Powerline Road Lane Repurposing Before and After Study

Introduction

Transportation projects that affect roadway capacity go through a robust planning process. The Florida Department of Transportation's (FDOT) planning process includes establishing the need for improvements. During the planning phase of a project, problems are identified that should be mitigated through the planned improvement. After an initial assessment, more detailed studies are typically performed in FDOT's Project Development and Engineering (PD&E) process. Before and after studies can provide insights and feedback on the project improvements.

FDOT's District 4 completed a lane repurposing project on Powerline Road between W Sunrise Boulevard and NW 29th Street in Broward County to improve safety conditions for all users along the corridor and to increase the connectivity of the bicycle lane network through the installation of buffered bicycle lanes.

To support FDOT's Lane Repurposing Guidebook, this study quantifies the safety and mobility for pedestrians, bicyclists, and automobiles within the analysis segment of Powerline Road as well as the potential economic impact on the local community. Previous before and after studies on Powerline Road's lane repurposing project included literature reviews and obtaining FDOT and stakeholder input on the completed projects. FDOT's Forecasting & Trends Office (FTO) conducted the analysis to capture safety and operations prior to the lane repurposing, during construction, and after the project's completion. FTO expanded the physical study area to account for how the lane repurposing project impacted the surrounding roadway network. These analyses account for safety and mobility conditions for each year from 2014 through 2019.

Study Area

Powerline Road is a north-south minor urban arterial, which parallels Interstate 95 and Andrews Avenue within the cities of Fort Lauderdale and Wilton Manors. The lane repurposing project limits are from W Sunrise Boulevard on the south to NW 29th Street on the north. Based on data availability, the analysis segment of Powerline Road is extended further north beyond 29th Street to W Oakland Park Boulevard. The project limits are 1.8 miles but the study segment is 2 miles in length to account for the linear data coverage. Data is parsed on segments that typically terminate at major arterials, as is the case with data along Powerline Road. The study area comprises an area bounded by Interstate 95 to the west, Andrews Avenue to the east, W Sunrise Boulevard (SR 838) to the south, and W Oakland Park Boulevard to the north (shown in **Figure 1**). A comparison area is also identified, which will be discussed in the Methodology section.

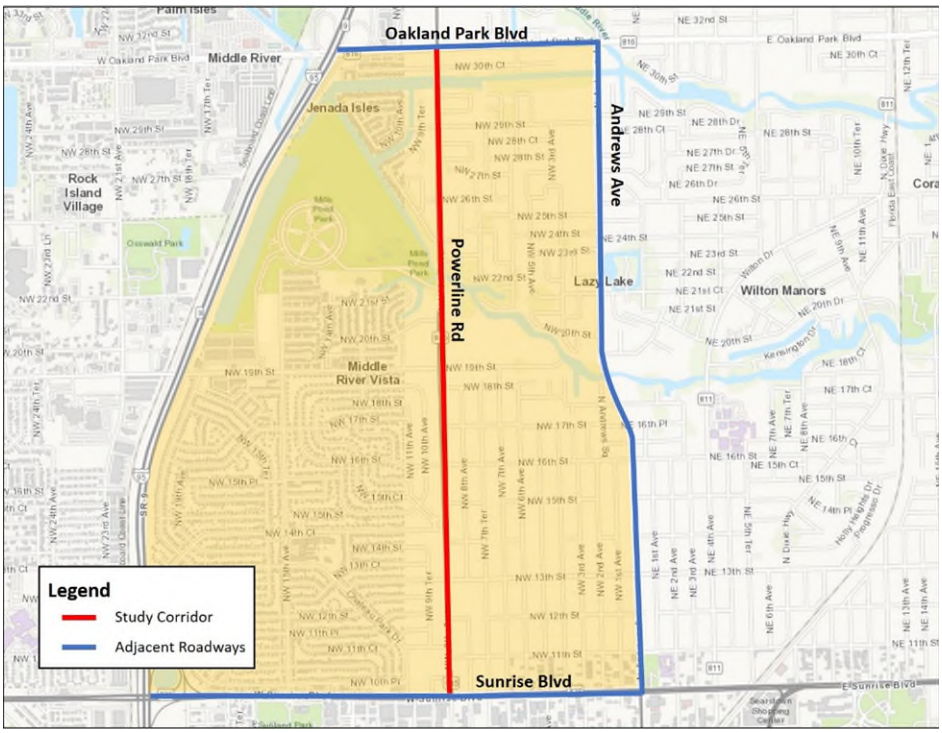
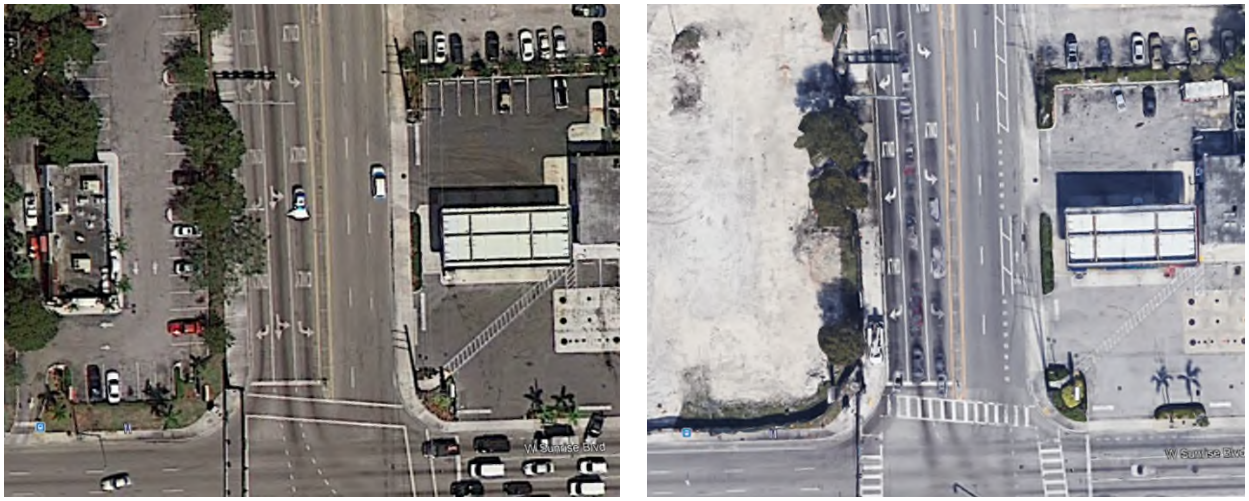


Figure 1 Study Segment

To improve safety conditions for vulnerable users and increase the connectivity of the bicycle lane network, the City of Fort Lauderdale proposed removing a lane of through traffic in each direction of the corridor, which modified the existing lane configuration from a six-lane divided arterial to a four-lane divided roadway with buffered bicycle lanes. Prior to the lane repurposing Powerline Road had continuous five-foot sidewalks, 3 eleven-foot lanes in each direction, and a median. The proposed lane repurposing project was to reduce the number of through lanes to two in each direction. A striped five-foot bicycle lane and a six-foot buffered striped area were to be placed in the space of the previous outer eleven-foot travel lane (**Figure 2**).



(a) Before (b) After

Figure 2 Powerline Road Project Before and After Street Views

In 2014, FDOT approved the implementation of this project. This proposed lane repurposing project was consistent with the policy direction provided in the City's *Fast Forward Fort Lauderdale 2035 Vision*[1]. Powerline Road was already scheduled for a programmed resurfacing, rehabilitation and restoration project (also known as *3R* project) by FDOT in the fall of 2014.

Methodology

As part of the Powerline Road lane repurposing analysis, the FTO, the System Implementations Office (SIO) and District 4 collaborated to identify measures that captured the effectiveness of the lane repurposing project. The construction started in January 2017 with completion in June 2017. Thus, the analysis considered 2014 to 2016 as the before-construction period, 2017 as the construction year, and 2018 to 2019 as the after-construction period. The following measures were applied for a six-year period from 2014 through 2019:

- Average annual daily traffic (AADT) and peak counts
- Average travel speed: daily, AM, and PM peaks
- Average speed vs. posted speed
- Planning time index
- Average travel time
- Vehicle delay
- Level of service (LOS)
- Level of traffic stress (LTS) for pedestrians and bicyclists
- The number of fatalities, serious injuries and nonserious injuries
- The number of bicyclist and pedestrian crashes
- Property values

The measures were partially determined by the availability of data. A variety of sources were used to collect data. To support the data collection effort, FTO also coordinated with District 4 to obtain local data. For measures that required data, not provided by the district, FTO obtained data from various sources. **Table 1** provides a list of data sources.

Table 1 Measures and Data Sources

Performance Measures	Data Source
AADT, including peak counts	Florida Traffic Online
Travel speed/travel time	RITIS
Average speed vs. posted speed	FDOT Source Book
Planning Time Index	RITIS
Vehicle hours of delay	FDOT Source Book
Level of Service (LOS)	District 4 annual LOS update
Level of Traffic Stress	Google Earth, RITIS, Florida Traffic Online

[1] *FDOT Powerline Road Lane Elimination Application* June 2014

Table 2 Measures and *Data Sources (Continued)*

Performance Measures	Data Source
Transit ridership	Broward County transit
All safety-related data	Signal Four Analytics
Property Value	Florida Department of Revenue

Operational changes to Powerline Road would likely impact the operations on the surrounding roadway network as well. In the case of a lane repurposing project, it is suspected that vehicle volume once utilizing Powerline Road will be redistributed onto other roads in the immediate area. To determine how this project could have affected the roads immediately adjacent to the improvement, FTO identified roads adjacent to the study segment for inclusion in the analyses. Besides Powerline Road, Andrews Avenue, W Sunrise Boulevard and W Oakland Park Boulevard were identified as surrounding corridors. However, due to the limitation of data availability, Andrews Avenue was not selected for most of the performance measures.

For the economic performance measure evaluation, a comparison area, with similar land use and roadway network context as the study area, was identified (**Figure 16**). It is bounded by Martin Luther King Junior Avenue to the west, Interstate 95 to the east, Sunrise Boulevard to the south and Oakland Park Boulevard to the north.

For details on the methodology of each individual mobility measure, please visit Methodologies for The FDOT Source Book: A Technical Report – 2020.

Mobility Performance Measures

To determine the impacts of this lane repurposing project, it is important to first understand the traffic patterns in the study area and the user experiences as metrics for how well the study area performs.

The mobility performance measure analyses focused on understanding not only vehicle traffic patterns but also the user experience of pedestrians, bicyclists and transit riders in the study area. The mobility performance measures include traffic volume, travel speed, travel time, planning time index, vehicle hours of delay, level of service (LOS), level of traffic stress (LTS) and transit ridership.

Traffic Volume

Historical Annual Average Daily Traffic (AADT) and peak hour traffic volume were obtained on Powerline Road, its parallel facility, Andrews Avenue, and its surrounding facilities, W Sunrise Boulevard and W Oakland Park Boulevard. They were then analyzed to understand the trends of traffic conditions in the study area and the mobility impact of the lane repurposing project.

Annual Average Daily Traffic

AADT remained relatively consistent from 2014 through 2019. Powerline Road had an AADT of 22,500 in 2014 and an AADT of 25,000 in 2019. Differences in AADT from 2014 to 2019 represent an 11% increase in volume over the six-year period (as seen in **Figure 3**). Adjacent roadways experienced similar growth in volume ranging from 4% to 17%.

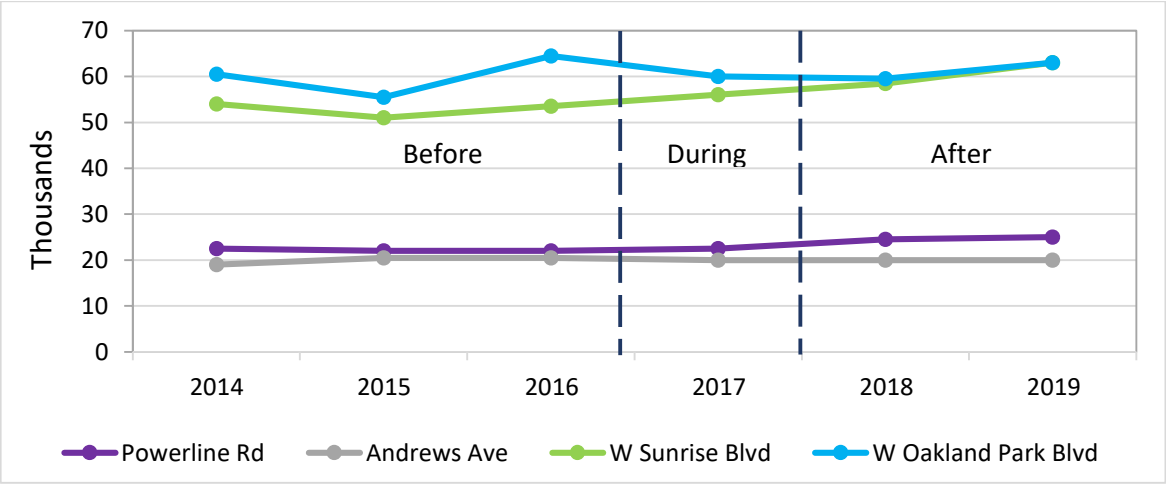


Figure 3 Historical AADT (2014 – 2019)

Peak Period Traffic Volume

To understand changes in traffic patterns, both the AM peak period (7 AM – 10 AM) and the PM peak period (3 PM – 6 PM) were evaluated. As part of District 4's traffic data collection process, single-day (24-hour) volume counts were collected on this facility annually between January and March. For this study, the traffic data were collected by District 4 and uploaded to Florida Traffic Online.

During the AM peak period, the study corridor (Powerline Road) carried less than 50% of the volumes observed on W Sunrise Boulevard and W Oakland Park Boulevard. Unlike Powerline Road, W Sunrise Boulevard and W Oakland Park Boulevard are oriented east and west. In 2014 the AM peak volume was 4,323. In 2019, the AM peak volume was 4,054. This represents a 6% decrease over the six-year time frame. During the same time, W Sunrise Boulevard and W Oakland Park Boulevard witnessed slight gains in traffic, 1% and 2%, respectively. **Figure 4** displays the AM peak period volumes for these three facilities.

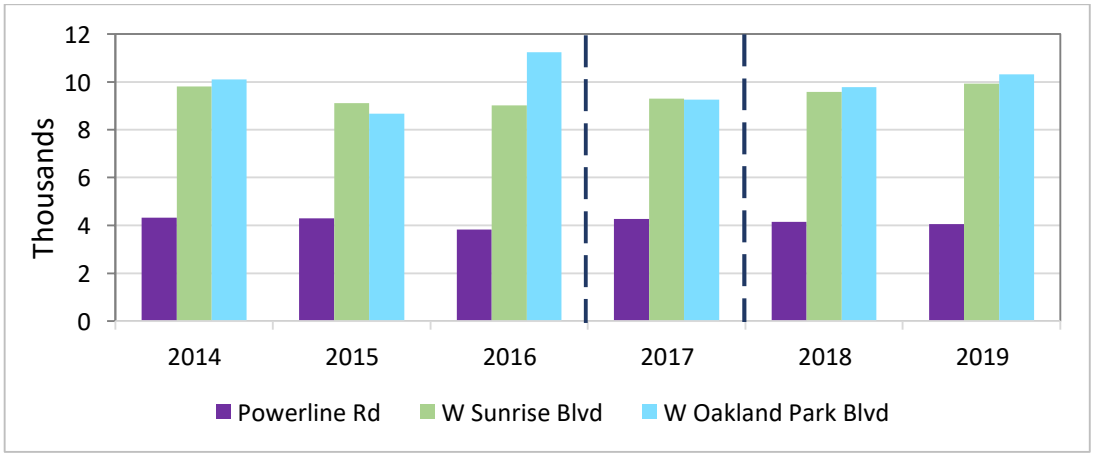


Figure 4 AM Peak Period Traffic Volumes

A similar trend was observed in the PM peak period. The volumes on Powerline Road were less than half of the amount carried individually along W Sunrise Boulevard and W Oakland Park Boulevard. The PM peak period volumes declined by 6% for the six-year period 2014 through 2019. W Oakland Park

Boulevard had a decrease of 2%, while W Sunrise Boulevard witnessed a 15% spike in PM peak period volumes during the same period as shown in **Figure 5**. The construction year (2017) did not experience the lowest traffic volumes. In 2016, Powerline Road, a north-south corridor, saw the lowest volumes whereas Oakland Park Blvd, an east-west corridor, witnessed the highest volumes throughout the six-year period.

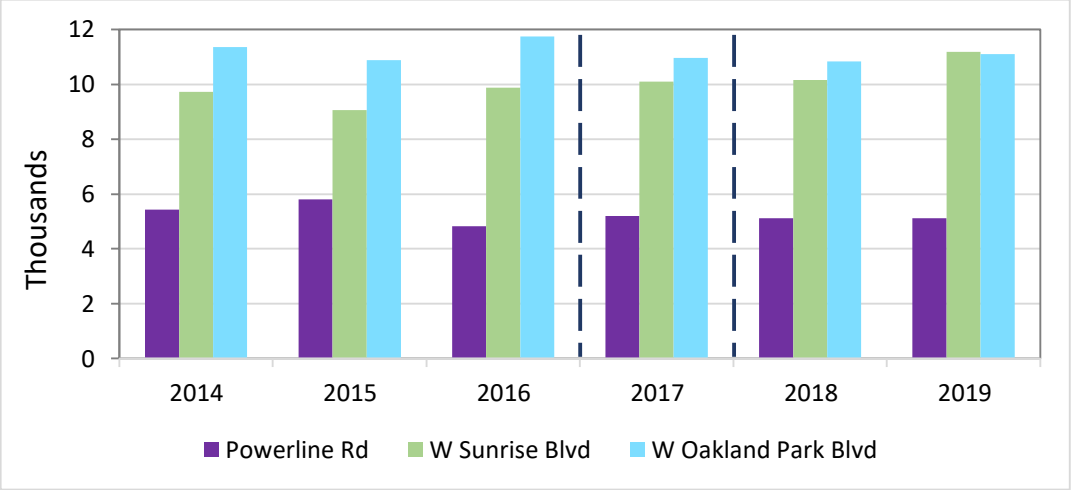


Figure 5 PM Peak Period Traffic Volumes

Travel Speed

The disruption caused by removing a through lane of traffic typically impacts throughput and travel speeds. For this analysis, average speed and average speed vs. posted speed were analyzed.

Average Travel Speed

Prior to construction, in 2014, average daily travel speeds in both directions were 27 miles per hour (mph) on Powerline Road. In 2017, it decreased to a little less than 25 mph due to the construction. After construction, in 2018, average travel speed increased to a little over 25 mph. In 2019, average travel speeds on the four-lane facility were approximately 26 mph, nearly as high as the speed on the six-lane facility back in 2014. A similar trend was observed on Sunrise Blvd with a faster speed by 2019. Speeds for Oakland Park Blvd were not available. The reduction in capacity had minimal effect on the overall travel speed on the corridor as seen in **Figure 6**.

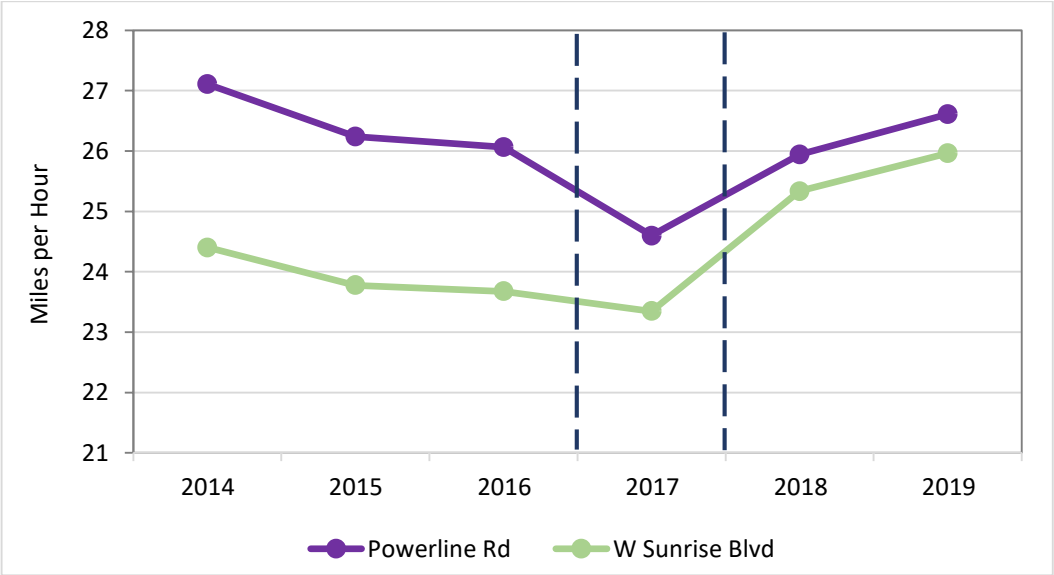


Figure 6 Average Daily Travel Speed

Average Speed Vs. Posted Speed

A good indicator of the quality of mobility along a facility is the ability of travel to achieve the posted speed limit. Average speed vs. posted speed was calculated by comparing the average peak hour speed against the posted speed limit. The output represented the overall percentage of the speed limit achieved in the peak hour. For the study at hand, the analysis was carried out for Powerline Road, W Sunrise Boulevard and W Oakland Park Boulevard. The output in **Figure 7** represents the overall percentage of the speed limit achieved in the peak hour (5 PM – 6 PM on a weekday). Consistent with the observed travel speed trend, vehicles achieved the lowest ratio during 2017. When compared with the before-construction period, the peak hour speed in the after-construction period had a lower percentage that achieved the posted speed limits. When compared with W Sunrise Boulevard and W Oakland Park Boulevard, Powerline Road had a higher percentage of vehicles that achieved the posted speed limit for the prior-to-, during-, and after-construction periods.

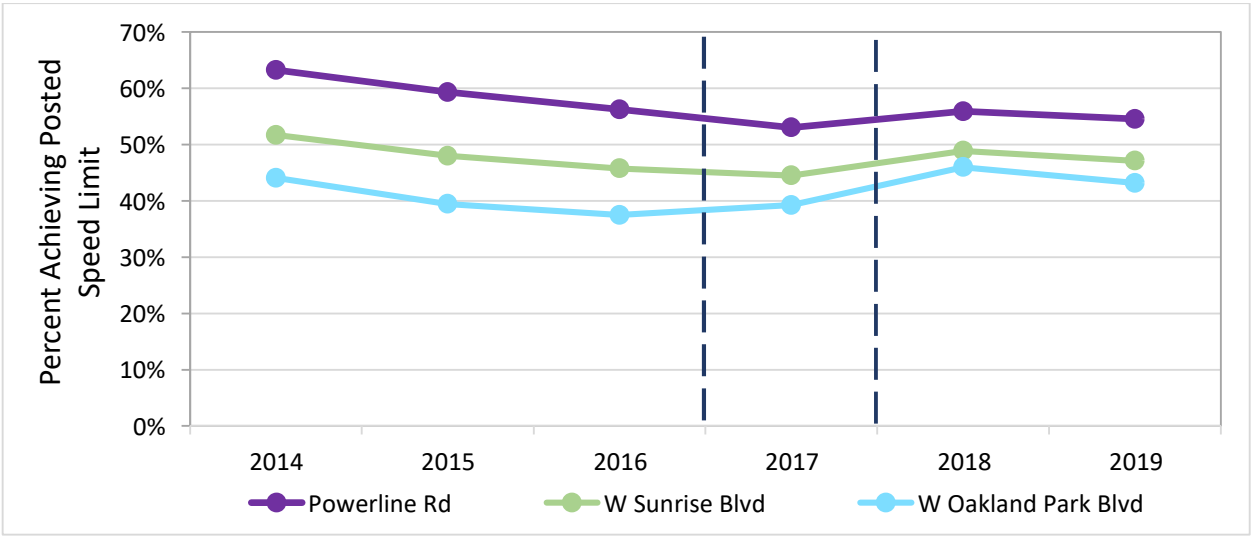


Figure 7 PM Peak Hour Average Speed Vs. Posted Speed

Travel Time

Speed and travel time have a direct correlation. In 2014, on average, it took vehicles 4 minutes and 27 seconds to travel 2 miles of Powerline Road. Six years later, in 2019 it took vehicles 4 minutes and 46 seconds to travel that same span of Powerline Road, as observed in **Figure 8**. The trend also applied to W Sunrise Blvd. Travel times for W Oakland Park Blvd were not available.

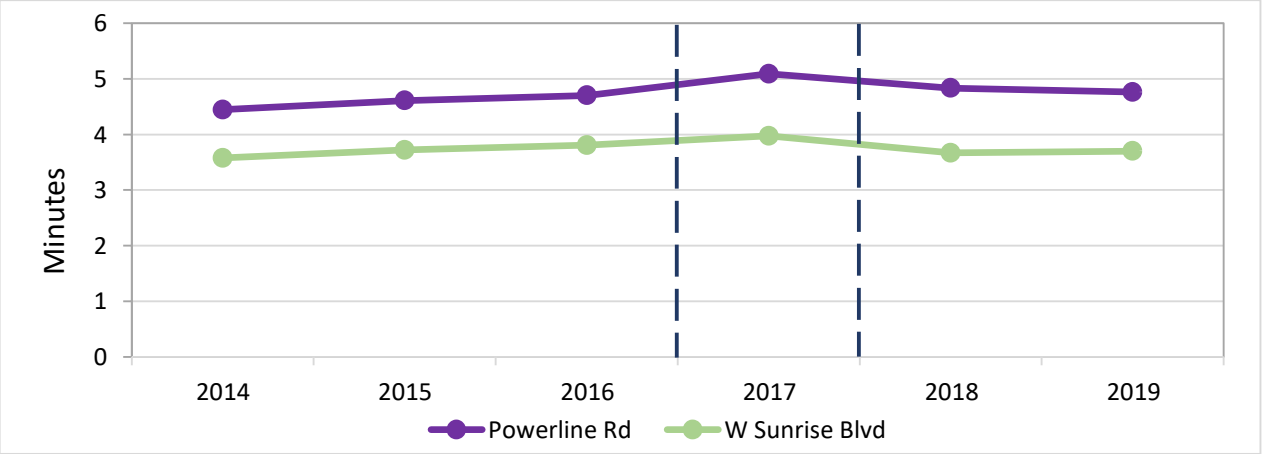


Figure 8 Average Travel Time

Boxplots are used to analyze travel time fluctuation patterns. Similar to average travel time, the median travel time slightly changed from 2014 through 2019. As shown in **Figure 9**, the construction year (2017), had more extreme travel times as outliers, which represented the lowest reliability. The PM peak period showed less reliability than both the AM peak period and daily travel times.

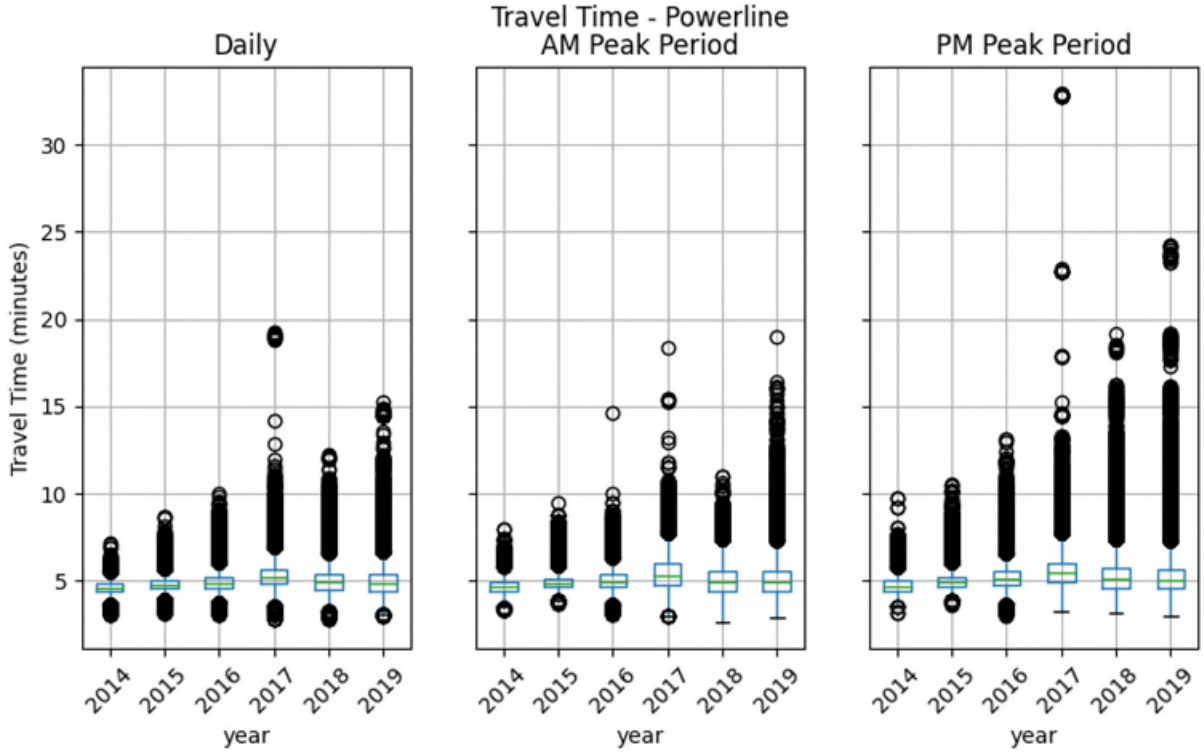
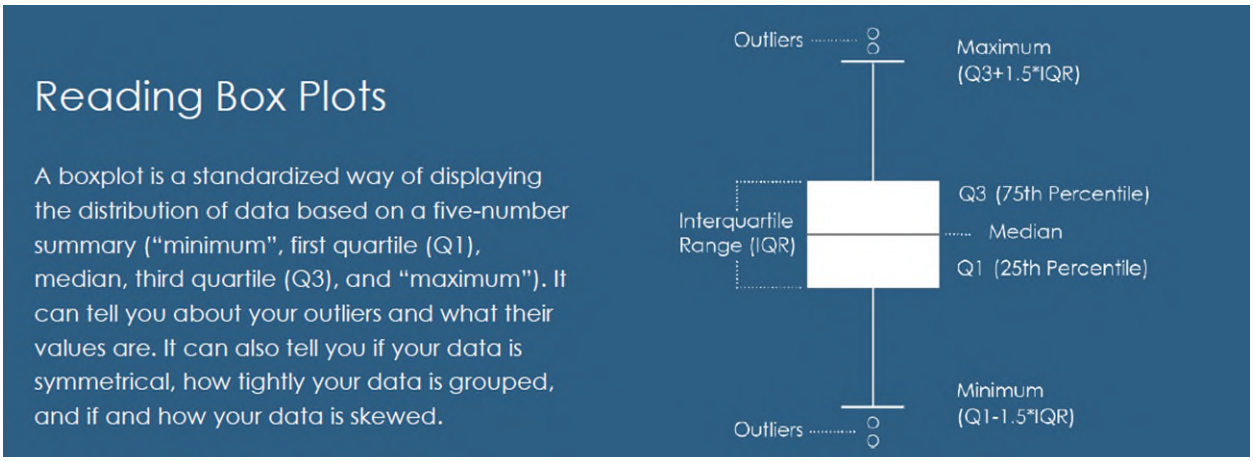


Figure 9 Travel Time Box along Powerline Road



Planning Time Index (PTI)

Travelers, shippers, and roadway operators prefer predictable and reliable travel times. Travel time variability can lead to unreliable travel conditions. Unreliable travel conditions typically result from nonrecurring events. The PTI is an indicator of the travel time variability, the higher the indices the more variable the travel time. This index is the ratio of the 95th percentile travel time to free flow travel times, the higher the value the less reliable the facility. In 2014, once a month it took travelers 5 minutes and 36 seconds to traverse the 2 miles study segment. Six years later in 2019, once a month it took travelers 7 minutes to traverse this segment of Powerline Road. **Figure 10** shows conditions were more reliable on Powerline Road than they were on W Sunrise Boulevard.

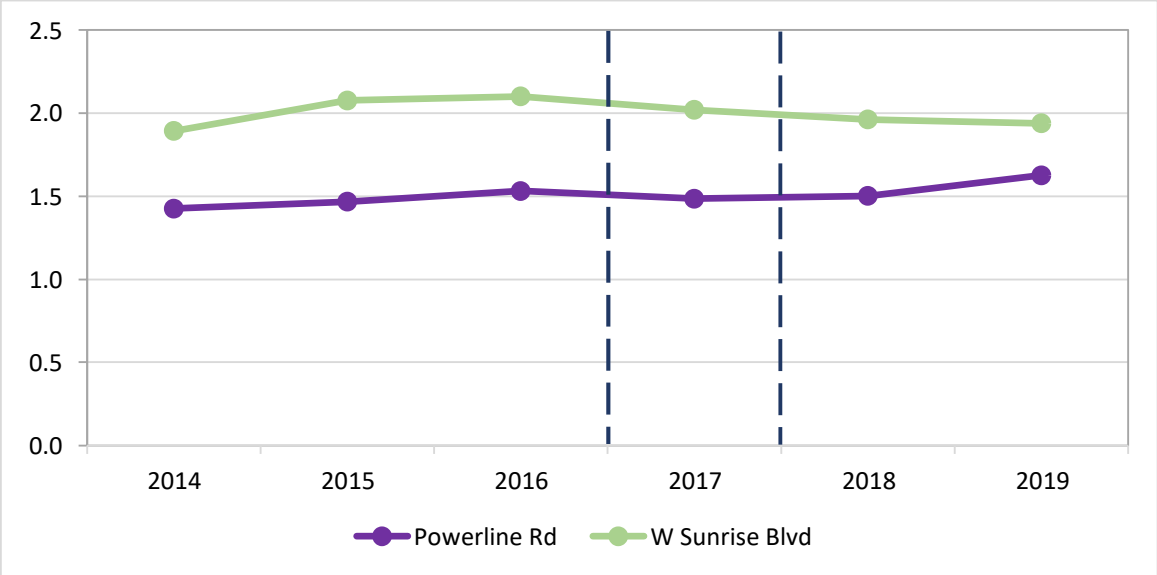


Figure 10 Planning Time Index

Vehicle Hours of Delay

Vehicle hours of delay were estimated on an hourly basis by determining the difference between delay threshold travel time and actual travel time along a facility. Delay is considered the additional travel time experienced by a motorist beyond what they would experience in uncongested conditions. Vehicle hours of delay are counted when speeds slower than the delay threshold speeds are observed. The delay threshold speeds are listed below:

- Powerline Road: 31 mph
- W Sunrise Boulevard: 31 mph
- W Oakland Park Boulevard between I-75 and Powerline Road: 31 mph
- W Oakland Park Boulevard between Powerline Road and Andrews Avenue: 22 mph

The difference in travel time is represented by the number of vehicles experiencing the conditions. Thus, more vehicles experiencing conditions below the thresholds more delay. Powerline Road experienced less delay than W Sunrise Boulevard and W Oakland Park Boulevard partially because it carried less volume, as seen in **Figure 11**. In 2014, there were 19 hours of delay on the study segment. In 2017, there were 48 hours of delay on the segment. In 2019, there were 37 hours of delay on the study segment. The patterns were similar for Powerline Road and Sunrise Blvd.

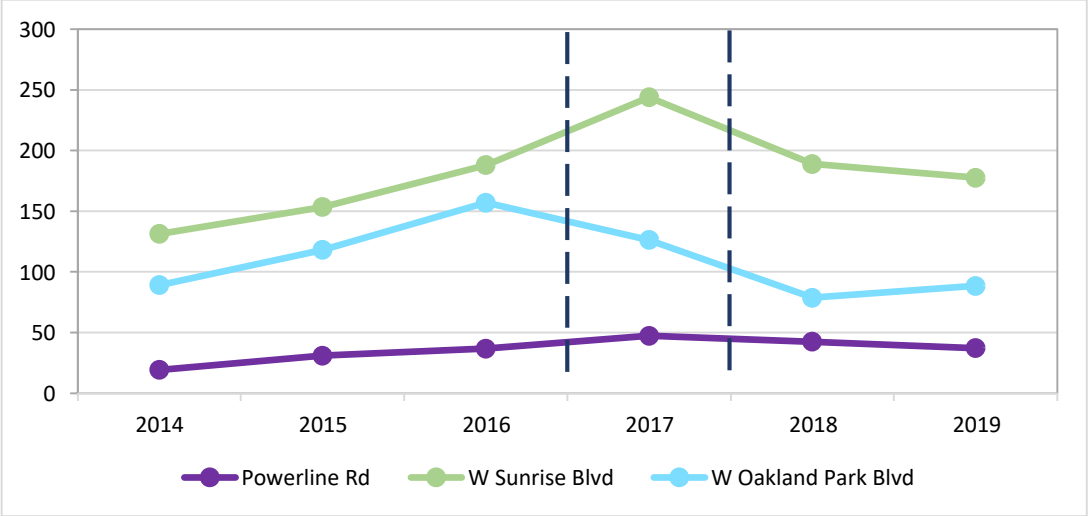


Figure 11 Vehicle Hours of Delay During Peak Hour

Level of Service (LOS)

As seen in **Table 3**, the level of service remained as "C" along Powerline Road from 2014 through 2019. The reduction in capacity had minimal effect on the overall level of service for the facility.

Table 3 Level of Service

Year	Level of Service		
	Powerline Road	W Sunrise Boulevard	W Oakland Park Boulevard
2014	C	C	F
2015	C	C	F
2016	C	C	F
2017	C	C	F
2018	C	F/C*	F
2019	C	F/C*	F

*W Sunrise Boulevard from I-95 to Powerline Road (approximately 1.0 miles) experienced LOS F and from Powerline Road to Andrews Avenue (approximately 0.6 miles) experienced LOS C.

Level of Traffic Stress (LTS)

One purpose of the lane repurposing project was to increase the quality of travel for non-automobile users. Level of traffic stress (LTS) provides an indicator of the quality of travel for both bicyclists and pedestrians. They are determined based on traffic, roadway characteristics and land use along the corridor. The parameters that take into consideration includes the type of bike facilities such as separated lanes from auto lanes or lanes without any buffers, auto travel speed, number of lanes, land use, parking condition, width of bike lane and parking lane, AADT and sidewalk width along the study corridor.

There are four scores for the bike LTS from an LTS of 1, which is comfortable for most of the general population, to an LTS 4, which is uncomfortable for even an experienced bicyclist. The higher the LTS score, the harder and more difficult it is for a bicyclist or a pedestrian to maneuver through the area. With an LTS 4, the roadway has high vehicle volumes and high automobile speeds with no specialized bicycle infrastructure. The same is true for the pedestrian LTS.

After the lane purposing project, the study corridor moved from LTS 4 to LTS 1 (**Table 4**), which indicated that the facility was appropriate for an eight-year-old child to ride on safely. The pedestrian LTS remained unchanged before and after the project since the pedestrian facility was not altered.

Table 4 Level of Traffic Stress

Year	Level of Traffic Stress (LTS)	
	Bike LTS	Ped LTS
2014	4	2
2015	4	2
2016	4	2
2017	1	2
2018	1	2
2019	1	2

Transit Ridership

A lane repurposing project is often associated with a complete street improvement. Complete streets are intended to improve travel conditions for all non-auto modes, including transit. The purpose of the lane repurposing on Powerline Road was not inherently intended to increase transit ridership along the study segment. Broward County Transit (BCT) Route 14 (approximately 40 miles) serves the study segment; BCT provided total ridership data for Route 14. However, ridership data for the transit stops along the study segment were not available. Changes in transit ridership over the six-year period from 2014 through 2019 are presented in **Table 5**.

Table 5 Broward County Transit Route 14 Ridership, 2014-2019

Year	Daily Ridership			Total Ridership
	Average Weekday	Average Saturday	Average Sunday	
2014	4,173	2,111	1,007	1,232,065
2015	4,067	2,111	1,115	1,213,226
2016	3,651	1,831	988	1,086,882
2017	3,362	1,716	885	991,740
2018	3,201	1,598	878	947,773
2019	3,081	1,513	841	912,198

Source: Broward County Transit

Safety Performance Measures

Typically, FDOT's Crash Analysis Reporting System (CARS) data has a 2-year lapse for all crash records. Therefore, the 2019 data will not be ready for use until later 2021. As an alternative, the University of Florida's Signal Four Analytics (Signal Four) was used for crash analyses. It is important to note that Signal Four is not an FDOT product. The software does not follow the same procedures for crash location processing, and location-based queries and using Signal Four will not completely align with the results derived from CARS. FDOT Engineering decisions that are dependent upon crash location data should be based on the verified location data in the State Safety Office's CARS database whenever possible.

To identify the lane repurposing impact on safety, the following safety performance measures were analyzed:

- The number of fatalities, serious injuries and nonserious injuries
- The percentage of injury crashes and noninjury crashes
- The number of pedestrian and bicyclist fatalities and injuries
- The percentage of bicyclist and pedestrian injury and noninjury crashes

Fatalities, Serious Injuries and Nonserious Injuries

As seen in **Figure 12**, the number of fatalities is lower from 2017 through 2019 than prior to the construction. There were more injuries right before and after the construction. By 2019, fewest fatalities and injuries were recorded along Powerline Road. It can be reasonably concluded that the lane repurposing project had a positive impact on improving safety along the corridor.

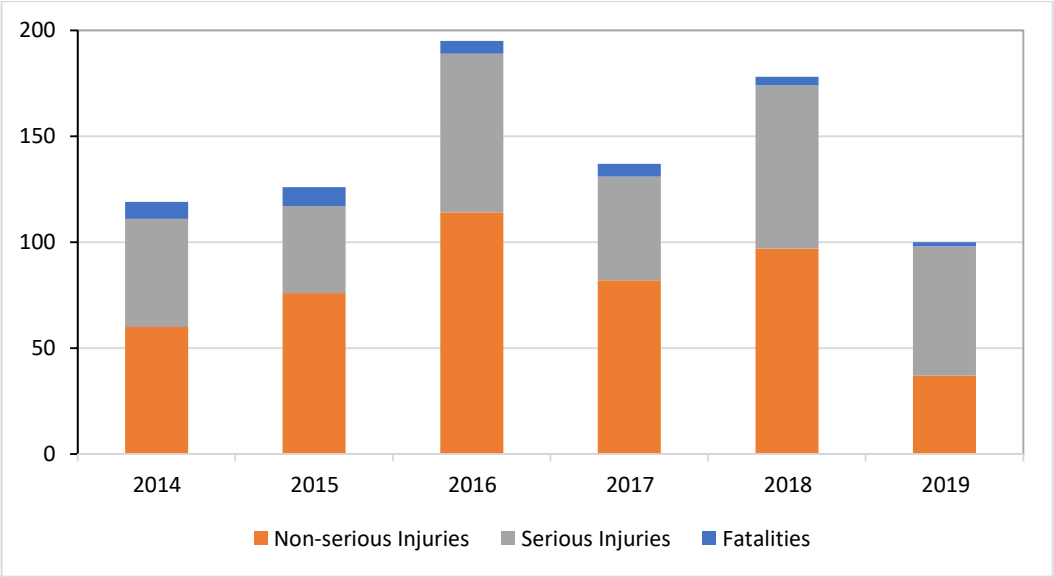


Figure 12 Fatalities and Injuries

Percentage of Injury Crashes and Noninjury Crashes

The change of severity pattern is also observed in **Figure 13**. Prior to the construction, from 2014 to 2016, injury crashes comprised 31.7% of total crashes on average. In 2015, the lowest percentage of injury crashes was observed over the six-year period. After construction, from 2018 to 2019, injury crashes comprised 29.3% of total crashes on average, lower than 2014 and 2016.

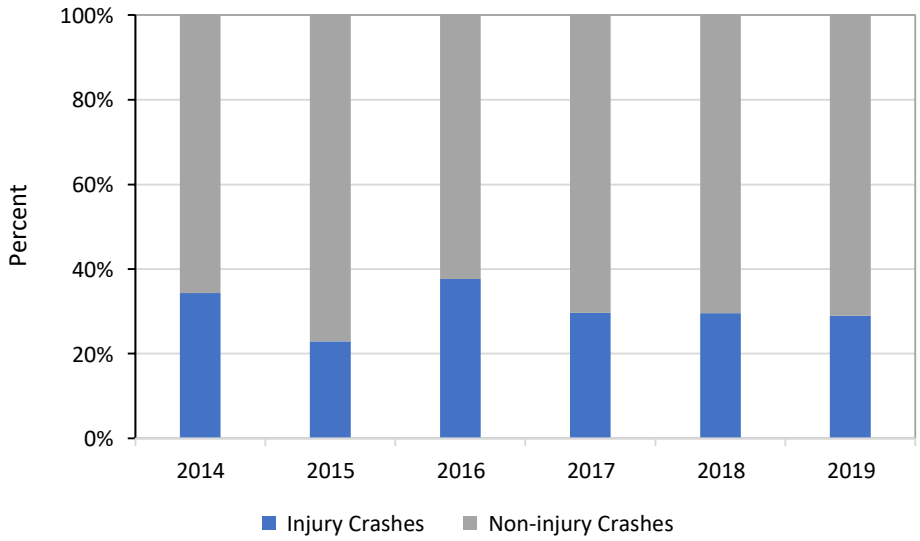


Figure 13 Percentage of Injury vs. Non-injury Crashes

Pedestrian and Bicyclist Fatalities and Injuries

From 2014 to 2019, no bicyclist fatalities were observed (**Figure 14**). From 2014 to 2016, the number of pedestrian injuries showed an increasing pattern. After a huge dip in 2017, pedestrian injuries started to increase again. A different pattern was observed for bicyclist injuries. In 2016 and 2017, there were 4 bicyclist injuries. After construction, bicyclist injuries dropped in 2018 and continued to drop to the lowest in 2019, which reflected the purpose of the project.

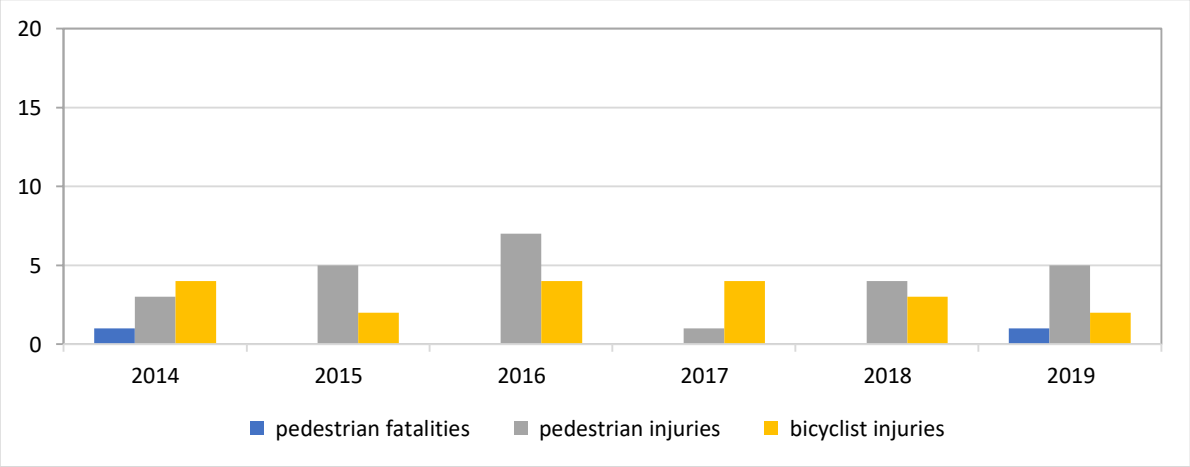


Figure 14 Pedestrian and Bicyclist Fatalities and Injuries

Percentage of Pedestrian and Bicyclist Crashes

Pedestrian safety along the corridor remained consistent in the before and after periods (as seen in **Figure 15**). In 2014, 4.0% of crashes involved pedestrians. In 2019, 3.9% of all crashes within the study segment involved pedestrians. While no obvious improvement on pedestrian safety was observed, the addition of a buffered bike lane has apparently increased safety for bicyclists. The percent of crashes involving bicyclists was 3.2% in 2014 and down to 1.3% in 2019.

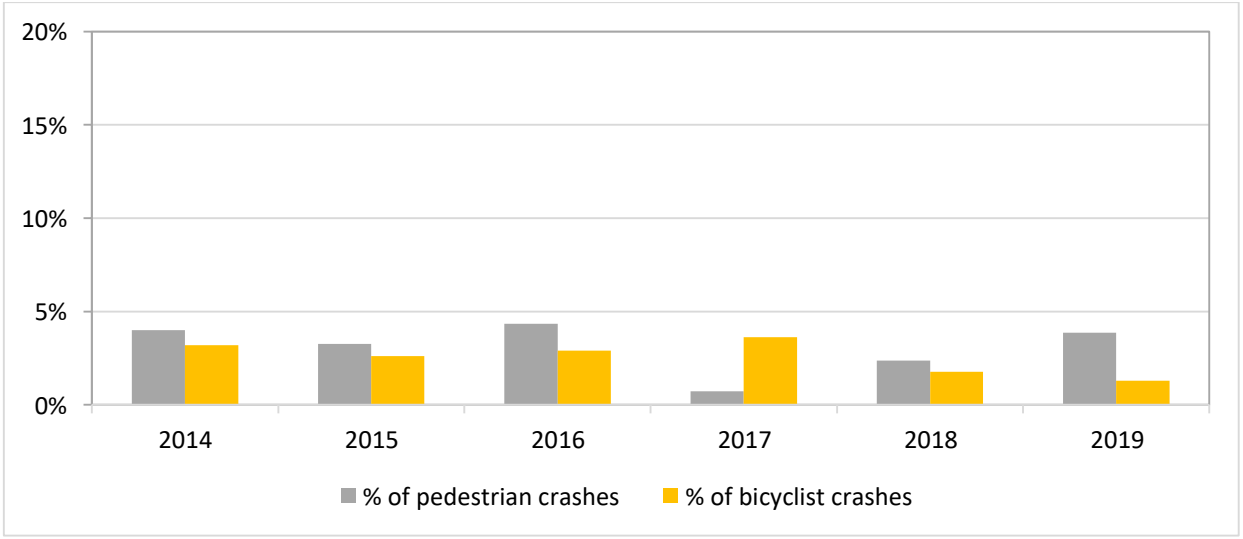


Figure 15 Percentage of Pedestrian and Bicycle Crashes

Economic Performance Measure

Lane repurposing projects are either the catalysts for neighborhood revitalization or part of a larger existing area revitalization plan. This project did not include new landscaping or street furniture. The area is primarily residential, and the project was completed to accommodate residents walking and riding their bikes. Without a strong sense of place or trip attractors, this corridor appears to primarily serve pass-through traffic. The economic measure selected for this analysis is the total residential property value.

To ensure the similar land use and roadway network context, the comparison area, which bounded by Martin Luther King Junior Avenue to the west, Interstate 95 to the east, W Sunrise Boulevard to the south and Oakland Park Boulevard to the north, was identified. **Figure 16** shows the study area and comparison area included in the property value assessment.

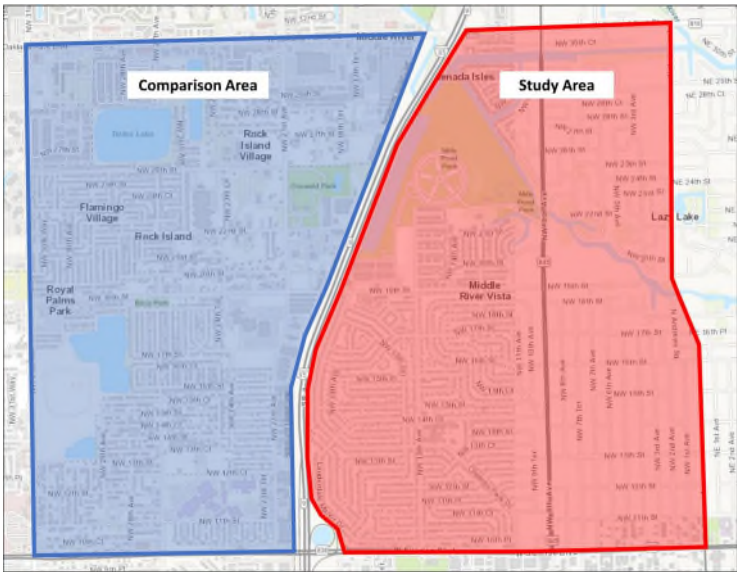


Figure 16 Map of Study Area & Comparison Area

Property values increased in the study area at a higher pace than the comparison area and Broward County as a whole. **Figure 17** illustrates the cumulative percent increase for all residential properties in the study area, the comparison area, and the county.

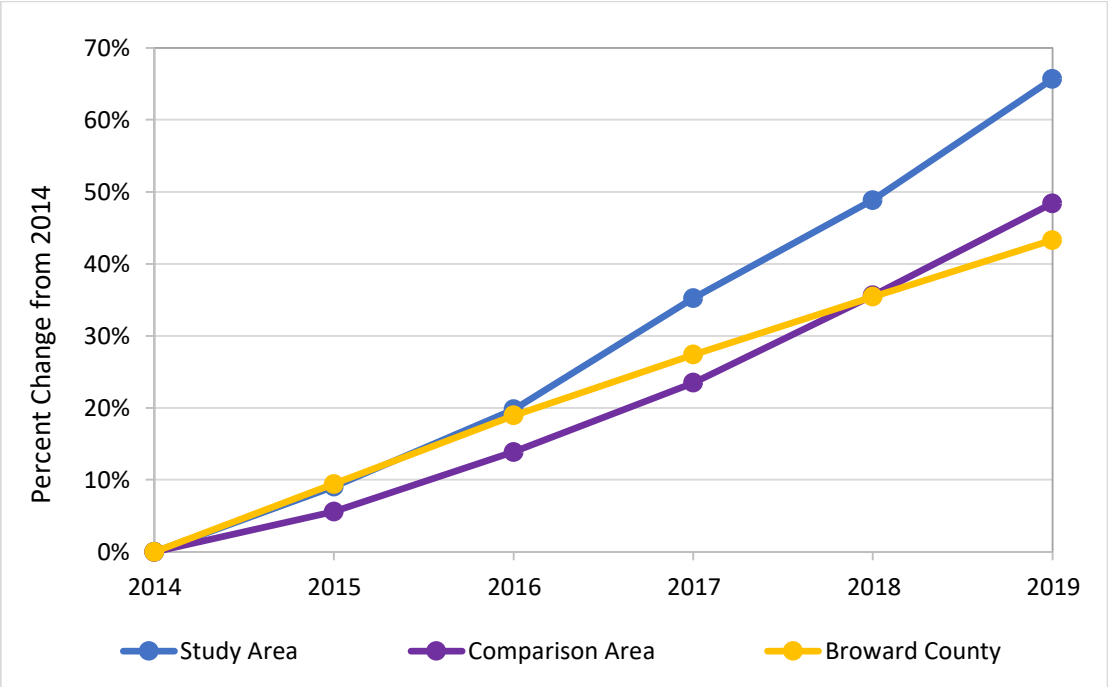


Figure 17 Percent Change of Property Value from 2014

Summary

This effort was conducted to help FDOT better understand how much certain improvement projects impacted mobility and safety conditions along segments of the State Highway System. Quantitative outcomes from this analysis provides information that could help predict how a similar improvement would perform. FDOT System Implementations Office and District 4 were engaged in this study to help identify performance measures to best incapsulate the findings. The measures selected were those that provided the best mobility and safety indicators for pedestrians, automobiles, and bicycles based on data availability.

Despite decreased roadway capacity, the throughput on Powerline Road continued to grow. Furthermore, the adjacent roads did not witness spikes in volumes to accommodate displaced Powerline Road traffic. The new four-lane configuration was able to meet automobile throughput needs. There was only a small decrease in average travel speed from slightly over 27 mph in 2014 to almost 27 mph in 2019. The increase in average travel time was also insignificant – from 4 minutes and 27 seconds in 2014 to 4 minutes 46 seconds in 2019. This lane repurposing project did not adversely affect mobility along Powerline Road.

This project was partially purposed to increase safety conditions along the study segment of Powerline Road. The number of fatalities went from 8 in 2014 to 2 in 2019 and the percentage of injury crashes went from to 31.7% three years before construction to 29.3% two years after construction. These two measures are positive indicators for automobile safety improving as a result of the lane repurposing. The percentage of bicyclist crashes went from 3.2% in 2014 to 1.3% in 2019. Both bicycle and automobile crashes, fatalities, and serious injuries have decreased substantially, which indicates a significant improvement on safety conditions for all users along the corridor.