CTA Bus Slow Zone Study
Final Project Report
CTA Route #79
79th Street

Prepared for:

Chicago Transit Authority

Chicago Department of Transportation

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1 INTRODUCTION

The Chicago Department of Transportation (CDOT) and the Chicago Transit Authority (CTA) have identified the 79th Street corridor as a bus slow zone and are collaborating in an effort to improve CTA bus speed, travel time and reliability along this corridor. See Exhibit A-Project Location Map. The study is funded through a "Community Planning Grant" administered by the Regional Transportation Authority (RTA).

The 79th Street Slow Zone area is an east-west corridor located on the City's south side between Kedzie Avenue-Columbus Avenue and Stony Island Avenue-South Chicago Avenue. The main CTA bus that serves the corridor is the CTA Route #79. See Exhibit B-Bus Route Map The 79th Street Slow Zones include the following six intersections:

1. Kedzie Avenue-Columbus Avenue
2. Ashland Avenue to Paulina Street
3. Halsted Street to Union Avenue
4. Lafayette Avenue-State Street
5. Martin Luther King Drive
6. Stony Island Boulevard-South Chicago Avenue

The stretch of 79^{th} Street that was examined runs from the Ashburn neighborhood, through the following neighborhoods of Auburn, Gresham, Chatham and ends in Avalon Park. The 79^{th} Street and Columbus Avenue/Kedzie Avenue intersection is a three road triangle intersection. All three roads (79^{th}, Columbus and Kedzie) consist of four lanes at this intersection. 79^{th} Street transitions from a four lane road to a two lane road after its intersection with Western Avenue. The intersections of 79^{th} Street and Ashland Avenue, Halsted Street, and Martin Luther King Drive are two lane intersections with parking on 79^{th} Street as well as the cross streets. Halsted Street has an existing bike lane running north and south across 79^{th} Street. The Lafayette Avenue/State Street couplet consists of an overpass over I-94 and a connection to the Red Line CTA station. The study area at Stony Island Avenue consists of a six-legged intersection of 79^{th} Street, South Chicago Avenue, and Stony Island Avenue. Bike lanes run north-west and south-east along South Chicago Avenue.

The 79^{th} Street Slow Zone study area is in the southern part of the City of Chicago. The #79 CTA bus serves the 79^{th} Street from the Lake Michigan Lakefront to the Cicero Avenue. At Cicero Avenue, the #79 proceeds north and serves the Ford City Mall at 76^{th} Street before it returns south to 79^{th} Street.

Prior to the Proposed Conditions Report, an Existing Conditions Memorandum was developed to describe the data collection methodology, and the physical, travel, socioeconomic and land use characteristics of the subject corridor. The Existing Conditions Memorandum included a crash history summary for the five-year period from 2010-2014 and traffic analyses for the project areas to aid in determining deficiencies and potential causes for the slowdown of CTA buses in the project area. This report provides recommendations, at the planning level, based on engineering analysis of potential solutions, developed from issues identified in the Existing Conditions Memorandum, to improve the progression of CTA transit buses. This report also provides recommendations for infrastructure improvements along the corridor including traffic signal optimization, intersection and corridor geometric design modifications, and the implementation of modern technology. The analyses compare existing and proposed conditions for the year 2040 based on projected traffic volumes and use using delay and level of service as quantitative measures of effectiveness (MOE).

2 DATA COLLECTION

The study team made a comprehensive effort to collect the data necessary to complete this CTA Bus Slow Zone Memorandum. The data collected for this memorandum included: traffic (vehicle, pedestrian and bicycle) volume data, existing traffic signal timing sheets, field observations, socioeconomic and land use data, and crash data.

The traffic volume data for the Synchro analysis was compiled from various sources. Recent traffic counts (2010 or newer) were either obtained from previous studies completed by the study teams, or conducted in 2017 for the bus slow zone study.

Existing traffic signal timings at each of the intersections were provided by CDOT. The implementation dates of each of the intersection traffic signal timings are shown in the table below.

Table 1: Existing Signal Timing Implementation Dates

Location	Date
79th - Columbus	11/22/2011
79th - Kedzie	4/29/2015
Kedzie - Columbus	11/22/2011
79th - Ashland	11/7/2015
79th - Halsted	5/3/2010
79th - Lafayette	3/1/2012
79th - State	5/11/2011
79th - King	1/10/2011
79th - Stony Island - South Chicago	3/29/2006

Field observations were conducted at all the intersections in the study area between May 31st and June 7th of 2017. Field observations for the physical characteristics were conducted during the off-peak hours and field observations for the travel characteristics were conducted during the weekday peak periods.

Land use and demographic (population, the number of households and employment) information was provided by the Chicago Metropolitan Agency for Planning (CMAP), and were filtered to the areas surrounding the study area. CMAP used the Chicago Community Area census data and land use inventory for Northeast Illinois to develop the 2040 demographic and land use forecasts, respectfully. These forecasts are based on mathematical modeling techniques that use current population and land use trends to model how the distribution of population and employment would change in response to different planning strategies.

Five years (2010-2014) of crash data for the study area was provided by CDOT. The analyzed data includes date, time, driving direction, weather, roadway surface type, crash severity based on the type of injuries/deaths, crash type, and lighting condition. Crash data was provided in the form of Excel spreadsheets where each crash was categorized by the above-mentioned criteria.

3 EXISTING CONDITIONS

3.1 Physical Characteristics

79th Street is an urban roadway facility and is functionally classified as a Minor Arterial. Between Columbus Avenue and Western Avenue, 79th Street is a four-lane roadway with a raised center median. Between Western Avenue and Stony Island Avenue, it is primarily a two-lane roadway. Both stretches include street lighting, sidewalks, and curb and gutters.

Access to the CTA Red Line is provided at the I-94 interchange of Lafayette Avenue and State Street. There are numerous CTA bus connections and a high pedestrian traffic at this location. Between Columbus Drive and Western Avenue, 79th Street borders the Norfolk Southern rail yard. Between Western Avenue and Stony Island Avenue, land use is commercial and residential.

The site visits in the study areas along 79th Street consisted of checking the following parameters:

1. Lane widths and lane configuration
2. Existing traffic signal heads
3. Bus stop locations
4. Accessibility of sidewalk ramps
5. Signage for parking, standing and loading zones

Key findings of the physical characteristics of each of the studied intersections along 79th Street are summarized below:

3.1.1 Kedzie Avenue / Columbus Avenue

Figure 1: Southwest Corner of 79th - Kedzie Bus Stop and Shelter

Kedzie Avenue and Columbus Avenue intersect at three closely spaced intersections forming a complex triangle. Kedzie Avenue is a four-lane north-south roadway; Columbus Avenue is a four-lane northeast-southwest roadway; and 79th Street is a four-lane east-west roadway. Both Kedzie Avenue and Columbus Avenue are functionally classified as Minor Arterials. The bus stops of concern are located near-side in each direction (eastbound and westbound) of both intersections of 79th Street and Columbus Avenue, and

79th Street and Kedzie Avenue. Bus shelters are located at the two bus stops at 79th Street and Kedzie Avenue. See exhibits C-1 and C-2 for detailed physical characteristics.

3.1.2 Ashland Avenue to Paulina Street

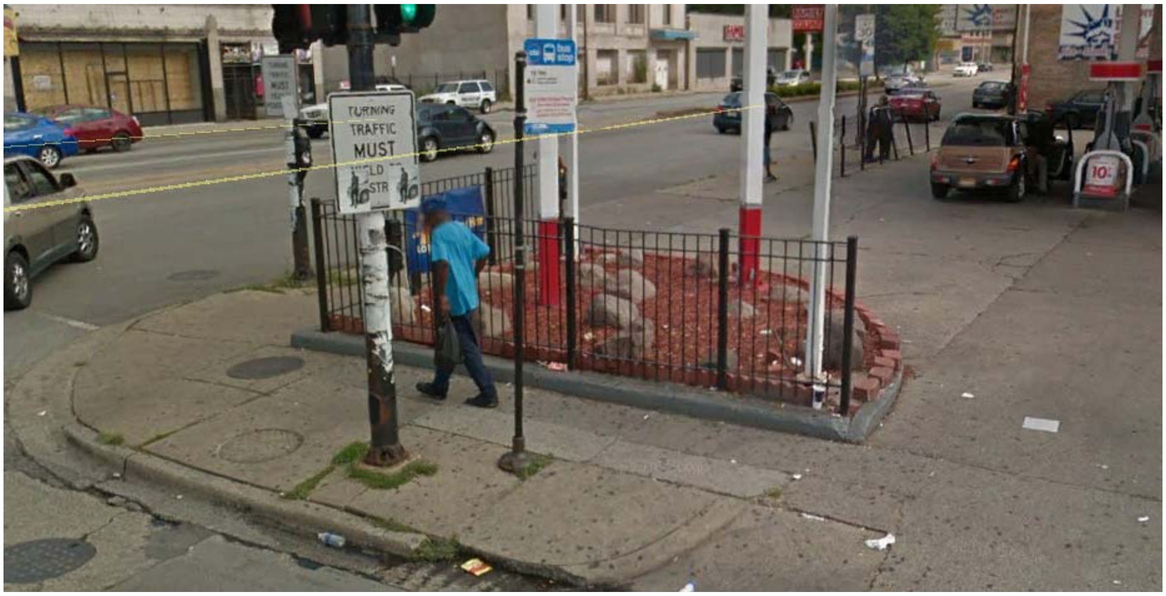

Figure 2: Southwest Corner of 79th - Ashland Bus Stop

Ashland Avenue is a four-lane roadway, Paulina Street is a one-lane roadway (one-way northbound south of 79th Street and one-way southbound north of 79th Street) and 79th Street is a two-lane roadway. Ashland Avenue has a functional classification of a Minor Arterial and Paulina Street is a local roadway. The bus stops of concern at Ashland Avenue are located near-side. The eastbound near-side bus stop on the southwest corner has a 4-inch curb that is deteriorating and needs to be replaced. The bus stop area is also very small due to the driveway from the gas station. Paulina Street is a stop-controlled intersection at 79th Street. See exhibit C-3 for detailed physical characteristics.

3.1.3 Halsted Street to Union Avenue

Halsted Street and 79th Street are both two-lane roadways. Union Avenue is a one-lane northbound local roadway. Halsted Street has a functional classification of a Minor Arterial. The bus stops of concern at Halsted Street are near-side for the eastbound traffic and far-side for the westbound traffic. Union Avenue is a stop-controlled intersection at 79th Street. The stop controlled intersection causes delays to all traffic and causing queuing on 79th Street in the eastbound and westbound direction. The delay caused to the buses is a concern at the intersection. See exhibit C-4 for detailed physical characteristics.

Figure 3: Northwest Corner of 79th - Halsted Bus Stop

3.1.4 Lafayette Avenue – State Street

Figure 4: North Curb Bus Stop between Lafayette and State

79th Street, Lafayette Avenue and State Street create the 79th Street Interchange with the I-94 Expressway and the CTA Red Line station forms a major transportation hub at this location. State Street is a one-way 3-lane northbound roadway; Lafayette Avenue is one-way 3-lane southbound roadway; and 79th Street is a four-lane east-west roadway. The westbound bus stops of concern are located far-side at Lafayette Avenue and midblock between Lafayette Avenue and State Street. The westbound far-side bus stop at Lafayette has a shelter. The eastbound bus stops of concern are located midblock between Lafayette Avenue and State Street and near-side at State Street. See exhibit C-5 for detailed physical characteristics.

3.1.5 Martin Luther King Drive

Figure 5: Northeast Corner 79th - King Bus Stop

King Drive and 79th Street are both two-lane roadways. King Drive has the functional classification of a Major Collector. The bus stops of concern are located near-side for westbound traffic and far-side for eastbound traffic. See exhibit C-6 for the detailed physical characteristics.

3.1.6 South Chicago Avenue / Stony Island Avenue

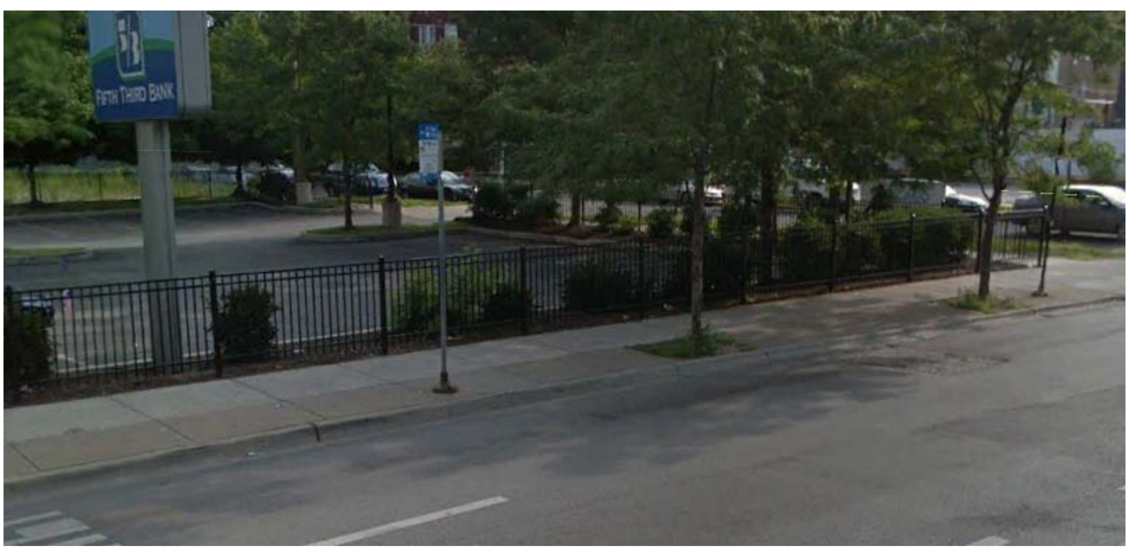

Figure 6: Northeast Corner Stony Island - South Chicago - 79th Bus Stop

South Chicago Avenue, Stony Island Avenue and 79th Street create a six-legged intersection that is larger than a typical intersection. South Chicago Avenue is a four-lane northwest-southeast roadway; Stony Island Avenue is north-south roadway (eight lanes north of the intersection and six-lanes south of the intersection); and 79th Street is a two-lane east-west roadway. South Chicago Avenue is functionally classified as a Major Collector and Stony Island Avenue is functionally classified as an Other Principal Arterial. Ramps to I-90 (Chicago Skyway) connect to Stony Island Avenue south of the intersection and the columns supporting the elevated ramps passing over the intersection impact sight distances. The bus stops of concern are located near-side and far-side for both eastbound and westbound traffic. See exhibits C-7 and C-8 for more detailed physical characteristics.

3.2 Travel Characteristics

The study team conducted field visits at the study areas along 79th Street during the AM peak (7am – 9am) and the PM Peak (4pm – 6pm), and quantified the following every 15 minutes:

1. Wheelchair ramp deployments – number of times buses were required to use wheelchair ramp for disabled passengers during every period
2. Pickups – number of times pedestrians were picked up by non-CTA vehicles during every period
3. Drop offs – number of times pedestrians were dropped off by non-CTA vehicles during every period
4. Parking usage – number of non-CTA vehicles using curbside parking at the end of every period
5. Loading frequency – number of trucks completing loading during every period
6. Queue lengths – length of queue for approach at the end of every period

During the field visits, the study team also observed the following qualitative parameters:

1. Traffic flow characteristics
2. Infrastructure/street furniture
3. Parking/loading/pick-up/drop-off usage activity
4. CTA bus operations and ridership
5. Intersection operations

The key findings of both the quantitative and qualitative parameters are summarized below:

3.2.1 Kedzie Avenue / Columbus Avenue

The study team observed that most westbound bus riders alighted at the bus stop on northeast corner of 79th Street and Kedzie Avenue, and crossed Kedzie Avenue. However, the westbound bus stop at Columbus Avenue is also used by passengers. The two closely spaced bus stops cause delay to the buses. Westbound CTA buses also experienced delay at Columbus Avenue.

The eastbound bus stop is located within the right turn lane at Kedzie Avenue. This is not an ideal location for the bus stop since the roadway reduces in width east of the intersection due to the presence of a railroad bridge. Eastbound buses were seen frequently lowering the bus for non-disabled passengers.

The closely spaced intersections have operational challenges although certain turning movements are prohibited. PM peak period queue lengths were longer than the AM peak period queue lengths on 79th Street at Kedzie Avenue. The study team observed westbound traffic delayed at Columbus Avenue traffic signal.

Eastbound to northbound left turns were observed completing the movement prohibited at 79th Street and Kedzie Avenue. The study team observed infrequent parking usage on both the north and south curbs of 79th Street. See exhibit D-1 for more detailed travel characteristics.

3.2.2 Ashland Avenue to Paulina Street

Buses frequently bunched in both eastbound and westbound directions. Paulina Street is a stop-controlled intersection at 79th Street. The stop controlled intersection causes delays to all traffic and causing queuing on 79th Street in the eastbound and westbound direction. The delay caused to the buses is a concern at the intersection. The study team observed that eastbound CTA buses were delayed at Paulina Street. Passenger vehicles were moving in front of CTA buses and blocking their entrance back into traffic.

The PM peak period queue lengths were longer than the AM peak period queue lengths. In particular, the eastbound traffic had an average queue of 255 feet and reached the Marshfield Avenue intersection.

Parking usage was infrequent on the north curb, but typically ranged between 7 and 13 vehicles on the south curb along 79th Street. Pavement at the intersection and along 79th Street is in poor condition. The pavement marking at intersection is also in poor condition. Sidewalk near the southwest bus stop is in poor condition as well. See exhibit D-2 for more detailed travel characteristics.

3.2.3 Halsted Street to Union Avenue

The upstream stop sign at Union Avenue caused significant delay for westbound buses. Westbound and eastbound buses bunched frequently. Passenger vehicles frequently parked on south curb between Halsted Street and Emerald Avenue to go to restaurant for carry outs.

Besides some minimal parking usage on 79th Street between Peoria Street and Union Avenue during the PM peak period (ranged from 2-8 vehicles), there were no other significant passenger vehicle curbside activities. The pavement marking at intersection is also in poor condition. See exhibit D-3 for more detailed travel characteristics.

3.2.4 Lafayette Avenue – State Street

Both the north and south curbs on 79th experienced a significant number of drop offs during the AM and PM peaks. However, the drop offs did not appear to slow down bus operations. Long queue lengths were observed for westbound traffic at State Street due to the significant number of right turning vehicles and pedestrians crossing the north leg. These queues did slow down westbound CTA buses, especially during the AM peak period.

Pavement markings are extremely worn between Lafayette Avenue and State Street. Drivers were observed using the bus lane as a through lane. Eastbound bus delays were caused by non-CTA vehicle drop-offs and Chicago Police Department Transit Police vehicles parked in the bus lanes. CTA buses frequently bunched together at the midblock bus stops. This caused delay and confusion for boarding passengers, as most would try to board the first bus nearest the bus stop (often crowded) and others would walk to the other bus. CTA buses would often stand still for several minutes after loading. Significant volumes of pedestrians were also observed using the south leg crosswalk of Lafayette Avenue. However, these pedestrians did not significantly delay eastbound to southbound right turning vehicles and negatively impact eastbound CTA buses. See exhibit D-4 for more detailed travel characteristics.

3.2.5 Martin Luther King Drive

The parking usage varied between 10 and 12 vehicles on the south curb of 79th Street for the PM peak period. Free parking between Calumet Avenue and King Drive occasionally delayed eastbound buses on 79th Street. There were no other significant passenger vehicle curbside activities.

Average westbound queue lengths at King Drive were both slightly under 100 feet. The study team observed that the signal timing controller was incorrectly using the ALL OTHER TIMES signal timing instead of the peak period specific timings. This resulted in excess green being given to north-south traffic on King Drive that could be used for additional green time on 79th Street. See exhibit D-5 for more detailed travel characteristics.

3.2.6 South Chicago Avenue / Stony Island Avenue

This is a complex intersection with six approaches that has operational difficulties. Eastbound buses were frequently stopped by the signal at Stony Island-South Chicago. The westbound bus stop is located within the right turn taper.

There was very little passenger vehicle curbside activity near the intersection. The westbound queue lengths were longer for the PM peak period than the AM peak period. There were insufficient gaps for westbound to southbound left turn vehicles, and the queue consistently built up beyond storage. Similarly, there was a lack of sufficient gaps for the eastbound to northbound left turn vehicles and the queue consistently built up beyond storage space as well. See exhibit D-6 for more detailed travel characteristics.

3.3 Bus Ridership and Travel Times

The Chicago Transit Authority (CTA) provided arrival and departure time data and ridership data for the locations included in this study. Arrival and departure time data was provided for May 24th 2016 and ridership data was provided for weekdays during October 2016.

The arrival and departure time data was used to develop bus speeds through the slow zone as well as speeds along 79th Street between the slow zones. This data confirmed that buses running through the CTA selected slow zones were indeed running at a slower speed when compared to the speeds between the slow zones. Speeds for the eastern three locations (Red Line Station, King Drive, and Stony Island Avenue) were less than the western three locations (Halsted Street, Ashland Avenue, and Columbus Avenue/Kedzie Avenue), possibly due to an increase in passengers boarding and alighting. Boarding at alighting at the eastern three stops was more than double that of the western three intersections. Dwell time was roughly correlated with the number of passengers boarding and alighting at each stop. The location of the stop, near-side vs far-side, did not have a major impact on the dwell time.

Ridership data provided insight into the usage of route #79 buses. As anticipated, boarding and alighting counts were highest at the Red Line Station, a major CTA ‘L’ Train connection. Other insights include larger boarding volumes when traveling towards the Red Line Station, and larger alighting volumes when traveling away from the Red Line Station. This occurs in both directions and suggests that the one of the major uses of the Route #79 buses is for access to the ‘L’ Train. Volumes for boarding and alighting in the eastbound and westbound direction show some correlation suggesting that the Route #79 bus passengers are returning to their AM departure stop in the PM.

Table 2: Eastbound 79th Street Travel Speeds, Dwell Times, Boarding and Alighting

	Average Speed through Slow Zone (MPH)	Minimum Speed through Slow Zone (MPH)	Maximum Speed through Slow Zone (MPH)	Average Dwell Time (Sec)	Average Peak Boarding (2 hrs)	Average Peak Alighting (2 hrs)	Average Speed Between Slow Zones (MPH)	Intersecting Bus Route
	Columbus/Kedzie – Near-side (Columbus to Albany)							
EB AM	5.8	4	15	24	39	5	9.6	Kedzie Ave 52A
EB PM	6.7	4	23	14	34	14	8.9	
	Ashland – Near-side (Paulina to Laflin)							
EB AM	6.21	4	12	37	136	43	9.0	Ashland Ave 9 & 9A
EB PM	5.5	4	13	54	116	59	8.8	
	Halsted – Near-side (Peoria to Union)							
EB AM	7.2	5	10	24	93	71	10.9	Halsted St 8
EB PM	6.2	4	9	35	89	84	8.0	
	Red Line Station – Mid-block (Perry to Wabash)							
EB AM	4.1	3	6	62	255	342	8.6	Lafayette St-State St 25 & 79
EB PM	3.0	2	6	99	491	159	8.7	
	King Drive – Near-side (Calumet to Eberhart)							
EB AM	5.2	4	9	24	51	75	11.1	MLK Drive 3
EB PM	5.5	3	8	29	65	80	8.4	
	Stony Island – Far-side (Anthony to East End)							
EB AM	3.4	2	6	2	35	90	N/A	Stony Island Ave 28
EB PM	3.4	2	10	6	47	79	N/A	

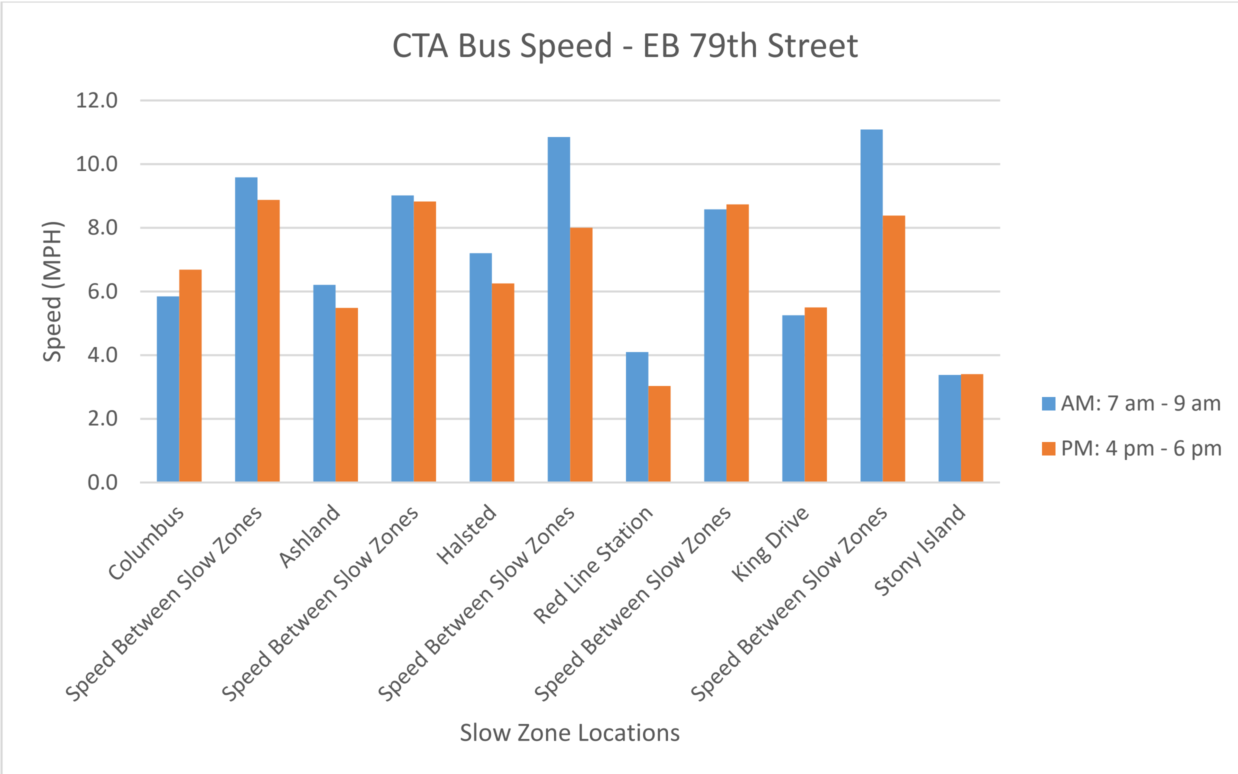

Figure 7: Eastbound 79th Street Bus Speed

Table 3: Westbound 79th Street Travel Speeds, Dwell Times, Boarding and Alighting

	Average Speed through Slow Zone (MPH)	Minimum Speed through Slow Zone (MPH)	Maximum Speed through Slow Zone (MPH)	Average Dwell Time (Sec)	Average Peak Boarding (2 hrs)	Average Peak Alighting (2 hrs)	Average Speed Between Slow Zones (MPH)	Intersecting Bus Route
	Stony Island – Far-side (East End to Anthony)							
WB AM	5.6	4	14	11	45	19	9.7	Kedzie Ave 52A
WB PM	4.6	3	7	25	73	18	9.3	
	King Drive – Near-side (Eberhart to Calumet)							
WB AM	5.45	4	11	19	83	82	11.0	Ashland Ave 9 & 9A
WB PM	5.4	3	10	15	55	51	9.5	
	Red Line Station – Mid-block (Wabash to Perry)							
WB AM	4.8	3	12	40	220	483	10.2	Halsted St 8
WB PM	4.8	2	15	54	387	222	9.2	
	Halsted – Far-side (Union to Peoria)							
WB AM	7.2	4	11	27	79	69	10.5	Lafayette St-State St 25 & 79
WB PM	4.0	2	9	62	82	86	9.1	
	Ashland – Near-side (Laflin to Paulina)							
WB AM	7.0	5	11	21	46	103	9.7	MLK Drive 3
WB PM	5.7	3	9	30	41	129	9.0	
	Columbus/Kedzie – Near-side (Albany to Columbus)							
WB AM	7.4	4	21	20	11	25	N/A	Stony Island Ave 28
WB PM	6.8	5	17	27	4	24	N/A	

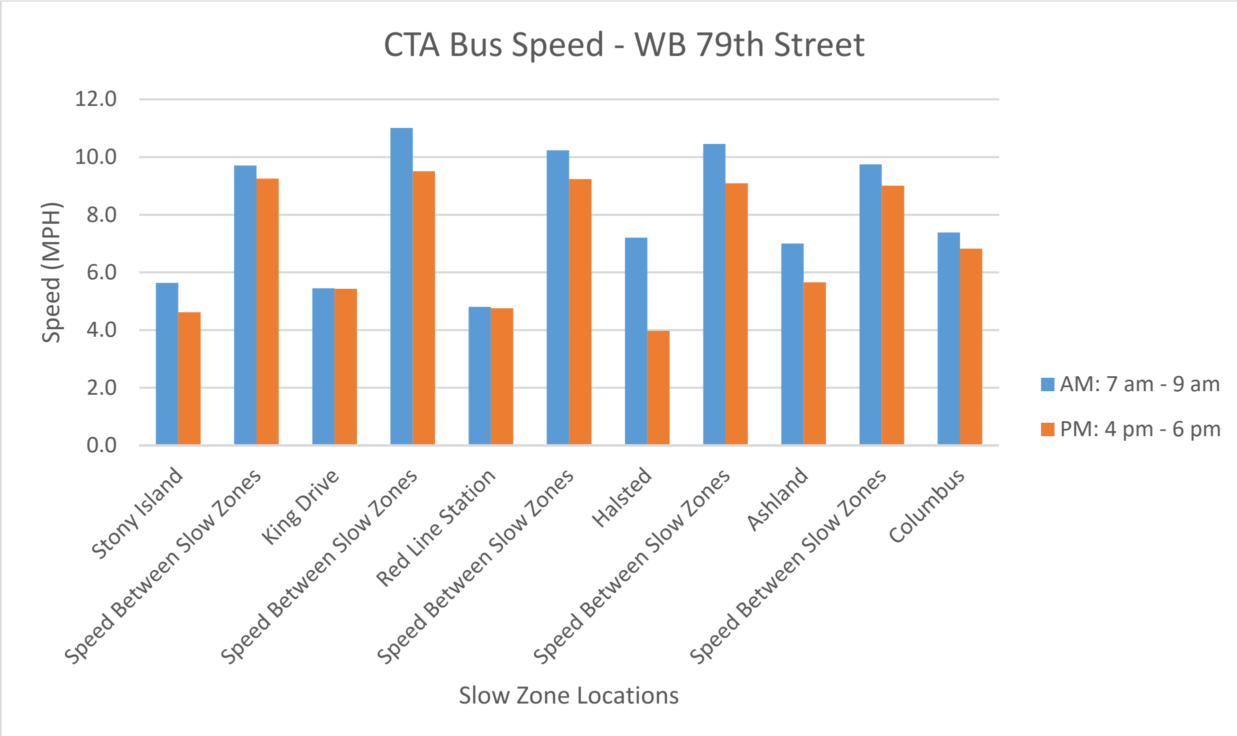

Figure 8: Westbound 79th Street Bus Speed

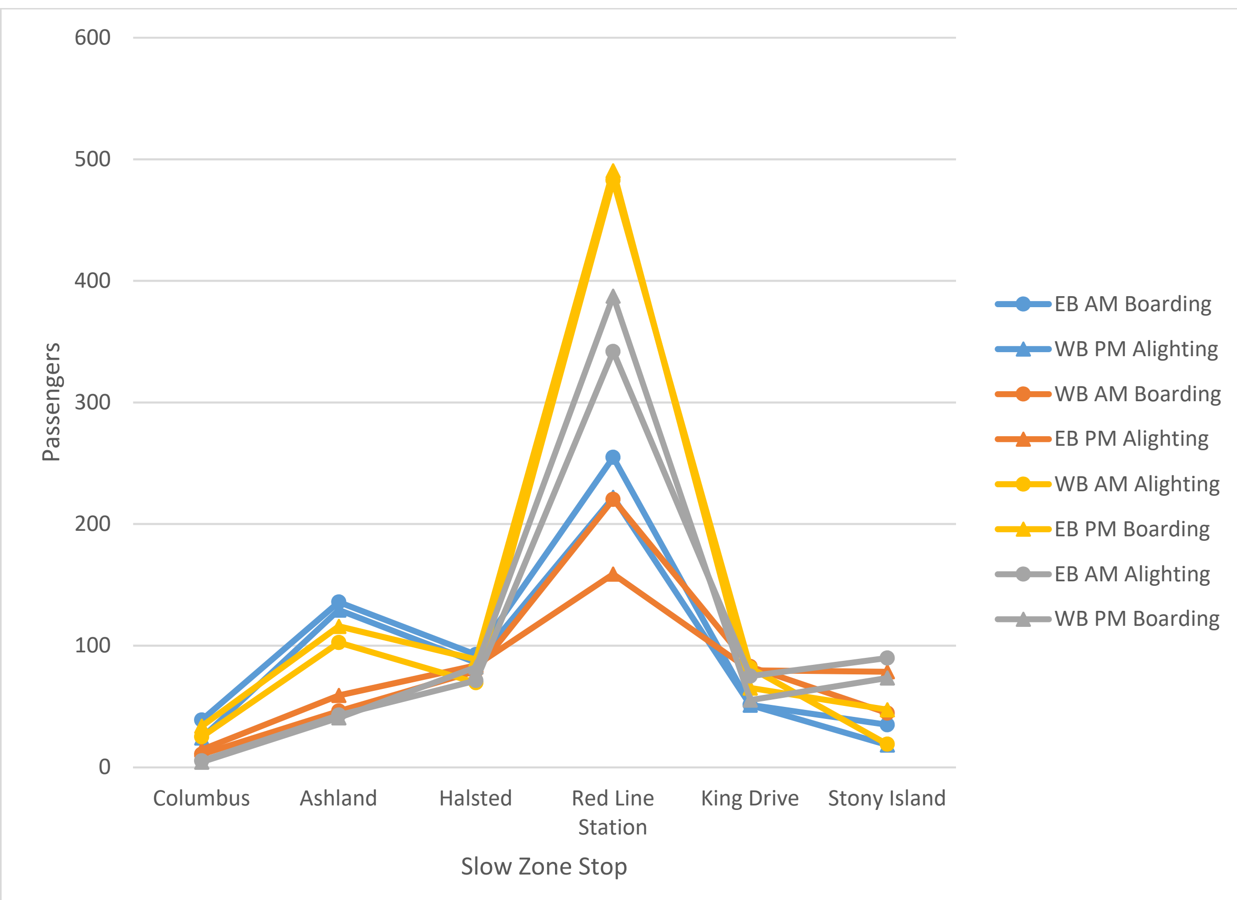

Figure 9: 79th Street Boarding and Alighting

4 SOCIOECONOMIC AND LAND USE CHARACTERISTICS

The three built-environment characteristics that most influence travel behavior are population, employment and land use. Trends in population, employment, housing, socioeconomic factors provide a window into understanding growth and to help to characterize the study areas. Because a transportation network can influence where people live and work, existing and future socioeconomic factors are identified to address changing commuting patterns and habits of the area. Effectively integrating land use and socioeconomic factors help to define and shape priorities for a transportation system and help to ensure that land use, development patterns, transportation facilities and transportation services support and reinforce each other. See exhibit E for the socioeconomic and land use map exhibits.

4.1 Socioeconomic

Population and demographic trends have a significant impact on communities, where and how people chooses to live, and where they work and play. It can shed light on areas where future housing and employment might take place within a community so that transportation services can be adjusted to future travel needs of the communities it serves.

In order to evaluate and recommend improvements for Bus Slow Zone corridors, it is important to understand the connections between the corridor and its surroundings in terms of the ways in which people travel around the corridor area and how they utilize the broader transportation network to access employment centers and other local attractions.

Currently, 79th Street is primarily a residential corridor at the six intersections reviewed. There is a wide range in population density within the corridor, with population increasing towards the east end of the corridor. By 2040, population is projected to rise modestly throughout the corridor. There are few employment centers within the corridor area and the greatest concentration of these centers is found at the eastern end. However, by 2040, employment is projected to increase by over 200% in the area surrounding the Kedzie Avenue-Columbus Avenue triangle while modest gains of 4.4%, 12.4%, and 7.9% are found at the Lafayette Avenue/State Street roadway couplet, at the King Drive intersection and at the South Chicago Avenue-Stony Island Boulevard, respectively. However, the percentage change reflects a small number of actual jobs. See Table 4 showing current and 2040 population, household and employment statistics for each of the study intersections.

Table 4: Percent Change in Socioeconomic Forecasts

79th Street Intersection Location	Population		% Change	Households		% Change	Employment		% Change
	YR 2010	YR 2040		YR 2010	YR 2040		YR 2010	YR 2040	
Kedzie-Columbus	5,132	5,594	9.00%	1,506	1,641	9.00%	479	1,547	222.90%
Ashland	17,374	17,842	2.70%	6,428	6,597	2.60%	682	858	25.80%
Halsted	13,577	15,246	12.30%	4,909	5,489	11.80%	868	1,248	43.80%
Lafayette-State	9,006	10,504	16.60%	3,875	4,506	16.30%	986	1,030	4.40%
King	14,811	16,471	11.20%	6,590	7,318	11.10%	1,084	1,219	12.40%
South Chicago-Stony Island	9,938	11,469	15.40%	3,874	4,551	17.50%	2,451	2,645	7.90%

4.2 Land Use

The land use mix near the Kedzie Avenue-Columbus Avenue triangle on 79th Street is comprised of residential (49%), industrial (11%) and institutional (10%) and to a lesser extent commercial (4%) parcels with 6% of the parcels vacant. However, 20% of the area is zoned as transportation/communication/ utilities or roadway right-of-way. Land use mix near the Paulina Street to Ashland Avenue segment is residential (62%) and to a lesser extent for commercial (7%), institutional (6%) while approximately 18% for transportation/communications/utilities and roadway ROW and 4% vacant with 3% either recreational or industrial. Land use mix near the Halsted Street intersection is residential (61%), commercial (7.0%) and institutional (8%), industrial (4%) with approximately 13% of the parcels vacant and the remaining 7% distributed between recreational, and transportation/communication/utilities.

The Lafayette Avenue/State Street roadway couplet on 79th Street fronts the Dan Ryan Expressway. The land use mix in the area surrounding this couplet is residential (60%), and transportation/ communications/utilities (22%) due to the Dan Ryan footprint and the CTA tracks between Lafayette Avenue and State Street, commercial (7%) with 11% distributed between roadway right-of-way, recreational, industrial, institutional or vacant parcels.

Land use near the 79th Street and Martin Luther King Drive intersection includes primarily residential parcels (87%) and a smaller portion for commercial (8%) and institutional (4%) with approximately 1% of the parcels vacant. Land use near the Chicago Avenue-Stony Island Avenue triangle is comprised of residential (52%), commercial (9%) and institutional (6%) parcels with 9% or the parcels vacant. With the close proximity to the Chicago Skyway, the railroad corridor is 13% transportation/communication/ utilities, 10% roadway ROW and 1% distributed between recreational and industrial parcels.

5 CRASH ANALYSIS

The crash data for the study area intersections were tabulated into analysis tables depicting crash rate, crash types, injury severity, fatalities, road surface conditions, lighting conditions, and weather conditions. The primary collision types are described in Table 5.

Table 5: Collision Type Descriptions

Collision Type	Description
Rear End	Both vehicles are traveling in same direction on same route. Lead vehicle may be going straight or turning. Lead vehicle is hit from behind by following vehicle.
Sideswipe, Same Direction	Vehicles traveling in same direction on same route, usually caused by a lane change or swerving maneuver.
Sideswipe, Opposite Direction	Vehicles traveling in opposite direction on same route (approaching each other). Usually caused by a lane change or swerving maneuver, crossing the median, if applicable.
Fixed Object	Vehicle hits a fixed object such as a median barrier, bridge pier, light pole, or tree.
Other Object	Vehicle hits an object in roadway such as material that has fallen from a lead vehicle or from an overhead structure.
Head On	Vehicle traveling in opposite direction on same route (approaching each other) and collide head on.
Overturn	Driver lost control of vehicle resulting in the vehicle overturning within or adjacent to the roadway, without hitting another vehicle or object first.
Parked Vehicle	Vehicle traveling in roadway hits a parked vehicle within or to the side of the roadway.
Animal	Vehicle traveling in roadway hits an animal crossing the roadway.
Right Angle	Vehicles traveling along crossing routes crash at right angle even if one vehicle was making a left or right turn.
Left Turn	Vehicles traveling in opposite directions on same route (approaching each other) with one vehicle turning left to the crossing route or driveway, or by a vehicle making a U-turn within a route segment.
Pedestrian	Any crash involving a vehicle traveling along the route and a pedestrian.
Bicyclist (Pedal Cyclist)	Any crash involving a vehicle traveling along the route and a bicyclist.
Other Non-Collision	Any crash resulting from conditions not described by other collision types, such as a vehicle running off the roadway into an embankment.

Crash severity is a key indicator in evaluating the current safety condition of the route. Understanding the severity of injuries allows the implementation of appropriate countermeasures to reduce the severity of crashes in the future. Table 6 depicts the crash severity categories.

Table 6: Crash Severity Descriptions

Severity	Description
Fatal	A crash in which at least one person dies within 30 days of the crash as a result of injuries sustained during the crash.
Type A (Incapacitating Injury)	Any injury, other than fatal, that prevents the injured person from walking, driving, or normally continuing the activities he/she was capable of performing before the injury occurred. Includes: severe lacerations, broken/distorted limbs, skull injuries, chest injuries and abdominal injuries.
Type B (Non-incapacitating Injury)	Any injury, other than a fatal or incapacitating injury, that is evident to observers at the scene of the crash. Includes: lumps on the head, abrasions, bruises, and minor lacerations.
Type C (Reported, injury not evident)	Any injury reported or claimed that is not listed above. Includes: momentary unconsciousness, claims of injuries not evident, limping, complaints of pain, nausea.
Property Damage	No injuries or fatalities, but damage is caused to either vehicle or other objects.

A total of 1,618 crashes occurred at the six study intersections over the five-year study period (2010-2014), with 355 (21.9%) occurring in 2010, 318 (19.7%) in 2011, 304 (18.8%) in 2012, 300 (18.5%) in 2013, and 341 (21.1%) in 2014. A graphical representation of the major crash types for the five-year period is depicted in Figure 10. Table 7 displays the break-down of injury crashes along 79th Street for the year 2010-2014.

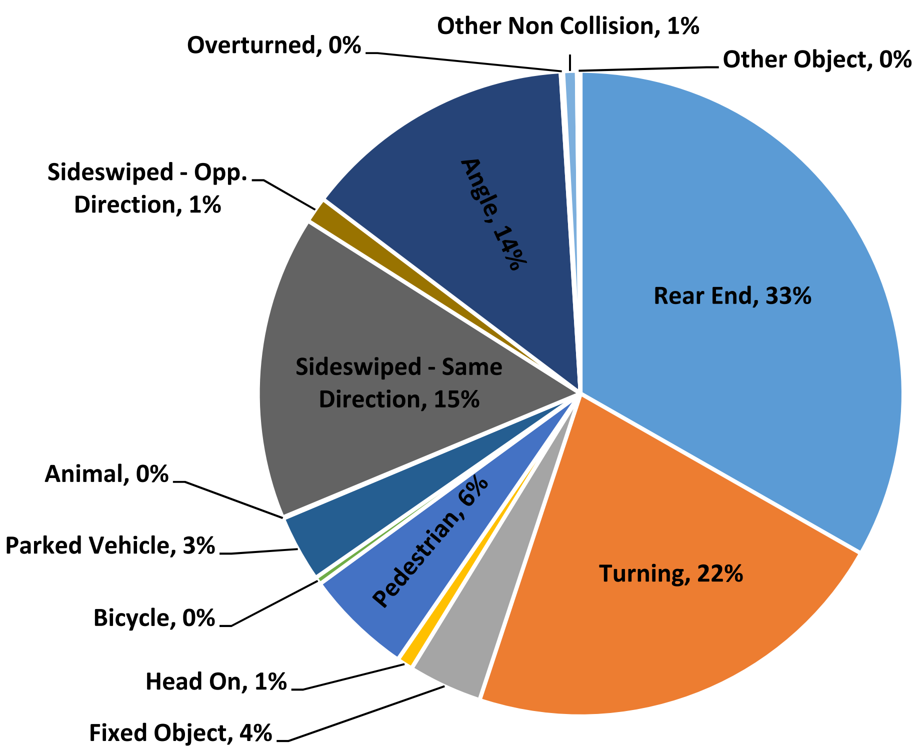

Figure 10: Total Crashes for the 79th Street Study Area 2010-2014

Table 7: Injury Crashes 2010-2014

Type of Injury Crash	2010	2011	2012	2013	2014	Total	Percentage of Total Crashes
Fatal Crashes	0	0	2	0	2	4	0.2
Type A Injury Crashes	7	5	10	7	13	42	2.6
Type B Injury Crashes	41	41	37	42	33	194	12.0
Type C Injury Crashes	39	31	35	29	43	177	10.9
Total Injury Crashes	**87**	**77**	**84**	**78**	**91**	**417**	**25.8**

5.1.1 Kedzie Avenue / Columbus Avenue

During the five-year analysis period, a total of 365 crashes occurred at the intersection of 79th Street and Columbus Avenue/Kedzie Avenue. Figure 11 below shows the number crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

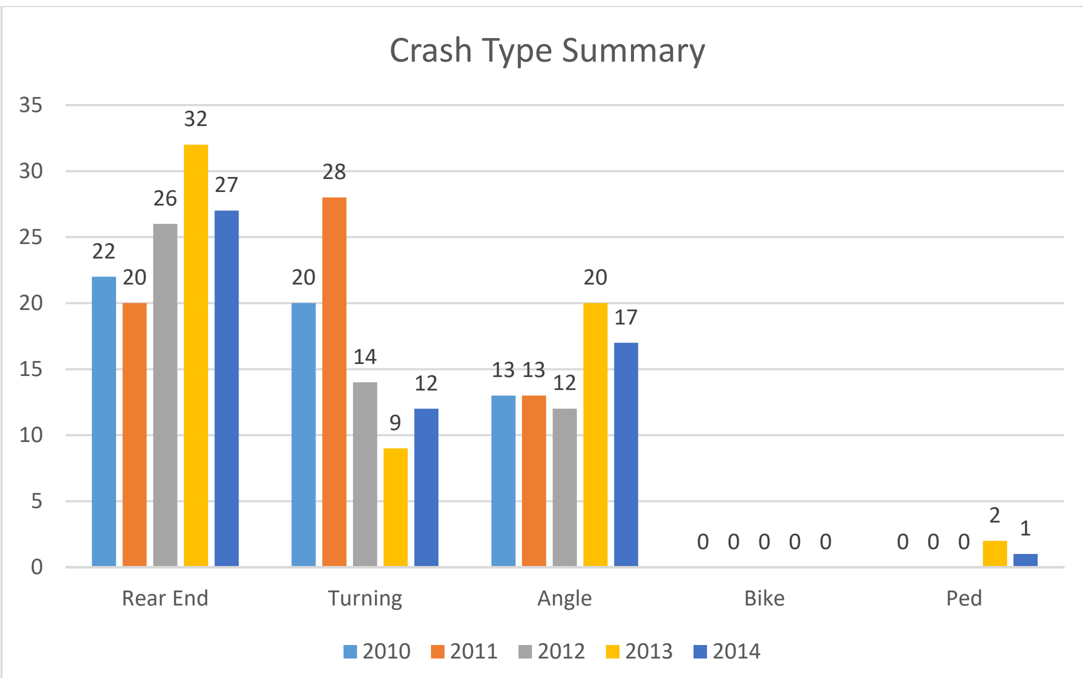

Figure 11: Crash Type Summary for Kedzie Avenue / Columbus Avenue

The most prevalent crash types were Rear End, Turning, and Angle collisions which accounted for 35 percent, 23 percent, and 21 percent of the total crashes reported, respectively. Of the 365 crashes, 80 of them involved injuries of Type B or C severity. There was 1 fatal crash and 14 crashes that resulted in Type A injuries.

5.1.2 Ashland Avenue

During the five-year analysis period, a total of 155 crashes occurred at the intersection of 79th Street and Ashland Avenue. Figure 12 below shows the number crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

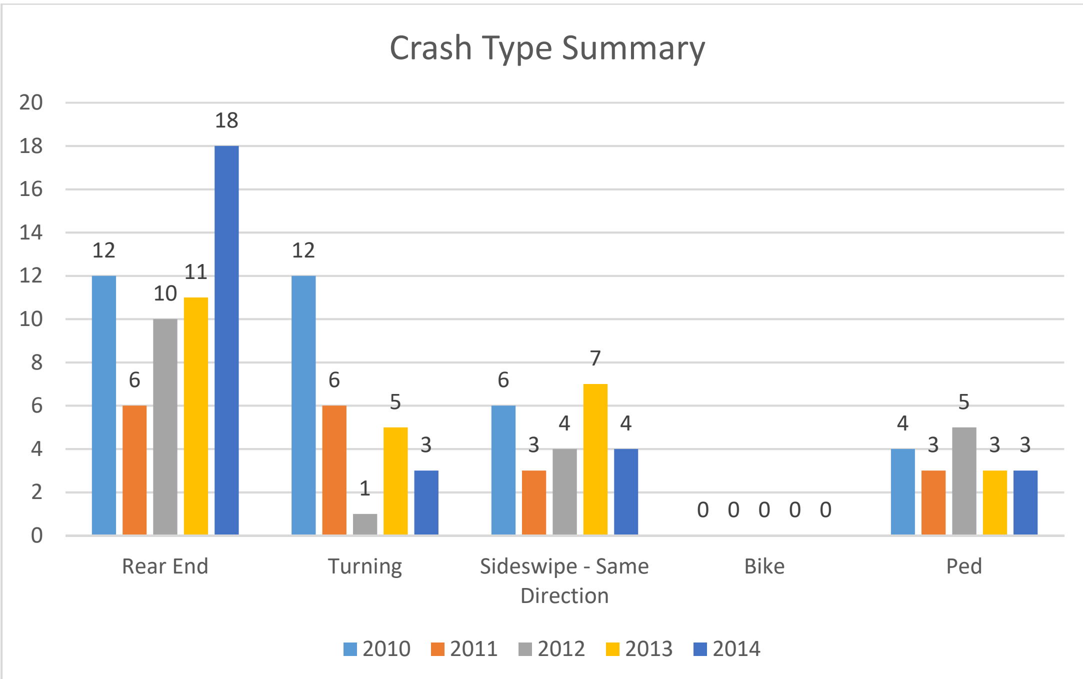

Figure 12: Crash Type Summary for Ashland Avenue

The most prevalent crash types were Rear-End, Turning, and Sideswipe – Same Direction, which accounted for 37 percent, 17 percent, and 16 percent of the total crashes respectively, respectively. Of these 155 crashes, 43 collisions involved injuries of Type B or Type C severity. There were 3 crashes resulting in Type A injury and no crashes resulting in a fatality.

5.1.3 Halsted Street

During the five-year analysis period, a total of 194 crashes occurred at the 79th Street and Halsted Street intersection. Figure 13 below shows the number of crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

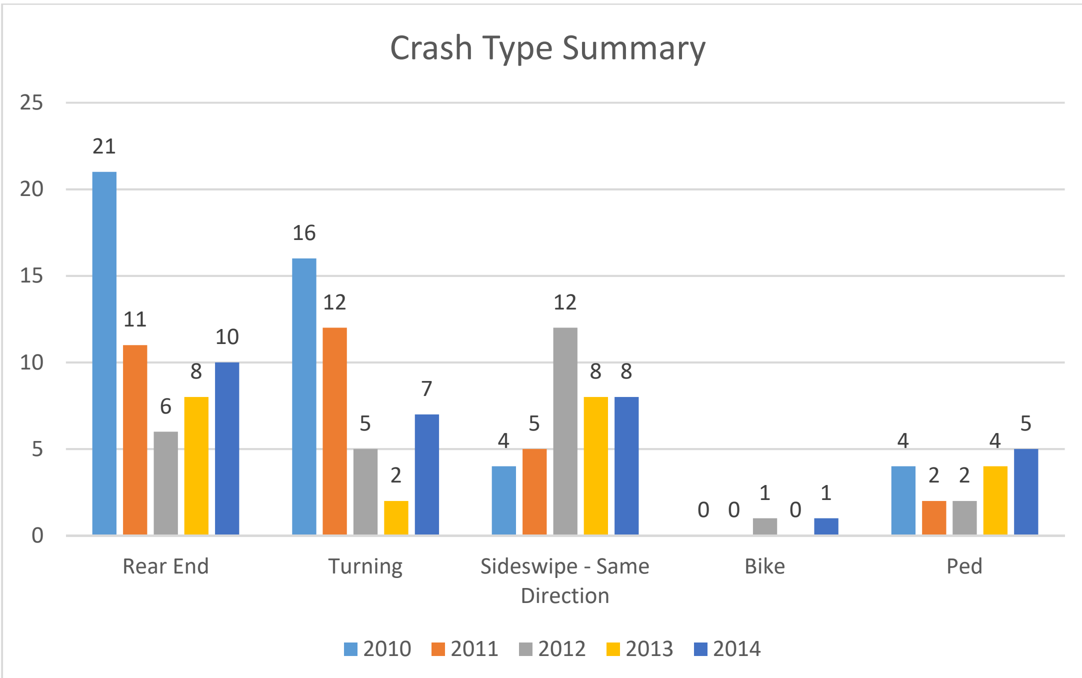

Figure 13: Crash Type Summary for Halsted Street

The most prevalent crash types were Rear-End, Turning, and Sideswipe - Same Direction collisions, which accounted for 29 percent, 22 percent and 19 percent of the total crashes reported, respectively. Of these 194 crashes, 55 collisions involved injuries of Type B or Type C severity. There were no fatal crashes and 7 crashes that resulted in Type A injuries.

5.1.4 Lafayette Avenue – State Street

During the five-year analysis period, a total of 265 crashes occurred at the 79th and I-94/Red Line intersection. Figure 14 below shows the number crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

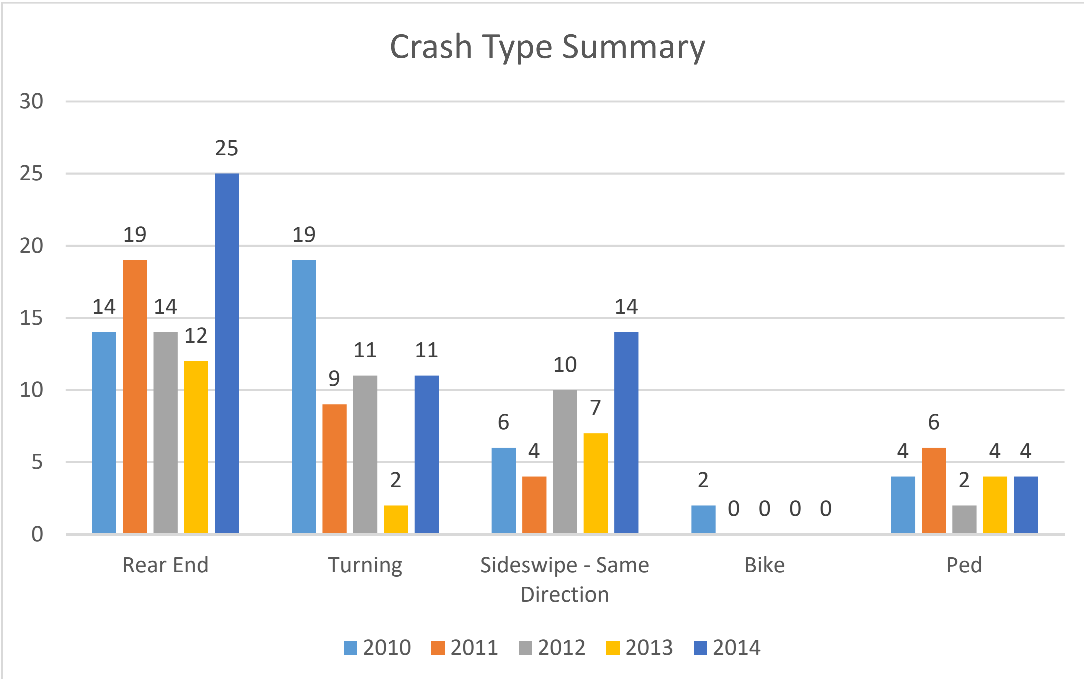

Figure 14: Crash Type Summary for Lafayette Avenue - State Street

The most prevalent crash types were Rear-End, Turning collisions, and Sideswipe - Same Direction, which accounted for 32 percent, 20 percent, and 16 percent of the total crashes, respectively. Of these 265 crashes, 55 collisions involved injuries of Type B or Type C severity. There was 1 fatal crash and 2 crashes that resulted in Type A injuries.

5.1.5 Martin Luther King Drive

During the five-year analysis period, a total of 116 crashes occurred at the intersection of 79th Street and Martin Luther King Drive. Figure 15 below shows the number crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

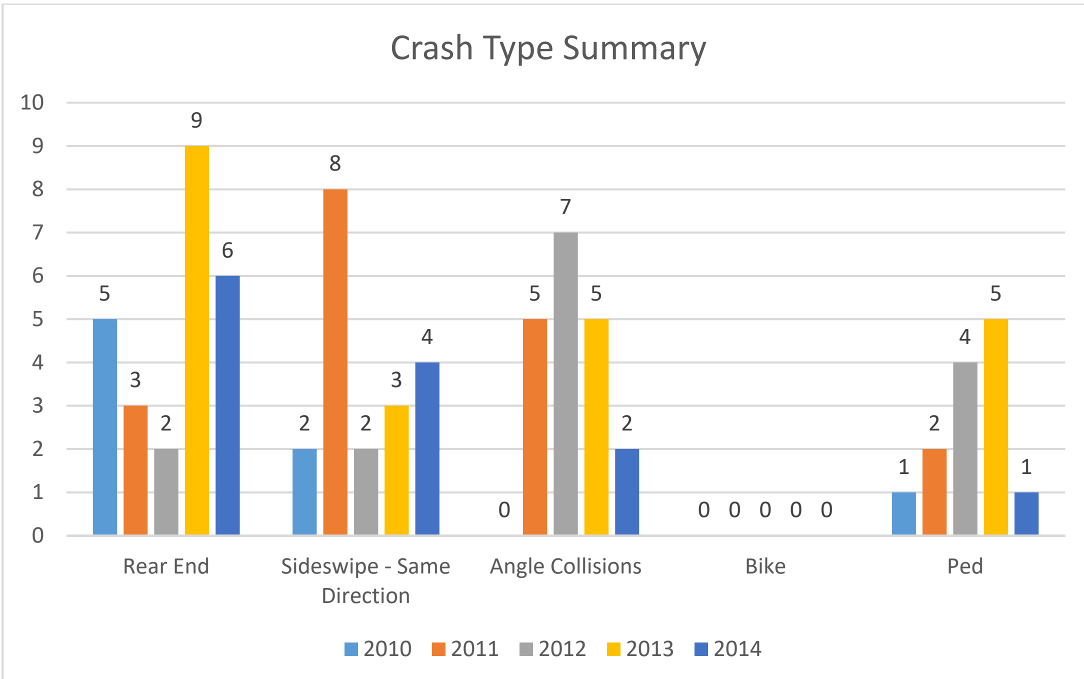

Figure 15: Crash Type Summary for Martin Luther King Drive

The most prevalent crash types were Rear-End, Sideswipe - Same Direction, and Angle collisions, which accounted for 22 percent, 16 percent, and 16 percent of the total crashes reported, respectively. Of these 116 crashes, 29 collisions involved injuries of Type B or Type C severity. There were no fatal crashes and 2 crashes that resulted in Type A injuries.

5.1.6 Stony Island Avenue / South Chicago Avenue

During the five-year analysis period, a total of 523 crashes occurred at the intersection of 79th Street and Stony Island Avenue. Figure 16 below shows the number crashes for the three most common crash types and bike and pedestrian crashes for each of the five years.

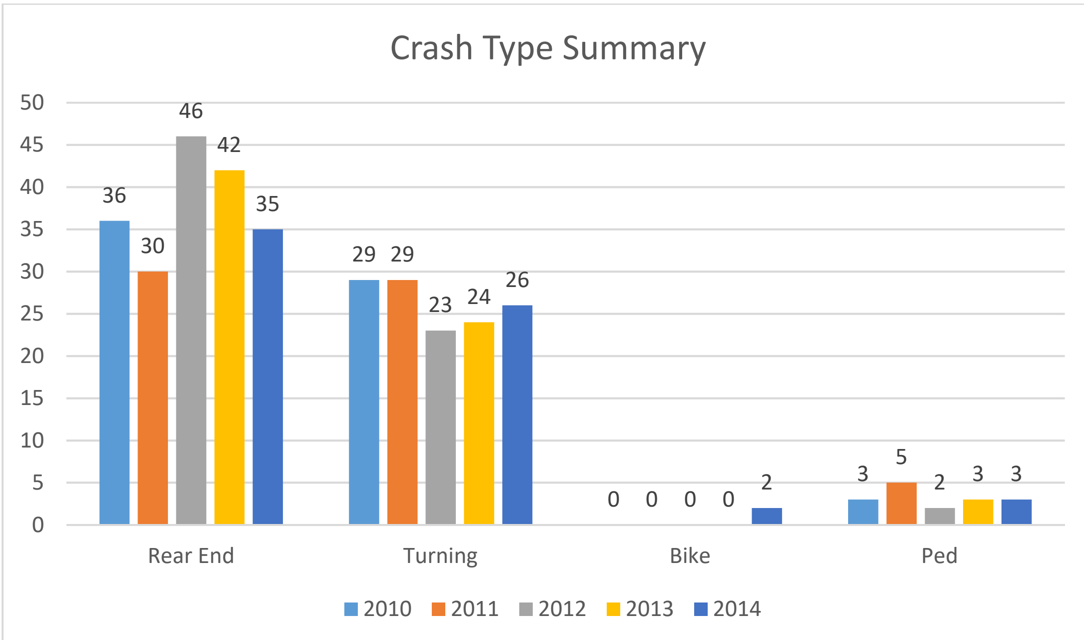

Figure 16: Crash Type Summary for Stony Island Avenue / South Chicago Avenue

The most prevalent crash types were Rear-End and Turning collisions, which accounted for 36 and 25 percent of the total crashes, respectively. Of these 523 crashes, 109 collisions involved injuries of Type B or Type C severity. There were 2 fatal crashes and 14 crashes that resulted in Type A injuries.

5.2 Crash Findings

The most prevalent types of crashes reported for the six intersections were Rear End, Turning, Sideswipe – Same Direction, and Angle collisions. Those four crash types accounted for 33 percent, 22 percent, 15 percent, and 14 percent respectively. In total they accounted for 84 percent of all crashes examined in the study. Most of these crashes occurred on dry pavement during clear daylight hours.

538 of the 1,618 crashes reported were Rear-End collisions. Rear-End collisions were the most common type of collision during the five-year period. A contributing factor may be that drivers were traveling at a too high rate of speed for conditions and rear-ended vehicles that had slowed or stopped at signalized intersections, side streets, or at local business driveways.

Of the 1,618 crashes, there were 353 Turning crashes which was the second most common type of crash during the five-year period. A contributing factor to these turning collisions may be traffic signal timing issues. This could include insufficient yellow plus all red time for turning vehicles to complete the turn, unprotected left turn movements, or drivers traveling at a too high rate of speed for conditions and unable to avoid colliding with turning vehicles in their path.

Sideswiped – Same Direction type crashes were the second most common type of crash during the five-year period with 247 of the 1,618 crashes. Inadequate roadway design, pavement markings, or signage can be a common causes of sideswipe collisions.

The fourth most common type of collision was Angle collision which accounted for 222 of the 1,618 total crashes reported over the five-year period. A contributing factor to these angle collisions may be inadequate sight distance or inadequate signal timing or equipment as was the case for turning collisions.

Of the 1,618 crashes observed over the five-year study period, there were 4 Fatal injury crashes, 42 Type A injury crashes, 194 Type B injury crashes, and 177 Type C injury crashes. The remaining 1,201 crashes had no injuries.

The crash data for these intersections was tabulated into analysis tables depicting crash rate, crash types, injury severity, fatalities, road surface conditions, lighting conditions, and weather conditions. These tables are in Appendix A.

6 EXISTING CONDITIONS TRAFFIC ANALYSIS

The study team completed the traffic analysis of the study intersections with Synchro 8, a microsimulation software. Existing data such as traffic volumes, peak hour factors, heavy vehicle percentages, lane widths, and pedestrian volumes were input into the software to analyze the existing traffic conditions.

The result tables show the delay, level of service (LOS), volume to capacity ratio (V/C) and 95th percentile queue length (feet) for each approach and intersection. According to the Highway Capacity Manual, Level of service (LOS) is defined in terms of a weighted average control delay for the entire intersection. Control delay quantifies the increase in travel time that a vehicle experiences due to the traffic signal control as well as provides a surrogate measure for driver discomfort and fuel consumption. Signalized intersection LOS is stated in terms of average control delay per vehicle (in seconds) during a specified time period (e.g., weekday PM peak hour). Control delay is a complex measure based on many variables, including signal phasing and coordination (i.e., progression of movements through the intersection and along the corridor), signal cycle length, and traffic volumes with respect to intersection capacity and resulting queues. Table 8 shows LOS criteria for signalized intersections, as described in the Highway Capacity Manual (Transportation Research Board, Special Report 209, 2000).

Table 8: Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (sec/veh)	General Description
A	≤10	Free flow
B	>10 - 20	Stable flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (congested and queues fail to clear)

The study team focused on approaches that had LOS E or F (unstable or forced flow), V/C ratio > 1.00 (traffic volume is greater than capacity of intersection) and 95th percentile queue lengths of > 330 feet (queue lengths greater than half a Chicago block), to identify problem areas that contribute to the 79th Street bus slow zones. The performance of each of the intersections is discussed below, and a detailed Synchro output is in Appendix B. Also the exstiing ADT map can be found as Exhibit F.

6.1.1 Kedzie Avenue / Columbus Avenue

The traffic analysis determined that the 79th Street approaches at Columbus Avenue and Kedzie Avenue performed at stable levels of service (LOS D or better), had V/C ratios < 1 and queue lengths for both peak periods were not causing any blocking issues. The exception is the northbound movement on Columbus Avenue that has poor operations and the longer queues were also observed during our site visit. The traffic signals at Columbus Avenue and Kedzie Avenue do not appear to significantly slow down CTA buses along 79th Street.

Table 9: Kedzie Avenue / Columbus Avenue Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / Columbus	Eastbound	28.5	C	0.82	277	23.2	C	0.72	171
	Westbound	20.9	C	0.59	123	26.1	C	0.86	192
	Northeastbound	64.6	E	0.98	497	34.9	C	0.72	291
	Southwestbound	27.2	C	0.57	285	25.2	C	0.64	291
	Overall	39.3	D	0.98	497	27.3	C	0.86	291
79th / Kedzie	Eastbound	8.0	A	0.38	63	9.6	A	0.47	87
	Westbound	31.6	C	0.48	162	34.4	C	0.67	247
	Northbound	37.7	D	0.81	258	33.5	C	0.79	211
	Southbound	10.1	B	0.53	61	10.3	B	0.79	46
	Overall	22.5	C	0.81	258	21.1	C	0.79	247
Columbus / Kedzie	Northbound	14.5	B	0.65	79	16.8	B	0.56	73
	Southbound	17.4	B	0.43	154	26.5	C	0.73	270
	Northeastbound	21.0	C	0.84	325	19.9	B	0.71	326
	Southwestbound	50.1	D	0.66	160	53.0	D	0.80	236
	Overall	22.6	C	0.84	325	28.0	C	0.80	326

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

6.1.2 Ashland Avenue to Paulina Street

The eastbound approach in AM peak period and both the westbound and eastbound approaches in the PM peak period, showed long queue lengths (> 300 ft) that delay 79th Street CTA buses. The eastbound approach queue lengths back up to Marshfield Avenue and the westbound approach queue length backs up to Justine Street. The eastbound delays during both peak periods were also high. These long queues were caused by the relatively short green times for the westbound and eastbound approaches. All the rest of the approaches for the intersection performed at tolerable levels.

The intersection of Paulina Street was analyzed as a stop-controlled intersection. The eastbound movement higher delays than other approaches. Longer queues are observed during eastbound and westbound direction.

Table 10: Ashland Avenue to Paulina Street Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / Ashland	Eastbound	84.5	F	1.10	617	56.1	E	0.95	483
	Westbound	34.6	C	0.76	358	60.0	E	0.99	555
	Northbound	27.4	C	0.68	272	24.0	C	0.55	143
	Southbound	21.6	C	0.40	145	37.7	D	0.89	435
	Overall	43.1	D	1.10	617	43.6	D	0.99	483
79th / Paulina	Eastbound	27.2	D	0.82	-	27.2	D	0.82	-
	Westbound	17.6	C	0.66	-	17.6	C	0.66	-
	Northbound	9.9	A	0.09	-	9.9	A	0.09	-
	Southbound	10.5	B	0.10	-	10.5	B	0.10	-
	Overall	21.8	C	0.82	-	21.8	C	0.82	-

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

6.1.3 Halsted Street to Union Avenue

The intersection has a LOS E and the eastbound delays during both peak periods were also high. The eastbound approach in AM and PM peak period, showed long queue lengths (> 300 ft) that delay 79th Street CTA buses. The high volume of through vehicles with one through lane and a relatively short green time caused the poor performance.

The intersection of Paulina Street was analyzed as a stop-controlled intersection. The eastbound movement higher delays than other approaches. Longer queues are observed during eastbound and westbound direction.

Table 11: Halsted Street Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / Halsted	Eastbound	122.2	F	1.23	541	80.7	F	1.12	514
	Westbound	55.8	E	0.94	368	40.5	D	0.88	375
	Northbound	20.3	C	0.68	315	23.9	C	0.69	212
	Southbound	13.7	B	0.35	130	71.4	E	1.07	590
	Overall	58.4	E	1.23	541	57.2	E	1.12	514
79th / Union	Eastbound	21.9	C	0.77	-	24.1	C	0.80	-
	Westbound	14.7	B	0.60	-	21.9	C	0.77	-
	Northbound	9.3	A	0.05	-	9.6	A	0.05	-
	Overall	18.5	C	0.77	-	22.7	C	0.80	-

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

6.1.4 Lafayette Avenue – State Street

The traffic analysis shows that both intersections performed at tolerable levels of service during both peak periods. The westbound approach during the AM peak period had high delays and longer queues where traffic is entering I-90/94. Similarly, V/C > 1 and longer queues were noted during the PM peak period on Lafayette Avenue where traffic is exiting I-90/94. The traffic signals at Lafayette Avenue and State Street do not appear to significantly slow down CTA buses along 79th Street.

Table 12: Lafayette Avenue – State Street Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / Lafayette	Eastbound	36.7	D	0.83	105	35.2	D	0.81	107
	Westbound	8.7	A	0.46	86	8.0	A	0.58	83
	Southbound	18.5	B	0.32	115	52.1	D	1.01	364
	Overall	23.3	C	0.83	115	36.8	D	1.01	364
79th / State	Eastbound	9.2	A	0.58	117	7.9	A	0.41	134
	Westbound	65.3	E	0.97	243	50.4	D	0.93	258
	Northbound	31.1	C	0.89	384	23.4	C	0.56	143
	Overall	30.4	C	0.97	384	25.2	C	0.93	258

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

6.1.5 Martin Luther King Drive

The traffic analysis shows that both intersections performed at acceptable levels of service during both peaks. The traffic signal at King Drive did not appear to significantly slow down CTA buses along 79th Street. Note: The traffic signal analysis used the correct signal timings for the AM and PM peaks, and not the incorrect signal timing for ALL OTHER TIMES observed in the field.

Table 13: Martin Luther King Drive Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / King	Eastbound	23.4	C	0.82	259	17.0	B	0.74	260
	Westbound	23.3	C	0.78	241	22.2	C	0.80	307
	Northbound	11.0	B	0.45	137	19.0	B	0.52	158
	Southbound	21.9	C	0.58	157	46.7	D	0.96	408
	Overall	19.5	B	0.82	259	28.1	C	0.96	408

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

6.1.6 South Chicago Avenue / Stony Island Avenue

The Synchro traffic analysis determined that the intersection of 79th-Stony Island-South Chicago had congested flow for both the westbound and eastbound approaches during both peak periods. The high left turn volumes, very short green time with no protected phase, insufficient number of available gaps and single left turn lane, led to LOS E or F and high V/C for both approaches. This poor performance leads to delays for CTA buses on 79th Street.

Table 14: South Chicago Avenue / Stony Island Avenue Synchro Results Summary

Intersection	Approach	AM Existing				PM Existing			
		Delay	LOS	V/C*	Queue**	Delay	LOS	V/C*	Queue**
79th / South Chicago / Stony Island	Eastbound	68.1	E	0.78	234	79.1	E	0.90	277
	Westbound	112.3	F	1.17	293	128.2	F	1.20	302
	Northbound	32.0	C	0.76	321	54.9	D	1.23	278
	Southbound	40.6	D	0.99	227	38.2	D	0.88	548
	Southeastbound	51.8	D	0.52	158	131.4	F	1.14	436
	Northwestbound	51.8	D	0.53	161	51.6	D	0.51	160
	Overall	47.9	D	1.17	321	64.1	E	1.23	548

*Note: The highest approach V/C is used for overall intersection V/C.

**Note: The highest approach 95th Queue (ft) is used for overall intersection queue.

7 SUMMARY OF EXISTING CONDITIONS

The study team analyzed the 79th Street Slow Zone study intersections and identified the areas of deficiency and possible causes as summarized below:

7.1.1 Kedzie Avenue / Columbus Avenue

Westbound CTA bus delay factor:

1. Lack of signal progression at Columbus Avenue traffic signal

General CTA delay factors

1. The eastbound bus stop located in a right turn lane is a concern
2. Two closely spaced bus stops cause delays to the buses
3. The closely spaced intersections present operational challenges for all vehicles

Other factors like bus stop location and infrastructure did not contribute to the bus operations at this location. The enforcement of existing left turn restrictions should be implemented.

7.1.2 *Ashland Avenue to Paulina Street*

Eastbound CTA bus delay factors:

1. Bus delay caused by stop controlled intersection at Paulina Street
2. Poor sidewalk condition near southwest bus stop increases boarding time for bus passengers
3. Eastbound near-side bus stop location not ideal due to the presence of driveway

Westbound CTA bus delay factors:

1. Bus delay caused by stop controlled intersection at Paulina Street. The stop sign at Paulina Street causes queuing that extends to Ashland Avenue.

General CTA bus delay factors:

1. Poor pavement and marking condition at the intersection and nearby segments forces all traffic to travel slower
2. Bus bunching results in slow boarding and delays for first bus
   Inadequate green time for eastbound and westbound traffic

Other factors like intersection geometry and bus stop infrastructure did not contribute to the bus operations at this location.

7.1.3 Halsted Street to Union Avenue

Eastbound CTA bus delay factor:

1. Inadequate green time for eastbound traffic

Westbound CTA bus delay factor:

1. Upstream stop sign at Union Avenue causes significant delay

General CTA bus delay factor:

1. Bus bunching results in slow boarding and delays for first bus

Other factors like intersection geometry and bus stop infrastructure did not contribute to the bus operations at this location.

7.1.4 Lafayette Avenue – State Street

Westbound CTA bus delay factor:

1. At State Street, lack of protected westbound right turn phase and large right turn volume queues due to pedestrians contributing to slow down of westbound buses

General CTA bus delay factors:

1. High boarding and alighting volumes due to CTA Red Line Station
2. Faded pavement marking leading to poor lane usage and passenger vehicles in the bus lanes
3. Chicago Police Department vehicles parking in bus lanes
4. Bus bunching results in slow boarding and delays for first bus
5. Inadequate green time for eastbound and westbound traffic at both Lafayette Avenue and State Street

7.1.5 Martin Luther King Drive

Eastbound CTA bus delay factor:

1. On-street parking maneuvers between Calumet Avenue and King Drive delayed eastbound buses

General CTA bus delay factor:

1. Incorrect ALL OTHER TIMES signal timing dial used by traffic signal controller resulting in excess green time for King Drive

Other factors like intersection geometry and bus stop infrastructure did not contribute to the bus operations at this location.

7.1.6 South Chicago Avenue / Stony Island Avenue

General CTA bus delay factor:

1. The complex six approach intersection present operational challenges for all vehicles
2. Traffic going through intersection has poor delineation and sight distances
3. Lack of protected left turn phase and large left turn volume queues spill into through lanes contributing to slow down of eastbound and westbound buses

Other factors like bus stop location and infrastructure did not contribute to the bus operations at this location.

8 IMPROVEMENT ALTERNATIVES TOOLBOX

The toolbox presented in this section describes "tools" or potential solutions to mitigate deficiencies causing delays to the buses. Each intersection included in the study was evaluated, using this toolbox, to assess the benefit(s), potential impact(s), and feasibility of implementing each potential solution. This process was used to develop the recommendations and considerations discussed in Section 9. The toolbox is shown in Table 15 and discussed in detail in below.

Table 15: Alternatives Toolbox

	Evaluation Category	Delay Factors	Alternatives
1	Bus Stop Location	• Near or Far-Side	• Relocate bus stop
2	Bus Stop Infrastructure	• Layout and Geometry • Boarding/Alighting Volume • High Disabled Usage	• Level or near-level boarding • Shelter layout • Bus stop bump out • Bus stop pull out • PROWAG compliance
3	Intersection Operations	• Traffic Control • Signal Operations • Emergency Preemption	• Traffic signals • Remove stop sign on bus route • Intersection phasing and timing • Transit signal priority
4	Roadway and Intersection Geometry	• Intersection Geometry • Lane Configuration • On-street Parking • Loading Zones	• Revise intersection geometry • Additional channelization • Bus lane • Queue jump lane • Evaluate parking restrictions • Evaluate loading zone restrictions • Pavement Marking
5	Fare Collection	Prepaid	• Evaluate prepaid boarding

The toolbox has been discussed according to evaluation categories.

8.1 Bus Stop Location

Bus stop spacing has a great influence on transit performance and reliability. When fewer bus stops are further apart, the bus is required to stop less often and its travel times is reduced. The tradeoff is that the rider may have to walk farther to or from the bus stop. The corridor was examined for potential areas where closely spaced stops could be combined without significantly altering the distance a bus rider would have to walk.

The location of a bus stop can be near-side, far-side or midblock in relation to an intersection. Each stop location type has advantages and disadvantages that are summarized in the Table 16. Bus stop locations were concurrently evaluated with consolidation opportunities.

Table 16: Comparison of Bus Stop Locations

Stop Type	Advantages	Disadvantages
Near-Side	• Minimizes interference when traffic is heavy on the far-side of the intersection • Passengers access buses closest to crosswalk • Intersection available to assist in pulling away from curb • No double stopping • Buses can service passengers while stopped at a red light • Provides driver with opportunity to look for oncoming traffic including other buses with potential passengers	• Conflicts with right turning vehicles are increased • Stopped buses may obscure curbside traffic control devices and crossing pedestrians • Sight distance is obscured for crossing vehicles stopped to the right of the bus. • The through lane may be blocked during peak periods by queuing buses • Increases sight distance problems for crossing pedestrians
Far-Side	• Minimizes conflicts between right turning vehicles and buses • Provides additional right turn capacity by making curb lane available for traffic • Minimizes sight distance problems on approaches to intersection • Encourages pedestrians to cross behind the bus • Requires shorter deceleration distances for buses • Gaps in traffic flow are created for buses re-entering the flow of traffic at signalized intersections	• Intersections may be blocked during peak periods by queuing buses • Sight distance may be obscured for crossing vehicles • Increases sight distance problems for crossing pedestrians • Stopping far-side after stopping for a red light interferes with bus operations and all traffic in general • May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light
Mid-block	• Minimizes sight distance problems for vehicles and pedestrians • Passenger waiting areas experience less pedestrian congestion	• Requires additional distance for no-parking restrictions • Encourages patrons to cross street at mid-block (jaywalking) • Increases walking distance for patrons crossing at intersections

Source: Federal Transit Administration

8.2 Bus Stop Infrastructure

The layout and other elements of the bus stop can contribute to inefficient boarding or alighting of passengers causing delays. High commuter volumes can exacerbate the problems experienced at a bus stop. The bus stops were reviewed to identify improvements.

8.2.1 Bus Stop Bump Out and Bus Bays (Pull Out)

Bus bump outs are a section of sidewalk that extends from the curb of a parking lane to the edge of the through lane. When used at a bus stop, the buses stop in the traffic lane instead of moving into the parking lane therefore there is no delay in re-entering the traffic stream. Figure 17 provides an example of bus bump out on a city street.

Table 17 gives a comparison of the advantages and disadvantages of implementing bus bump out. For this project, a bump out was considered only when two through lanes exist in a direction.

Bus bays or pull outs provide for the bus to pull out of the travel lane and into a dedicated bus loading zone to board and alight passengers without blocking traffic. In congested areas and during peak travel periods, busses often have trouble reentering the travel lane adding delay to bus travel time.

The 79th Street slow zones were evaluated to determine if and where bus bump outs would be appropriate and could provide benefit. Bus bays are not feasible in urban corridors with limited roadway widths and Right-of-way.

Figure 17: Example of a Bus Bump Out

Source: www.nacto.org

Table 17: Bus Bump out Comparison

Advantages	Disadvantages
• Permits more on-street parking • Decreases the walking distance (and time) for pedestrians crossing the street • Provides better sight lines to bus patrons waiting for the bus • Provides additional sidewalk area for bus patrons to wait • Segregates waiting bus patrons from circulating pedestrian flow on the sidewalk • Results in minimal delay to the bus and its on-board passengers by reducing bus merge delay • Provides additional space for amenities including bus shelters	• Can cause traffic to queue behind a stopped bus, thus causing traffic congestion • May cause drivers to make unsafe maneuvers when changing lanes to avoid a stopped bus • Costs more to install compared with curbside stops, particularly for addressing street drainage requirements

Note 1 Source: Federal Transit Administration

8.2.2 Level or Near-Level Boarding

The height difference at a sidewalk or curb level stop is often 4-6 inches between the ground level and the bus floor. For the handicapped, elderly, or passengers carrying luggage or large items, buses are equipped with an adjustable suspension which allows for the driver to physically lower the bus to provide easier access entering the bus. Kneeling busses can add delay to the travel route because of the time it takes for the bus to adjust its suspension level. Level or near-level boarding refers to raising the sidewalk at a bus stop that provides a reduced height difference between curb and bus floor. The level or near-level boarding reduces bus dwell time by eliminating the need for the driver to adjust the bus suspension.

Providing level or near-level boarding is not possible at all locations because of multiple doorways, physical constraints and other impacts associated with raising a curb height 4-6 inches for the length of the bus stop. CTA prefers a minimum 100-foot area for a bus to stop to accommodate articulated buses. Raising the curb height can have impacts on Americans with Disabilities Act (ADA) and Public Right of Way Access Guide (PROWAG) compliance for sidewalks in public right of ways. Water flow and drainage could also be impacted and design of level boarding must prevent water from ponding in the sidewalk or backflowing into buildings. Narrow sidewalks with driveway and business front access pose implementation challenges. Raised curbs should be avoided where there is adjacent street parking because of conflicts with the passenger car door levels and potential vehicle damage. Examples of boarding types are shown in Figure 18 and Figure 19.

The 79th Street Study areas were evaluated to determine if and where level or near-level boarding would be appropriate and could provide benefit. The physical constraints and passenger volumes were reviewed for this evaluation.

Figure 18: Example of Non-Near-Level Boarding

Source: Chicago Tribune

Figure 19: Example of Near-Level Boarding

Source: ByteofKnowledge via Wikimedia Commons (Open Source)

Detailed topographic survey is needed to evaluate PROWAG compliance of a bus stop. An evaluation of the bus stop locations is recommended during the preliminary engineering phase of the project if near-level boarding is desired at that location.

8.3 Intersection Operations

The intersection operations play a critical role is the progression of traffic and the delay experienced by buses. The intersection traffic control and operations were reviewed to identify measures to improve traffic flow.

8.3.1 Traffic Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices (MUTCD) is a document produced by the Federal Highway Administration (FHWA) and is a compilation of national standards for all traffic control devices, including road markings, highway signs, and traffic signals. The MUTCD requires an engineering study of current traffic conditions, pedestrian characteristics, and physical characteristics for implementing a traffic signal at a specific location. The process of evaluating the need for a traffic control signal investigates the operation and safety of the location and the potential for improvement through a series of nine warrants.

Stop controlled intersections were examined to determine the operational and safety improvement potential for implementing a new traffic control signal using the Traffic Signal Warrant Analysis methodology established in the MUTCD.

8.3.2 Traffic Signal Optimization

Optimized traffic signals process vehicles more efficiently than unoptimized signals. FHWA describes "Traffic Signal Optimization" as the process of developing optimal signal-phasing and timing plans for isolated signalized intersections, arterial streets or signal networks. For this study, the software program Synchro was used to determine and evaluate signal coordination potential, optimal cycle lengths, phase splits, and offset timings. Coordinated signals operate on the same cycle length and can improve traffic progression along corridors. Signal coordination is not always possible due to differences in traffic patterns or distance between intersections. When possible, coordinating and optimizing signals together allows for better over all traffic flow, although, an individual signal in a system of coordinated signals may not optimally operate as a single intersection.

Using Synchro, optimized timing plans were developed for each Slow Zone along the 79th Street study area for the AM and PM peak hour periods for existing and proposed conditions. Section 10 Traffic Analysis discusses the results of traffic signal optimization in further detail.

8.3.3 Transit Signal Priority

Transit signal priority (TSP) gives special treatment to transit vehicles at signalized intersections using location detection technology. An active priority strategy involves detecting the presence of a transit vehicle at a signal and the system giving an early green signal or extending a green signal that is already displaying.

Currently, TSP is present on Ashland Avenue and Western Avenue. TSP on 79th Street was not considered at intersections with existing crossing TSP route.

8.4 Roadway and Intersection Geometry

The roadway including intersection geometry, pavement markings, lane configuration, on-street parking and loading zones were reviewed to identify improvements and determine impacts.

8.4.1 Intersection Geometry and Pavement Marking

Intersection geometry and lane configuration was reviewed to identify opportunities for turn lane changes to improve intersection operations. Efficient intersection operations can benefit bus operations by reducing delays for all vehicles. Intersections were also reviewed for addition of protected left turn phases.

Pavement marking that are either missing, incorrect or in poor condition can cause confusion and negatively affect safety. Slow zone intersections were reviewed for pavement marking condition.

8.4.2 Dedicated Curbside Bus Lanes

A dedicated curbside bus lane is a transit-only facility in the right-most travel lane on a street, as shown in Figure 20. There are several different configurations of dedicated bus lanes, for example, bus lanes can be in the median or in offset configurations where the dedicated bus lane runs adjacent to parking, a right turn lane, a bike lane or any combination in the outermost portion of the right-of-way. Bus lanes can also operate as a dedicated bus lane at peak travel periods, with appropriate signing and enforcement, and provide for general curbside uses, such as parking permitting mixed traffic, at other times. This configuration has also been implemented in the Chicagoland area on Jeffry Boulevard from 67th Street to South Chicago Avenue. Figure 21 is an example of a peak hour bus facility sign used by the LA Metro.

Dedicated bus lanes are typically a minimum width of 11-feet, although, a 12-foot lane is generally preferred, the width can be as low as 10-feet in certain circumstances.

Figure 20: Example of a Dedicated Bus Lanes

Figure 21: Example of a Peak-Hour Bus Lane

Source: NACTO.org (credit LA Metro)

8.4.3 Queue Jump Lane

A queue jump lane is a short stretch of bus lane located at the intersection and the bus gets dedicated signal. These enable buses to by-pass traffic queues but cutting out in front by getting an early green signal. In many instances, a queue jump lane functions as a combined bus plus right-turn only lane, permitting straight-through movements for buses only. This minimizes the overall traffic congestion an intersection by removing buses out of through-travel traffic lanes or out of a queue of traffic when at a stop light or stop sign. Additionally, queue bypass / right-turn lanes reduce merging conflicts with other motorists while accessing far-side bus stops, and freeing lane space for other motorists to proceed through an intersection with less congestion. Figure 22 and Figure 23 show implementation of queue jump lanes.

Both TSP and queue jump lanes work most efficiently with far-side bus stops. The 79th Street Study area was evaluated for locations where the implementation of queue jump lanes could benefit bus performance. The implementation of a queue jump lane requires the installation of a dedicated bus signal head. A new ATC 1000 controller is proposed at locations a queue jump lane is proposed to facilitate bus detection and implementation of the queue jump phase.

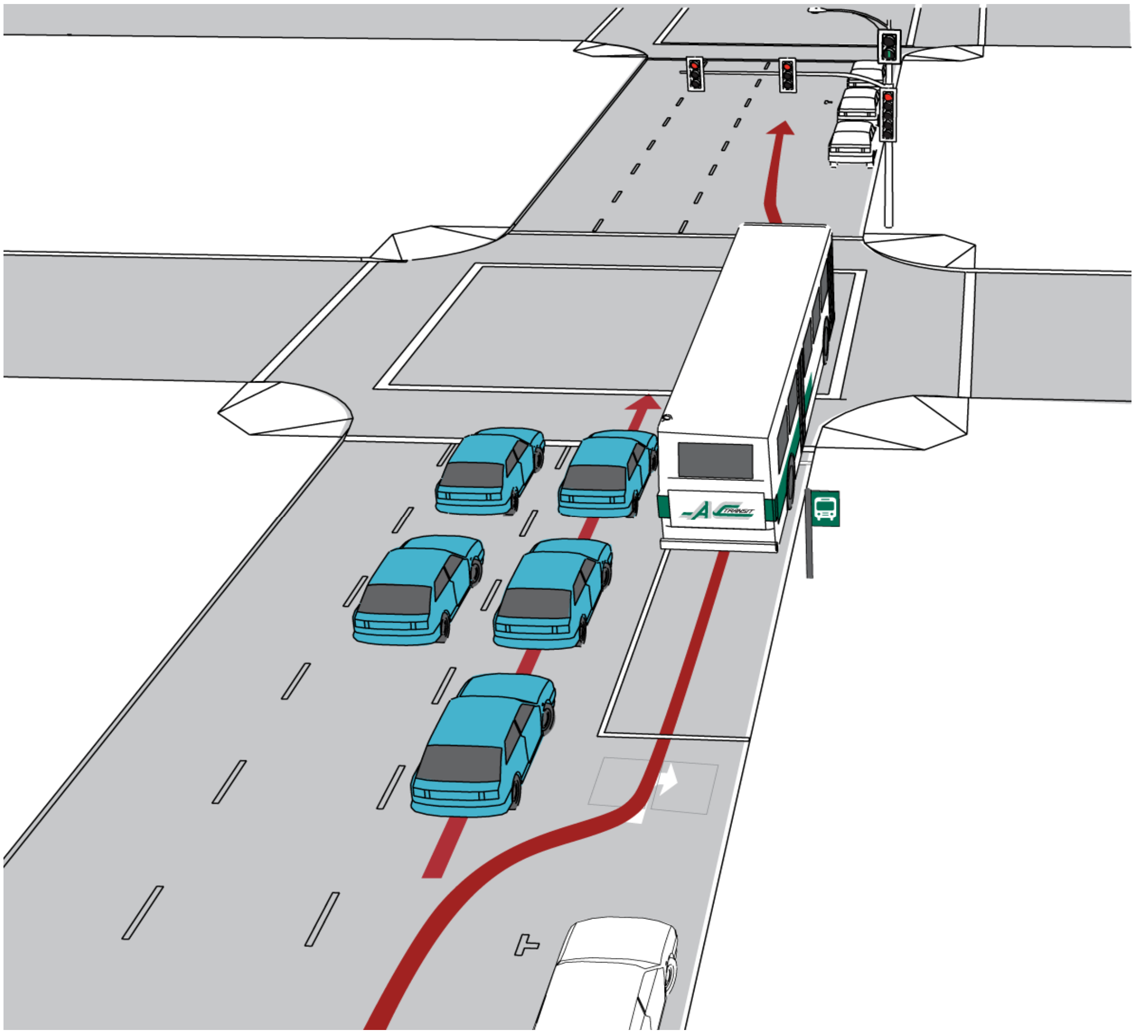

Figure 22: Example of a Queue Jump Lane

Figure 23: Example of Bus Priority Signal and Signage

Note 2 Source: raisethehammer.org

8.4.4 Parking and Loading Zone Restrictions

The on-street parking and loading zones are important in urban areas for local businesses. The limits and type of on-street parking and loading zones were surveyed. The parking and loading zones were reviewed for modifications to help bus access to bus stops and accommodation of bus lanes. Any impacts due to recommended improvement have been noted on the exhibits.

8.5 Fare Collection

The ticket payment although electronic occurs on the bus and requires the swiping of the Ventra card. During peak periods, when the boarding volumes are high, the ticket collection process can delay the buses. The elimination of on-board fare collection can help reduce bus delays. Prepaid boarding options were reviewed at each slow zone bus stops.

CTA has conducted pilot studies to evaluate prepaid boarding that were reviewed for this slow zone study. The pilot study included two locations:

1. Loop Link – Madison/Dearborn Platform

   This concept included platforms designed for turnstile installation at the top of each ramp. Mobile fare collection equipment located at the turnstile is used for fare collection.

2. Belmont Blue Line Station

   This concept included fenced areas for controlling the flow of passengers and to discourage evasion. Mobile fare collection equipment located in the fenced area is used for fare collection.

In both methods, a bus supervisor will be on duty to help customers prepay and board efficiently, and to discourage evasion. A TRTW employee will assist as resources permit.

The current method for implementing pre-paid boarding have space requirements and resource needs that are challenges for bus stops located on roadways in congested conditions.

9 IMPROVEMENT RECOMMENDATIONS

Each slow zone was reviewed using the Alternatives Tool Box to identify potential improvements. All likely improvement alternatives were identified for consideration irrespective of its cost, negative impacts or constructability. Alternatives not considered feasible due to site constraints and other factors were eliminated from further consideration. The improvements considered feasible and expected to reduce bus delays are discussed in this section. In addition, the improvements have been separated into short term and long term improvements. Short term improvements are considered as such if they are easy to implement, are lower in cost and can be implemented quickly. Long term improvements involve larger capital expense and will require further planning and work to implement.

The alternatives analysis is documented in tables for each slow zone and is included in Appendix F.

9.1 Kedzie Avenue/ Columbus Avenue

The intersections of 79th Street, Columbus Avenue and Kedzie Avenue form closely spaced intersections. Signal timing and phasing optimization is recommended to improve intersection operations. The viaduct east of Kedzie Avenue is a constraint that restricts the roadway width and limits improvement options considered for the slow zone.

In the westbound direction, bus stops are closely spaced at the intersections of Kedzie Avenue and Columbus Avenue. The two near-side stops can be consolidated to one midblock stop between the two stops. Similarly, bus stops in the eastbound direction are closely spaced. The near-side stop at Columbus Avenue is recommended to be removed. The consolidation of these bus stops will reduce the delays caused by multiple stops.

In order to reduce bus delays, an eastbound queue jump lane is proposed at the intersection of Kedzie Avenue. This will be a shared queue jump and right turn lane. A bus lane that extends across the Kedzie Avenue intersection is not feasible due to the narrow roadway width under the viaduct.

A bus lane is also recommended in the westbound direction starting west of Kedzie Avenue continuing west through the intersection of Columbus Avenue. Right turns from the bus lane would be restricted since right turns can occur at the intersection of Kedzie Avenue. A sign will be posted in advance of the intersection to notify drives that at right turn at Kedzie Avenue will give them access to northeast bound Columbus Avenue. Additional regulatory signage will be added at the intersection of Columbus Avenue to restrict right turns.

In order to improve intersection safety, access to Sawyer Avenue is recommended to be closed. This could be accomplished by implementing a cul-de-sac or similar improvement. Alternatively, Sawyer Avenue could be converted to one-way northbound to prohibit vehicles from entering the intersection at Columbus Avenue.

The improvement recommendations at the Kedzie Ave slow zone are shown in Exhibit H.

9.2 Ashland Avenue

The slow zone at Ashland Avenue also includes a review of the all-way stop-controlled intersection of Paulina Street. The intersection has crosswalks on all approaches.

Paulina Street

The all-way stop-controlled intersection of Paulina Street is a source of delay for buses in both directions. The westbound queuing at the Paulina Street intersection also affects the operations at the Ashland Avenue intersection. A traffic signal is not warranted at the intersection based on the warrant analysis conducted. It is recommended to remove the stop signs on 79th Street in order to reduce bus delays. A refuge median on both approaches of 79th Street and pedestrian signing is also recommended to enhance pedestrian safety. Also, to expedite bus progression through this slow zone, peak hour bus lanes and signs are recommended through the Paulina Street and Marshfield Avenue intersections.

Ashland Avenue

The on-street parking on 79th Street has peak hour restrictions. On-street parking is restricted between the hours of 7:00 am and 9:00 am in the eastbound direction and between the hours of 4:00 pm and 6:00 pm in the westbound direction. A peak hour bus lane is recommended in both directions where a parking lane exists. The peak hour bus lane can be implemented at other locations along 79th Street where peak hour parking restrictions exist. Pavement marking modifications and overhead signing is necessary to implement the peak hour bus lane.

The near-side eastbound bus stop is located adjacent to a gas station driveway with very limited space for standing. The near-side stop is recommended to be moved far-side where more space is available. This change impacts current on-street parking.

In order to reduce bus delays, a shared bus and right turn lane is recommended in the eastbound and westbound directions. The bus lanes can be extended across the intersection and marked accordingly.

The improvement recommendations at the Ashland Avenue slow zone are shown in Exhibit I.

9.3 Halsted Street

The slow zone at Halsted Street also includes a review of the all-way stop-controlled intersection at Union Avenue. The intersection has crosswalks on all approaches.

Union Avenue

The all-way stop-controlled intersection at Union Avenue is a source of delay for buses in both directions. A traffic signal is not warranted at the intersection based on the warrant analysis conducted. It is recommended to remove the stop signs on 79th Street in order to reduce bus delays. Pedestrian signing is also recommended to enhance pedestrian safety. A similar condition exists to the west of Halsted Street at Peoria Street, we recommend that this intersection be reviewed at a future time.

The westbound bus stop at Union Avenue is recommended to be removed since there is a bus stop at Lowe Avenue. The eastbound bus stop at Union Avenue is recommended to be relocated to near-side at Lowe Avenue. In order to reduce bus delays, peak hour bus lanes are recommended in both directions.

Halsted Street

In order to reduce bus delays, a shared bus and right turn lane is recommended in the eastbound and westbound directions at the intersection. The bus lane can be extended across the intersection and marked accordingly. Peak hour bus lanes are recommended beyond the intersection.

On-street parking is observed west of the intersection. Paid parking exists east of the intersection on the north and south side. Parking impacts are anticipated for the implementation of bus lanes.

The pavement markings along 79th Street have deteriorated. The pavement markings at the intersection will need to be completed with the proposed bus lane markings.

The improvement recommendations at the Halsted Street slow zone are shown in Exhibit J.

9.4 Lafayette Avenue – State Street (Red Line Station

The Lafayette Avenue and State Street intersections at 79th Street are part of the Interstate 90 interchange. The 79th Street Red Line Station is located at the interchange between Lafayette Avenue and State Street. This is a busy transfer location between the two CTA modes creating pedestrian traffic at the interchange.

At the Lafayette Avenue intersection, implementing two advanced left turn lanes, one through lane and a shared bus and right turn lane are recommended in the eastbound direction to improve interchange operations. A refuge island is proposed in the median to provide additional safety to crossing pedestrians.

At the State Street intersection, one advanced left turn lane, two through lane and a shared bus and right turn lane are recommended in the westbound direction to improve interchange operations. A protected-only left turn operation is recommended in the eastbound direction due to the presence of dual left turn lanes. A refuge island is also proposed at this intersection for pedestrian safety.

A dedicated bus lane is recommended along the curb between the two intersections. The bus lane will allow buses experiencing bunching to wait and allow other CTA vehicles to temporarily park in the bus lane. In addition, this recommendation reduces the existing lane widths in order to provide an additional through lane in the westbound direction. This improvement will also require a queue jump to be installed at Lafayette Avenue.

The pavement markings along 79th Street have deteriorated. The pavement markings through the entire interchange needs to be completed with the proposed bus lane markings between Perry Avenue and Wabash Avenue to define the lanes.

The improvement recommendations at the Lafayette Avenue and State Street slow zone are shown in Exhibits K-1 and K-2 .

9.5 Martin Luther King Drive

In order to reduce bus delays, a shared bus and right turn lane is recommended in the eastbound and westbound direction at the intersection. The bus lane can be extended across the intersection and marked accordingly.

One paid parking space could be impacted east of the intersection on the north side of 79th Street. Other parking impacts are not anticipated.

The pavement is in poor condition and the pavement markings have deteriorated. Pavement marking improvements need to be completed to implement the bus lanes. The pavement could also be resurfaced at the intersection.

The improvement recommendations at the Martin Luther King Drive slow zone is shown in Exhibit L.

9.6 South Chicago Avenue / Stony Island Drive

This is a complex intersection with six approaches and overhead ramps. The intersection has safety concerns in addition to operational issues. The optimization of the signal timings is recommended since the previous signal timing update was completed in 2006. A protected left turn phase is recommended in the westbound direction that will require replacement of existing 3-section signal head.

In order to reduce bus delays, a shared bus and right turn lane is recommended in the eastbound and westbound direction at the intersection. The bus lane can be extended across the intersection and marked accordingly.

Skip-dash pavement marking to delineate the through lanes is recommended through the intersection in the eastbound and westbound direction.

The improvement recommendations at the Stony Island Avenue slow zone are shown in Exhibit M.

The peak hour bus lanes along the corridor are recommended for a minimum period of two hours in the morning and evening. The traffic data available for the study included two hours of counts for the period of 7:00 am to 9:00 am and 4:00 pm to 6:00 pm collected in various years before 2017. The exceptions were the intersection of Union Avenue and Paulina Avenue where 12-hour counts were conducted in 2017. Based on these counts, the peak hours are 7:30 am to 9:30 am in the morning and 2:30 pm to 5:30 pm. The peak hour restriction could vary along the corridor and should be based on current traffic data collected for at least three hours in the morning and evening peak period.

10 PROPOSED CONDITIONS TRAFFIC ANALYSIS

The project team completed traffic analysis of the slow zones using Synchro 10, a microsimulation software. Data including traffic volumes, peak hour factors, heavy vehicle percentages, lane widths, and pedestrian volumes were input into the software to analyze the traffic conditions. Traffic analysis was conducted for existing traffic conditions and projected 2040 traffic volumes with and without the improvement recommendations for the morning and evening peak period. The projected 2040 ADT's were obtained from CMAP. The ADT and DHV map is included as Exhibit G.

The proposed scenarios analyzed are as follows:

- Existing Traffic Volumes, Existing Geometry, Optimized Signal Timing
- 2040 Projected Traffic Volumes, Existing Geometry, Optimized Signal Timing
- 2015 Existing Traffic Volumes Proposed Geometry and Optimized Signal Timings
- 2040 Projected Traffic Volumes, Proposed Geometry and Optimized Signal Timings

Exhibit N shows the LOS for each scenario. The analysis summary tables are included in Appendix G and detailed Synchro outputs and included in Appendix H. The result tables show the delay and level of service (LOS) of each movement, approach and intersection.

The key findings of the traffic analysis are as follows.

- The optimization of traffic signal timings improves operations and is recommended at all slow zones intersections.
- A short queue jump phase has minimal negative impact on the intersection operations.
- The implementation of a shared bus and right turn lane benefits the intersection by eliminating the right turns and buses from the through traffic. There is a capacity benefit from this improvement.
- The traffic is anticipated to increase according to the 2040 projections. However, the implementation of a shared bus and right turn lane at the intersections and bus lanes, dedicated or peak hour lanes, will help reduce the effects of the increased traffic. It should be noted that the traffic projections do not account for a major change to the transportation system by adding bus lanes.

11 CONCLUSION

The City will pursue recommended improvements along the corridor potentially in larger or smaller segments and scope, depending on availability of funds. The improvements could be pursued in combination with other roadway projects. The City could also pursue improvements with private developments along the corridor. The improvements could be implemented using City funds or the City may pursue federal funds. Additional studies will be required if federal funds are considered to meet IDOT and FHWA requirements.