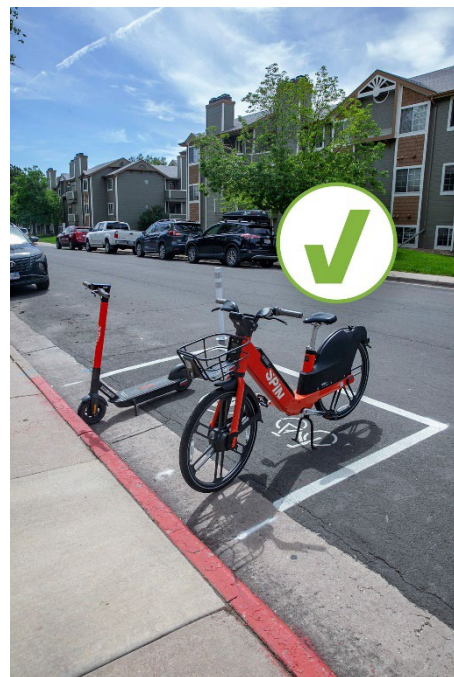




## Shared E-bikes and E-scooters

A Study of Barriers Created by Shared E-bike and E-scooter Parking and the Effects of Countermeasures to Address Barriers



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## Abstract

E-bike and e-scooter share is a public transportation option that advances Fort Collins' climate change goals and offers many benefits to riders. However, residents raised concerns that improperly parked e-bikes and e-scooters may impede accessibility. To better understand the issues of barriers, we conducted a study of parked shared e-bikes and e-scooters, paying particular attention to issues that could impact people with disabilities. We observed parked vehicles in Fall 2022 and recorded whether vehicles were barriers. We then developed and implemented parking countermeasures such as providing more places to park, educating riders on proper parking, imposing penalties for improper parking, and encouraging reporting of improper parking. We observed parked vehicles again in Fall 2023 after implementing parking countermeasures and found a 12% reduction in parked vehicles that were a barrier after implementing countermeasures compared to before.

## Background

Shared e-bikes and e-scooters integrate on-board technology with an app for renting. E-bike and e-scooter share is a public transportation option that supports Fort Collins' goals for climate change, active modes, Vision Zero traffic safety, and transportation demand management. About one-third of e-bike and e-scooter share trips replace motor vehicle trips, reducing emissions and decreasing the number of motor vehicles on the roads which reduces crashes and traffic congestion. Spin operates Fort Collins' e-bike and e-scooter share program as a dockless system. In dockless systems, riders rent a bike or scooter where they find it and end their ride at their destination. This offers greater flexibility than station-based systems but introduces the possibility of improper parking that can be a barrier.

To understand the issue of barriers better, FC Moves conducted a study of parked Spin vehicles, beginning with a review of communications from residents about parked vehicles<sup>1</sup>. This study paid particular attention to the impacts of shared mobility for people with disabilities.

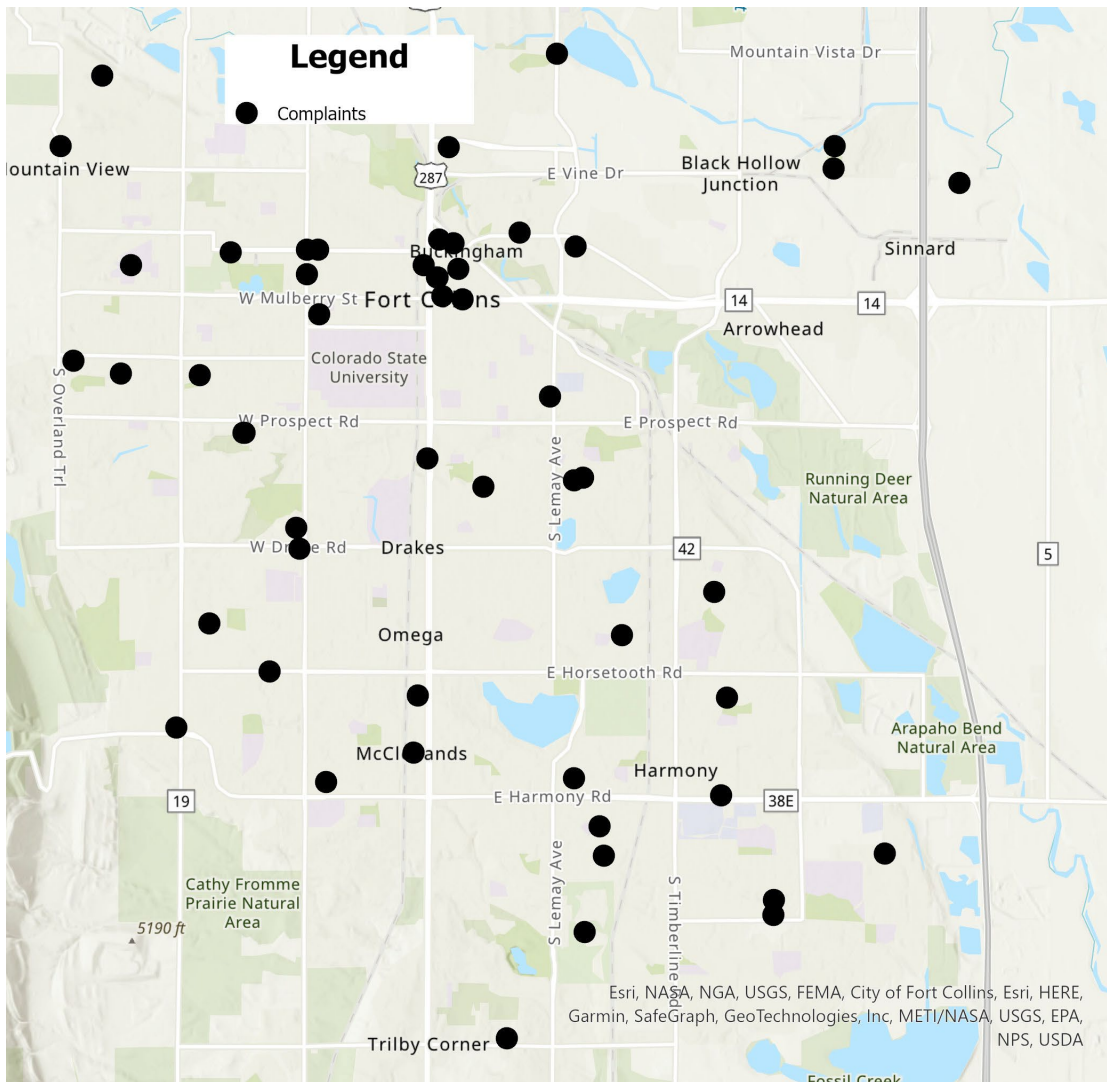
### Review of complaints

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FC Moves receives communications from residents through the City's online portal for residents, [Access Fort Collins](#), and directly from residents. The 56 communications about e-bike and e-scooter share received between July 2021, when Spin launched in Fort Collins, through August 2022 were reviewed and mapped (Figure 1). Some communications were reports of improperly parked e-bikes and e-scooters and some communications were requests to relocate e-bikes and e-scooters, which may or may not have been parked improperly. Objective data were needed to better understand the issue.

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<sup>1</sup> For ease of reading, "vehicles" refers to shared e-bikes and e-scooters throughout this report.  
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*Figure 1 Locations of parked Spin e-bikes and e-scooters in complaints received by FC Moves from July 2021 – August 2022*

## **Benefits and burdens of shared mobility for people with disabilities**

Barriers in the public right of way may disproportionately impact people with disabilities. For example, an able-bodied person can step around a bike or scooter blocking a sidewalk but a person in a wheelchair may not have enough room to navigate around the obstacle. This study examined Spin bikes and scooters as barriers to the general population as well as impediments to ADA accessibility.

However, people with disabilities also benefit from the Spin program. It is important to consider both the benefits and burdens of the program. While this study did not quantitatively analyze the benefits of e-bike and e-scooter share to people with disabilities, here is a brief summary of some benefits.

People with mobility disabilities may be more likely than the general population to use Spin. In a survey of Spin riders<sup>2</sup>, people with mobility disabilities were slightly overrepresented (8%) compared to the Fort Collins population (6.5%), as were people with visual disabilities (3% compared to 2.5%). People with disabilities who do not drive risk losing independence without transportation options such as shared e-bikes and e-scooters. For example, a resident whose vision impairment prevents him from driving reported that Spin e-bikes and e-scooters benefit him because he does not have ground-level space to store his own e-bike.

Spin has another option as well for people with disabilities. Spin maintains a fleet of adaptive bikes with hand cycles, upright trikes, and a recumbent trike and provides them for temporary use at no charge.

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<sup>2</sup> Survey of Spin riders: <https://www.fcgov.com/fcmoves/files/2022-fc-spin-rider-survey.pdf?1672771566>  
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# Study Design

## Study objectives

FC Moves carried out a two-part study to determine the extent of the problem and assess the effectiveness of countermeasures. Phase 1, carried out during Fall 2022, aimed:

- To establish baseline measures of e-bike/e-scooter share parking behaviors impeding access to the public right of way for people with disabilities and for the general population.
- To develop and assess the potential impact of parking countermeasures.

After Phase 1 was complete, parking countermeasures were implemented.

Phase 2, carried out during Fall 2023 after implementation of parking countermeasures, aimed to assess the impact of parking countermeasures.

This report describes the results of Phase 1, the countermeasures implemented, and the results of Phase 2.

## Timeline

The study was carried out from Fall 2022 through Fall 2023 (Table 1). Phase 1 was conducted in Fall 2022. Countermeasures were implemented over several months, from December 2022 through September 2023. Phase 2 was conducted in Fall 2023.

*Table 1 Timeline of parking study*

Year	2022					2023												
Month	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Study Design																		
Collect data		Phase 1													P2			
Analyze data							Phase 1										Phase 2	
Encourage reporting																		
Bike/scooter boxes																		
City ordinance																		
Parking quiz																		

Researchers observed parked Spin e-bikes and e-scooters and recorded data about how they were parked and whether they constituted a barrier. A field survey app created in Survey 123<sup>3</sup> was used to collect these data before and after parking countermeasures were implemented (Table 2).

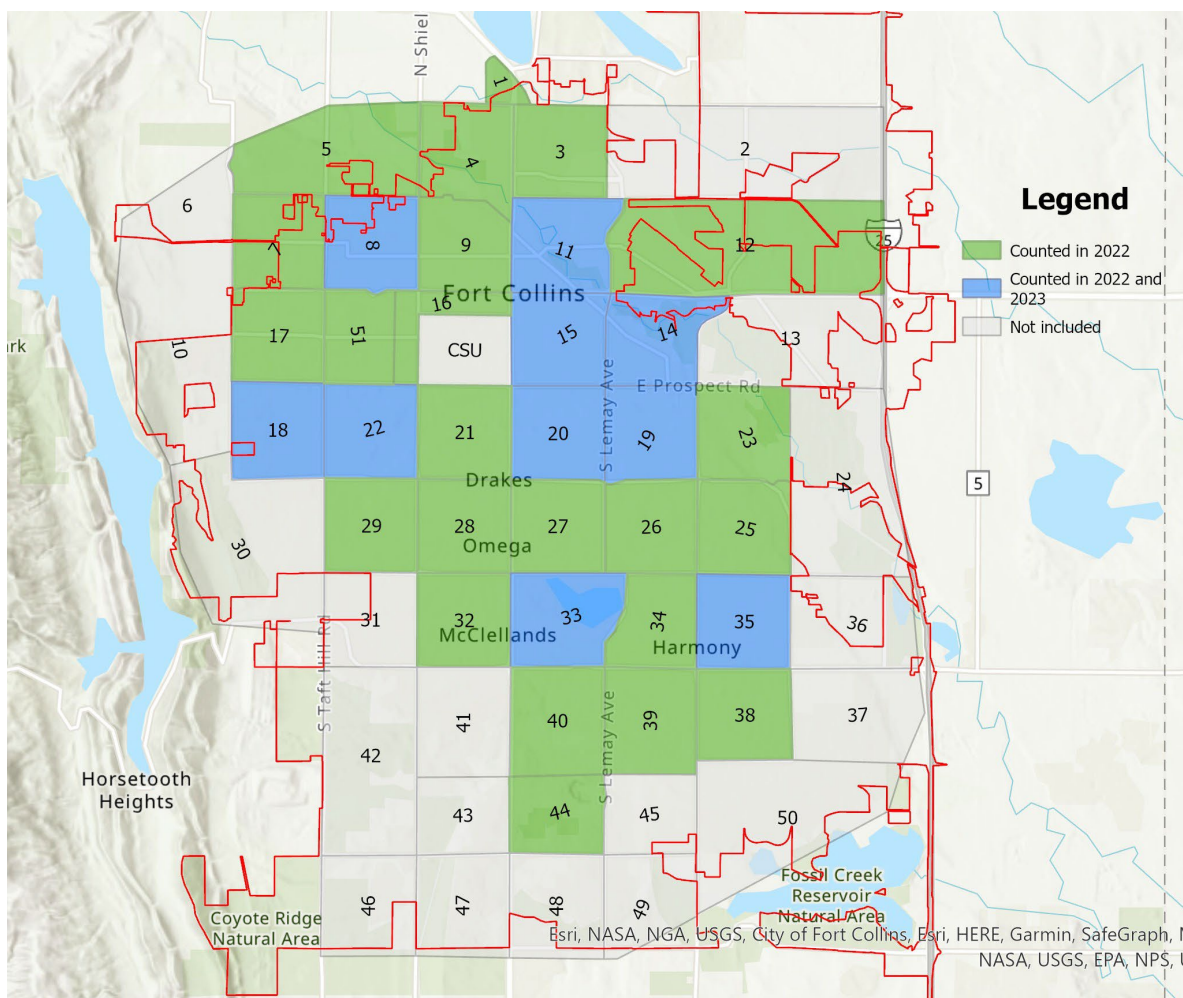


Figure 2. Observations were conducted in chunks about one square mile each

To facilitate and organize observations, the Spin service area was divided into chunks of approximately one square mile (Figure 2). Observations were conducted for two hours or until all vehicles present in the chunk had been observed, whichever came first. Information recorded about the location of each vehicle included the GPS coordinates, the city chunk number, the

<sup>3</sup> Connor Stephens, an intern at FC Moves from the Colorado State University Masters in Public Health program, designed the study, collected Phase 1 data with FC Moves staff, and analyzed Phase 1 data. The Disability Advisory Board and the Bicycle Advisory Committee provided feedback on the study concept. Jaclyn Menendez, Disability Advisory Board member, provided feedback on the study design. FC Moves staff oversaw and participated in all aspects of the study.



land uses of the area, and where on the street it was parked, such as on the sidewalk or in the roadway.

Information was recorded about whether the vehicle was parked legally and whether it was upright. If it was not parked legally, observers recorded if there was a legal spot available nearby (within fifty feet). Vehicles may not be upright because the person who parked it left it lying down or because it fell down after it was parked. A vehicle parked on dirt, gravel, grass, or other soft surface may fall over more easily after being parked, so this information was also recorded.

Information was recorded about whether the vehicle constituted a barrier, what it was blocking, and whether it impeded ADA accessibility. A vehicle could be a barrier for the general population, for ADA accessibility, or for neither (Figure 3). A vehicle was only counted as impeding ADA accessibility if it was located on a path that was otherwise compliant with the Americans with Disabilities Act (ADA). For example, a vehicle blocking a sidewalk that was less than four feet wide was considered an impediment to the general population but not specifically impeding ADA accessibility because the path itself was not ADA compliant. A vehicle on a path that was wider than four feet could impede ADA accessibility if there was less than four feet of clearance to pass by the vehicle. Such a vehicle was categorized as both a barrier and further flagged as impeding ADA accessibility.



*Figure 3. Examples of parked vehicles. The scooter on the left is a barrier for a person with a disability because there is less than four feet of clearance and because it blocks the curb ramp. The scooter on the right is a barrier for the general population, but the path is not ADA compliant.*

Baseline observations in 2022 were conducted in chunks that contained five or more vehicles, omitting CSU campus which has different rules for parking shared e-bikes and e-scooters than the rest of the city. Post-countermeasure observations in 2023 were conducted in ten randomly selected chunks.

Phase 1 data collection began September 15, 2022 and ended November 8, 2022. Data from Ride Report, the third-party system that independently collects data from vehicles, were downloaded for each day of data collection to record how long each vehicle observed had been parked in that location.

*Table 2 Data collected in Survey 123 app on parked Spin e-bikes and e-scooters*

Field	Answer Options/Type	Notes
<b>Vehicle Type</b>	E-bike, E-scooter	
<b>Vehicle ID</b>	Number	
<b>City Chunk</b>	Number	
<b>Area Type</b>	Residential, Commercial, Mixed Use, Industrial, Park/Natural Area, Not sure	
<b>Where vehicle is parked</b>	Street, Sidewalk, Furniture zone, Bus stop, Storefront, Unpaved surface, Parking lot, At/near bike rack, Bike/scooter box, Other	Select all that apply. “Furniture zone” refers to the hard surface between the pedestrian path and the roadway, and is often the location of amenities such as benches, trees, trash cans, etc.
<b>Upright</b>	Yes, No	
<b>Blocking anything</b>	Yes, No	
<b>Blocking what?</b>	Text box	
<b>ADA compliant path?</b>	Yes, No	Path must be at least 4 feet wide with no more than 1/2 inch vertical displacement
<b>Impeding ADA?</b>	Yes, No	Does it leave less than 4 foot path? Would someone in a wheelchair be able to get past it? Is it a trip hazard for someone vision impaired?
<b>Legal?</b>	Yes, No	<u>Phase 1</u> : At or near a bike rack, in a designated area, the area between the road and the sidewalk. Must be on a hard surface. <u>Phase 2</u> : On a sidewalk, shall not impede normal & reasonable movement of pedestrian & other traffic. On the road at any angle to the curb or edge where parking is allowed.
<b>Legal within 50 feet?</b>	Yes, No	If it is parked illegally, is there a legal place to park it nearby?

<b>Field</b>	<b>Answer Options/Type</b>	<b>Notes</b>
<b>Land ownership</b>	Private, Public	<i>Spin rules, but not City ordinance, require vehicles be parked on public right-of-way</i>
<b>How many motor vehicles on the block are blocking access for pedestrians or bicyclists?</b>	Number	
<b>Location</b>	<i>GPS pin</i>	
<b>Photo</b>	<i>Photo upload</i>	
<b>Idle time</b>	<i>Date/time</i>	Downloaded from Ride Report and calculated to the date/time the vehicle was observed (not collected in the Survey 123 app)

Utilizing the descriptive survey data, analysis within R-Studio Version 2023.03.0 Build 386 was completed (RStudio Team, 2020). Comparative analyses were done on the type of vehicle and type of area a vehicle was located in. The GPS pin from Survey123 allowed for spatial analyses through ArcGIS Pro Version 3.1 using the average nearest neighbor, kernel density and near analysis tools. T-test was used to determine statistical significance of parking behavior changes before vs. after countermeasure implementation.

# Phase 1

In 2022, 408 vehicles in 33 of the 51 chunks were observed. Chunks were excluded if they held fewer than five vehicles at the beginning of the study period, and Colorado State University campus was excluded because the parking rules are different on campus. Data were analyzed to determine the extent of barriers. Further analysis was conducted to understand the characteristics of parking behaviors and density of vehicles to develop effective countermeasures.

## Barriers

The study found that 20% of vehicles impeded ADA accessibility and 16% were barriers but did not impede ADA accessibility (Figure 4). The type of vehicles that were barriers or impeding ADA accessibility did not differ statistically significantly between e-bikes and e-scooters.

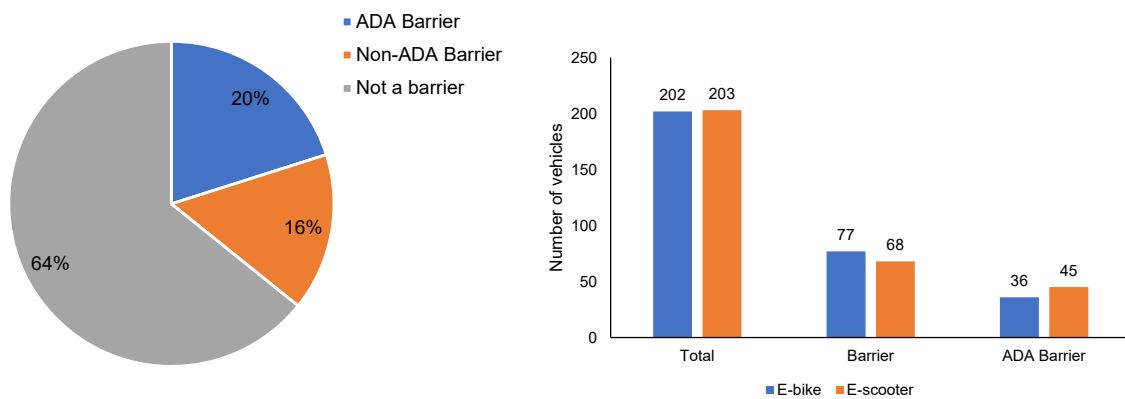


Figure 4. Baseline barriers (left) and number of barriers by type of vehicle (right)

## Parking characteristics

To develop countermeasures, parking characteristics were assessed:

- Whether vehicles had fallen over;
- Whether vehicles were parked legally, and whether a legal space was nearby;
- The street location where vehicles were parked;
- The area type where vehicles were parked.

### Vehicles not upright

Vehicles that are not upright may pose a greater trip hazard, depending on how they are positioned. Vehicles may not be upright because the last rider parked them laying down or because they fell over after the rider parked. Factors that contribute toward falling over include surface instability such as unpaved surface or a slope, wind, and vandalism. Most vehicles were upright; 14% were not upright (Figure 5).

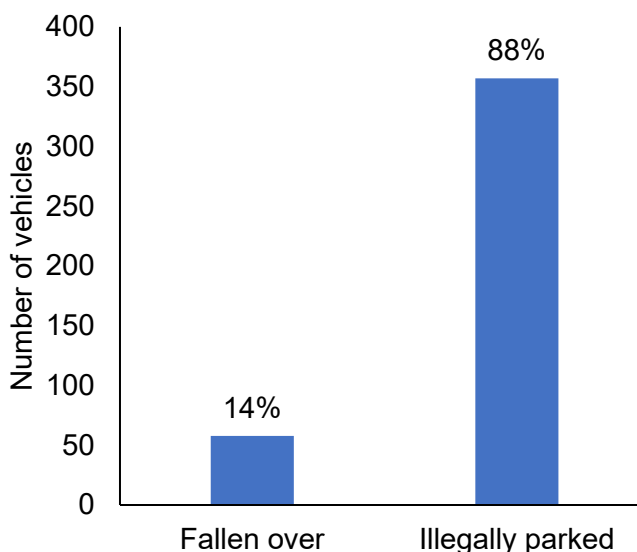


Figure 5. Baseline parking characteristics

### Illegally parked vehicles

In the 2022 ridership survey, most riders (57%) stated parking at the edge of a sidewalk or near a bike rack is allowed. There is limited awareness about the legality of how shared mobility vehicles may be parked, but the legality affects what countermeasures may be implemented. For example, on-street parking cannot be promoted as a preferred option over sidewalk parking, if both are illegal. Most vehicles (88%), whether or not they were a barrier, were not parked legally (Figure 5). For 82% of illegally parked vehicles, there was no legal space to park nearby (within 50 feet). This suggests that the system does not function well with the existing regulations.

### Street location

Understanding where within the street riders park vehicles can inform countermeasures. Most vehicles were parked on the sidewalk, bike rack, or an unpaved surface (Figure 5).

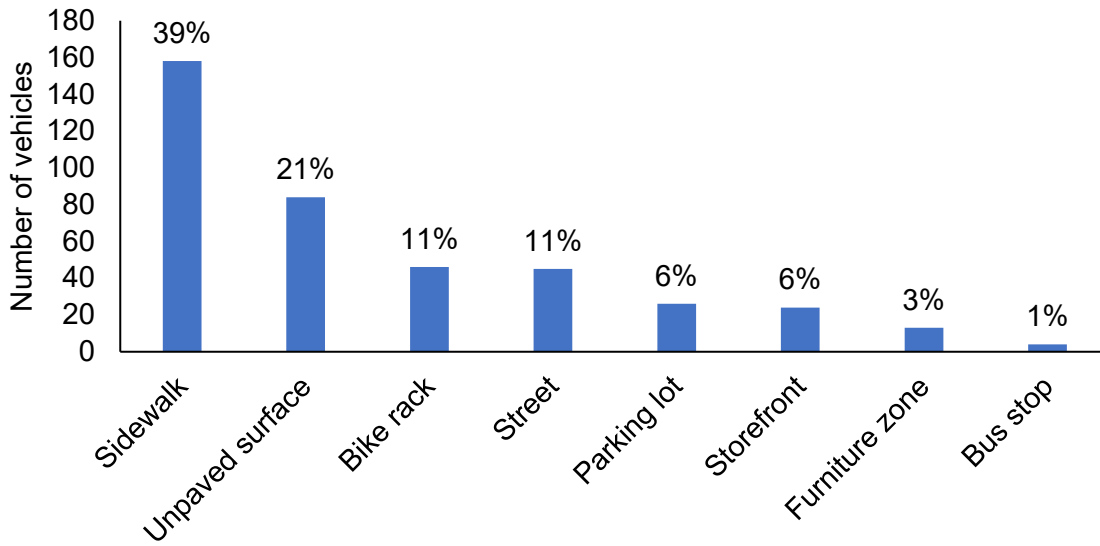


Figure 6. Baseline parking streetscape location. Percentages add up to more than 100% because a location can be described to more than one streetscape location.

### Area type

The area type where vehicles are parked is relevant to what countermeasures are most relevant. Most vehicles were parked in residential (59%), commercial (20%), or mixed-use (15%) areas (Figure 6).

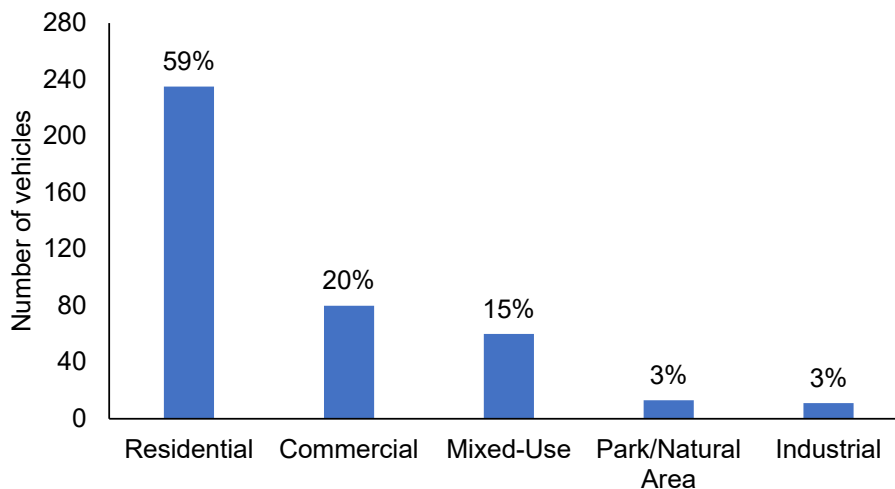


Figure 7. Baseline parking area types

### Density

Vehicle density was examined to determine where designated parking areas could be installed that would have the greatest impact in providing better parking options (Figure 7). The expected Shared E-bike/E-scooter Barriers Study | February 2024

mean distance was 1000 meters between vehicles, but an average of 141 meters were observed indicating a clustered pattern of distribution (z-score = -33.2). The clusters were then mapped with a kernel density plot with cells of 50 square feet, looking within 500 feet for vehicles. Because roads classified as “local” are likely the best candidates for designated parking areas, the densest areas near local roads were identified, and 12 locations were identified. These locations were general, with more study, site visits, and outreach to determine more precise locations.

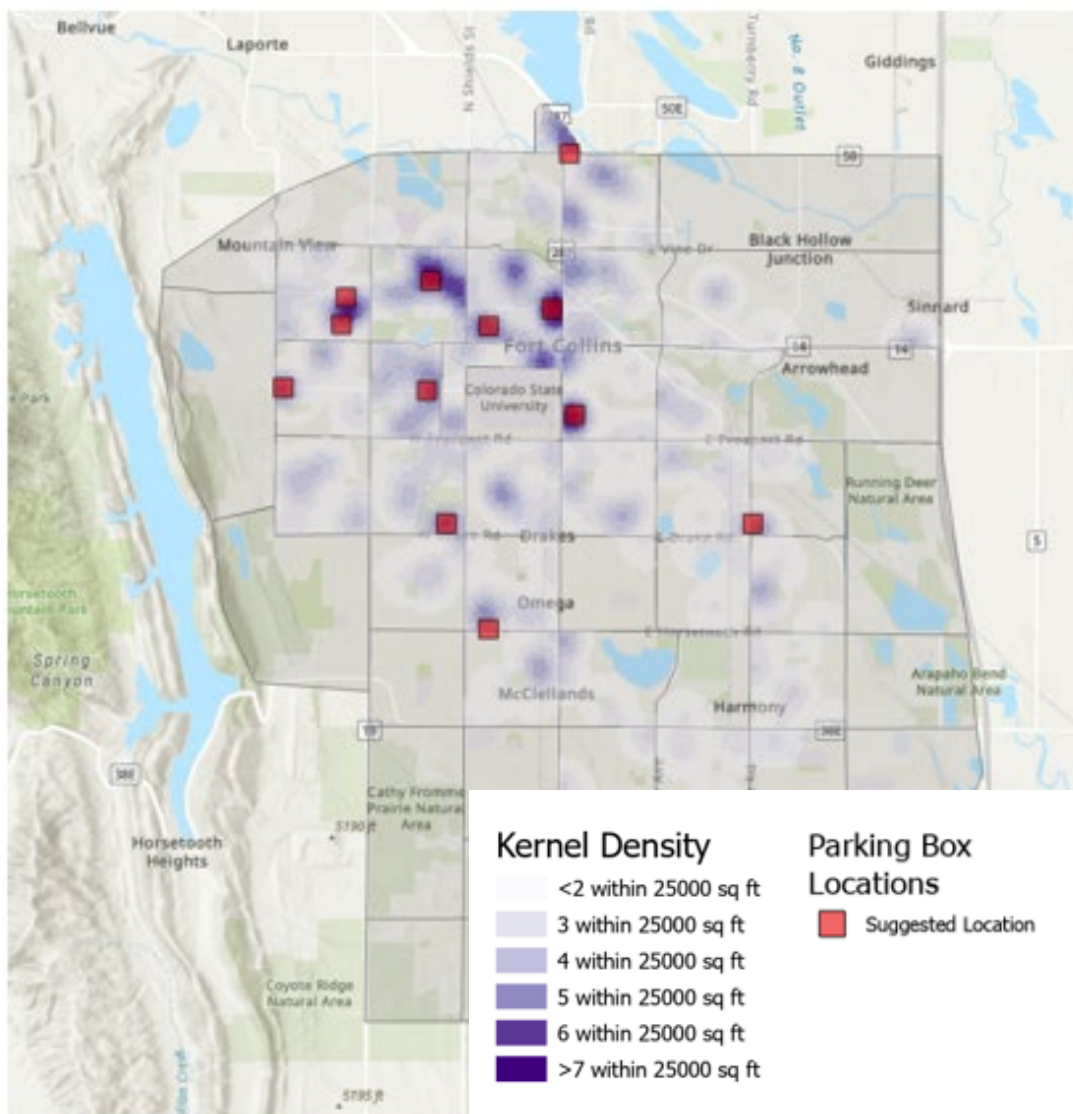


Figure 8. Density of parked vehicles. The Average Nearest Neighbor analysis tool of ArcGIS Pro Version 3.1 was utilized with the Euclidean distance method.

## **Potential impact of proposed countermeasures**

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The potential impact of two countermeasures on reducing improper parking was analyzed: designated parking areas, or bike/scooter boxes, and allowing on-street parking.

### **Potential impact of bike/scooter boxes**

The Near Analysis ArcGIS tool was used to assess vehicles within 500 feet of suggested bike/scooter box locations. Assuming 6 vehicles per box, the 12 suggested bike/scooter boxes could result in a maximum reduction of 9.8% vehicles blocking access for everyone and a maximum reduction of 11.6% vehicles impeding ADA accessibility.

### **Potential impact of on-street parking**

The same analysis was used to assess the potential impact of allowing on-street parking on local roads. There were 134 illegally parked vehicles within 100 feet of local roads, so allowing on-street parking could result in a maximum reduction of 56.1% of vehicles that block everyone and 54.8% of vehicles that impede ADA accessibility.

These estimates are the maximum possible reduction in barriers. The actual impact is likely to be less, suggesting the need for more than 12 bike/scooter boxes and countermeasures in addition to bike/scooter boxes and allowing on-street parking.



# Parking Countermeasures

Parking countermeasures focused on providing better parking options, education, penalties, monitoring, and encouragement of reporting problems.

## Parking Options

In a 2022 survey, Spin riders reported that better parking options would help them to park properly (Figure 8). Better parking options could be provided through changing City ordinance regulating the parking of shared mobility and by installing designated parking areas, or bike/scooter boxes.

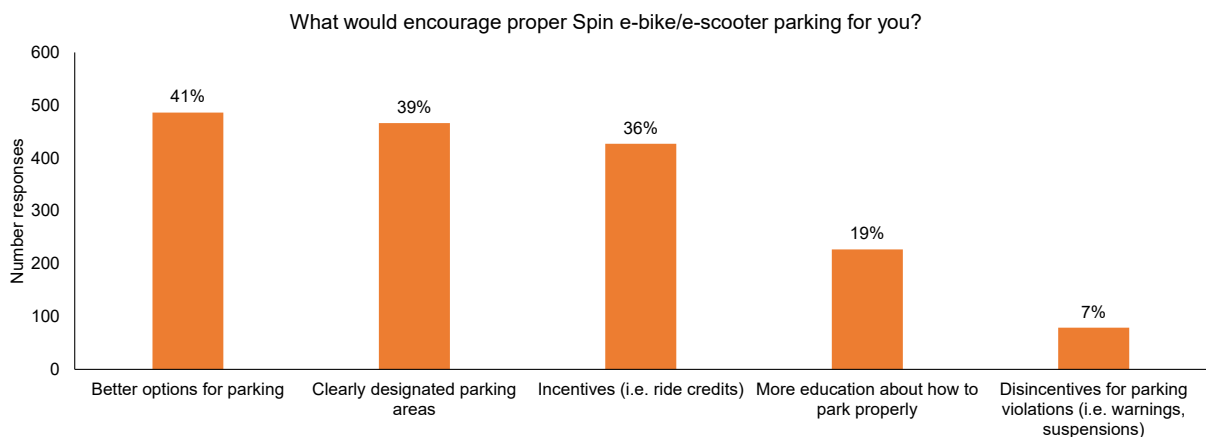


Figure 9 Responses to survey question about parking encouragement. Data from [2022 Survey of Fort Collins Spin Riders](#)

## Ordinance

When Fort Collins allowed dockless shared e-scooters in 2019 with a pilot trial, the City modified municipal code to regulate them. While personally owned e-bikes were allowed to park on streets and sidewalks, shared e-bikes and e-scooters could only park near bike racks, in designated parking areas, and in the furniture zone, the portion of the sidewalk between the pedestrian travel way and the curb (for example, where benches and trash cans are placed). Few streets have a furniture zone, leaving no legal parking options in most of the City.

In August 2023, based on feedback from stakeholders including law enforcement, code enforcement, Traffic Operations, Streets, the Bicycle Advisory Committee, the Transportation Board, and others, City Council adopted an ordinance so the rules governing parking of bikes, e-bikes, and e-scooters are the same regardless of whether the vehicle is personally owned or shared (Fort Collins Traffic Code §2108).

### **Bike/scooter boxes**

The dockless nature of the Spin program allows riders more flexibility in where they start and end their ride than a station-based system does, thus serving less dense areas of the community as well as the denser areas that station-based systems serve. Communities such as Denver and Boulder are adopting a system that is a hybrid of station-based and dockless by providing bike/scooter bike/scooter boxes in some areas (Figure 9). Spin has designated parking areas in-app, mostly at breweries that opt-in, but these are not physically marked.



*Figure 10 A bike and a scooter parked in a bike/scooter box*

The density analysis suggested 12 general locations for placing bike/scooter boxes. The general locations were studied further, and specific locations were identified where bike/scooter boxes could be installed. Bike/scooter boxes were installed in those locations in May and September 2023 (Figure 10, Table 4). Only one on-street parking space was removed to install a bike/scooter box because bike/scooter boxes were placed within 30 feet of a stop sign or within 20 feet of an intersection, where on-street parking is not allowed. Therefore, most bike/scooter boxes were not taking a parking spot away from motor vehicle drivers. Siting them within 30 feet of a stop sign helped protect the visibility of the stop sign.

Some bike/scooter boxes installed in May were not well received by residents adjacent to the bike/scooter box despite letters mailed to them in advance of installation, and one bike/scooter box had to be removed after installation. Therefore, before the September installations, FC Moves conducted additional outreach to residents near specific locations. Some residents objected, primarily because they are used to parking within 30 feet of a stop sign, so some locations were removed from the list.

Table 3. Bike/scooter box locations

Bike/scooter box locations	Notes	Date installed	Number of trips ending in the bike/scooter box in 2023
Jackson & Mulberry	Next to bike rack	5/24/2023	83
Orchard & Skyline	Within 20 feet of the intersection	5/24/2023	77
Baystone & City Park	Within 30 feet of the stop sign	5/24/2023	62
Pitkin & Welch	Within 20 feet of the intersection	5/24/2023	33
College & Bristlecone	On sidewalk next to transit stop, in front of Bike Co-op	5/24/2023	21
Riverside & Pitkin	Within 30 feet of the stop sign	9/16/2023	20
Jamith & Laporte	Within 30 feet of the stop sign	5/24/2023	16
Larimer County Jail	Installed by Larimer County in parking lot	7/27/2023	11
Oak & Sheldon	Next to bike rack	9/16/2023	8
Remington & Parker	One parking space removed	9/16/2023	2
Spring Canyon Park	Parking lot	9/16/2023	Data not available
Avery Park	Concrete pad from former Pace station	9/16/2023	Data not available
Irish & Vine	Within 30 feet of the stop sign	9/16/2023	Data not available
Trail near Jerome & Vine	Concrete pad from former Pace station	9/16/2023	Data not available
Bryan & Crestmore	<i>Removed on 10/3 after resident request</i>	5/24/2023	<i>Not incentivized</i>

Spin riders are incentivized to use bike/scooter boxes because they receive \$1 ride credit when they end their ride in a bike/scooter box. Initial assessment of use of the bike/scooter boxes installed in May showed that riders were using the bike/scooter boxes (Table 4).

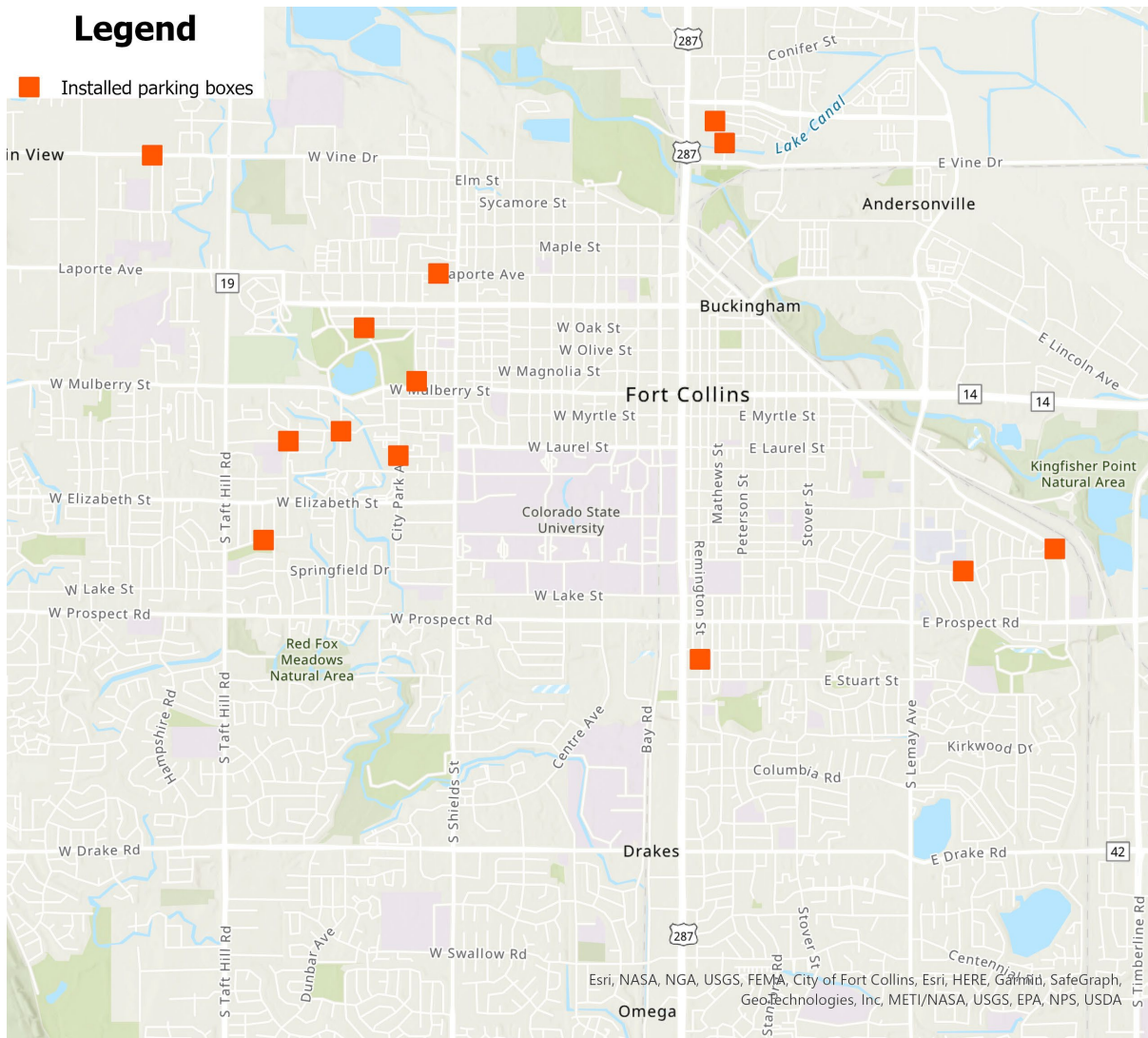


Figure 11 Bike/scooter box locations as of September 2023

## Education

When a trip is started, the rider sees a screen with information including instructions to park properly. However, the information does not describe what is or is not proper parking. In a 2022 survey, Spin riders expressed a desire for more information about how to park properly (Figure 8).

After the ordinance was changed to allow Spin e-bikes and e-scooters to be parked on the street, FC Moves created a quiz<sup>4</sup> that encourages riders to park in a bike/scooter box or next to a bike rack, and that parking on the street in an unmanaged, unmetered parking spot is

<sup>4</sup> <https://www.fcgov.com/fcmoves/spin#cb-51543-7199>  
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preferred over the sidewalk. When parking on the street, riders were encouraged to park perpendicular rather than parallel to the curb, because due to the slope of the street, the vehicles are more stable when parked perpendicular to the curb and less likely to fall over.

Spin promoted the quiz<sup>5</sup> to riders through emails and push notifications for one month. Spin offered \$5 ride credit for riders who passed the quiz with 100% correct answers. The correct answer with additional information was shown after each question (Figure 11). The rider could go back and change their answers and could take the quiz multiple times but could only receive one \$5 ride credit.



*Figure 12 An example of information shown in the parking quiz after the rider answers a question*

Whether they passed the quiz or not, riders who attempted the quiz received information about the proper way to park. During the first nine days that the parking quiz was available (August 23 – September 1, 2023), the quiz was attempted 615 times by 573 unique users, with 42 users attempting the quiz multiple times. One-third (33%) of the respondents passed the quiz 100% and earned \$5 ride credit. The quiz is still available and as of November 6, 2023, 246 ride credits have been issued.

## Penalties

Spin penalizes riders for improper parking. Prior to January 2023, penalties were issued mostly in response to complaints. Beginning in January 2023, Spin instructed its staff to report improper parking that they observe when picking up vehicles. For each report of improper parking, whether the report came from a complaint or from Spin staff, the Spin manager reviews

<sup>5</sup> The parking quiz is available at <https://www.fcgov.com/fcmoves/spin#cb-51543-7199>.  
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the photo the last rider submitted at the end of their ride of their parked vehicle. If the photo shows that the rider parked improperly or if the rider did not submit a photo, Spin issues a penalty to the rider.

Per the City’s request, Spin began reporting on the number of complaints received and the number of penalties issued in January 2023. Spin issued 383 warnings from January to October 2023 (Figure 12). Most warnings (224, 58%) result from Spin staff observations rather than from complaints. Most complaints (159 of 549, 71%) do not result in a warning if Spin staff determined the vehicle was properly parked. The first penalty a rider receives is a warning. Repeat offenders face a one-day suspension (2<sup>nd</sup> offense) or a permanent ban (3<sup>rd</sup> offense). The permanent ban can be appealed with a minimum 15-day ban. There are very few repeat offenders. Since January 2023, 3 riders received a one-day suspension and 6 riders were permanently banned. At least one rider was banned for a reason other than improper parking (damage to rental vehicles).

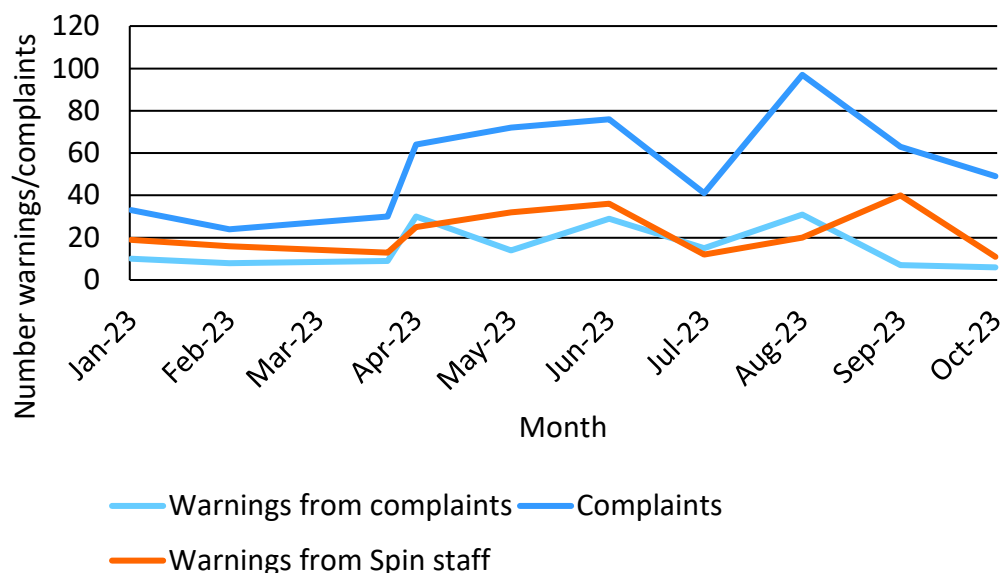


Figure 13 Numbers of complaints and warnings

Since Spin formalized a system for its staff to report improper parking, combined with FC Moves’ efforts to increase reporting of improper parking, the number of warnings has increased substantially from previous years. However, improper parking is a small percentage of total trips (Table 5) with almost no repeat offenders, suggesting that improper parking is due to a small number of riders and that riders are responsive to education.

Table 4 Number of complaints and penalties, January – October 2023

Total trip ends	Complaints	1 <sup>st</sup> Warnings	2nd or 3rd offenses
192,000	549	383	9
% total trips	0.29%	0.20%	

## Reporting

In July 2022, FC Moves added the text number and email for the local Spin team to the Fort Collins Spin website and promoted this information through the Momentum<sup>6</sup> newsletter and social media. The number of complaints Spin received increased from 157 in the first year to 441 in the second year (281% increase). FC Moves also identified groups of staff who could be trained to report improper parking. Staff from Parks are well positioned to observe improper parking in parks and Transfort staff at bus stops. City staff may observe improper parking during the course of their workday. FC Moves encouraged City staff to report improperly parked Spin vehicles through presentations and newsletters:

- December 7, 2022 Parks Department Management Retreat
- January 12, 2023 edition of Fort Shorts (Figure 13)
- April 11, 2023 Transfort Safety and Training Meeting

01.12.23 Fort Shorts

Communications & Public Involvement Office <cpio-admi  
To: Rachel Ruhlen  
Retention Policy: COFC 730 Retention (2 years) Expires: 1/11/2025  
You forwarded this message on 1/16/2023 4:29 PM.  
If there are problems with how this message is displayed, click here to view it in a web browser.

### Report poorly-parked Spin devices



Is there an orange Spin scooter or bike in your way? Take a photo and report bad parking to Spin. They will move it - and penalize the user who left it there! Text 970-387-2799 or email [fortcollinsops@spinteam.pn](mailto:fortcollinsops@spinteam.pn).

As always, you can report a near-miss or a safety concern related to electric bikes or electric scooters in Fort Collins or on CSU's campus through Access Fort Collins.

*Figure 14 Item about Spin parking in Fort Shorts*

<sup>6</sup> The Momentum newsletter can be subscribed to at <https://www.fcgov.com/fcmoves/>.  
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## Phase 2

After implementing countermeasures, FC Moves conducted observations on 97 devices in 10 randomly selected chunks<sup>7</sup> (Figure 2). Phase 2 data collection was carried out between October 1, 2023 and October 21, 2023. Phase 2 data on barriers and parking characteristics were compared to the baseline data collected in Fall 2022 on 145 vehicles that were observed in the same chunks.

### Barriers

There was a statistically significant ( $P < 0.05$ ) decrease from 2022 to 2023 in the percentage of vehicles that were a barrier while the percentage of vehicles that impeded ADA accessibility was not statistically significantly different (Figure 15). The decrease in vehicles that were a barrier suggests that the countermeasures are working. The lack of change in vehicles impeding ADA accessibility is disappointing and may be due to a low baseline rate (i.e. lack of room for improvement) and insufficient data. We will continue to implement countermeasures, monitor vehicles impeding ADA accessibility, and consider additional countermeasures.

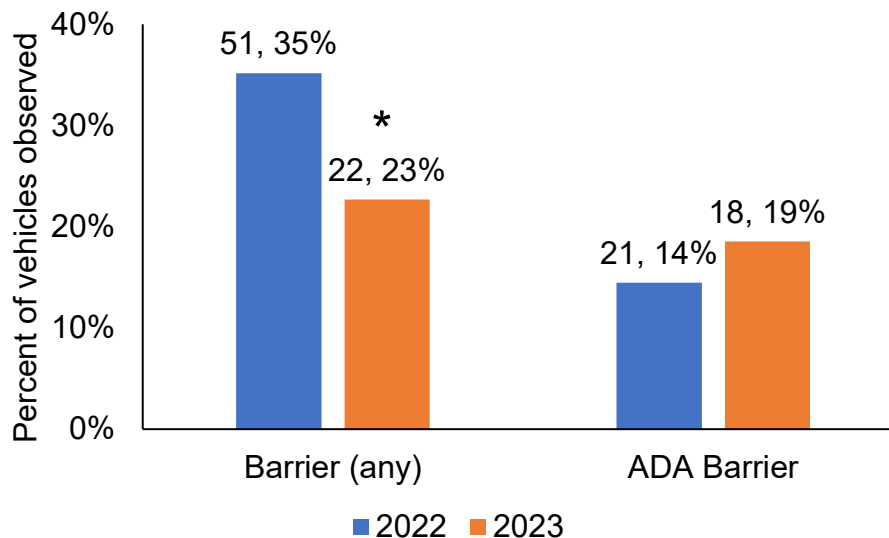


Figure 15 Percent of vehicles observed blocking access or blocking ADA accessibility in the ten chunks (see Figure 2) observed both in 2022 (145 vehicles) and 2023 (97 vehicles). \* $P < 0.05$  2022 vs. 2023

<sup>7</sup> Thanks to volunteers Chip McMahan and Anna Stewart who conducted Phase 2 observations.  
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## Parking Characteristics

Parking characteristics of whether a vehicle was upright or parked legally and its street location before and after countermeasure implementation were compared.

### Vehicle not upright

Properly parked vehicles may be less likely to fall over. The percentage of vehicles fallen over not statistically significantly different in 2023 compared to 2022 (Table 6).

### Illegally parked vehicles

Since the ordinance was amended to allow more legal options for parking, we would expect to see a decrease in the number of vehicles parked illegally. There was a 57% decrease in the percentage of vehicles that were parked illegally Table 6.

*Table 5. Percentage increase or decrease from 2022 to 2023 of parking behavior*

	2022	2023	% change
<b>Fallen over</b>	20 (14%)	9 (9%)	-5%
<b>Illegally parked</b>	128 (88%)	30 (31%)	-57%*
<b>Total</b>	145	97	

\*P<0.05

### Street location

The location of vehicles on the street can be indicative of the success of countermeasures, since countermeasures encouraged parking on street and discouraged parking on sidewalks. The location of vehicles on the street overall was not statistically different from baseline (Table 7).

*Table 6. Percentage increase or decrease from 2022 to 2023 of locations of parked vehicles on the street*

	Bike rack	Bus stop	Furniture zone	Parking lot	Sidewalk	Storefront	Street	Unpaved surface
<b>2022 (Total 145)</b>	14 (10%)	0	3 (2%)	14 (10%)	59 (40%)	6 (4%)	20 (14%)	29 (20%)
<b>2023 (Total 97)</b>	13 (13%)	0	1 (1%)	10 (10%)	40 (41%)	7 (7%)	17 (18%)	15 (15%)
<b>Change from 2022 to 2023</b>	<b>+3%</b>	<b>0%</b>	<b>-1%</b>	<b>0%</b>	<b>+1%</b>	<b>+3%</b>	<b>+4%</b>	<b>-5%</b>

## Conclusions

We demonstrate here a method to objectively assess the extent of barriers posed by dockless e-bike and e-scooter share. Using this information, we developed parking countermeasures to decrease barriers, especially those impeding ADA accessibility. After implementing countermeasures, we observed a decrease in the proportion of vehicles that are a barrier, suggesting that countermeasures successfully changed behavior.

The percentage of vehicles impeding ADA accessibility was not statistically significantly different from baseline after countermeasures were implemented. The randomly selected chunks monitored after countermeasures had a lower baseline percentage of ADA accessibility impediments than the total chunks sampled for baseline. This baseline rate of ADA accessibility impediments may be too low to detect an effect with the sample size used, i.e. little room for improvement.

Limitations of this study were the short amount of time countermeasures had been in place before post-countermeasure observations were made, and that countermeasures are still being implemented, such as installing additional bike/scooter boxes. We expect consistent messaging, penalties, and incentives to continue to improve parking behavior and hope to create a culture of proper parking among all Spin riders.

This study focused on the barriers posed by these vehicles and opportunities to mitigate these barriers. We observed other barriers unrelated to the vehicles that deserve attention as well, such as sidewalks too narrow for a wheelchair, motor vehicles parked on sidewalks and in bike lanes, and sidewalks blocked by overgrown bushes.

## Next steps

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We will continue to implement the countermeasures described in this report and monitor parking behaviors, particularly those that impede ADA access. Spin routinely increases the frequency of monitoring in areas where vehicles impeding ADA accessibility have been observed and removes offending vehicles promptly. The reduction observed after implementation of countermeasures in parking behaviors resulting in general barriers suggests that the countermeasures are effective and with consistent and continued application we expect a reduction in parking behaviors that impede ADA accessibility as well.

E-bike and e-scooter share provides both benefits and burdens. The benefits of e-bike and e-scooter share to all riders and to riders with disabilities are important. The efforts described here are to mitigate burdens of the service on people using the public right of way, particularly people with disabilities.