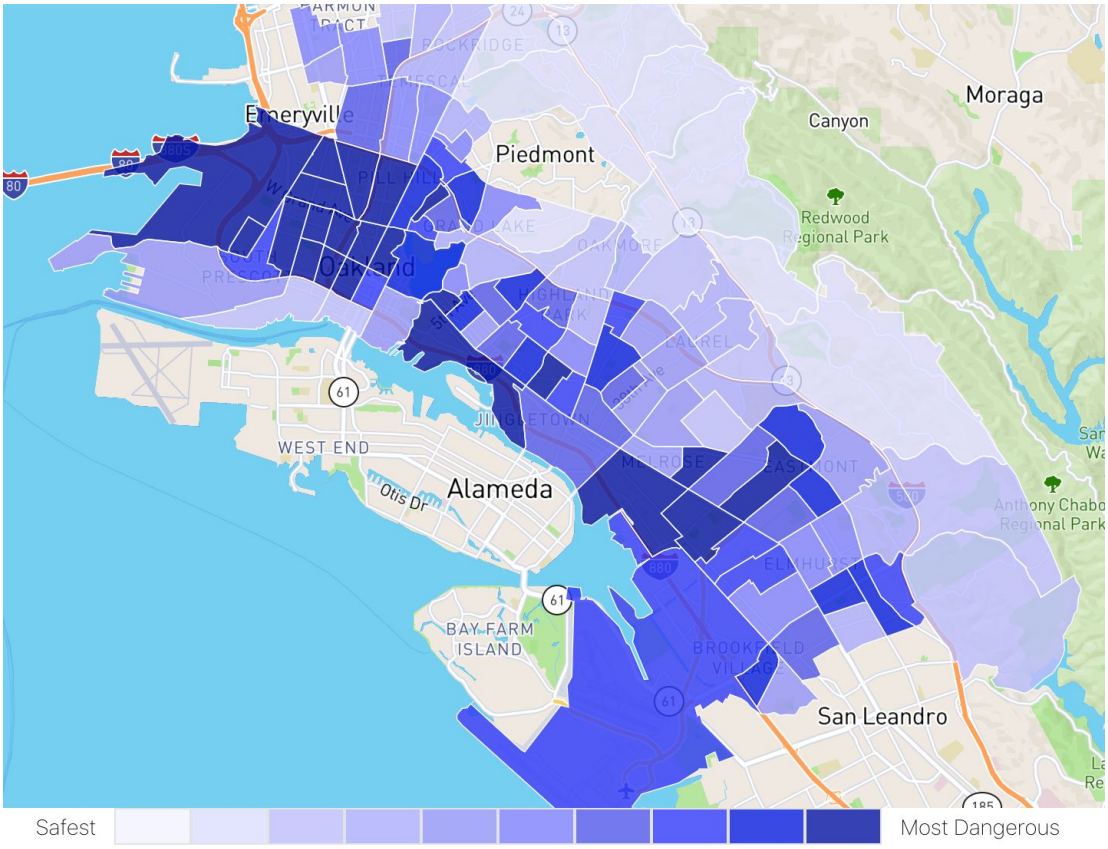


Stacked line chart of tickets issued per ticketing route over time[2]

While we recognize that choropleth maps can be very misleading, in that different geographic areas may seem to dominate or be overwhelmed due to their size and overall not give the most intuitive sense of data distribution, we did want to refer to what other sites use these types of maps for and what useful interaction information we could gain. The interactivity in choropleth maps online can be very useful, in that it gives a sense of geographic boundaries, and encourages interaction amongst the users to click around and see the different data for different regions. We thought this example of crime rates in Oakland (below) was a good example of an interactive map - while it's not strictly

[2] Image source: https://medium.com/@loganathansathyajit/visualizing-and-analysing-the-la-parking-citations-dataset-7114cb7d4496

parking citation related, we knew we wanted to include map interfaces in our final project, and this was a good starting point.



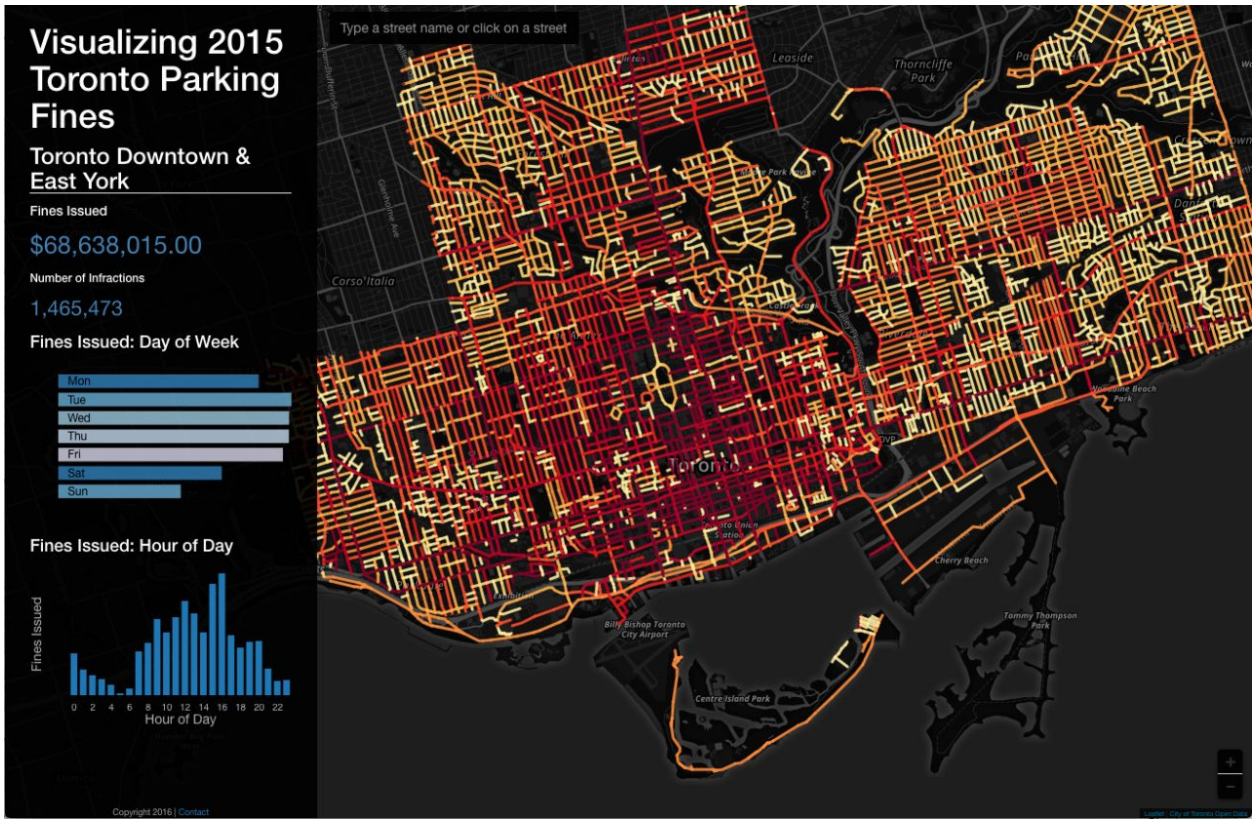
Oakland Crime Map[3]

2.2. Jessie

A very similar infographic visualized parking ticket fine map in 2016 distribution in Toronto Downtown and East York. The main section is a map of the Toronto downtown area with monochromatic colors of different saturations indicating the fine levels. There are two bar charts on the side visualizing the ticket distribution by weekdays and hours of the day. Our project is highly related to this project since we are also interested in visualizing the ticket prices and accumulated revenue from parking violation tickets. We

[3] Image source: https://www.neighborhoodscout.com/ca/oakland/crime

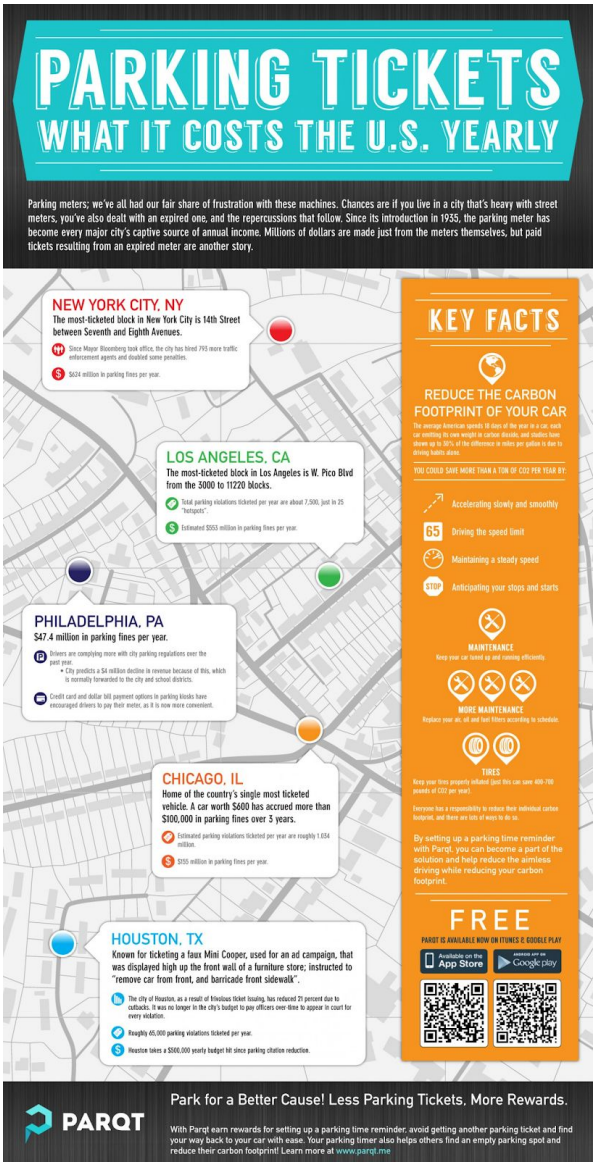
think overall this visualization is effective, though the legend for color markers used in the map is unclear.



2015 Toronto Parking Fines[4]

Another example that is related to our project is an infographic about parking tickets facts for major cities in the U.S. yearly. This infographic has similar visualization content with our project. However, this is not a good data visualization as it matches cities on streets, causing misleading information to the users.

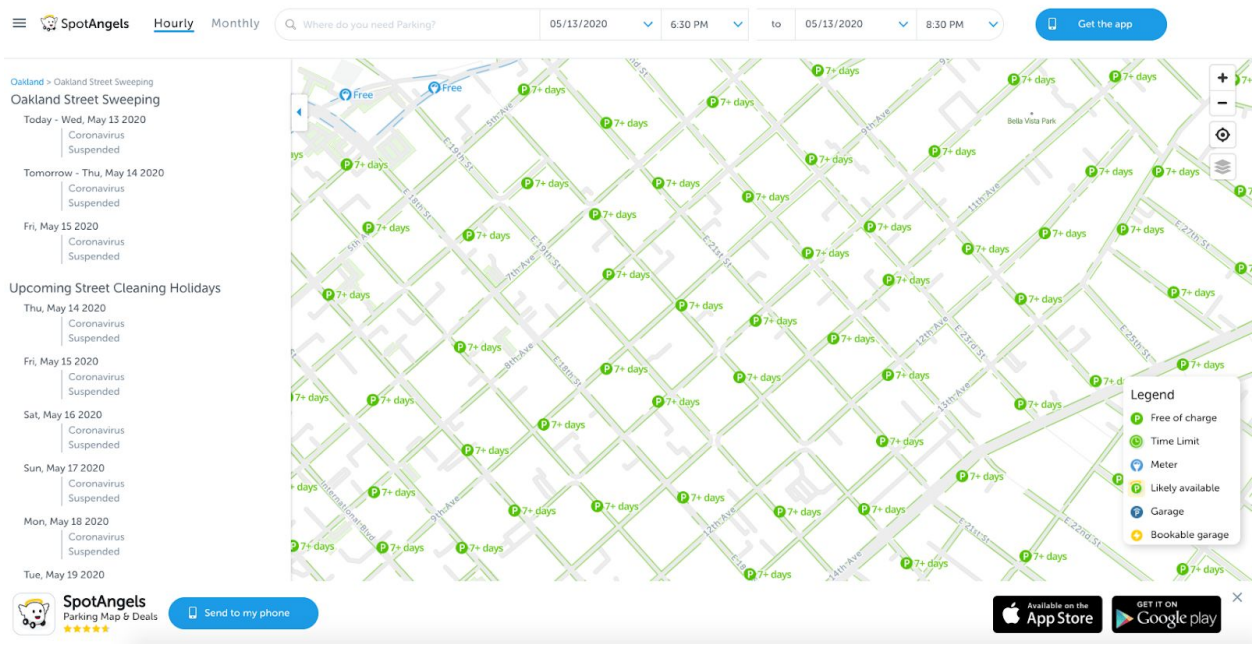
[4] Image source: https://mapsontheweb.zoom-maps.com/image/148988972559



U.S. Parking Tickets[5]

The last related work is a third-party application called SpotAngel. It visualizes street parking information for all streets in the city of Oakland and denotes upcoming street sweeping hours for each street. Though this is an application instead of a visualization website, the way the application shows the street sweeping schedule by adding notations on the map could be used in our visualization as well.

[5] Image source: https://visual.ly/community/infographic/environment/parking-tickets-what-it-costs-us-yearly

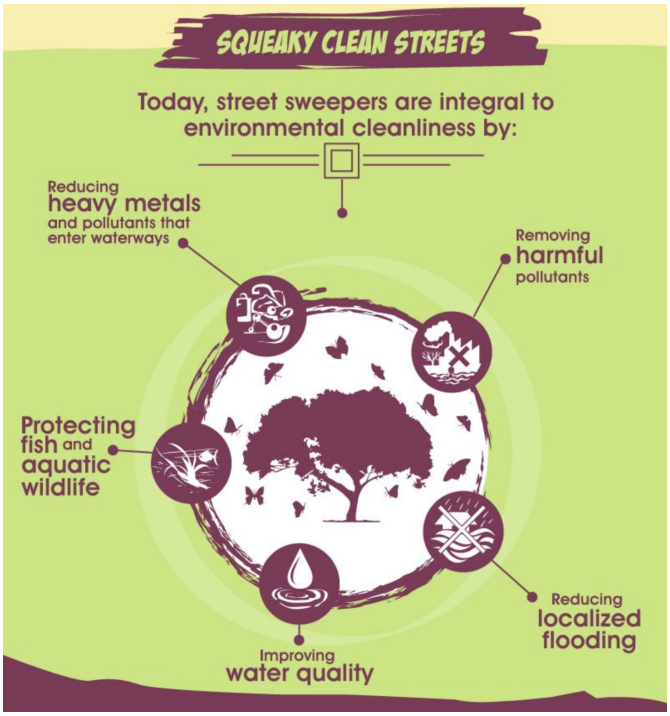


SpotAngel[6]

2.3. Tobey

People usually take clean streets for granted. However, there is usually a great amount of planning and execution involved to keep the environment clean but the efforts are not widely known by the general public. There is a piece of information visualization work about the history of street sweepers as well as their impact on the planet. In our visualization, we hope to do similar things which is to inform the general public about the necessity of street sweeping activities as well as the impact it has on our living environment.

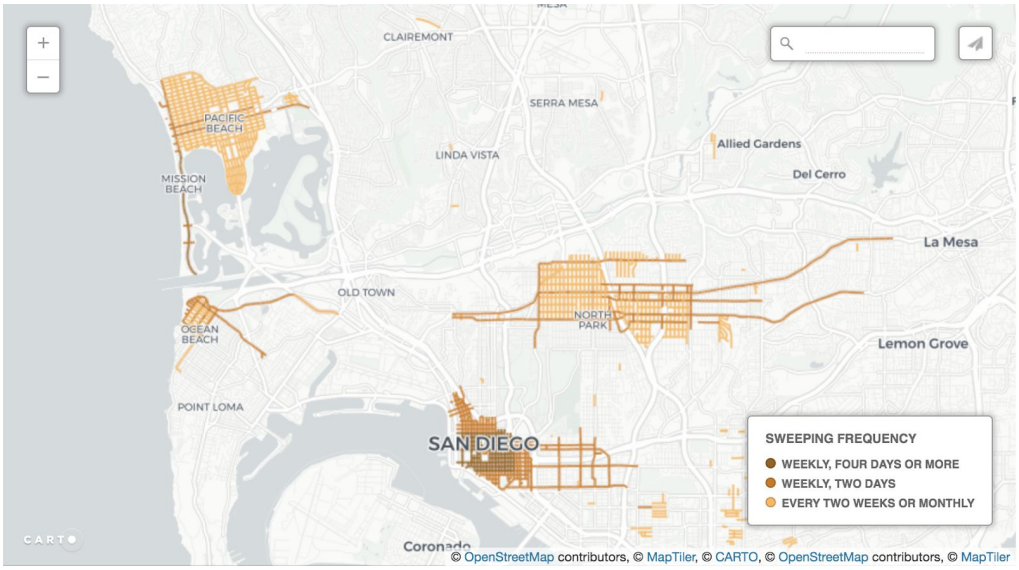
[6] Image source: https://www.spotangels.com/oakland/oakland-street-sweeping-map



The history of street sweepers[7]

Another piece of work that is highly related to our project is the street sweeping schedule visualization made by the City of San Diego. The visualization on this site helps residents keep track of the street sweeping schedule. It has a bar graph showing the number of street segments by sweeping frequency. It also shows a map indicating whether the street segments have signs posted that restrict parking during street sweeping hours. Another visualization that is almost identical to our visualization is that they plot the street sweeping routes on the map and use different colors to indicate street sweeping frequency, which coincides with our design.

[7] Image source:
https://visual.ly/community/Infographics/transportation/clean-sweep-history-street-sweepers



San Diego street sweeping frequency[8]

The last piece of related work was done on the LA parking citation dataset. It's very similar to our project. This work was done on all the parking citations data including different types of violations. It plotted the number of tickets by year and month using a heatmap and a line graph. It also breaks down all the parking tickets by different categories. The most relevant one is the screenshot below that shows the street sweeping violation hotspot in LA as well as the heatmap of ticket density by weekday and time of the day.

[8] Image source: https://data.sandiego.gov/stories/keep-track-street-sweeping/

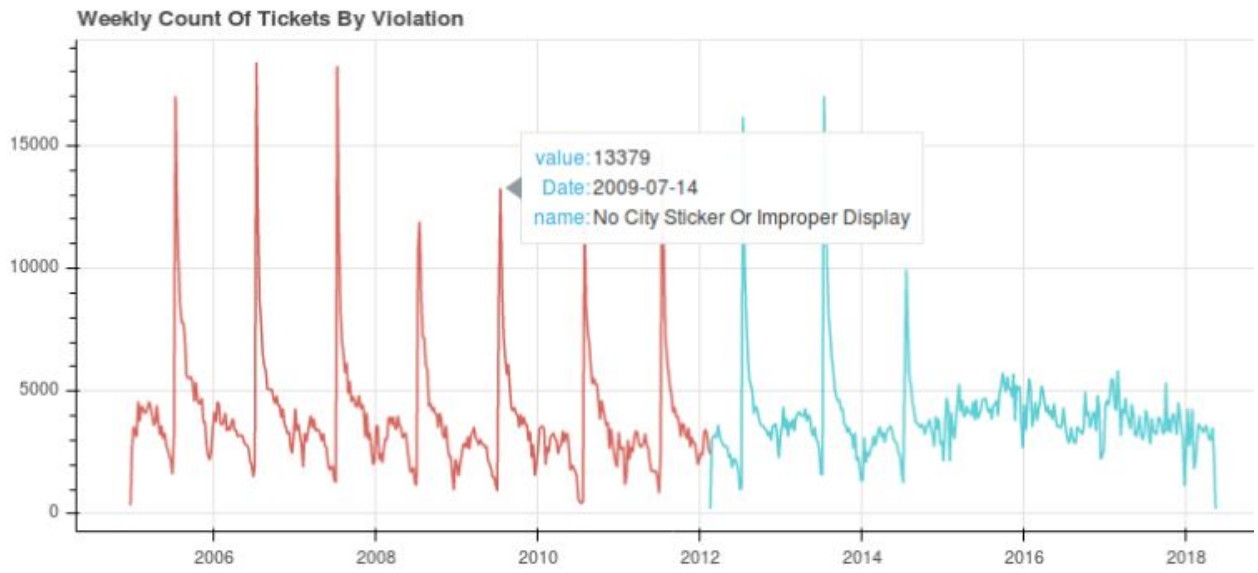
Los Angeles 9 million parking citation[9]

2.4. Yi

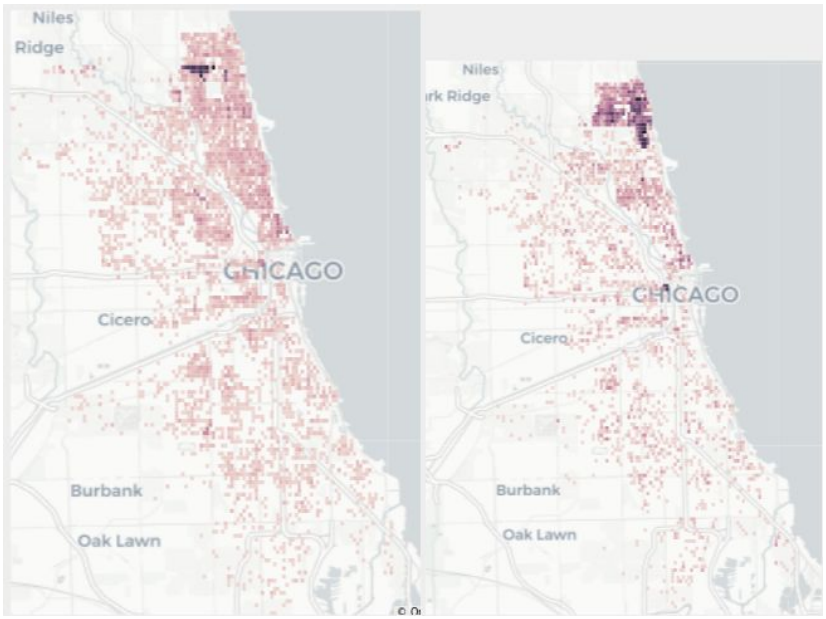
A major piece of the information we are visualizing in the website is the street sweeping violation ticket data. The key message we want to deliver through the ticketing data visualization is to improve information transparency of the parking ticketing situation at the city of Oakland. We found some good examples of doing similar things for other cities.

One example is the [parking ticket visualization in Chicago](https://mchap.io/parking-ticket-visualization-in-chicago.html)[10], where the work was originated by a frustrated car owner who wanted to appeal for a parking ticket he/she received from a very data driven way. The author obtained the parking ticket data and analysed the ticketing pattern based on time series for one type of parking ticket - City Sticker Improper Display.

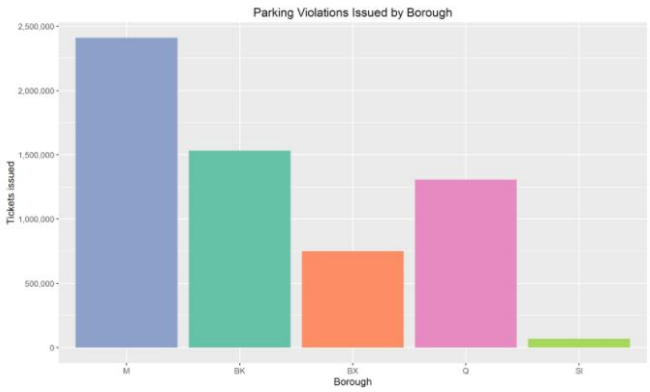
[9] Image source: https://www.brettkobold.com/9-million-parking-tickets-la/
[10] Chicago Parking Ticket Visualization by Matt Chapman, https://mchap.io/parking-ticket-visualization-in-chicago.html



The author used time series data that clearly showcase a prominent pattern of ticketing activity behind this violation type - there is a periodic spike of No Sticker violations and that happens in mid July yearly before 2015. Furthermore, the author also shed some light on the street cleaning related parking ticket in the city of Chicago. This analysis approaches it from a time slicing perspective by visualizing how the ticketing patterns differ in odd hours and even hours and found that a certain area (Ward 40) has earlier ticket issuing hours. However, the visualization in this part was not properly labeled so we were not sure whether the heat map below was a snapshot of different hours of the day or an aggregation of odd hours vs. even hours based on the report explanation. But the idea of looking at ticket situations at different times of the day was a really great angle.

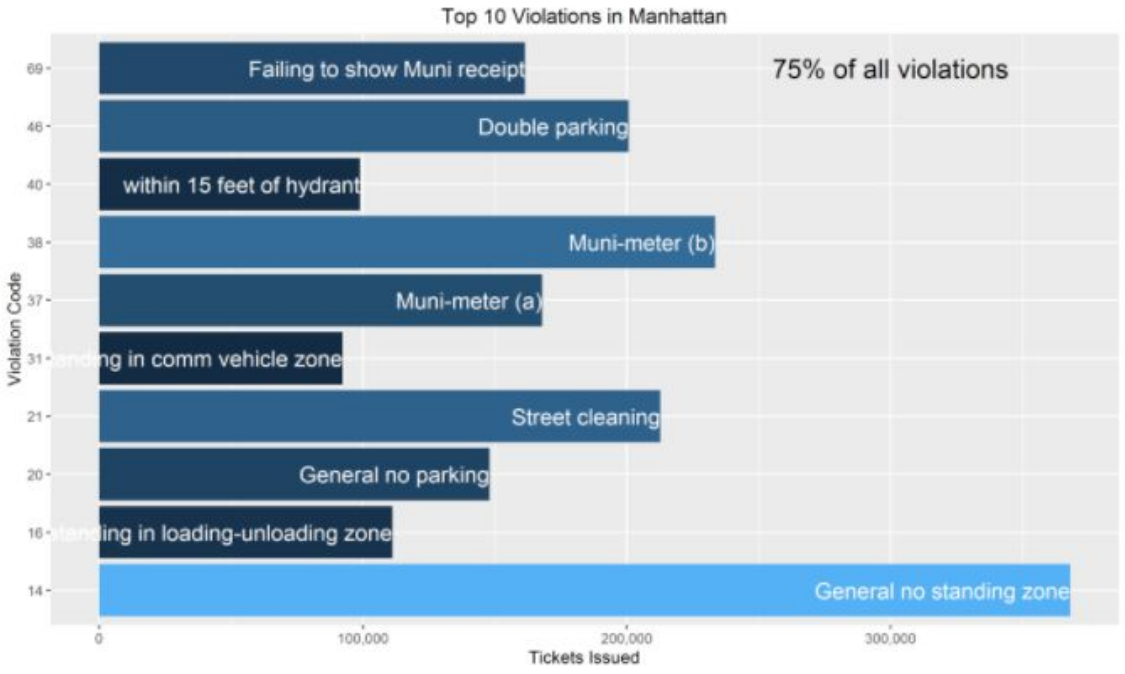


Another example is the [parking violation data visualization work] done by a NYC Data Science student[11]. This visualization work is closely related to our section 2 that employs bar charts to identify hot spots of parking tickets based on violation types. The analysis started by comparing the parking tickets by boroughs of NYC using a bar chart. Although the bar chart is very accurate in presenting the differences and amount, this work was not very effective in highlighting the Borough names (axis labels could be not meaningful for people who are not familiar with NYC) and the exact amount.



[11] Visualizing Parking Violation Data of New York City: https://nycdatascience.com/blog/student-works/visualizing-new-york-citys-parking-violation-data/

When visualizing the ticket amount by violation type, the author did a great job to translate vague violation code to languages that the audience could recognize. However, the violation labels were put directly on top of the bars. This results in problems that the bar may not be long enough to house their respective descriptions. As a reader, I feel that I am a bit lost navigating between different bars and lost track of the last category when moving to the next one, because the names are not on the same eye level. And the violation code labels on the y-axis is not very helpful and could be redundant from my non-NYC resident perspective. Therefore, in my chart which is trying to convey a similar message, I got rid of the violation code and put the violation description on the same level so that the audience could compare apple to apple at a glance.

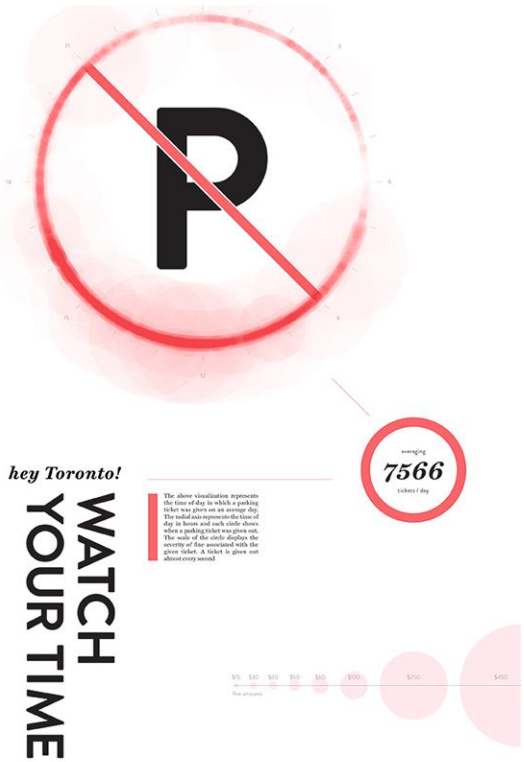


The third example I found was a [infographic design] to visualize the parking ticket data in Toronto[12]. This work employs a very visible attractive and engaging icon of the parking sign to depict the key message of the design - this is about parking. The design uses a red circle to showcase how many tickets are issued in the Toronto city on a daily basis,

[12] Toronto Parking Ticket Data Visualization:
https://www.behance.net/gallery/11605995/Toronto-Parking-Ticket-Data-Visualization

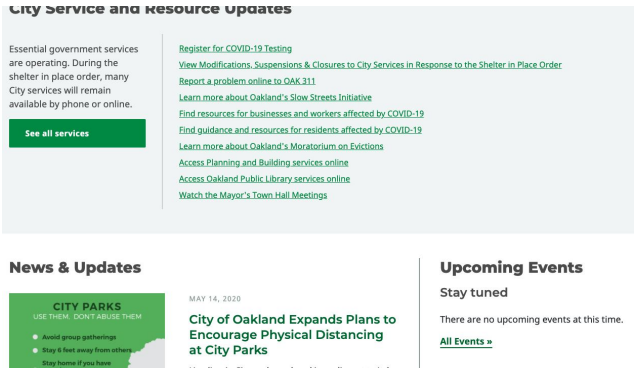
and further breaks down that number to a more meaningful dollar amount by different hours of the day in the light pink bubble chart. Overall I think this is a really clear and impressive design. However, putting the fine amount in the bubble chart by hour of the day makes me a bit confused about the information. Is the fine amount due to the increased number of tickets? Or is the increasing fine due to more expensive tickets towards the later of the day? Without knowing the amount of tickets being issued, and how much each ticket is, it is a bit hard to understand the actual situation behind.

Therefore, although we first thought about using the dollar amount of the different violation type in our section 2 bar graph, we later decided to use the actual number of tickets with how much each ticket cost as information provided in the axis label. In this way, we could provide all information that our audience could possibly be interested in, no matter the intensity of the tickets, or the cost of the tickets.



3. Visualization Description

For the color palette and typefaces, we choose the colors and fonts that match the theme colors of Oakland Government website.



Left: Oakland.gov; right: color palette for our website

We also applied the same color palette for all the illustrations, to keep the style consistent.

For a better view experience, please visit the live website: https://sweepsmart.github.io/.

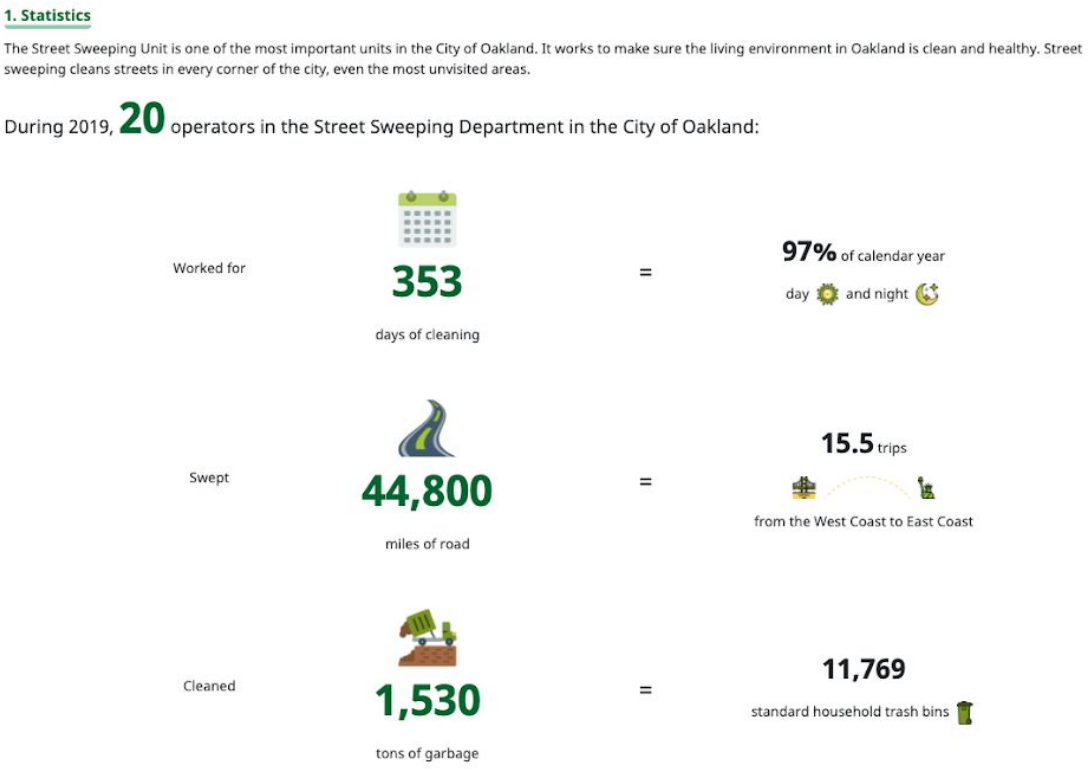
3.1. Section 1

Upon opening the website, the user will encounter a huge title text, followed by an illustration of the city and the street sweeping vehicle.

A screenshot of header section

The purpose of this section is to draw the user's attention. So we use bold text, with highlighted "clean" to emphasize the key term. For the illustration, we deliberately make the city behind the vehicle colorful and the city in front of the vehicle gray to tell the user that the city is greener because of street sweeping.

Following the splash page we come to the first section about street sweeping statistics.



A screenshot of statistics section

In this section we want to visualize the important numbers about street sweeping. Such as the number of days swept, miles swept, and amount of garbage cleaned. In order to make the number more understandable, we broke down each number to more understandable explanations, for example, 353 days = 97% of the calendar year.

3.2. Section 2

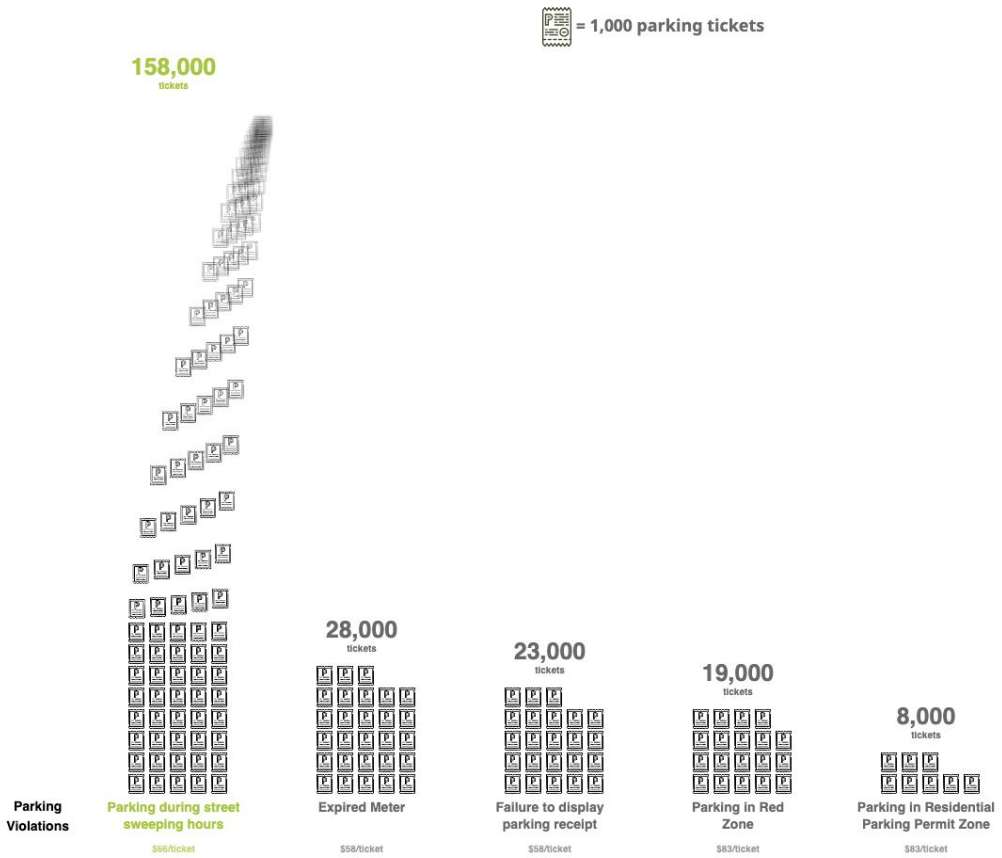
With the understanding of the street sweeping efforts by the city and the importance of these efforts to help keep the city clean, the audience needs to be transitioned into the main topic of our website - street sweeping parking violations. The intersection between section 1 and section 2 makes the connection between the messages. Since street sweeping is so important, we would like to see sweeping happen seamlessly. However, if there are cars parking on the streets during these street sweeping hours, it is impossible to complete the sweeping in those areas. The connecting section explains the necessity

of enforcing parking restriction during the street sweeping hours, especially after the context built in the first section. It helps prepare the audience for the new topic - we will learn about parking violations related to street sweeping now.

In section 2, before diving into more details about street sweeping violations, we first want to showcase and also emphasize how severe the problem is. Therefore, we decided to use a bar graph to accurately visualize the quantitative difference among the ticketing amount of various parking violation types. Inspired by the marvellous work “The Fallen of World War II” by Neil Halloran[13], we decided to use a similar “piling up” animation of the ticket isotype to visibly emphasize the huge quantity of tickets incurred. There are in total 57 types of parking violations, but we decided to visualize only the top 5 categories to improve clarity and aesthetics of the design. The data also strongly supports the message we are trying to convey here - street sweeping parking violations are way more than any other parking violation types.

Please see a screenshot of the animation in action below. For better experience of the animation, please visit the website.

[13] http://www.fallen.io/ww2/, The Fallen of World War II, Neil Halloran



A screenshot of animation in section 2

3.3. Section 3

After viewing the tremendous amount of tickets incurred by street sweeping parking violations, we hope to dive deeper into the distribution of the citations. The introduction to the section tries to make a smooth transition into a more detailed analysis by asking readers to think about how the ticket distribution would look like. The text in the smaller font is meant to give users a summary of the following visualization. The key takeaway is that tickets are not evenly distributed -- downtown areas incur more tickets than residential areas and the time of day also makes a difference.

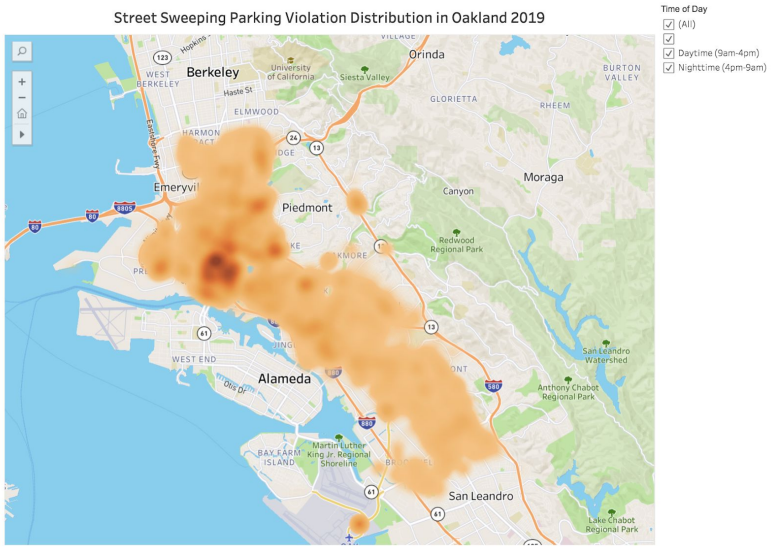
Which areas are getting ticketed?

Street Sweeping parking violations are not evenly distributed across different neighborhoods. Some areas incur more street sweeping tickets than others. And the density of street sweeping tickets differs between day time and night time.

In our map visualization, we use a heatmap to represent ticket density on the map, hoping to show the difference in the number of tickets between neighborhoods. We made the map interactive so users can navigate to their neighborhood as well as the areas they are interested in taking a closer look at. Since the ticket distribution also differs during daytime and nighttime, we added a filter on the side to select ticket distribution at different times. The major difference is that busier areas, such as downtown and major roads, are usually swept during nighttime. The significant difference can be easily seen using this visualization method. Hopefully, it helps our target audience understand the rationale of the schedule plan.

3. Heatmap

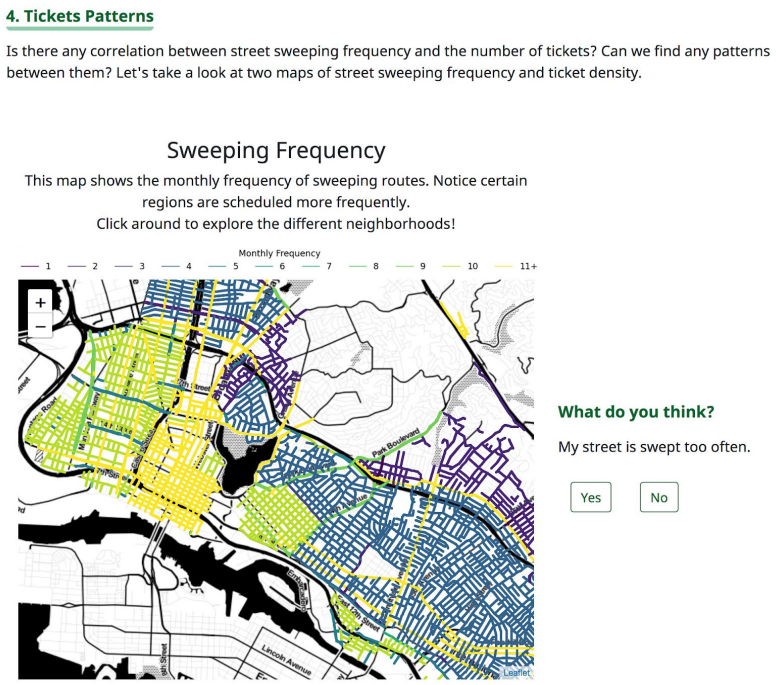
A heat map of the number of street sweeping violation ticket issued in 2019. The darker the color, the more street sweeping tickets there are in the area.



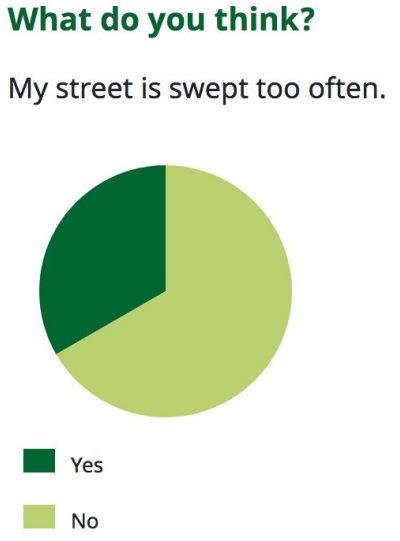
3.4. Section 4

The introduction to the fourth section poses the question of the uneven distribution of sweeping tickets. We believe that this is a very relevant question in the topic of street sweeping, in that certain communities and areas seem to be more heavily impacted than others, and we want to encourage exploration into the subject.

Following this is an introduction to the data visualized in section 4, which is ticket patterns and sweeping frequency, expressed by interactive maps of Oakland. The maps allow users to click and drag to view different areas of Oakland, zoom in or out for a different field of vision, as well as click on individual streets to check the street name.

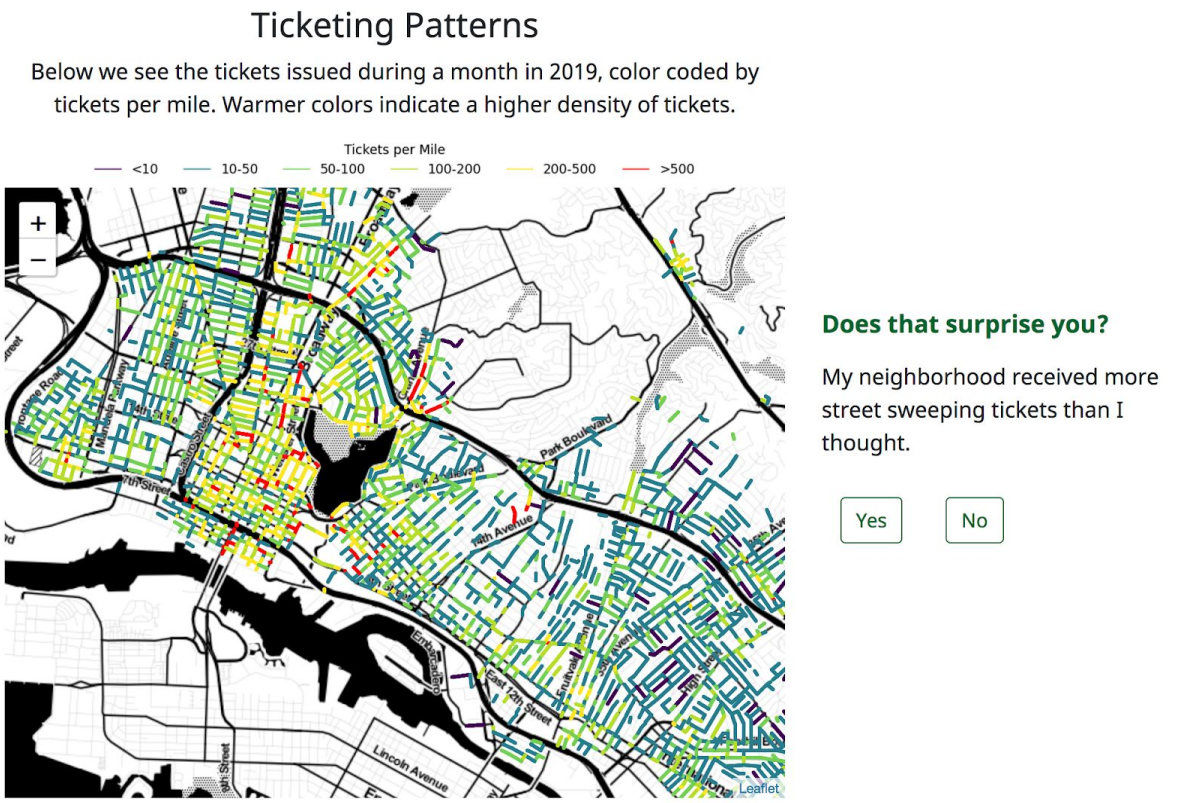


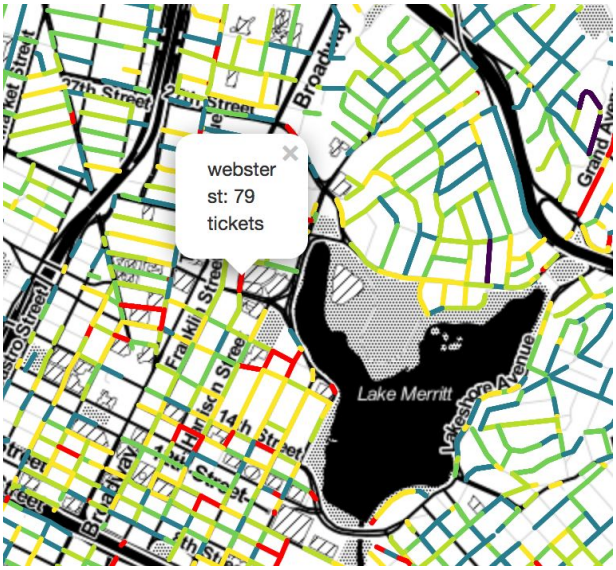
On the right is a poll - encouraging further interaction and incentivizing users to find specific areas in the map. The question asks a simple yes/no question regarding the users opinion of the frequency of sweeping in their neighborhood, and then outputs a simple pie chart displaying the yes/no split from all respondents (currently using dummy data). We recognize pie charts aren't always ideal, but because there are only two categories, we believe in this case it makes sense to pick a simple and easily recognizable graph type, and is more appealing and just as useful as a bar chart.



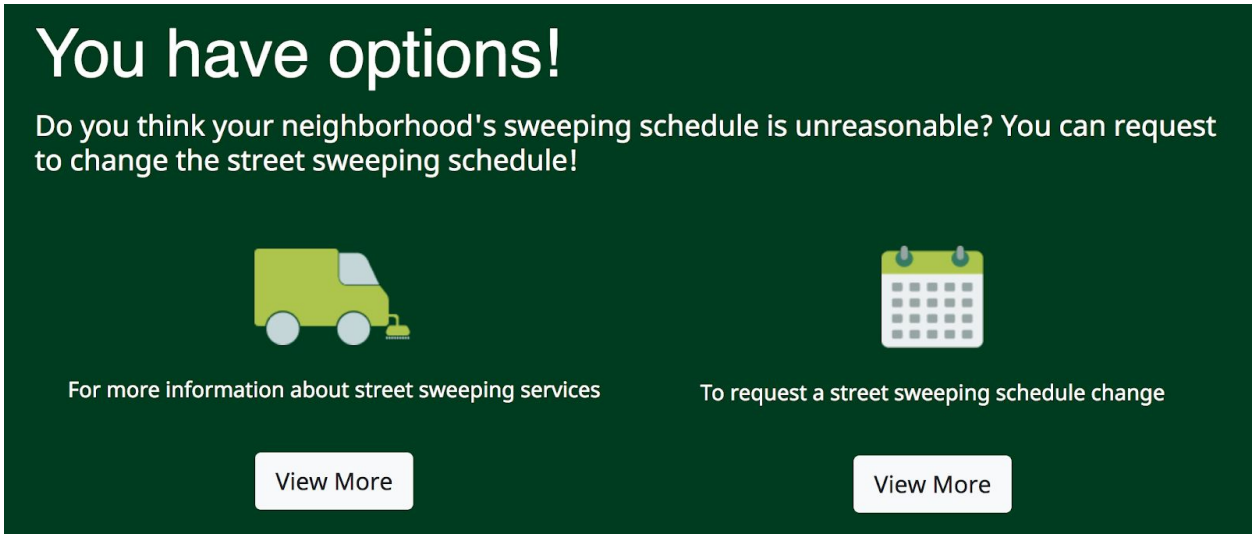
Following this is a second map depicting the number of tickets, scaled by number of tickets per mile (method for obtaining this explained in Tools and Techniques section). This map has the same level of interaction as the first, and also includes the total number of tickets found on a given street in a month when you click on it.

Similarly has a poll on the right as well to incentivize interaction. When a user votes, the yes/no buttons vanish and are replaced with the pie chart depicting the aggregate user results. For the pie chart colors, we wanted to keep the colors consistent with the rest of the website, so we opted for the same shades of green as used elsewhere. For the poll questions themselves, we wanted to ask fairly simple and straightforward questions that people would likely have some sort of opinions on (provided they were actually Oakland residents that is), and also encourage them to actually play around with the map interfaces rather than skim it.





Following this section, at the end of the website page we aim to educate the viewer about options they have regarding street sweeping; they are able get more specific information from the city of Oakland website[14], and can even put in a request for a street sweeping change[15].



[14] https://www.oaklandca.gov/topics/street-sweeping

[15] https://www.oaklandca.gov/topics/street-sweeping-schedule-change

4. Data Sources

Our data was provided by the Department of Parking and Transportation; this included sweeping route data and all Oakland ticketing history from the years 2012-2019. We also obtained additional information regarding general street sweeping statistics such as information on the amount of garbage collected by the sweepers, the operators employed by the department, and so forth, that we included in Section 1.

The sweeping route data was a csv file containing entries for each section of a street, denoted by an id number, its address range, the street name, the coordinates of the street section, the route that the section belongs to, the scheduled sweeping days and times for the street section, along with several other attributes. Each entry in this dataset is the most granular level available of our route data, in that each entry is a small section of a street (so that multiple entries may refer to the same street), and furthermore each entry is a smaller section of a route.

The ticketing data consists of all ticket infractions, not only limited to street sweeping tickets. Ticketing data includes the violation code (which we used to determine if the ticket was a street sweeping ticket or not), the date and time the ticket was issued, the address where the ticket was issued, and other additional attributes.

Most of the data we used are also publicly available at Oakland public dataset[16].

5. Tools and Techniques

We built the website using HTML5, CSS3, and Javascript. The website is hosted on free github.io domain. Source code could be found in the appendix.

[16] https://data.oaklandnet.com/dataset/Parking-Citations-2019/hzn4-3jp4

We imported JQuery and D3 to support animation and information visualization. For the whole page layout, we used Bootstrap styling library. We also imported Google Fonts to our project.

5.1. Section 1

For this section, we used some free iconography resources from flaticon.com[17], a website with free, open-source icons. The whole section was aligned using Bootstrap. Color themes of the icons (SVG file) are adjusted using Figma to align with the website theme color.

5.2. Section 2

The original data come in slightly different formats for different months. We used Python Pandas library for data cleaning, stitching and exploratory analysis. After the number of categories and ticket amount of each category being finalised, the data was manually imported into JavaScript in JSON format for further processing.

The animation of this section was generated using the D3 library. The isotype of the image is obtained and directly reference from the image repository Flaticon.com[18]. We used the SVG container of D3 library and appended 5 groups to contain each ticket pile and their axis titles individually. Each ticket in their respective group is assigned a sequence number based on how many tickets in total there are in this group. The position of each ticket isotype is then calculated based on the integer division (y value) and the remainder (x value) of dividing the ticket sequence number by 5. Ticket isotypes are then rendered into their individual group with a transition time based on their sequence number. We used the D3 library built-in transition function to drop tickets from one location to their designated position from opacity 0 to 1.

[17] Please refer to the appendix about the reference of each icon being used in this project.
[18] The url of the ticket isotype: https://image.flaticon.com/icons/svg/708/708944.svg

5.3. Section 3

The heatmap generated in this section was using Tableau map features. To make the map more understandable for the user, we added a background layer that helps readers to easily identify roads, terrain, and neighborhoods. A filter on the side is also added to make comparing daytime and nighttime data easily. The dataset is extracted and the tableau workbook is made public on the tableau sharing community. The only thing that needs to be done is adding the generated HTML frame to our website and slightly adjust the size and its position.

5.4. Section 4

The maps in section 4 were generated using a Python tool called Folium. Folium is a convenient package that uses leaflet.js as a mapping visualization. Out of the mapping tools available, Folium seemed to work the best with what we wanted for these particular maps and the format of our original data. As mentioned earlier, our route data was provided in the level of granularity of individual street sections, which furthermore includes geographic coordinates in the form of Linestring objects. With Linestrings, we can easily plot lines on a map using the Folium package. Customizable options include the exact coordinates to be plotted, the width and color of the lines, and popup messages from user interaction. Folium then can output the resulting map into an html file; this html file is then embedded into our final website. We opted for a black and white map background, so that the color-coded streets would be more easily visible. The legends were generated separately using matplotlib - we wanted the legend to be placed above the map to avoid having a section of the map covered up by a legend, and matplotlib has an easy legend-generating feature.

For the first map in section 4, we needed to use the route data attributes of the scheduling days/times and the route coordinates. From the scheduling data, we could determine for any given street section how many times a month it’s scheduled to be

swept. Given the distribution of monthly sweeping frequencies, we decided to depict the ranges of frequencies from 1-11+, with all streets swept 11 or more times in one category, as streets swept more than 10 are relatively uncommon, and this was the cleanest and most intuitive way to group the frequencies. The route coordinate data was provided as a Linestring object, which we can use to gather the start and end coordinates for each street section and plot them as a series of lines, color-coded by their monthly frequency. For our coloring scheme, we picked cooler tones for less frequent sweeping, and brighter warmer tones for more frequent sweeping. This is also documented in the legend, but the gradual change in color hue going from cooler to warmer tones is a fairly commonly used color metric, and while the colors don't inherently mean anything, we think that users can pick up on the intentions of the colors quickly.

For the second map, we needed to merge the route and ticketing data sources in order to determine the relative sweeping frequency for each street section. For this, it was important to have a level of granularity higher than that of only streets alone, as some streets are substantially longer than others and will thus aggregate more tickets. Instead, we wanted to highlight smaller street sections that have more tickets, so in the case of longer streets, we can specifically find which areas have more tickets than others. It was also important here to scale the tickets by some common metric - in this case, we picked 'tickets per mile' as our metric, and even for streets shorter than a mile, it gives a sense of the ticket density. We kept the color scheme similar to the first map, but also added the red color for extremely high ticket density areas. For this map we also include the total ticket count on the street in the popup when you click on a street section.

The interactive poll and pie charts placed to the right of these maps were generated using D3. For the pie chart results, we wanted to incorporate interactive polling results from the yes/no questions, and in this iteration of the website we use dummy data for historical results from other users - in the future, we would like to store the accumulated data in a database so that user responses will be saved and we can report more accurate findings from these surveys.

6. Results

Along with our initial usability testing as outlined in our usability testing report, we presented the sweep smart website as part of the final project presentation during the MIMS20 final project showcase and received a lot of positive feedback. With our initial usability testing, some of our feedback that we received was that some of the statistics we reported were not immediately comprehensible for people who were not already very familiar with the subject - for example, reporting that 44,800 miles of road being swept is hard to interpret, as people don't have a strong frame of reference for how long that distance is. We also received feedback that some of the wording in the transition text and section headers didn't seem to exactly correlate with the points we were trying to get across, and other phrases we incorporated in an attempt to grab attention instead came off as vague or confusing. This was very helpful for us when we were working on how to rephrase these texts to be more useful. All of this was taken into consideration for our final design that we presented at the capstone presentation. Below are some testimonials from our potential users after viewing our product.

"I park sometimes in the discussed areas, and I wish this is gonna help with the situation." -- S.W.

"This is a terrific project -- I particularly like the website that you produced." -- H.F.

"This is a really useful resource. If this works too well, does that impact the city's revenue?" -- M.R.

We also followed up with the participants with whom we conducted the usability test for residents. In the follow up, we asked two questions: 1) Please rate the enjoyableness of reading this, from 1 (not enjoyable) to 5 (very enjoyable); 2) What would you like to recommend for future improvement? Out of the follow-up interviews, all participants gave us a 5 in terms of enjoyableness. We also gathered ideas for improvements, including thinking about how to make more residents aware of this resource, to make it reflect live

ticketing data, etc. Overall, we received really positive feedback about the website and our Oakland resident users would like to introduce our website to their neighbors.

In the meanwhile, we are working with the technology department of the City of Oakland to feature our website on the homepage of the Department of Transportation of the city of Oakland.

7. Final Website

Link to the website: http://sweepsmart.github.io/

8. Group Member Contributions

Members	**Contributions**
Jessie Lyu	Prototype Design ● Designed the information architecture and visual layout of low-fidelity sketches, Iterations 1, iteration 2, and the final mockup. ● Created and applied the design system of the website, including fonts, color palette, and UI elements. ● Contributed most of the illustrations of the page. Usability Testing ● Drafted the user testing guide for the government user group. ● Lead the usability testing with 1 resident participant, 1 government participant, and participated as note taker in 2 usability testing with resident participants. ● Contributed to the qualitative analysis of the usability test findings and design iterations Development ● Created the whole page structure and skeleton. ● Implemented the first and the last section, and all transition sections. ● Adjusted the whole page layout and styling.
Yi Gai	Prototype Design ● Designed the key storyline, flow and content of the website. ● Designed the prototype of section 2 ● Wrote the transition texts of the website ● Designed the metaphors of calendar day number, mileage and

	tonnage number with icons Usability Testing ● Designed the questionnaire and usability testing guide for the resident user group ● Led the usability testing with 2 participants from the resident user group ● Facilitated the usability testing with 2 participants from the street sweeping planning team ● Contributed to the qualitative analysis of the usability test findings and design iterations Development ● Data cleaning, stitching and graphing for ticket by violation type bar graph in section 2 ● Implemented the animation in section 2 using D3
Tobey Yang	Prototype Design ● Did EDA on the parking citation dataset, explored the ticket distribution in terms of time and location. ● Proposed a first draft idea with EDA result. ● Designed the map visual for section 3. Usability Testing ● Participated in usability testing with 1 participant from the resident user group and recorded responses. ● Participated in usability testing with 1 participant from the government official group. ● Gathered feedback from the official group and documented what needs to be changed. Development ● Cleaned and grouped the data for section 3 use. ● Implemented the Tableau workbook for section 3, including the map and filter interaction.
Anna Waldo	Prototype Design ● Did EDA on route schedules and locations, as well as ticketing distributions and patterns ● Proposed first draft idea for overall narrative layout of site ● Developed various different map prototype ideas for section 4 Usability Testing ● Participated in usability testing with 1 participant from the resident user group and recorded responses. ● Gathered quantitative responses from usability tests and analyzed

	results Development ● Gathered, cleaned, and merged route and ticketing data ● Developed map interfaces in section 4 ● Worked on pie chart and polling option in section 4 ● Assisted in wording of and editing transition text

Appendix

Design iterations

Figma link:

https://www.figma.com/file/uJypMpG5cRyVH9nAjRY53T/BCOT?node-id=587%3A5

Usability testing

Testing guide:

https://docs.google.com/document/d/1-FGh_OmfarXJsUc1Blw6OMqBAbu5SSL6b8TxlYFfQtc/edit?usp=sharing

Quantitative questionnaire:

https://drive.google.com/file/d/1tcdJTDLWq9tJkVU8rSUj35daetgpxaCu/view?usp=sharing

EDA

Tableau workbook:

https://drive.google.com/file/d/16S3qaaAs7SOs995oPCEyqbBkC0c9xArO/view?usp=sharing

Icons references

Calendar: https://www.flaticon.com/free-icon/calendar_2738169?term=calendar&page=1&position=69

Driver: https://www.flaticon.com/free-icon/courier_2308972?term=driver&page=1&position=53

Road: https://www.flaticon.com/free-icon/road_426171?term=road&page=1&position=22

Garbage: https://www.flaticon.com/free-icon/landfill_2371898

SF icon: https://www.flaticon.com/premium-icon/golden-gate_1896014?term=san%20francisco&page=1&position=9

NY icon: https://www.flaticon.com/free-icon/statue-of-liberty_619090?term=new%20york&page=1&position=10

Day: https://www.flaticon.com/free-icon/hot_2893025?term=sun&page=1&position=54

Night: https://www.flaticon.com/free-icon/moon_867904?term=moon&page=1&position=24

Trash bin: https://www.flaticon.com/free-icon/trash-bin_829391?term=trash%20bin&page=1&position=83

Ticket icon: https://image.flaticon.com/icons/svg/708/708944.svg