Let's Start Counting!

A Methodology to Count On-Street Parking Spaces in Oregon Cities

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SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

1. Our Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and
2. Our Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

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INTRODUCTION

Parking Policy Updates

In November 2022, the Oregon Department of Land Conservation and Development issued parking reforms[1] for cities with populations above 5,000 to address the financial and environmental burdens of parking mandates. In addition to reforms that all included cities must make, the cities with populations over 100,000 must choose between eliminating parking mandates or adopting pricing for five percent of all on-street parking spaces by 2023, and ten percent of all on-street parking spaces by 2025.

Should a city choose this route to comply with these reforms, it needs to know how many on-street parking spaces there are in total. Like most cities, the City of Eugene has varied GIS data but lacks accurate and comprehensive GIS data tracking on-street parking; therefore, our team was tasked with developing a methodology to inventory the on-street parking in Eugene that could be applied to other Oregon cities with populations greater than 100,000.

The main objective of this project is to develop a repeatable methodology for identifying on-street parking spaces and estimating their quantity. Our methods leverage widely available GIS data and collection tools to determine the presence of on-street parking based on the characteristics of streets that we sampled and analyzed. To ensure repeatability, we include recommendations based on our research into the street design standards and databases of Eugene and other Oregon cities.

METHODOLOGY

The purpose of developing this methodology is to have it available to other cities across the state. The selection of an approach to meet this requirement began with research into the availability of parking data across large cities in Oregon. We found that while each city has a GIS data mapping hub, there are inconsistencies in the type and availability of data that would indicate availability of parking. Furthermore, some cities

[1] For a more detailed explanation of this policy, see this link to Oregon's DLCD website. https://www.oregon.gov/lcd/CL/Pages/CFEC.aspx

have datasets that are extremely relevant to measuring street parking, but do not cover the entire area of the city subject to parking reforms. For example, Gresham has bus stop data, but Bend does not. Meanwhile, Bend has sidewalk data, but not Salem. And Eugene has incredibly detailed parking curb data, but only for the city center.

Processing Existing GIS Data

The selection of our final methodology was driven by the ability for multiple jurisdictions to implement the same practice. This would help achieve consistent and repeatable parking estimations throughout the state of Oregon. The other factor determining our methodology was the limited availability of data layers indicating the absence of parking.

Method Eliminated from Study

Our initial method was to deduce the locations of permitted parking based on GIS layers that would indicate the inability to park. This method led us to seek GIS data that represented locations where parking was not allowed, permitted, or possible. Such layers included fire hydrants, fire stations, curb cuts, no-parking zones, street intersections, driveways, business entrances, pedestrian crossings, street functional classes, right-of-way (ROW) width, bus stops, business loading zones, bike lanes, bioswales, and others. Two layers would be essential to this method, but do not exist: driveways and business entrances. Unavailability of this data was our first barrier to implementing this method.

The initial method would require us to erase portions of our streets layer based on buffers applied to those GIS layers mentioned above. The distances applied to the buffers would be applied to all similar instances throughout the city (based on street function class, ROW width, etc.). This gross assumption was our second barrier in applying this method. For example, some driveways are cut to account for two cars wide while others are cut for single car width. We found that a subtractive method could not be successfully implemented with the current GIS data available to Oregon cities and requires more technical GIS work than is desirable.

Chosen Method

Based on the constraints discussed above, we concluded that the best approach to counting street parking in a city is by categorization and sampling. These categories are determined by the factors we believe to influence on-street parking most strongly: **zoning**, **street functional class**, and **ROW width**. Zoning maps are readily available for cities, and street centerline data contains information such as: street functional class, owner, ROW width, street name, and segment lengths. We determined that these GIS layers would be most useful based on research into the street design guidelines, municipal code, and other relevant documents specific to Eugene. In addition, we investigated the GIS resources of other Oregon cities to confirm that this information is accessible in any city that might wish to repeat this methodology.

Data Preparation

In order to prepare these layers for parking analysis, we eliminated the portions of the data that fell outside of the scope of this project or that we knew contained no street parking. First, we clipped the road centerline layer so that it was reduced to the boundaries of the city of Eugene. We then reduced the centerline layer to just those segments that were owned by the city of Eugene. Then we removed those functional classes that do not contain parking (major arterials). Finally, we removed streets too narrow to allow parking at any time (right-of-way width equal to 20 feet or less), which left us with about 8,250 segments.

BUCKETS

The 8,250 segments acted as the foundation of our analysis. The total length of segments results in a total city-owned road system of about 2.8 million ft. We know that not all two million-plus feet of Eugene roadway can host parking for cars on both sides of the road. We also assume that a typical space allocated to parking of privately owned vehicles on a street is about **22 ft**. (Manual on Uniform Traffic Control Devices – MUTD). Our team set out to explore the availability of parking varied throughout the city based on three primary factors. Street design transitions occur in areas where land use type, right-of-way width, or street type change (Eugene Street Design Guide, 1999). We created three new columns (attributes) within the street centerline layer to account for the three factors selected.

Factor One (Bucket 1): Zoning Class

Land use in the city has some impact on the design of streets. Depending on the land use throughout the city, different design standards may be applied to account for the movement of different vehicle types, amount of traffic, need for parking, speed of travel, etc. There are about 20 zoning categories in the city of Eugene. To make our assessment more manageable we bucketed road segments into five zoning categories. Those road segments that fell between two or more zoning categories were split.

Table 1: Zoning Categories

Zoning Category 1	AG - Agricultural
Zoning Category 2	C-1 | Neighborhood Commercial C-2 | Community Commercial C-3 | Major Commercial E-1 | Campus Employment E-2 | Mixed Use Employment GO | General Office S-H | Historic S | Special Area
Zoning Category 3	I-2 | Light-Medium Industrial I-3 | Heavy Industrial
Zoning Category 4	NR | Natural Resource PL | Public Land PRO | Park, Recreation & Open Space
Zoning Category 5	R-1 | Low-Density Residential R-2 | Medium-Density Residential R-3 | Limited High-Density Residential R-4 | High-Density Residential

Factor Two (bucket 2): Street Classification

The most significant change in the design of the street might be attributed to its functional class. Streets serve different levels of service based on their connection to other streets. Those streets with the least connectivity and least efficiency tend to be local or residential streets. Those with the greatest amount of connectivity and efficiency are typically major collectors or minor arterials. Some major roads in Eugene contain little to no on street parking (such as Bailey Hill Road or South Bertelsen Road) while others do (such as High Street or Patterson Street). Street classification was already attributed to each road segment in the underlying centerline data.

Table 2: Street Classifications

FCLASS	Functional Class
MINART	Minor Arterial
MAJCOLL	Major Collector
MINCOLL	Minor Collector
LOCAL	Local

Factor Three (bucket 3): Right-of-way width

The amount of available ROW limits the space to allocate items such as parking, sidewalks, bicycle lanes, etc. Some ROW widths might have little to no impact on the availability of parking. For example, some parts of Warren Street (local road) have ROW width of 80 feet and allow parking on both sides. But East 32nd Avenue (local road) have ROW width of 40 feet and allow parking on both sides. Our sampling (discussed later) allows us to gain a representative understanding of typical parking conditions across different ROW widths. Our final factor to distinguish our road segments is ROW widths that were broken into seven categories divided by typical design standard categories from the Eugene Street Design Guide, 1999. We excluded ROW widths less than 21 ft since any space smaller than that would not allow parking and passable roadway. Street ROW width was already attributed to each road segment in the underlying centerline data.

Table 3: Right-of-Way Width Categories

ROW 1	21 ft -- 39 ft
ROW 2	40 ft -- 44 ft
ROW 3	45 ft -- 49 ft
ROW 4	50 ft -- 54 ft
ROW 5	55 ft -- 59 ft
ROW 6	60 ft -- 74 ft
ROW 7	75 ft +

Resulting Unique Segments

By categorizing all road segments by the buckets from above, the result were 95 unique segment categories (populated cells in Table 4). Table 4 depicts the total footage of road falling into each unique category. Of note are two categories accounting for a combined 50% of all road length in the City of Eugene: Local Roads, within residential zoning, that have a ROW width of 50’ to 54’ and ROW width of 60’ to 74’. For a more complete depiction of our resulting categories, see

Appendix A: Eugene-specific Data, Tables, Maps.

Table 4: Centerline Feet in Each Road Category

Centerline Feet in Each Road Category	LOCAL	MINCOLL	MAJCOLL	MINART	Row Total
Zoning 1 (Ag)	**4,730**	**769**	**2,014**	**12,319**	**19,832**
RoW 1 (21-39)	797				797
RoW 2 (40-44)	800		1,787	161	2,748
RoW 3 (45-49)	484				484
RoW 4 (50-54)	982		138	205	1,325
RoW 5 (55-59)	406			13	419
RoW 6 (60-74)	998	65	52	6,972	8,087
RoW 7 (75+)	263	704	37	4,968	5,971
Zoning 2 (Com)	**151,724**	**12,507**	**49,346**	**78,191**	**291,768**
RoW 1 (21-39)	1,343				1,343
RoW 2 (40-44)	5,038	265	473		5,776
RoW 3 (45-49)	2,456			200	2,656
RoW 4 (50-54)	14,242	1,064	3,554	278	19,138
RoW 5 (55-59)	1,295		536		1,832
RoW 6 (60-74)	123,027	7,936	26,821	54,043	211,826
RoW 7 (75+)	4,323	3,242	17,962	23,670	49,198
Zoning 3 (Ind)	**55,786**	**5,670**	**21,549**	**26,432**	**109,438**
RoW 1 (21-39)	4,272				4,272
RoW 2 (40-44)	3,057				3,057
RoW 3 (45-49)	483				483
RoW 4 (50-54)	7,291		3,116	905	11,312
RoW 5 (55-59)	18				18
RoW 6 (60-74)	38,740	5,543	12,734	12,616	69,633
RoW 7 (75+)	1,925	127	5,700	12,910	20,662
Zoning 4 (Pub)	**36,893**	**10,216**	**18,726**	**32,429**	**98,265**
RoW 1 (21-39)	4,644				4,644
RoW 2 (40-44)	2,811				2,811
RoW 3 (45-49)	403	73			476
RoW 4 (50-54)	4,196	923	38	558	5,714
RoW 5 (55-59)	1,882			1,056	2,937
RoW 6 (60-74)	21,907	5,656	16,253	16,534	60,350
RoW 7 (75+)	1,050	3,564	2,435	14,282	21,332
Zoning 5 (Res)	**1,817,822**	**140,135**	**109,234**	**216,639**	**2,287,103**
RoW 1 (21-39)	49,516				49,516
RoW 2 (40-44)	116,613	2,169	1,617	1,980	122,378
RoW 3 (45-49)	90,655	1,089		903	92,647
RoW 4 (50-54)	747,559	15,951	7,181	3,516	775,164
RoW 5 (55-59)	124,248	3,926	1,373	2,706	134,567
RoW 6 (60-74)	661,074	107,053	74,313	122,111	964,552
RoW 7 (75+)	28,157	9,948	24,751	85,423	148,280
	2,066,955	**169,298**	**200,870**	**366,010**	**2,806,406 TOTAL FEET**

Sampling Assignments

Our method required us to conduct in-field sampling from parts of the city that would represent the specific categories we placed all road segments in. The results from Table

4 categories helped us determine which categories should be prioritized in our sampling. Since local, residential streets made up the vast majority of city street footage, those in ROW 4 and ROW 6 received the greatest number of samples. We wanted to ensure that our sampling was proportional to footages present in each category. More about sampling will be discussed after we present how we established our field workspace and prepared for back-end analysis.

Creating a map on ArcGIS Online that can be used in Field Maps

ArcGis Online Field Maps Designer was used to create the collection tool, allowing segments to be collected in the field and be uploaded to a shapefile. For this project we determined that our samples would consist of measuring parking and no parking areas on both sides of the road. Field Maps supports the collection of line features, making it ideal for this purpose. A key consideration when designing the collection layer was whether to prioritize time spent doing collection or time spent processing the data.[2] For this project, the only fields collected were shape length and whether the feature was a parking or no parking segment. We also included the ability to upload pictures and additional notes with a collection but did not make consistent use of this option.

Field Maps supports additional non-editing layers in the collection app, which can be turned on/off by the field worker as needed. ArcGIS online does not easily support styling a layer on more than two attributes, so four new layers (one for each functional class) were created and included in the app. Each layer was styled to show zoning and ROW category. This was intended to help field workers make collections within the same bucket. After initial testing, two new layers were included: 1) One that just showed ROW categories and 2) one that highlighted which street segments each field worker was supposed to collect. This latter layer was also used to process and calculate the result.

[2] The more fields included in the collection layer, the longer it takes to collect a segment as you must answer questions for each new feature being created. While Field Maps supports templates, with 34 buckets to collect in this seemed an unwieldy number of templates to create. However, collecting *only* parking/no parking meant that in order to be useful, the collected features needed to be processed by associating them with a collection bucket before using the data. Depending on the relative availability of data collectors and data processors, it may be beneficial to do this in the field instead.

In order to aid field workers in collecting the appropriate data, a high-resolution satellite imagery layer was included from the Oregon Spatial Data Library REST server. This layer did not work on the Android version of Field Maps.

Field Work

Each team members were assigned 12 samples of at least 400 centerline feet to obtain. As most of the samples were in the Residential zoning category, four team members split the samples as equally as possible. Two team members collected samples in Agricultural, Commercial, Industrial, and Public zoning categories. To ensure that samples were collected in a diverse range of neighborhoods, the city was split into four main areas:

- Northeast (Wards 4 & 5)
- West (Wards 6, 7, & 8)
- South (Ward 2 & Part of 3)
- Central (Ward 1 & Part of 3)

Each team member with Residential collections took one area and the other two chose geographically diverse collections spread across areas. After assigning sample buckets, each team member used a combination of the Field Maps web map, Google Maps, and Street View to locate segments that seemed 'typical' for the area. Figure 1 shows an example of one list of collections.

Sample	Zoning	Fclass	RoW	Streetname	Description	EugID	Neighborhood	Length
1	5	Local	3	Jeffrey Way	Between Merlin and Prasling	23903	West Eugene	511
2	5	Local	6	Praslin St	Between Jeffrey and Baden	13040, 13039	West Eugene	478
3	5	MinCol	6	Avalon St	Between Frigon and Lawing	7443	West Eugene	698
4	5	MinArt	7	N Terry St	Above Avalon	22775	West Eugene	1090
5	5	Local	1	Willowbrook St	Above Irvington	7485, 7484, 7483	River Road	595
6	5	Local	2	Leonards Way	East of Irvington	7220	River Road	461
7	5	Local	4	Blackburn St	Between Seymore and Shane	555	Churchill	748
8	5	Local	4	Cleveland St	South of West 18th	427	Churchill	427
9	5	Local	4	Robin Ave	West of Taney St	4205	West Eugene	1191
10	5	Local	5	Mackin Ave	Between Patricia and Gipson	7566	River Road	530
11	5	Local	6	Quaker St	Between 17th & 15th	4094, 4093, 4089	Churchill	682
12	5	Local	6	W 29th	West of Shields Ave	6585	South Eugene	1944

Figure 1: Collection Locations

Data Collection

Using the ArcGIS Field Maps App, we collected parking and no parking segments for each of our samples between May 12 and May 26. This resulted in a new feature layer with 1,324 segments. Although the plan was to collect a minimum of 58,000 feet, many sample segments were longer than 400 feet and in total we collected more than 105,000 feet (20 miles) of curb parking information.

Figure 2: Data Collection using Field Maps App

Data Processing

Before the collected data could be used to calculate street parking spaces in Eugene, the samples needed to be weighted by the amount of centerline miles in each bucket. There are a few ways to approach this[3], but the method we chose was to add three new fields to the street centerline shapefile:

- Parking Length
- No Parking Length
- Parking Ratio

Where the ends of collected samples did not align with the centerline segments, centerline segments were split or joined to match with the collected area. This was done

[3] See Future Suggestions section for some alternatives.

so that when the new fields were filled in, the total length (Parking + No Parking) would add up to twice the centerline feet of the segment and the resulting ratio would be correct.

Then, for each centerline segment that had a collected sample, the Parking Length and No Parking Length fields were filled in. Parking Ratio was calculated using the formula [Parking Length / (Parking Length + No Parking Length)].

Computation

The buckets in which samples were collected account for 95% of centerline feet for streets that might have parking.[4] A fundamental assumption underlying our method is that street segments within each bucket (the combination of Zoning, ROW, and Functional Classification) are more similar to each other than otherwise. Although individual segments will vary in the amount of parking, in aggregate the percentage of parking would be close to our sample percentages. To calculate the amount of parking in our sampled buckets, we summed the Parking length and No Parking length and divided by the total. This produced a percentage for the entire bucket that could then be applied to the total centerline feet in that bucket.

	LOCAL		
	Parking	No Park	Ratio
Zoning 5 (Res)	**30237.42**	**26801.34**	**53%**
RoW 1 (21-39)	738.4	2131.05	26%
RoW 2 (40-44)	3407.75	3063.34	53%
RoW 3 (45-49)	866.8	1023.87	46%
RoW 4 (50-54)	10686.07	8164.73	57%
RoW 5 (55-59)	2324.92	1922.09	55%
RoW 6 (60-74)	12213.48	8265.15	60%
RoW 7 (75+)	0	2231.11	0%

Figure 3: Residential Zoning Local Street Segment Parking Ratio

For the other 5% of centerline feet that were not sampled, we tested several different methods of calculating a ratio. Due to the small percentage of centerline feet that were

[4] This is less than 95% of all street centerlines in Eugene, because it does not include Major Arterials or Alleys, which do not have parking.

not sampled, there was less than 1% variation in our final parking space number between these different methods. The method we used for this project was to assign ratios to empty buckets based on existing buckets in the same Functional Class and Zoning. When more than one bucket was sampled, an average was computed by summing Parking and No Parking feet.[5]

MINART		
Parking	**No Park**	**Ratio**
2418.54	**9511.07**	**20%**
		0%
		0%
		0%
0	571.01	**0%**
		26%
1986.95	5224.9	**28%**
431.59	2572.69	**14%**

Figure 4: Applying Ratios Across ROW Widths

The outcome of this was a table that had a parking ratio for each bucket in our table of centerline feet. "Park-able Feet" for each bucket was then calculated by multiplying centerline feet times 2 times the ratio.[6]

[5] This results in more weight being given to buckets that have more samples. This could be an issue, but again did not dramatically impact our final number.

[6] Centerline Feet times 2 because there are two sides of the street.

	LOCAL		
Zoning 5 (Res)	Ratio	Centerline Feet	Parkable Feet
RoW 1 (21-39)	26%	49,516	25,484
RoW 2 (40-44)	53%	116,613	122,819
RoW 3 (45-49)	46%	90,655	83,124
RoW 4 (50-54)	57%	747,559	847,547
RoW 5 (55-59)	55%	124,248	136,033
RoW 6 (60-74)	60%	661,074	788,531
RoW 7 (75+)	0%	28,157	-

Figure 5: Calculating Park-able Feet from Parking Ratio

Summing park-able feet across buckets resulted in 2,456,052 park-able feet across the city. Dividing this by **22 feet** (length of a parking space) resulted in 111,638 parking spaces in the city of Eugene.

DISCUSSION

The methodology detailed in this report can be applied to any city that wants to estimate their parking inventory. GIS data can be inconsistent across cities and often incomplete within cities. The data exists for downtown and most of the inner city but does not cover the entire Urban Growth Boundary. Thus, the best method to use is to rely on the simplest data set to ensure that there is consistency. GIS geoprocessing was minimized in favor of real-world surveying of streets as this is more accessible to cities with varying staff sizes and administrative capacity. We estimate roughly 60 hours of labor for any other city personnel to take our methodology detailed here and carry out their on-street parking inventory. We chose our methodology because it is possible with a small amount of GIS data and does not take excessive analysis or time for the quality of the outcome that we achieved.

Other Potentials Methods

We acknowledge there might be other methods solely based on GIS data that can infer the number of on-street parking spaces in a city. Since our main objective was for other cities to repeat the methodology, we refrained from using extensive GIS calculations and analysis. If a particular city has all the data on the street elements that impact on-street parking, then our initial method (subtractive) will prove to be efficient.

Cities might be able to use a different method with more ease in the future if they make some improvements to their existing GIS database – for example, having data for curb cuts, parking signs, or more detailed ROW/pavement width data can help tremendously.

Improvements

- To streamline the process and cut down labor hours, we suggest having a preset worksheet/Excel template with all the fields and expressions filled out. This will save time on the backend calculations.
- Furthermore, having Field Map App set up with all the required fields will also save time.

Lessons Learned:

- **Geodesic and Planar distances**. Planar distance is straight-line Euclidean distance calculated in a 2D Cartesian coordinate system and Geodesic distance is calculated in a 3D spherical space as the distance across the curved surface of the world[7]. Calculate geometry on layers to coordinate the units of measurement. We spent our time correcting the coordinates to get the accurate measurements. To avoid that, we caution those setting up the Field Map app to thoroughly choose the projection and units of measurements. If not, the app chooses default options on different phones based on other factors.
- There might be two Shape_Length fields. The default behavior of the app/ArcGIS is to use planar distance because it is faster than geodesic. Even though the difference between planar and geodesic is proportionally smaller in a small geography such as a city, but we found drastic differences in how ArcGIS Pro calculated and reflected the distances noted by the Field Maps App.

[7] ArcGIS Pro | https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/geodesic-versus-planar-distance.htm

- Set all layers to the same projection. This was something we had to resolve in our process. If you have a layer in ArcGIS Pro that is in state plane, and if you publish it from a map whose projection is something other than state plane, the hosted layer will be published with the map's projection (Cartesian system) not the layer's projection (i.e., the layer takes the projection of the map it is published from rather than its own projection). The default is Web Mercator. While using ArcGIS online, avoid mixing projections at all costs. Either everything is Web Mercator, or everything is state plane (including the base map).

Size of a Parking Space

The size of a parking space depends on which document you refer to. Some city documents have the length of a parking space to be between 18 feet to 22 feet. We found 16 feet to 26 feet in another city's documents. For our methodology, we chose 22 feet but there was no clear standard. We referred the Manual on Uniform Traffic Control Devices (MUTD). Cities can change the length of parking to fit their standards.

APPENDICES

Appendix A: Eugene-specific Data, Tables, Maps

Attached below is our work while we crafted this methodology, so that people working in cities can see an example of the process and refine it to their expertise.

Figure 6: Centerline Feet as Percentage of City's Total Centerline Feet

Centerline feet as percentage of city total centerline feet					
	LOCAL	**MINCOLL**	**MAJCOLL**	**MINART**	Row Total
Zoning 1 (Ag)	**0.17%**	**0.03%**	**0.07%**	**0.44%**	**0.71%**
RoW 1 (21-39)	0.03%				0.03%
RoW 2 (40-44)	0.03%		0.06%	0.01%	0.10%
RoW 3 (45-49)	0.02%				0.02%
RoW 4 (50-54)	0.03%			0.01%	0.05%
RoW 5 (55-59)	0.01%				0.01%
RoW 6 (60-74)	0.04%			0.25%	0.29%
RoW 7 (75+)	0.01%	0.03%		0.18%	0.21%
Zoning 2 (Com)	**5.41%**	**0.45%**	**1.76%**	**2.79%**	**10.40%**
RoW 1 (21-39)	0.05%				0.05%
RoW 2 (40-44)	0.18%	0.01%	0.02%		0.21%
RoW 3 (45-49)	0.09%			0.01%	0.09%
RoW 4 (50-54)	0.51%	0.04%	0.13%	0.01%	0.68%
RoW 5 (55-59)	0.05%		0.02%		0.07%
RoW 6 (60-74)	4.38%	0.28%	0.96%	1.93%	7.55%
RoW 7 (75+)	0.15%	0.12%	0.64%	0.84%	1.75%
Zoning 3 (Ind)	**1.99%**	**0.20%**	**0.77%**	**0.94%**	**3.90%**
RoW 1 (21-39)	0.15%				0.15%
RoW 2 (40-44)	0.11%				0.11%
RoW 3 (45-49)	0.02%				0.02%
RoW 4 (50-54)	0.26%		0.11%	0.03%	0.40%
RoW 5 (55-59)					0.00%
RoW 6 (60-74)	1.38%	0.20%	0.45%	0.45%	2.48%
RoW 7 (75+)	0.07%		0.20%	0.46%	0.74%
Zoning 4 (Pub)	**1.31%**	**0.36%**	**0.67%**	**1.16%**	**3.50%**
RoW 1 (21-39)	0.17%				0.17%
RoW 2 (40-44)	0.10%				0.10%
RoW 3 (45-49)	0.01%				0.02%
RoW 4 (50-54)	0.15%	0.03%		0.02%	0.20%
RoW 5 (55-59)	0.07%			0.04%	0.10%
RoW 6 (60-74)	0.78%	0.20%	0.58%	0.59%	2.15%
RoW 7 (75+)	0.04%	0.13%	0.09%	0.51%	0.76%
Zoning 5 (Res)	**64.77%**	**4.99%**	**3.89%**	**7.72%**	**81.50%**

RoW 1 (21-39)	1.76%				1.76%
RoW 2 (40-44)	4.16%	0.08%	0.06%	0.07%	4.36%
RoW 3 (45-49)	3.23%	0.04%		0.03%	3.30%
RoW 4 (50-54)	26.64%	0.57%	0.26%	0.13%	27.62%
RoW 5 (55-59)	4.43%	0.14%	0.05%	0.10%	4.80%
RoW 6 (60-74)	23.56%	3.81%	2.65%	4.35%	34.37%
RoW 7 (75+)	1.00%	0.35%	0.88%	3.04%	5.28%
	73.65%	**6.03%**	**7.16%**	**13.04%**	**100.00%**

Appendix B

Check out our Story Map

Appendix C: Steps for Practitioners

1. Gather GIS resources
    a. Street Centerlines
        i. Street Function Class
        ii. Right of Way Widths
    b. City Limits
    c. Zoning
2. Determine a schema for categorizing street characteristics based on the target city
    a. Determine zoning categories
    b. Determine Street Functional Class categories
    c. Determine ROW width categories
    d. Note: the categories used in the analysis of Eugene's on street parking were based on Eugene's specific features. Find the most appropriate way to categorize zoning and ROW widths for the target city.
3. Prepare GIS data for analysis
    a. Clip street centerlines layer to city boundaries
    b. Remove street segments that aren't subject to this parking reform (e.g. privately owned streets)
    c. Remove street segments that cannot have parking due to their functional class (i.e. major arterials)
    d. Remove street segments that are too narrow to park on (i.e. ROW width less than or equal to 20 ft)
4. Categorize street segments in ArcGIS by the following characteristics
    a. Zoning
    b. Functional Class
    c. ROW Width
5. Calculate percentage of road length for each bucket type
    a. See appendix A for an example of this
6. Create surveying tool on Field Maps to aid in data collection

7. Assign samples to each bucket based on relative percentages that buckets take up of total road length.
    a. Buckets with higher % get more sampling.
8. Conduct on-street surveying using Field Maps
9. Calculate ratios of park-able footage to total footage for each bucket.
10. Calculate the number of parking spaces in the city by dividing total park-able length by a standard parking space length
    a. Based on our research, we chose 22ft as the length of a parking space

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