

# Minneapolis/Hennepin County Pedestrian Crossing Study



October 15, 2019

# **Table of Contents**

Page 3	Introduction
Page 4	Guiding Policy, Plans, Studies, and Initiatives
Page 9	Location Selection
Page 12	Improvement Strategies
Page 21	Intersection Improvement Concepts
Page 22	Lake Street W/Lyndale Ave S
Page 27	West Broadway Avenue/Lyndale Avenue N
Page 31	Franklin Avenue W/Nicollet Avenue S
Page 36	Lake Street E/Bloomington Avenue S
Page 41	Franklin Avenue W/ 3 <sup>rd</sup> Avenue S
Page 46	26 <sup>th</sup> Street W/Lyndale Avenue S
Page 51	Lake Street E/28 <sup>th</sup> Avenue S
Page 56	Franklin Avenue E/Midblock Crossing between 13th Ave S & 14th Ave S
Page 60	Cedar Avenue S/Little Earth Crossing (midblock south of 24 <sup>th</sup> St E)
Page 64	Cedar Avenue S/6 <sup>th</sup> Street S
Page 68	Sources
Page 70	Appendices

# Introduction

After the completion of the Minneapolis' <u>Pedestrian Crash Study</u> (2017), the City and Hennepin County partnered to prioritize 10 intersections to develop and refine concepts to improve pedestrian safety. At each intersection, the pedestrian crash details and traffic data were reviewed to identify the key safety issues and opportunities. This study summarizes the project history and approach to how the 10 intersections were selected, a review of the key issues, and recommended improvements.

# **Agency Coordination**

From July 2018 to April 2019, a Project Management Team (PMT) and Technical Advisory Committee (TAC) were assembled to provide guidance to the consultant team and to guide draft work products.

# **Project Management Team**

The PMT included representatives from the City of Minneapolis, Hennepin County, and SRF.

- Forrest Hardy, City of Minneapolis
- Scott Poska, City of Minneapolis
- Jordan Kocak, Hennepin County
- David Sheen, Hennepin County

# **Technical Advisory Committee**

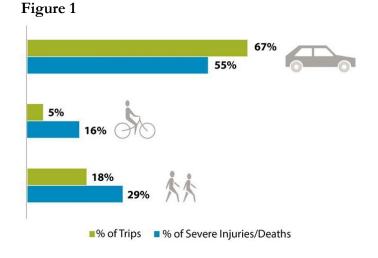
- Michael Jischke, SRF Consulting Group
- Emily Gross, SRF Consulting Group
- Adrian Potter, SRF Consulting Group
- The Technical Advisory Committee (TAC) included members of the PMT as well as additional representatives listed below:
- Allan Klugman, Traffic and Parking Services, City of Minneapolis
- Nathan Koster, Transportation Planning and Programming, City of Minneapolis
- Ole Mersinger, Transportation Engineering and Design, City of Minneapolis
- Steve Collin, Transportation Maintenance and Repair, City of Minneapolis
- Jeremy Strehlo, Surface Water and Sewers, City of Minneapolis
- Ben Hao, Hennepin County
- Jay Russell, Metro Transit
- Sonja Burseth, Metro Transit

# **Guiding Policy, Plans, Studies, and Initiatives**

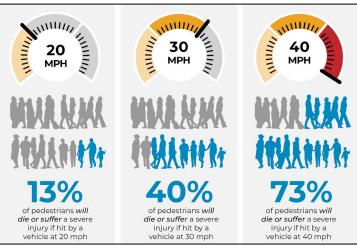
Adopted policies at both the City and County levels commit to improving pedestrian safety as well as the safety of all users of the street. At the same time, previous studies have found a clear correlation between street designs that accommodate unimpeded vehicle flow and a higher rate of crashes and severe injury for pedestrians. Major guiding policies and plans that demonstrate the City and County's commitment to improving pedestrian safety are described below.

# **Minneapolis Vision Zero Commitment**

- In 2017 the City of Minneapolis committed to a Vision Zero policy to eliminate fatalities and severe injuries that are a result of crashes on city streets by 2027.
- Pedestrians are overrepresented in severe and fatal injury crashes. Pedestrians make up only 18% of all trips in the city but represent 29% of crashes resulting in severe injury and death (1) (Figure 1).
- Traffic fatalities and severe injuries are preventable through a systemic approach to transportation that coordinates efforts across engineering, public safety, health, and community outreach.
- Traffic speed management is a focus area for the City's Vision Zero work because higher traffic speeds make crashes more likely to happen and make crashes more likely to result in a severe injury or death. National research has found that a person hit at 20 miles per hour has a 13% likelihood of suffering a severe injury or being killed while a person hit at 40 miles per hour has a 73% likelihood of suffering a severe injury or being killed while a person hit at 40 miles per hour has a 73% likelihood of suffering a severe injury or being killed (2) (Figure 2).

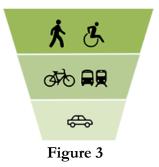






Graphic Source: Denver Vision Zero Action Plan (3)

# **Minneapolis Complete Streets Policy**



- The City of Minneapolis Complete Streets policy (2016) established a modal priority framework that prioritizes public right-of-way use in the following order: walking, biking or taking transit, and driving motor vehicles (**Figure 3**).
- The Complete Streets policy supports citywide efforts to improve health, the environment, land use patterns, economic development, and congestion reduction.
- For decades, streets have been designed primarily for travel by car, which has made it harder to get around by other modes. Rebalancing our transportation networks necessitates addressing the needs of people walking, riding a bicycle, or taking transit.
- Transportation investments influence travel choices; greater investment in high-quality pedestrian, bicycle, and transit facilities will have an impact of how frequently and how many people use these facilities.

# **ACCESS Minneapolis**

- ACCESS Minneapolis is the City's 10-year transportation action plan (2007-2017) that addresses a full range of transportation options and issues, including pedestrians, bicycles, transit, automobiles, and freight.
- ACCESS contains the City's Pedestrian Master Plan, which includes a host of implementation strategies for increasing pedestrian safety, access, and comfort, as well as increasing the prevalence of pedestrians throughout the city.
- ACCESS contains the City's Street Design Guidelines which are used to assist staff and stakeholders in the decision-making process for planning and designing complete streets that support and encourage walking, bicycling and transit use while promoting safe operations for all users

# Minneapolis 2040 Comprehensive Plan

- The transportation policies of the Minneapolis 2040 Comprehensive Plan support a multimodal network that prioritizes walking, biking and transit. The polices are intended to achieve outcomes that increase equity in our transportation system, address climate change and reduce carbon emissions, improve human health through improved air quality and increases in active travel, and enable the movement of people, goods, and services across the city.
- Minneapolis is uniquely positioned, along with Saint Paul, to lead the region in confronting the challenges of climate change and energy consumption. A multi-pronged approach is necessary to

substantially reduce vehicle emissions, including supporting environments that encourage walking as an attractive option, increased options for safe and comfortable bicycling, more reliable and attractive public transit, shared mobility options that support a car-free or car-lite lifestyle, and adoption of electric vehicles.

# **Hennepin County Pedestrian Plan**

- Walkable communities have a high quality of life, improve personal and environmental health, and promote strong and connected communities and economies.
- Every person is a pedestrian at some point in their day; People share a common desire for a safe, comfortable, and convenient pedestrian experience.
- There are three primary goals of the Hennepin County Pedestrian Plan: Improve the safety of walking; Increase walking for transportation; Improve the health of county residents through walking

# **Hennepin County Complete Streets Policy**

- Hennepin County is committed to develop and maintain a safe, efficient, balanced and environmentally sound county transportation system and to support active living integrating physical activity into daily routines through activities such as biking, walking, or taking transit.
- The County will enhance safety, mobility, accessibility and convenience for all corridor users including pedestrians, bicyclists, transit riders, motorists, commercial and emergency vehicles, and people of all ages and abilities by planning, designing, operating, and maintaining a network of Complete Streets.
- Developing Complete Streets will be a priority on all corridors, including corridors that provide connections or critical linkages between activity centers and major transit connections, and in areas used frequently by pedestrians and bicyclists today or with the potential for frequent use in the future.
- Given the diversity of the natural and built environment in Hennepin County, flexibility in accommodating different modes of travel is essential to balancing the needs of all corridor users.

# Hennepin County Mobility 2040 Transportation Plan

- The County Mobility 2040 Transportation Plan has 5 goals for the transportation system:
  - Preserve and modernize the transportation system
  - o Improve safety, reliability, and comfort for all transportation users
  - o Provide affordable transportation choices and convenient access to destinations

- Improve our transportation system to enhance quality of life, health, livability, and competitiveness
- Create a transportation system that protects and enhances the environment.
- Safety performance indicators in the plan include reducing crash rates for all modes by 50% by 2040 from a baseline of 3.35 crashes per million vehicle miles in 2017.
- 2040 mode share targets in the plan include increasing walk to work rates to 5% from a baseline of 3.4% in 2016, doubling transit ridership from a baseline of 27 million annual trips, and doubling bike to work rates from a baseline of 3.4% of trips in 2016.
- 2040 environmental targets include reducing vehicle miles traveled (VMT) by approximately 4% from 2.14 billion annual VMT to 2.06 billion annual VMT.

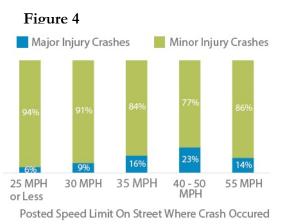
### **Hennepin County Toward Zero Deaths**

- Toward Zero Deaths (TZD) is Minnesota's cornerstone traffic safety program, employing an interdisciplinary approach to reducing traffic crashes, injuries and deaths on Minnesota roads.
- In May 2019, Hennepin County Board accepted a mini grant from the Minnesota Department of Public Safety to launch the County's Toward Zero Deaths Program.
- The Hennepin County TZD Program will create and implement a county-based collaborative effort to improve road safety and build a coalition of governmental agencies, community stakeholders, law enforcement and first responders

# **Minneapolis Pedestrian Crash Study**

The *City of Minneapolis Pedestrian Crash Study (2017)* assessed trends, contributing factors, and characteristics of pedestrian crashes in the City of Minneapolis to better understand where, how, and why pedestrian crashes were occurring. The 2017 Pedestrian Crash Study evaluated the pedestrian crashes over a 10-year period (2007-2016) at all intersections in Minneapolis. A few of the key findings from the study include:

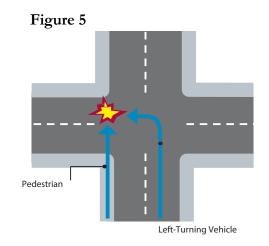
• Speed matters – higher speeds result in increased injury Pedestrian crashes are less likely to be severe on lower speed streets. While the vast majority of pedestrian crashes occur on streets with a 30-mph speed limit, pedestrian crashes increase in severity when they occur along higher speed streets (Figure 4).



- Fewer lanes are better for pedestrians Streets with fewer lanes have fewer pedestrian crashes per mile. Crashes per mile are 2.75 times higher on four lane streets compared to two lane streets, according to the study.
- The majority of pedestrian crashes in the city happen at signalized intersections More than two-thirds of pedestrian crashes occurred at intersections with traffic signals, and the most common location for a pedestrian crash is in a crosswalk area.
- Drivers were more likely to be at fault than pedestrians in crashes Vehicle drivers were found to be most at fault in 62 percent of pedestrian crashes and drivers are more likely than pedestrians to have at least one contributing factor in the crash. The most common contributing factor by a vehicle is failing to yield to the pedestrian right of way
- Left turning vehicles pose a unique threat to pedestrians

Nearly half of pedestrian crashes involved a turning vehicle, and nearly three-quarters of those crashes involve a pedestrian and left-turning vehicle both approach from the same direction prior to the turn (**Figure 5**).

• Pedestrian crashes were overrepresented in areas of concentrated poverty While 31% of Minneapolis residents lived in areas of concentrated poverty during the study period, these areas represented 42% of all pedestrian crashes in the city.



The 2017 Pedestrian Crash Study also identified the top 25 high-crash locations throughout the city based on total crashes and crash rate. These locations were also identified by street jurisdiction, whether it be a City of Minneapolis, Hennepin County or MnDOT-owned street. These high-crash location tables from the 2017 Pedestrian Crash Study formed the basis of location selection within this 2019 City & County Pedestrian Crossing Study. There were a total of 32 unique intersections identified on Hennepin County roadways from these tables. Those 32 intersections are shown on the Location Selection Map (Figure 6, Page 11).

# **Location Selection**

### **Intersection Selection Screening Process**

The 2019 City & County Pedestrian Crossing Study continued the effort of the previous crash study by developing intersection safety improvement concepts at 10 intersections along Hennepin County roads in Minneapolis. The study PMT identified five criteria to further narrow down the top 32 high-crash locations from the previous study, to a list of 10 concept development locations. Each of the factors below weighted towards removing a location from further consideration in discussions with the PMT and TAC.

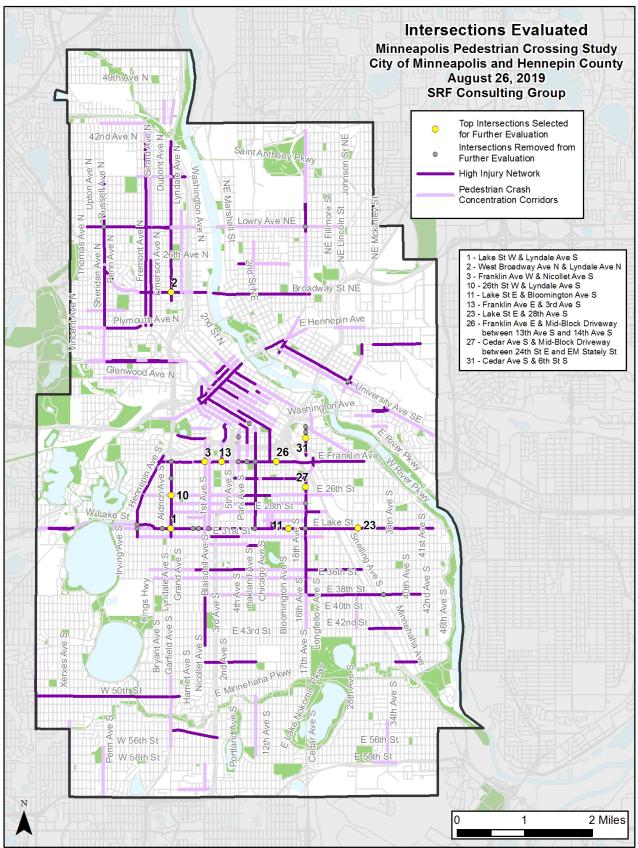
- **Recently improved** The crash data was based on a 10-year period (2007 2016); Some locations had major intersection improvements or corridor crossing improvements constructed within the study period (such as the installation of a traffic signal, pedestrian refuge islands at non-signalized intersections, or full reconstruction that significantly altered street geometry, etc.).
- Planning or design underway separately Certain locations had recent studies or concept level designs already completed by either County or City. While these locations might not have an identified capital project, they were seen as having a parallel design effort already completed or underway.
- Impacted by existing project A few additional locations were impacted by projects already underway within the City/County CIP. These might have an associated design completed, or otherwise will be impacted by major construction that would limit the opportunity for interim change.
- Similar/nearby intersection selected Many high-crash corridors had multiple locations within the list of top 32 ranking high-crash intersections. In such a case, the intersection with the highest crash occurrence was chosen as a representative sample along the corridor or within a characteristic segment. Other nearby lower-crash locations were then eliminated from consideration to provide the study with a broader selection of treatment locations across the city.
- Larger study needed Some locations present complex challenges requiring in-depth analysis beyond the scope of this study. For example, some four lane corridors with multiple high-crash intersections might be suitable for a separate four-to-three lane reduction study. However, this criterion alone did not warrant removing a location from further consideration.

The location selection process, according to the five criteria outlined above, were compiled within the Intersection Evaluation Matrix, provided in <u>Appendix A</u>. Additional consideration was given to intersections that had the greatest opportunity for geometric improvements to the pedestrian crossings. Results of the evaluation process identified the following 10 intersections for concept development, map of the locations is found in **Figure 6** on page 11:

# **Intersection Locations Selected for Conceptual Studies**

- 1. Lake Street W/Lyndale Avenue S (County/County)
- 2. West Broadway Avenue N/Lyndale Avenue N (County/City)
- 3. Franklin Avenue W/Nicollet Avenue S (County/City)
- 4. Lake Street E/Bloomington Avenue S (County/City)
- 5. Franklin Avenue E/3rd Avenue S (County/City)
- 6. 26<sup>th</sup> Street W/Lyndale Avenue S (City/County)
- 7. Lake Street E/28th Avenue S (County/City)
- 8. Franklin Avenue E/Midblock Crossing between 13th Avenue S and 14th Avenue S (County/City)
- 9. Cedar Avenue S/Little Earth Crossing Between midblock south of 24th Street E (County/City)
- 10. Cedar Avenue S/6th Street S (County/City)

Figure 6 : Location Selection Map



# **Improvement Strategies**

The most significant factors that influence pedestrian crashes are well outlined in the City's Pedestrian Crash Study. Among the factors that were most over-represented or influential in determining crash rate and severity were: streets with a higher number of travel lanes, signalized intersection locations, vehicles making left-hand or right-hand turns prior to a crash, evening hours (6pm-3am), and areas of concentrated poverty (ACP-50 census tracts). The engineering improvement strategies highlighted below take a holistic approach to reducing pedestrian crashes by considering these influential crash factors within the broader context of the existing street infrastructure. Both short-term and long-term strategies were considered at each location. Short-term interim strategies are meant to work within existing constraints such as the existing curb geometry, while long-term strategies provide a more substantial solution that might require a deeper assessment of larger trade-offs.

As noted in the City's 2017 Pedestrian Crash Study, vehicle turning maneuvers are a contributing factor to nearly half of pedestrian crashes. At signalized intersections, where the majority of pedestrian crashes in the city are reported, turning vehicles present a conflict with pedestrians crossing legally with the signal. Therefore, in developing the concepts below, much focus was given to slowing turning vehicles and separating vehicle turning maneuvers from pedestrian crossing movements. Also noted in the 2017 Crash Study, efforts to improve pedestrian safety should involve all 6 E's – Engineering, Education, Enforcement, Encouragement, Education, and Equity. While this study focuses on engineering improvements at 10 intersections (i.e., infrastructure improvements), the City of Minneapolis is defining a holistic traffic safety strategy as part of its <u>Vision Zero Action Plan</u>.

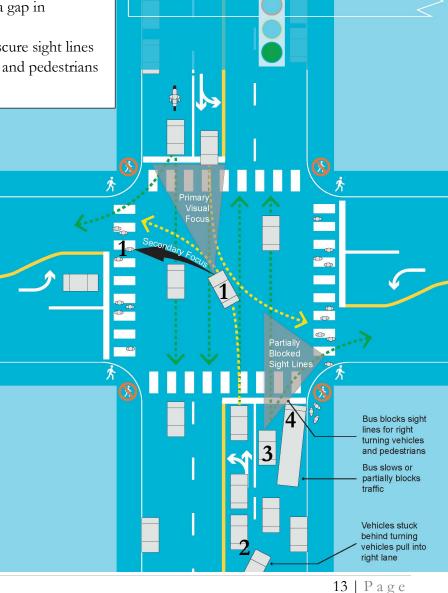
### **Geometric Modifications**

**Four-to-three lane conversions** – Converting a four-lane street to a three-lane street has the potential to improve vehicle safety as well as pedestrian safety at intersections. FHWA (Federal Highway Administration) has documented a crash reduction factor of approximately 30 percent when using this treatment (<u>4</u>). Restriping a four-lane roadway to a three-lane also provides additional space to construct curb extensions, pedestrian refuge islands, and/or bike lanes, which are common treatments that contribute to improved safety. **Figure 7** on page 13 summarizes some of the common operational issues with four lane streets, which can be a contributing factor to crashes. **Figure 8** on page 14 summarizes some of the benefits of four-to-three conversions which may simplify maneuvers and have a positive influence on safety.

### Four Lane Street: Common issues

- 1. Left turning drivers must simultaneously negotiate oncoming traffic and pedestrians in the crosswalk. This has been shown to reduce a driver's mental focus (<u>5</u>), which may increase the risk for crashes, including with pedestrians crossing with the walk signal.
- 2. Vehicle left turn queues block a through lane in each direction, which causes sporadic merging and further increases the risk of rearend or side-swipe crashes.
- **3.** Where pedestrian activity is high, outside lanes might also be blocked by right turning vehicles waiting to negotiate a gap in pedestrian traffic.
- **4.** Nearside bus stops might obscure sight lines between right turning drivers and pedestrians in the crosswalk.

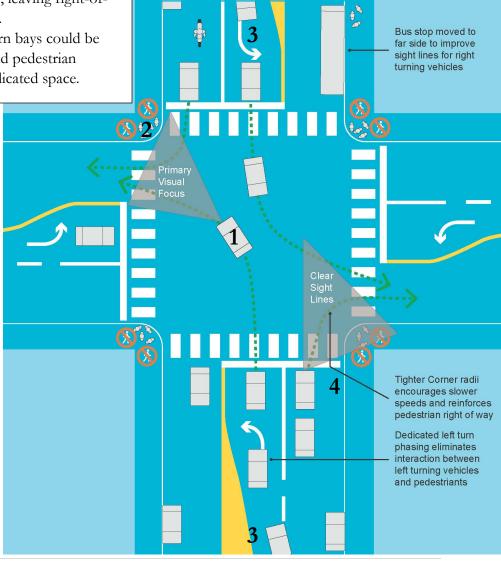
Figure 7



### Three Lane Street with protected-only left turn phasing: Safety and operations advantages

- 1. A protected left turn phase eliminates the possibility that a driver will misjudge simultaneous gaps in oncoming traffic and pedestrians in the crosswalk; the driver simply turns when there is a green arrow
- 2. The protected-only left turn phase separates left turns from pedestrian crossing movements. This effectively eliminates the potential for a left-hand turn crash except in the case of non-compliance violations.
- **3.** Left turn accommodations are consolidated into one opposing left turn lane, rather than in two center travel lanes, leaving right-of-way width for other uses.
- 4. Additional right-hand-turn bays could be added if turn volumes and pedestrian volumes warrant this dedicated space.

Figure 8



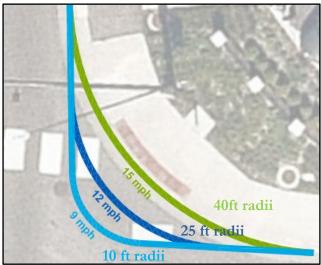
### Figure 9

Add left turn lanes – Similar to the documented safety benefits of a four-to-three lane reduction, adding left turn lanes at an intersection can have a positive effect on reducing crashes. The Left Turn Pedestrian & Bicyclist Crash Study completed by the New York City Department of Transportation (NYDOT) in August 2016, found that adding left-turn lanes reduced left turn pedestrian injuries by 24% and total pedestrian injuries by 9% (6). In that study, NYCDOT provides some reasoning for the observed trend: "left turn bays improve traffic organization by allowing left turning vehicles their own space before turning left, which helps reduce back pressure from other vehicles". In a constrained urban environment, adding left turn lanes should be accommodated by modifying parking along the block rather than impacts to pedestrian or bicycle facilities in the cross section.

**Narrow curb radii** - Minimizing corner radii serves to reduce vehicle turning speeds and shorten pedestrian crossings at an intersection. As shown in **Figure 10**, narrowing the curb radii from 40 feet, to 25 feet, to 10 feet will reduce vehicle turning speed from 15 mph, to 12 mph, to 9 mph, respectively. A smaller turning radius also helps to reinforce the pedestrian's legal right-of- way in the crosswalk to right-turning vehicles. Right turn crashes with larger vehicles are especially serious due to higher ground clearance and susceptibility of pedestrians being crushed by the front or rear wheel.

Temporary treatments such as plastic delineators might serve as an interim treatment for tightening corner radii that could be quickly implemented. Similar devices have been proven effective by NYCDOT and other agencies to tighten radii for smaller vehicles, while still allowing larger commercial vehicles to physically navigate the turn, though with increased caution (Z).







Above: Examples of right turn maneuvers in downtown Minneapolis



**Pedestrian Refuge Median** – Pedestrian refuge medians reduce the crossing distance and time that a pedestrian is exposed to vehicle traffic. These are most effective when coupled with a two or three lane cross section. Ideally refuge medians allow a pedestrian to negotiate one lane of vehicle travel at a time. This prevents a pedestrian from being exposed to a "double threat" scenario, whereby one or more lanes of traffic in a multiplelane crossing does not stop for the pedestrian in the crosswalk. Studies have found that installing pedestrian refuge medians is associated with a 31.5% percent reduction in pedestrian crashes (8).



**Curb extensions** – Curb extensions, or "bumpouts", benefit pedestrians by shortening the crossing distance, and improving sightlines. These are especially beneficial in areas with wide streets and heavy parking utilization, as parked vehicles tend to obscure the sightlines of crossing pedestrians. Corridors with bumpouts as a standard treatment at multiple intersections might also experience a traffic calming effect, as drivers may tend to reduce their speed within this perceived narrower street width.

### **Traffic Signal Modifications**

### Basic pedestrian signal operations

Traffic signal programming can greatly influence the behavior, compliance and safety of pedestrians, bicyclists, and drivers at intersections. City and County should continue to collaboratively test and evaluate the impact of signal operations practices on pedestrian safety throughout the city. The City's Complete Streets Policy should guide the prioritization of signal operations. Aside from conventional vehicle operations metrics, signal operations should be guided by a comprehensive set of multimodal data points at an intersection, including: pedestrian and bicycle counts varying time of day and week, pedestrian compliance with crossing signal, multimodal crash data, adjacent building uses and density, future development, major events and pedestrian generators, and bicycle network attributes.

### Pedestrian Push Button Response Time -

At several unique locations in the city, pedestrian push buttons have been programmed for nearly instantaneous response times. This reduces pedestrian delay and can thereby increase pedestrian safety and pedestrian crossing compliance at the intersection. Portland, Oregon reprogrammed 25 signal locations in a similar manner to reduce pedestrian delay (2). In Minneapolis, this operation has been used sparingly, though it has also shown documented effectiveness at increasing safety.



**Above:** Intersection at Broadway St NE and 5<sup>th</sup> St NE in Minneapolis

Typical locations are along collector or arterials streets outside of a major activity node, where the minor street is an important pedestrian or bicycle network connection. In 2011, the traffic signal at Broadway Street NE and 5<sup>th</sup> Street NE was programmed for greater push button responsiveness along a bicycle boulevard route. An evaluation of this signal revealed a 100% crash reduction for all modes, compared to the un-signalized condition in the three years prior to installation (<u>10</u>).

# Install Leading Pedestrian Interval (LPI) -

LPI is a signal operation feature that gives the walk signal to pedestrians prior to a green light for automobiles. The use of LPI is expected to increase visibility of pedestrians, reduce conflicts between pedestrians and vehicles, and increase the likelihood of motorists yielding to pedestrians. This strategy has the most benefit where there are significant conflicts or crashes with turning vehicles, especially left-turning vehicles.



Above: LPI in downtown Minneapolis

The Left Turn Pedestrian & Bicyclist Crash Study completed by the NYDOT, found that LPI reduced leftturn pedestrian and bicycle injuries by 14 percent and reduced 56 percent of fatal or severe injury type crashes(<u>11</u>). The Federal Highway Administration (FHWA) Safety Evaluation of Protected Left-Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety, dated October 2018 reviewed signals in Chicago, New York City, and Charlotte before and after LPI was installed. The combined cities had a crash modification factor (CMF) for pedestrian crashes of 0.87 (i.e. a 13 percent reduction in pedestrian related crashes) (<u>12</u>).

**Install Protected Left-turn Phasing** - A protected left turn phase eliminates the possibility that a driver will misjudge simultaneous gaps in oncoming traffic and pedestrians in the crosswalk; the driver simply turns when there is a green arrow. This operation has significant potential for reducing severe and fatal crashes for pedestrians crossing legally within the crosswalk. The *Left Turn Pedestrian & Bicyclist Crash Study* completed by the NYDOT, found that installing protected left-turn signals reduced leftturn pedestrian and bicycle serious injuries and fatalities by 33 percent (<u>13</u>).



**Above:** Protected-only left turn in Minneapolis

### Lighting and Sight Line Modifications

**Enhance Lighting Levels** – Improving lighting levels increases pedestrian visibility. Nationwide from 2008 – 2017, between 69 and 74 percent of pedestrian fatalities occurred after dark (<u>14</u>). Time of day trends were not reported in the City's 2016 Pedestrian Crash Study, though time-of-day crash variables were considered in recommending specific treatments within this report. The City's <u>Pedestrian Street Lighting policy</u> provides direction on street lighting standards and fixture types. Replacing outdated high-pressure sodium luminaires with LED luminaires improve light distribution and color-rendering. Additional detailed photometric analysis of existing light locations in the immediate vicinity of the study locations may also identify where additional lighting is warranted.

# **Signing and Striping Modifications**

**Restrict Left-Turns** – Restricting left-turns can reduce the potential for a left-turn pedestrian crash. However, if left-turns are not geometrically restricted, additional enhancements and enforcement may be needed to obtain a high compliance rate. The *Left Turn Pedestrian & Bicyclist Crash Study* completed by the NYDOT, found that restricting left-turn lanes reduced left-turn pedestrian and bicycle injuries by 41 percent.

Restrict Right-Turn on Red - Right-turn on red (RTOR) allowances first received nationwide acceptance as an energy conservation measure in the 1970's. RTOR has subsequently become adopted

as a standard operation in most road jurisdictions nationwide. The MUTCD provides criteria by which RTOR restrictions might be considered, and the City of Minneapolis has its own established guidelines for when to install no right-turn on red (RTOR) signage. Typical criteria for establishment of RTOR restrictions includes locations with high pedestrian volumes, sight distance issues, RTOR crash warrants, unique geometrics, areas near schools, hospitals or other vulnerable pedestrian groups, and locations where an engineering study has recommended installation based upon these or other established factors. However, the City's guidance notes that widespread use of RTOR restrictions was found to be ineffective at reducing pedestrian crashes (15). To increase the probability of effectiveness, this treatment should only be used where implementation criteria are met.

**Install Variable/Dynamic Message Signage** – Variable message signs are typically used to call attention to special conditions such as bus-only lane restrictions, information related to special events, or to encourage safe driving practices. In Minneapolis, variable message signs are primarily located on certain downtown streets and on freeways. As a pedestrian safety measure, variable message signs might be considered along high crash corridors to supplement other safety features related to lane geometry or signalization. For example, this device could be used to restrict turns during certain hours of the day, or to reinforce to drivers that pedestrians have the legal right-of-way in the crosswalk. Variable message signs should be implemented strategically so that they do not proliferate and create visual distractions, which may be counter to safety goals.



**Above:** A variable message sign in Minneapolis alerts drivers to "watch for pedestrians"

**Update Continental Crosswalks to More Durable Material** - Minnesota State Statute establishes pedestrians' right to cross at any intersection regardless of the presence of a marked crosswalk, though marked crosswalks help to further reinforce this law at signalized intersections in the city. In 2016, the City updated its crosswalk marking practices to install continental style crosswalks at all signalized intersections. This style of crosswalk is more visually robust than the previous parallel line crosswalk. The City also installs crosswalks at unsignalized intersections with some form of active warning device, such as a pedestrian flasher or at school patrolled crossings. Replacing crosswalks from standard latex paint material to a more durable poly-preform material improves crosswalk longevity over multiple seasons. This is advantageous throughout the year but is especially beneficial in spring, when it is typically still too cold to refresh crosswalks in latex paint for the season.

Move Stop Bars Back 10' From Marked Crosswalk – Stop bars are a visual indicator to motorists at signalized intersections to keep the nose of vehicles from infringing into the crosswalk. Minneapolis has found that a 10-foot distance between the stop bar and the crosswalk is most effective for vehicle compliance with this marking. Therefore, the City's stop bar setback distance for City-maintained crosswalks is 10 feet. All intersections in this study should be updated to be consistent with this common practice.

Install Left-Turn Traffic Calming (i.e. Median Delineators) - NYCDOT tested installing "left-turn traffic calming" at 107 citywide intersections in 2016, 110 intersections in 2017 and 113 intersections in 2018. Treatments included marking of a guiding radius, permanent plastic delineators and permanent rubber curbs with delineators on the double yellow centerline ("hardened centerline"). As of 2019 at treated intersections, pedestrian injuries were reportedly down by 20%, left turn speeds were down approximately 20% on average, and the number of vehicles crossing the yellow line to make left turns decreased between 80% to 100% depending upon the type of treatment (15). These positive results might provide reason for City and County to consider testing similar treatments locally.



**Above:** Example of left turn traffic calming (Source, NYCDOT)

# **Intersection Concept Improvements**

### **Conceptual Design and Cost Estimating Overview**

Intersection concepts were developed using the above strategies for the 10 intersections selected for the study. The existing layouts and improvement concepts for the 10 intersections are included in the figures within this section (Figures 9A to 18C). These concepts and their associated cost estimates are based on a planning level review. Further study and engineering design would need to be conducted to better understand the feasibility of each concept and more accurately assess the costs.

The cost estimates represent the extent of improvements illustrated in the concept figures and are broken down into four main categories:

- Geometric Modifications
- Traffic Signals
- Lighting
- Signing and Striping

Since the designs are at a concept level, a contingency factor of 20% is included in each line item. Additionally, Contractor Mobilization and Traffic Control for the future construction site is also included. In concepts that propose lane reconfiguration that would go beyond the immediate intersection (such as a 4-lane to 3-lane conversion), only the immediate intersection costs are included. Extensive striping extending further along the block face is not included.

### **Guiding Principles**

Several primary **Guiding Principles** were used when developing the proposed improvements for each intersection:

- Reduce potential for interaction between modes through physical separation and signal phasing
- Promote safer travel speeds through intersections. Reducing travel speed gives more opportunity for motorists and pedestrians to react and avoid crashes and reduces crash severity.
- Layer multiple improvements (geometric modifications, traffic signals, lighting, signing and striping) to comprehensively address issues at each location.
- Shorten crossings to minimize the time that pedestrians are in the roadway.
- Increase pedestrian visibility to motorists.

### **Intersection Characteristics**

The Lake Street/Lyndale Avenue intersection is the center of the busy Lyn-Lake commercial district, with many bars, restaurants, residential, and retail establishments. Due to the number of adjacent nighttime entertainment uses, the intersection is especially busy during PM hours. The intersection is currently signalized with left-turn protected/permitted phasing on Lyndale Avenue. At this intersection, Lake Street is a four-lane undivided roadway with no turn lanes and Lyndale Avenue is a four-lane undivided roadway with additional left-turn lanes. There are existing curb bump outs at each corner of the intersection and on-street parking along both sides of each roadway. There are transit stops along Lake Street and along Lyndale Avenue. A graphic illustrating existing conditions is shown in **Figure 11A** below.

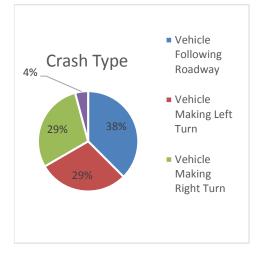
Currently Lake Street is signed as no left-turns during the a.m. (7:00 to 9:00 a.m.) and p.m. (4:00 to 6:00 p.m.) peak periods. Traffic count data show that there are motorists that do not comply with the signing. Crash data indicate that lack of compliance to no left-turn related pedestrian crashes were reported during the a.m. and p.m. peak periods.



### Figure 11A : Existing Conditions

### **Crash History**

### Figure 11B

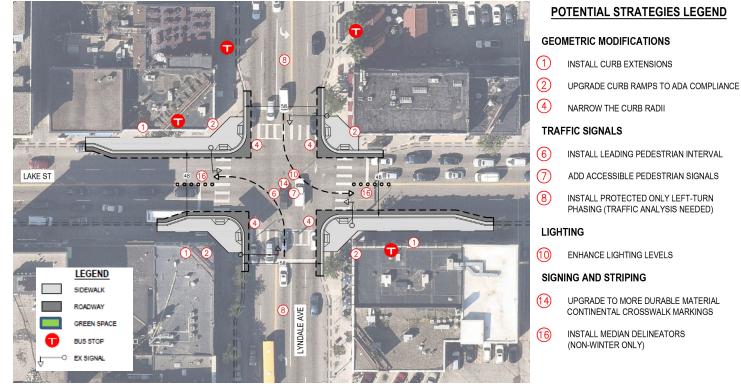


- A total of 24 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- This intersection had the highest number of reported pedestrian crashes in the city.
- Approximately 60 percent of pedestrian crashes occurred when a vehicle was making a left- or right-turn and 40 percent of crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- Similar number of crashes for pedestrians crossing Lake Street and Lyndale Avenue
- Of the 24 crashes, 16 occurred during the evening (between 8:00 p.m. and 3:00 a.m.)

### Recommendations

Two safety improvement concepts were developed and are illustrated in **Figure 11C** and **Figure 11D**. Concept 1 focus more on interim treatments within the existing lane geometry, while Concept 2 proposes major changes to the geometry that would require further study. Both concepts include accommodating future bus stops for the Metro Transit B Line Bus Rapid Transit (BRT), slated to open in 2023. The two concepts both include expanded curb extensions, enhanced lighting levels, modified curb radii to reduce vehicle turning speeds and increase the pedestrian queuing area, LPI, protected only left-turn phasing for northbound/southbound left-turns, modifications to the intersection to be ADA compliant, and upgrading the crosswalk to a more durable material. As noted under crash history, a high percentage of crashes at this intersection are occurring when it is dark. With headlight glare and the current lighting levels, it is difficult to see pedestrians waiting to cross at the intersection. A lighting evaluation should be conducted, with reference to the City's Pedestrian Street Lighting Policy, to determine what type of lighting improvements are appropriate.

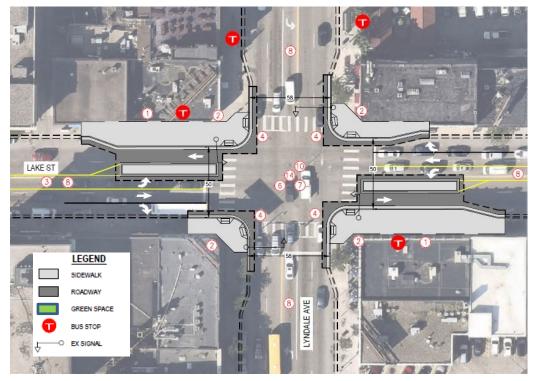
**Concept 1 (Figure 11C)** – This concept proposes to install centerline delineators as a left-turn traffic calming treatment. Protected-only left turn signal phasing is also proposed for Lyndale Ave which is meant to reduce the crash potential on the east and west intersection legs. Curb geometry reflects a typical BRT station area design, in anticipation for future BRT along the corridor.



#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON
   FUTURE B-LINE ARTERIAL BRT STOPS

**Concept 2 (Figure 11D)** – This concept proposes to convert Lake Street to a three-lane roadway with eastbound and westbound left-turn and right-turn lanes. To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Lake Street rather than implemented as an intersection-specific treatment. This concept also proposes protected-only left turn phasing on Lake Street and on Lyndale Ave. This would physically separate all left turning vehicle movements from pedestrian crossing movements at this intersection. Further traffic analysis and refinement is needed to verify the lane and curb geometry, and signal operations proposed in this concept.



### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
   UPGRADE CURB RAMPS TO ADA COMPLIANCE
   CONVERT TO THREE LANES (TRAFFIC ANALYSIS NEEDED)
   NARROW THE CURB RADII
   TRAFFIC SIGNALS
- 6 INSTALL LEADING PEDESTRIAN INTERVAL
- (7) ADD ACCESSIBLE PEDESTRIAN SIGNALS
- 8 INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

(10) ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON FUTURE B-LINE ARTERIAL BRT STOPS
- PERFORM A CORRIDOR STUDY ALONG LAKE
   STREET TO ASSESS LANE RECONFIGURATION

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below. These are planning-level estimates which do not include design or other soft costs.

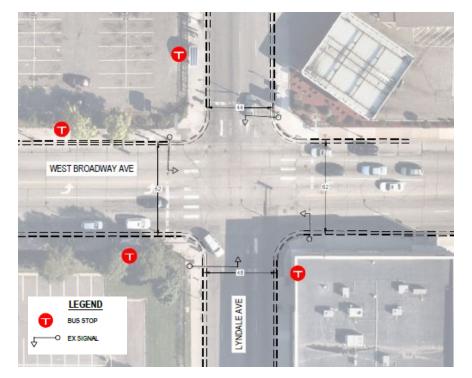
Lake Street/ Lyndale Avenue	Concept 1	Concept 2
Geometric Modifications	\$143,000	\$186,000
Traffic Signals	\$60,000	\$60,000
Lighting	\$8,000	\$8,000
Signing and Striping	\$29,000	\$24,000
Mobilization	\$12,000	\$14,000
Traffic Control	\$8,000	\$9,000
Total Estimate	\$260,000	\$301,000

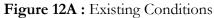
### Coordination

- Both Concept 1 and Concept 2 recommend installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts, in order to assess the potential safety advantages of implementing this treatment.
- Prior to implementation of Concept 2, a corridor study is recommended along Lake Street to review the operational impacts to traffic operations and confirm that bus operations are reasonably accommodated. In this further study, priority transit facilities might be explored to accommodate transit operations over general-purpose travel, to mitigate operational impacts to this higher efficiency mode.
- Additional coordination is needed with Metro Transit to further review plans for a future Metro Transit B Line BRT stop. This includes refined station dimensions and boarding location for future BRT vehicles as well as local service bus.

### **Intersection Characteristics**

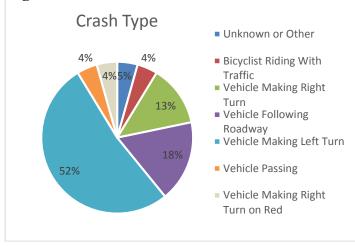
The West Broadway Avenue/Lyndale Avenue intersection is located on a busy commercial corridor in North Minneapolis a few blocks west of Interstate 94. Immediately adjacent uses include a grocery store, liquor store, pharmacy, and gas station. This intersection is currently signalized with left-turn protected/permitted phasing on West Broadway Avenue. At this intersection, West Broadway is a four-lane undivided roadway with left-turn lanes and Lyndale Avenue is a four-lane undivided roadway with no turn lanes and transitions to a two-lane roadway north of West Broadway Avenue. There are transit stops along West Broadway (westbound is farside and eastbound is nearside) and along Lyndale Avenue (both are nearside). A graphic illustrating existing conditions is shown in **Figure 12A**.





### **Crash History**

### Figure 12B

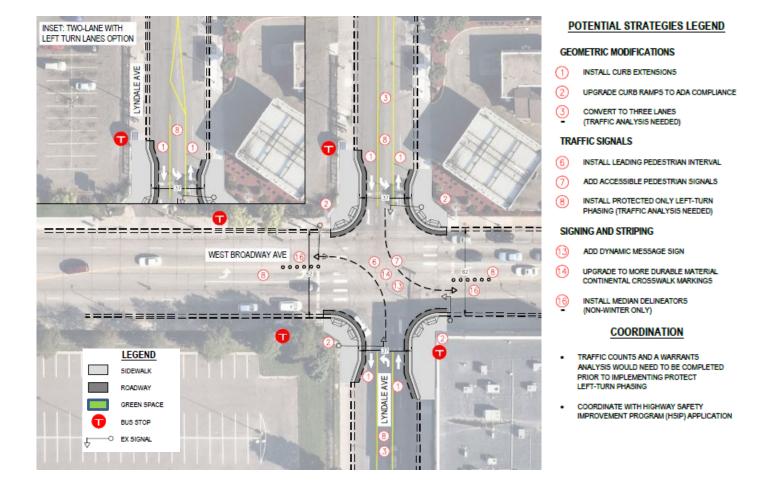


- A total of 23 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 70 percent of pedestrian crashes occurred when a vehicle was making a left- or right-turn.
- A majority (70 percent) of the pedestrians were crossing West Broadway Avenue when hit by a vehicle.

### Recommendations

A safety improvement concept was developed and is illustrated in **Figure 12C**. To reduce left-turn related crashes, this concept proposes to convert Lyndale Avenue to a three-lane roadway (or a two-lane roadway with left-turn lanes at the West Broadway Avenue intersection), install LPI, install protected only left-turn phasing for West Broadway Avenue, and install median delineators for the left-turn traffic calming treatment. In addition, the concept proposes to modify the intersection to be ADA compliant, install curb extensions on Lyndale Avenue to reduce the crossing distance and improve visibility and to install a dynamic message sign to alert motorists that a pedestrian is crossing. The dynamic message sign so that the sign is activated when the detection identifies a pedestrian crossing.

**Concept 1 (Figure 12C)** – The concept shows an alternative option for the Lyndale Avenue segment north of West Broadway Avenue. Instead of a three-lane segment, a two-lane roadway with left-turn lanes at key intersections could also be considered. In addition to reducing vehicle speed, a two-lane roadway would provide additional space for on-street parking to the north.



### **Estimated Costs**

Estimated construction costs are summarized in the table below. These are planning-level estimates which do not include design or other soft costs.

West Broadway Avenue/ Lyndale Avenue		Cost
Geometric Modifications		\$129,000
Traffic Signals		\$60,000
Lighting		\$8,000
Signing and Striping		\$29,000
Mobilization		\$12,000
Traffic Control		\$7,000
	Total Estimate	\$245,000

### Coordination

- This concept recommends installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts to assess the potential safety advantages of implementing this treatment.
- Hennepin County is submitting a Highway Safety Improvement Program (HSIP) funding application for this intersection, which includes Flashing Yellow Arrows (FYA) along West Broadway. Additional coordination is needed to determine if/when FYA and protected left-turn phasing should be implemented throughout the day.

### **Intersection Characteristics**

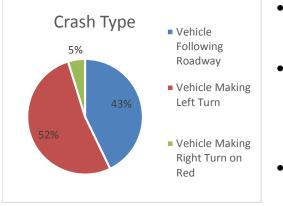
The Franklin Avenue/Nicollet Avenue intersection is a major intersection along the Nicollet Ave commercial corridor, also known as "Eat Street". Immediately adjacent uses include mixed-use commercial/residential buildings, a church, and a liquor store to the south. Franklin Avenue and Nicollet Ave both serve high-frequency transit routes, which contributes to high pedestrian activity at this intersection. The surrounding Whittier and Steven's Square neighborhoods contain dense multifamily housing which similarly contributes to pedestrian activity in the area. The intersection is signalized with permissive left-turns on all approaches. At this intersection, Franklin Avenue is a four-lane undivided roadway with no turn lanes and Nicollet Avenue is a two-lane undivided roadway with additional left-turn lanes. On-street parking is permitted outside of weekday peak hours along the curbside lanes of Franklin Ave. A graphic illustrating existing conditions is shown in **Figure 13A**.



### Figure 13A : Existing Conditions

### **Crash History**

### Figure 13B

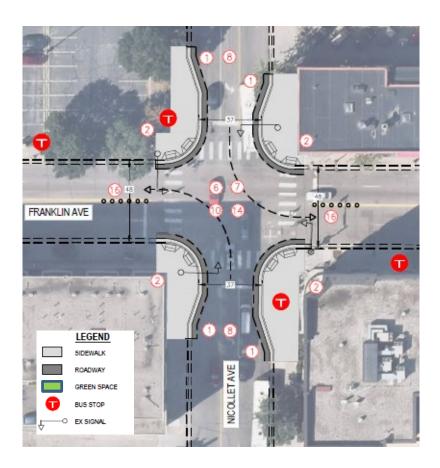


- A total of 21 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 50 percent of pedestrian crashes occurred when a vehicle was making a left-turn and 45 percent of crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- A similar number of crashes for pedestrians crossing Franklin Avenue and. Nicollet Avenue (9 and 8, respectively).

### **Recommendations**

To improve pedestrian safety, two concepts were developed and are illustrated in **Figure 13C** and **Figure 13D**. Concept 1 focus more on interim treatments within the existing lane geometry, while Concept 2 proposes major changes to the geometry that would require further study. Both options include enhanced lighting levels, curb extensions on Nicollet Avenue, installing LPI, modifying the intersection to be ADA compliant, and upgrading the crosswalk to a more durable material.

**Concept 1 (Figure 13C)** – Concept 1 proposes to install median delineators for the left-turn traffic calming treatment. Protected-only left turn signal phasing is also proposed for Nicollet Ave, which is meant to reduce the crash potential on the east and west intersection legs.



### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- 1 INSTALL CURB EXTENSIONS
- 2 UPGRADE CURB RAMPS TO ADA COMPLIANCE

#### TRAFFIC SIGNALS

- (6) INSTALL LEADING PEDESTRIAN INTERVAL
- ADD ACCESSIBLE PEDESTRIAN SIGNALS
- INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

(10) ENHANCE LIGHTING LEVELS

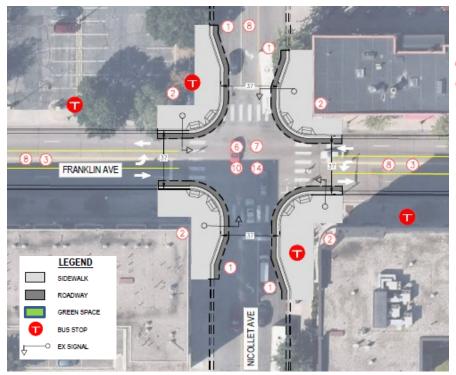
#### SIGNING AND STRIPING

- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- INSTALL MEDIAN DELINEATORS (NON-WINTER ONLY)

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON FUTURE STREET CAR STUDY

**Concept 2 (Figure 13D)** – Concept 2 proposes to convert Franklin Avenue to a three-lane facility (or a two-lane roadway with left-turn lanes at key intersections). To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Franklin Ave rather than implemented as an intersection-specific treatment. This concept also proposes protected-only left turn phasing on Franklin Ave as well as on Nicollet Ave. This would separate all left turning vehicle movements from pedestrian crossing movements at this intersection. Further traffic analysis and refinement is needed to verify the lane and curb geometry, and signal operations proposed in this concept.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
- UPGRADE CURB RAMPS TO ADA COMPLIANCE
- CONVERT TO THREE LANES (TRAFFIC ANALYSIS NEEDED)

#### TRAFFIC SIGNALS

- 6 INSTALL LEADING PEDESTRIAN INTERVAL
- 7) ADD ACCESSIBLE PEDESTRIAN SIGNALS
- INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

- (10) ENHANCE LIGHTING LEVELS
- SIGNING AND STRIPING
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON FUTURE STREET CAR STUDY
- PERFORM A CORRIDOR STUDY ALONG FRANKLIN AVENUE TO ASSESS LANE NECONFIGURATION

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below.

Franklin Avenue/ Nicollet Avenue	Concept 1	Concept 2
Geometric Modifications	\$147,000	\$161,000
Traffic Signals	\$60,000	\$60,000
Lighting	\$8,000	\$8,000
Signing and Striping	\$29,000	\$24,000
Mobilization	\$13,000	\$13,000
Traffic Control	\$8,000	\$8,000
Total Estimate	\$265,000	\$274,000

### Coordination

- Both Concept 1 and Concept 2 recommend installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts, in order to assess the potential safety advantages of implementing this treatment.
- Prior to implementation of Concept 2, a corridor operations study is recommended along Franklin Avenue. The County is currently conducting this study and expects it to be completed in 2020.
- Additional coordination is needed with Metro Transit to review plans for a future transitway along Nicollet Avenue.

# Lake Street E/Bloomington Avenue S

### **Intersection Characteristics**

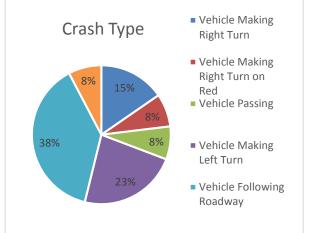
The land use immediately around the East Lake Street/Bloomington Avenue South intersection is an busy neighborhood commercial hub and includes the Mercado Centrale on the southwest corner. The intersection is currently signalized with left-turn protected/permitted phasing on Bloomington Avenue. At this intersection, Lake Street is a four-lane undivided roadway with no turn lanes and Bloomington Avenue is a two-lane undivided roadway with left-turn lanes. There are transit stops along West Broadway (westbound is farside and eastbound is nearside) and along Lyndale Avenue (both are nearside). A graphic illustrating existing conditions is shown in **Figure 14A**. Currently Lake Street is signed as no left-turns during the a.m. (7:00 to 9:00 a.m.) and p.m. (4:00 to 6:00 p.m.) peak periods. Traffic count data indicates that there are motorists that are not in compliance with the signing.

### Figure 14A : Existing Conditions



### **Crash History**

### Figure 14B

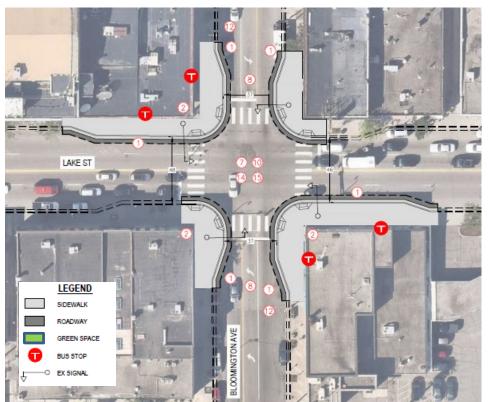


- A total of 13 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 45 percent of pedestrian crashes occurred when a vehicle was making a left- or right-turn and 40 percent of crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- A majority (70 percent) of the pedestrians were crossing Bloomington Avenue when hit by a vehicle.

### Recommendations

To improve pedestrian safety, two concepts were developed and are illustrated in **Figure 14C** and **Figure 14D**, respectively. Both options include modifying the intersection to be ADA compliant, installing protected only left-turn phasing on Bloomington Avenue, restricting right-turn on red, enhancing lighting levels, and upgrading the crosswalk to a more durable material. Concept 1 focus more on interim treatments within the existing lane geometry, while Concept 2 proposes major changes to the geometry that would require further study.

**Concept 1 (Figure 14C)** – Concept 1 proposes to install curb extensions on all approaches to reduce the crossing distance and improve visibility. Protected-only left turn signal phasing is also proposed for Bloomington Ave, which is meant to reduce the crash potential on the east and west intersection legs.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- 1 INSTALL CURB EXTENSIONS
- UPGRADE CURB RAMPS TO ADA COMPLIANCE

#### TRAFFIC SIGNALS

- ADD ACCESSIBLE PEDESTRIAN SIGNALS
- 8 INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

O ENHANCE LIGHTING LEVELS

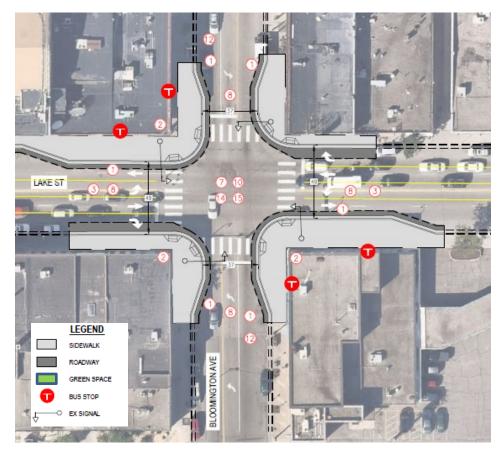
#### SIGNING AND STRIPING

- (12) RESTRICT RIGHT TURN ON RED
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- MOVE STOP BARS BACK 10' FROM MARKED CROSSWALK

#### COORDINATION

 COORDINATE WITH METRO TRANSIT ON FUTURE 8-LINE ARTERIAL BRT STOPS

**Concept 2 (Figure 14D)** – Concept 2 proposes to convert Lake Street to a three-lane facility (or a two-lane roadway with left-turn lanes at key intersections) with protected left-turn phasing on Lake Street. To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Lake Street rather than implemented as an intersection-specific treatment. This concept also proposes protected-only left turn phasing on Lake Street and on Lyndale Ave. This would physically separate all left turning vehicle movements from pedestrian crossing movements at this intersection. Further traffic analysis and refinement is needed to verify the lane and curb geometry, and signal operations proposed in this concept.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- 1 INSTALL CURB EXTENSIONS
- 2) UPGRADE CURB RAMPS TO ADA COMPLIANCE
- CONVERT TO THREE LANES
   (TRAFFIC ANALYSIS NEEDED)

## TRAFFIC SIGNALS

- 7) ADD ACCESSIBLE PEDESTRIAN SIGNALS
- INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

10 ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

- 2 RESTRICT RIGHT TURN ON RED
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- MOVE STOP BARS BACK 10' FROM MARKED CROSSWALK

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON FUTURE 8-LINE ARTERIAL BRT STOPS
- PERFORM A CORRIDOR STUDY ALONG LAKE STREET TO ASSESS LANE RECONFIGURATION

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below.

Lake Street/ Bloomington Avenue	Concept 1 Cost	Concept 2 Cost
Geometric Modifications	\$188,000	\$218,000
Traffic Signals	\$60,000	\$60,000
Lighting	\$8,000	\$8,000
Signing and Striping	\$24,000	\$24,000
Mobilization	\$14,000	\$16,000
Traffic Control	\$9,000	\$10,000
TOTAL ESTIMATE	\$303,000	\$336,000

### Coordination

- Both Concept 1 and Concept 2 recommend installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts, in order to assess the potential safety advantages of implementing this treatment.
- Prior to implementation of Concept 2, a corridor study is recommended along Lake Street to review the operational impacts to traffic operations and confirm that bus operations are reasonably accommodated at this intersection. In this further study, priority transit facilities might be explored to accommodate transit operations over general-purpose travel, to mitigate operational impacts to this higher efficiency mode.
- Additional coordination is needed with Metro Transit to further review plans for a future Metro Transit B Line BRT stop.

### **Intersection Characteristics**

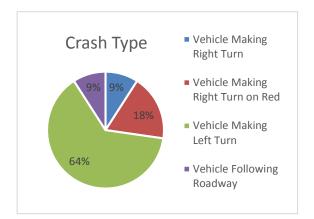
The Franklin Avenue/3rd Avenue intersection is a few blocks west of Interstate 35W in a predominantly multi-family residential area with the exception of the gas station on the southwest corner. The intersection is currently signalized with left-turn permitted phasing on all approaches. At this intersection, Franklin Avenue is a four-lane undivided roadway with no turn lanes and 3rd Avenue is a two-lane undivided roadway with no turn lanes. There is on-street parking along 3rd Avenue (parking on the east side is permitted at all hours of the day; however, parking on the west side is restricted during the weekday p.m. peak period and used as a travel lane). There is on-street parking along Franklin Avenue along the outside travel lanes; on-street parking is restricted on weekdays during the a.m. and p. m. peak period so that Franklin Avenue can operate as a four-lane roadway during the peak times. There are transit stops along Franklin Avenue and along Nicollet Avenue. A graphic illustrating existing conditions is shown in **Figure 15A**.



### Figure 15A : Existing Conditions

### **Crash History**

Figure 15B

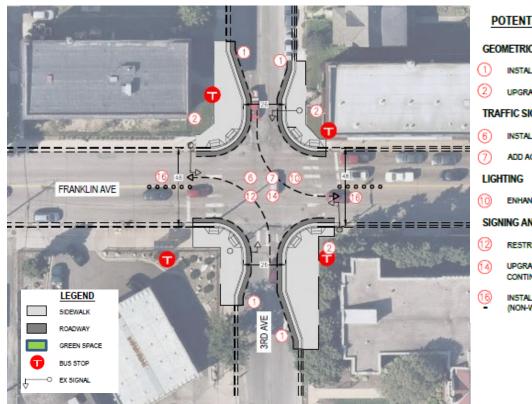


- A total of 11 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 65 percent of pedestrian crashes occurred when a vehicle was making a left-turn and 25 percent of crashes occurred when a vehicle was making a right-turn.
- A majority (90 percent) of crashes occurred when pedestrians were crossing Franklin Avenue.

### Recommendations

To improve pedestrian safety, two concepts were developed and are illustrated in **Figure 15C** and **Figure 15D**, respectively. Both concepts include enhanced lighting levels, curb extensions on 3rd Avenue (which would remove the second southbound thru travel lane along 3rd Avenue during the p.m. peak period), installing LPI, modifying the intersection to be ADA compliant, and upgrading the crosswalk to a more durable material.

Concept 1 (Figure 15C) - Concept 1 proposes to install median delineators for the left-turn traffic calming treatment in addition to the treatments described above.



### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
- UPGRADE CURB RAMPS TO ADA COMPLIANCE

#### TRAFFIC SIGNALS

- INSTALL LEADING PEDESTRIAN INTERVAL
- ADD ACCESSIBLE PEDESTRIAN SIGNALS
- ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

- RESTRICT RIGHT TURN ON RED
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- INSTALL MEDIAN DELINEATORS (NON-WINTER ONLY)

**Concept 2 (Figure 15D)** – Concept 2 proposes to convert Franklin Avenue to a three-lane facility (or a two-lane roadway with left-turn lanes that are developed at key intersections). To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Franklin Ave rather than implemented as an intersection-specific treatment. Further traffic analysis and refinement is needed to verify the lane and curb geometry proposed in this concept. The County has plans to conduct a corridor study along Franklin Avenue to review the impacts of the three-lane conversion to traffic operations along the corridor.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
- 2 UPGRADE CURB RAMPS TO ADA COMPLIANCE
  - CONVERT TO THREE LANES
  - (TRAFFIC ANALYSIS NEEDED)

#### TRAFFIC SIGNALS

- INSTALL LEADING PEDESTRIAN INTERVAL
- ADD ACCESSIBLE PEDESTRIAN SIGNALS

#### LIGHTING

(1) ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

- 12 RESTRICT RIGHT TURN ON RED
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS

#### COORDINATION

COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below.

Franklin Avenue/ 3rd Avenue	Concept 1 Cost	Concept 2 Cost
Geometric Modifications	\$141,000	\$144,000
Traffic Signals	\$60,000	\$60,000
Lighting	\$8,000	\$8,000
Signing and Striping	\$29,000	\$24,000
Mobilization	\$12,000	\$12,000
Traffic Control	\$8,000	\$7,000
TOTAL ESTIMATE	\$258,000	\$255,000

### Coordination

Prior to implementation of Concept 2, a corridor operations study is recommended along Franklin Avenue. The County is currently conducting this study and expects it to be completed in 2020.

### **Intersection Characteristics**

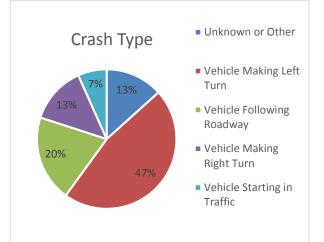
The 26th Street/Lyndale Avenue intersection is the focus of an active neighborhood mixed-use commercial and residential area. In the southeast corner, a new larger mixed-use building (shown under construction in the image below) is now complete. The intersection is currently signalized, and 26th Street is a two-lane undivided one-way westbound roadway with a right-turn lane. 26th Street has on-street parking on the south side and on-street protected bike lanes on the north side. Lyndale Avenue is a four-lane undivided roadway with no turn lanes and on-street parking on both sides. There are transit stops along Lyndale Avenue (both are nearside). A graphic illustrating existing conditions is shown in **Figure 16A**.



Figure 16A: Existing Conditions

### **Crash History**

### Figure 16B

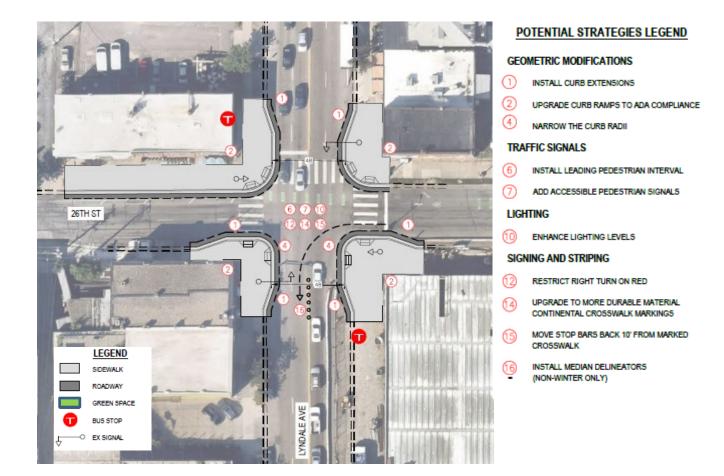


- A total of 15 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 60 percent of pedestrian crashes occurred when a vehicle was making a left- or right-turn and 20 percent of crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- A majority (70 percent) of the pedestrians were crossing Lyndale Avenue when hit by a vehicle.

### **Recommendations**

To improve pedestrian safety, two concepts were developed and are illustrated in **Figure 16C** and **Figure 16D**. Both concepts include modifying the intersection to be ADA compliant, installing curb extensions on 26th Street to reduce the crossing distance and improve visibility, restricting right-turn on red, and enhancing lighting levels. Prior to implementation, a corridor study should be conducted along Lyndale Ave S to review the impacts of the three-lane conversion concept to traffic operations and confirm that bus operations can continue to be reasonably accommodated at this intersection.

**Concept 1 (Figure 16C)** – Concept 1 proposes to construct curb extensions on Lyndale Avenue and install median delineators for the left-turn traffic calming treatment. The existing protected bikeway along 26<sup>th</sup> St E could potentially be realigned behind the curb at the intersection.



**Concept 2 (Figure 16D)** – Concept 2 proposes to convert Lyndale Avenue to a three-lane facility (or a two-lane roadway with left-turn lanes at key intersections) with protected left-turn phasing. A southbound right-turn lane is also recommended along Lyndale Avenue at this intersection. To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Lyndale Ave rather than implemented as an intersection-specific treatment. Further traffic analysis and refinement is needed to verify the lane and curb geometry proposed in this concept.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
- UPGRADE CURB RAMPS TO ADA COMPLIANCE
- CONVERT TO THREE LANES
   (TRAFFIC ANALYSIS NEEDED)
- A NARROW THE CURB RADII

#### TRAFFIC SIGNALS

- 6) INSTALL LEADING PEDESTRIAN INTERVAL
- ADD ACCESSIBLE PEDESTRIAN SIGNALS
- INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)
- LIGHTING
- ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

- RESTRICT RIGHT TURN ON RED
- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- MOVE STOP BARS BACK 10' FROM MARKED CROSSWALK)

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- PERFORM A CORRIDOR STUDY ALONG LYNDALE AVENUE TO ASSESS LANE RECONFIGURATION

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below.

26th Street/ Lyndale Avenue	Concept 1 Cost	Concept 2 Cost
Geometric Modifications	\$192,000	\$240,000
Traffic Signals	\$72,000	\$72,000
Lighting	\$8,000	\$8,000
Signing and Striping	\$24,000	\$24,000
Mobilization	\$15,000	\$18,000
Traffic Control	\$9,000	\$11,000
TOTAL ESTIMATE	\$320,000	\$373,000

### Coordination

- Both Concept 1 and Concept 2 recommend installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts, in order to assess the potential safety advantages of implementing this treatment.
- Prior to implementation of Concept 2, a corridor study is recommended along Lyndale Ave to review the operational impacts to traffic operations and confirm that bus operations are reasonably accommodated at this intersection. In this further study, priority transit facilities might be explored to accommodate transit operations over general-purpose travel, to mitigate operational impacts to this higher efficiency mode.

### **Intersection Characteristics**

The Lake Street/28th Avenue intersection is surrounded by four different land uses – neighborhood commercial, a bank, multi-family residential, and a Hennepin County Public Library. It is currently signalized with left-turn permitted phasing on all approaches. At this intersection, Lake Street is a four-lane undivided roadway with no turn lanes, and 28th Avenue is a two-lane undivided roadway with no turn lanes. There is on-street parking along Lake Street and 28th Avenue. There are transit stops along Lake Street (both nearside). A graphic illustrating existing conditions is shown in **Figure 17A**.

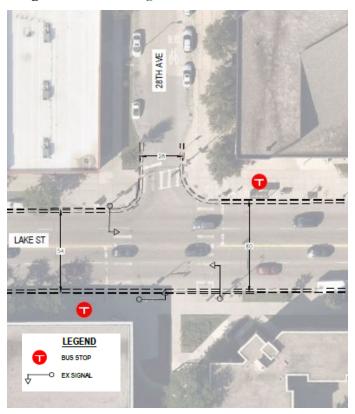
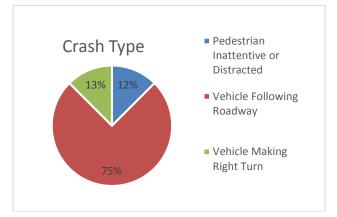


Figure 17A : Existing Conditions

### **Crash History**

### Figure 17B

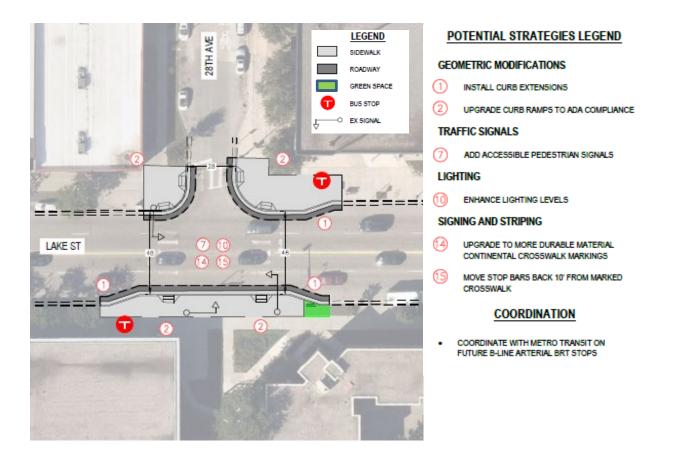


- A total of 8 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 75 percent of pedestrian crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- A majority (90 percent) of crashes occurred when pedestrians were crossing Lake Street.

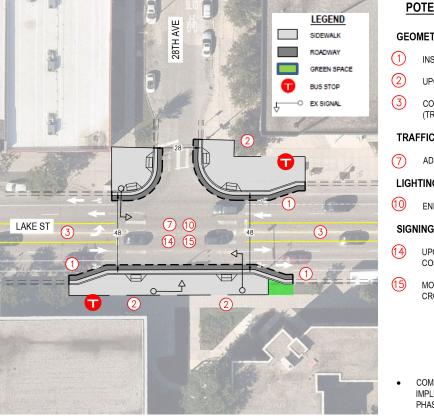
### **Recommendations**

To improve pedestrian safety, two concepts were developed and are illustrated in **Figure 17C** and **Figure 17D**. Both concepts include enhanced lighting levels, curb extensions on Lake Street and 28th Avenue, modifying the intersection to be ADA compliant, and upgrading the crosswalk to a more durable material.

**Concept 1 (Figure 17C)** – Concept 1 proposes curb extensions, including within the southern curb line of this "T" intersection.



Concept 2 (Figure 17D) - Concept 2 proposes to convert Lake Street to a three-lane facility (or a two-lane roadway with left-turn lanes at key intersections) with on-street bike lanes and protected leftturn phasing on Lake Street. To increase continuity and safety along the corridor, a three-lane section should be explored for a longer segment of Lyndale Ave rather than implemented as an intersectionspecific treatment. Further traffic analysis and refinement is needed to verify the lane and curb geometry proposed in this concept.



### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- INSTALL CURB EXTENSIONS
- UPGRADE CURB RAMPS TO ADA COMPLIANCE
- CONVERT TO THREE LANES (TRAFFIC ANALYSIS NEEDED)

#### TRAFFIC SIGNALS

ADD ACCESSIBLE PEDESTRIAN SIGNALS

#### LIGHTING

ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

- UPGRADE TO MORE DURABLE MATERIAL CONTINENTAL CROSSWALK MARKINGS
- MOVE STOP BARS BACK 10' FROM MARKED CROSSWALK

#### COORDINATION

- COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECTED LEFT-TURN PHASING
- COORDINATE WITH METRO TRANSIT ON FUTURE B-LINE ARTERIAL BRT STOPS
- PERFORM A CORRIDOR STUDY ALONG LAKE STREET TO ASSESS LANE RECONFIGURATION
- COORDINATE WITH THE CITY OF MINNEAPOLIS ON POTENTIAL LAKE STREET **BIKE ROUTE**

### **Estimated Costs**

Estimated construction costs for Concept 1 and Concept 2 are summarized in the table below.

Lake Street/ 28th Avenue	Concept 1 Cost	Concept 2 Cost
Geometric Modifications	\$117,000	\$117,000
Traffic Signals	\$12,000	\$12,000
Lighting	\$5,000	\$5,000
Signing and Striping	\$18,000	\$18,000
Mobilization	\$8,000	\$8,000
Traffic Control	\$5,000	\$5,000
TOTAL ESTIMATE	\$165,000	\$165,000

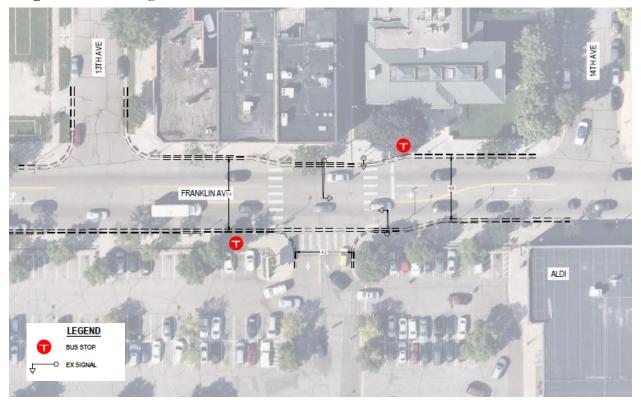
### Coordination

- Prior to implementation of Concept 2, a corridor study is recommended along Lake Street to review the operational impacts to traffic operations and confirm that bus operations are reasonably accommodated at this intersection. In this further study, priority transit facilities might be explored to accommodate transit operations over general-purpose travel, to mitigate operational impacts to this higher efficiency mode. Bikeway connectivity for East Lake Street might also be considered along the corridor due to close proximity to the Lake Street / Marshall Street bridge over the Mississippi River.
- Additional coordination is needed with Metro Transit to further review plans for a future Metro Transit B Line BRT stop.

## Franklin Avenue E/Midblock Crossing between 13th Ave S and 14th Ave S

### **Intersection Characteristics**

This high-crash study location is a signalized driveway serving a grocery store between 13<sup>th</sup> Ave S and 14<sup>th</sup> Ave S in the Midtown Philips segment of Franklin Ave. In addition, the intersection has smallerscale neighborhood commercial properties, including Hennepin County Public Library on the north side. It is currently signalized with left-turn protected/permitted phasing on Franklin Avenue (westbound left-turn). At this intersection, Franklin Avenue is a three-lane roadway with a center twoway left-turn lane and the grocery store commercial access has a left- and right-turn lanes exiting. There are high-frequency transit stops along Franklin Avenue (both are nearside). A graphic illustrating existing conditions is shown in **Figure 18A**.

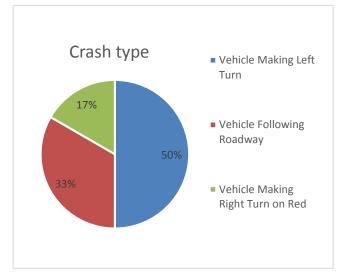


### Figure 18A : Existing Conditions

## Franklin Avenue E/Midblock Crossing between 13th Ave S and 14<sup>th</sup> Ave S

### **Crash History**

### Figure 18B



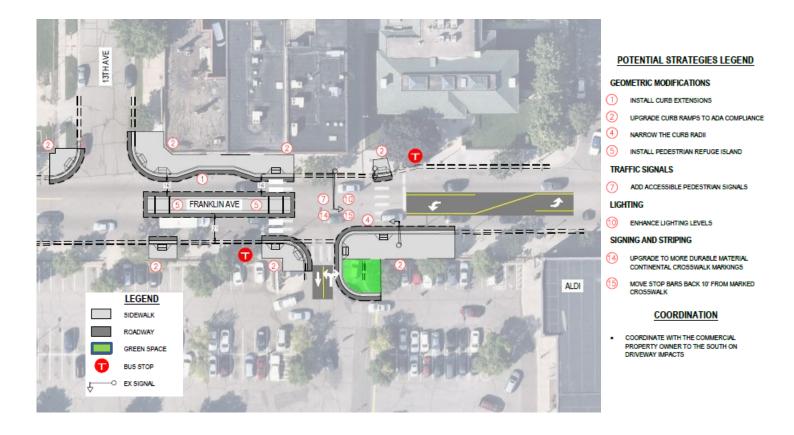
- A total of 6 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 50 percent of pedestrian crashes occurred when a vehicle was making a left-turn and 33 percent of crashes were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield.
- All crashes occurred when pedestrians were crossing Franklin Avenue when hit by a vehicle.

### Recommendations

To improve pedestrian safety, a concept was developed and is illustrated in **Figure 18C**. The concept proposes modifying the intersection to be ADA compliant, narrowing the curb radii, installing curb extensions on the west approach along Franklin avenue as well as installing a pedestrian refuge island to reduce the crossing distance and improve visibility, restricting right-turn on red, enhancing lighting levels, and upgrading the crosswalk to a more durable material. This concept also proposes to restripe the left-turn lane storage between the grocery store access and 14th Avenue and extend the pedestrian refuge island along Franklin Avenue to create a two-stage crossing at the 13th Avenue intersection.

## Franklin Avenue E/Midblock Crossing between 13th Ave S and 14<sup>th</sup> Ave S

**Concept 1 (Figure 18C)** – Concept 1 proposes multiple strategies to address this unique offset intersection configuration. The center median refuge, driveway narrowing, and curb extensions would create shorter crossing distance for pedestrians.



## Franklin Avenue E/Midblock Crossing between 13th Ave S and 14th Ave S

### **Estimated Costs**

Estimated construction costs are summarized in the table below.

Franklin Avenue E and the Midblock Crossing Between 13th Avenue S/14th Avenue S	Cost
Geometric Modifications	\$163,000
Traffic Signals	\$42,000
Lighting	\$5,000
Signing and Striping	\$18,000
Mobilization	\$12,000
Traffic Control	\$7,000
TOTAL ESTIMATE	\$247,000

### Coordination

Prior to implementation additional coordination is needed with the commercial property owner to the south to discuss the proposed modifications to the driveway access.

### **Intersection Characteristics**

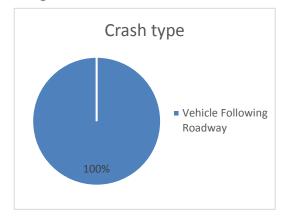
The Cedar Avenue intersection at the driveway to the Little Earth of United Tribes building is located between 24th Street and EM Stately Street. The surrounding land use is predominantly multi-family residential, a community center on the east side, and Cedar Field Park is immediately to the west. There is an existing pedestrian bridge to the north. The intersection is currently signalized with no left-turn protected. At this intersection, Cedar Avenue is a four-lane undivided roadway with on-street parking along Cedar Avenue; on-street parking is restricted on weekdays in the northbound direction during the a.m. and the southbound direction during p. m. peak period. There are transit stops along Cedar Avenue (south of the driveway in both directions). There is a pedestrian bridge north of the signalized intersection, however the bridge adds a significant distance to travel over Cedar Avenue. A graphic illustrating the existing conditions is shown in **Figure 19A**.



### Figure 19A : Existing Conditions

### **Crash History**

### Figure 19B

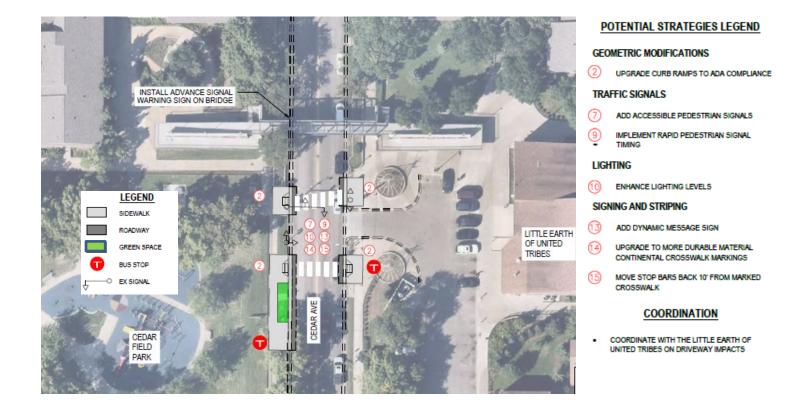


A total of 6 pedestrian related crashes were reported during the 10-year analysis period (2007-2016). All six crashes (100 percent) were when a vehicle was traveling through the intersection and either the pedestrian or the motorist failed to yield. All of the crashes occurred when pedestrians were crossing Cedar Avenue when hit by a vehicle.

### **Recommendations**

To improve pedestrian safety, a concept was developed and is illustrated in Figure 19C. The concept proposes modifying the intersection to be ADA compliant, enhancing the signal timing to be more responsive when pedestrians push the button, installing a dynamic message sign to alert motorists of pedestrians crossing, enhancing lighting levels, and upgrading the crosswalk to a more durable material. This concept also proposes to add advance warning signage to the existing pedestrian bridge to improve visibility of the pedestrian signal on the southbound approach. The signal poles are located in atypical locations at this signalized intersection and during the design phase consideration should be given to relocating the signal poles.

**Concept 1 (Figure 19C)** – Concept 1 proposes multiple strategies to address this unique signalized private driveway intersection configuration. The design includes providing sidewalk pavement and striping on the south leg of the intersection where none exists today enabling pedestrians to more directly connect to the bus stops.



### **Estimated Costs**

Estimated construction costs are summarized in the table below.

Cedar Avenue S and the Mi Between 24th Street E/EM		Cost
Geometric Modifications		\$48,000
Traffic Signals		\$42,000
Lighting		\$5,000
Signing and Striping		\$18,000
Mobilization		\$6,000
Traffic Control		\$4,000
	TOTAL ESTIMATE	\$123,000

### Coordination

Prior to implementation additional coordination is needed with the Little Earth of United Tribes.

### **Intersection Characteristics**

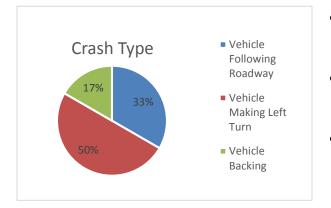
Located near several high-density residential towers to the west and just north of Interstate 94, the Cedar Avenue/6th Street intersection is at the threshold of the Cedar Avenue commercial district that extends up to Riverside Avenue. It is currently signalized but has no protected left-turn phasing. At this intersection, Cedar Avenue is a two-lane undivided roadway with left-turn lanes and 6th Street is a two-lane undivided roadway with no turn lanes. On-street parking is permitted along the east side of Cedar Avenue and along both sides of 6th Street. This intersection is located within a critical parking district and on-street parking it highly utilized. A graphic illustrating existing conditions is shown in **Figure 20A**.

### Figure 20A



### **Crash History**

### Figure 20B



- A total of 6 pedestrian related crashes were reported during the 10-year analysis period (2007-2016).
- Approximately 50 percent of pedestrian crashes occurred when a vehicle was making a left-turn.
- All of the pedestrians were crossing Cedar Avenue when hit by a vehicle.

### **Recommendations**

To improve pedestrian safety, a concept was developed and is illustrated in **Figure 20C**. The concept proposes modifying the intersection to be ADA compliant, installing curb extensions on all approaches to reduce the crossing distance and improve visibility, installing protected only left-turn phasing on Cedar Avenue, installing LPI, enhancing lighting levels, and upgrading the crosswalk to a more durable material.

**Concept 1 (Figure 20C)** – Concept 1 proposes multiple strategies to address this intersection at the transition from an auto-dominated interstate interchange zone to the mixed-use neighborhood. Protected left-turn phasing is proposed on Cedar where none exists today, and curb extensions shorten the pedestrian crossing distance on all legs of the intersection.



#### POTENTIAL STRATEGIES LEGEND

#### GEOMETRIC MODIFICATIONS

- 1 INSTALL CURB EXTENSIONS
- 2 UPGRADE CURB RAMP5 TO ADA COMPLIANCE

#### TRAFFIC SIGNALS

- 6 INSTALL LEADING PEDESTRIAN INTERVAL
- 7 ADD ACCESSIBLE PEDESTRIAN SIGNALS
- INSTALL PROTECTED ONLY LEFT-TURN PHASING (TRAFFIC ANALYSIS NEEDED)

#### LIGHTING

10 ENHANCE LIGHTING LEVELS

#### SIGNING AND STRIPING

MOVE STOP BARS BACK 10' FROM MARKED CROSSWALK)

#### COORDINATION

 COMPLETE TRAFFIC ANALYSIS PRIOR TO IMPLEMENTING PROTECT LEFT TURN PHASING

### **Estimated Costs**

Estimated construction costs are summarized in the table below.

Cedar Avenue/ 6th Street	Cost
Geometric Modifications	\$176,000
Traffic Signals	\$60,000
Lighting	\$8,000
Signing and Striping	\$24,000
Mobilization	\$14,000
Traffic Control	\$8,000
TOTAL ESTIMATE	\$290,000

### Coordination

• This concept recommends installation of protected left-turn phasing. Further operations study would need to be performed to document the potential traffic impacts, to assess the potential safety advantages of implementing this treatment.

## **Sources**

1: https://www.visionzerompls.com/safety-data

Traffic safety information and high injury network maps, City of Minneapolis.

2: https://aaafoundation.org/impact-speed-pedestrians-risk-severe-injury-death/

Impact speed and a pedestrian's risk of severe injury or death. Brian C. Tefft. 2013. AAA Foundation for Traffic Safety.

3:<u>https://www.denvergov.org/content/dam/denvergov/Portals/705/documents/visionzero/Denver-</u> <u>Vision-Zero-Action-Plan-draft-July2017.pdf</u>

Overall Vision Zero action plan with the goal of having zero traffic deaths by 2030, City of Denver.

4: <u>http://www.cmfclearinghouse.org/collateral/FHWA\_Desktop\_Reference\_Guide.pdf</u> Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11.

5: <u>https://www.frontiersin.org/articles/10.3389/fnhum.2013.00053/full#h3</u> Scientific study on brain activity during driving with distraction, Frontiers in Human Neuroscience, 2013.

6: <u>http://www.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf</u> Report summarizing crash data on vehicle left-turn crashes with pedestrian and bicyclists and strategies for reduction, New York City, 2016.

7: <u>https://www1.nyc.gov/html/dot/html/pedestrians/left-turn-traffic-calming.shtml</u> Strategies for left-turn traffic calming, implementation, and results, New York City.

8: <u>http://www.cmfclearinghouse.org/collateral/FHWA\_Desktop\_Reference\_Guide.pdf</u> Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11.

9: <u>https://trec.pdx.edu/sites/default/files/Bussey\_Half%20Signals%20Report%20FINAL.pdf</u>

Report on traffic signal timing optimization with the goal of increasing pedestrian trips and pedestrian compliance with signals, City of Portland.

10: <u>http://www.minneapolismn.gov/www/groups/public/@publicworks/documents/images/wcmsp-195582.pdf</u>

Report summarizing experimental bicycle signals at 5th St NE and Broadway Ave NE, City of Minneapolis.

11: <u>http://www.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf</u> Left Turn Pedestrian and Bicycle Crash Study, New York City, 2016.

12: <u>https://www.fhwa.dot.gov/publications/research/safety/18044/18044.pdf</u> Safety Evaluation of Protected Left Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety, Federal Highway Administration, 2018.

13: <u>http://www.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf</u> Left Turn Pedestrian and Bicycle Crash Study, New York City, 2016. 14: <u>https://www.ghsa.org/sites/default/files/2019-02/FINAL\_Pedestrians19.pdf</u> Report on pedestrian traffic fatalities by state, Governor's Highway Safety Association, 2018.

15:<u>http://www.ci.minneapolis.mn.us/www/groups/public/@council/documents/webcontent/convert\_269673.pdf</u> No Turn on Red Implementation Guidelines, City of Minneapolis, 2005

# Appendices

- A. Intersection Evaluation Matrix
- B. Draft Implementation Matrix
- C. Additional Maps:

Hennepin County Roadways

Pedestrian Generators

## **Appendix A – Intersection Evaluation Matrix**

The tables below outline the primary considerations in identifying 10 priority locations for further concept development within this report. The location selection process was outlined in more detail on page 9 of this report.

						Reason for Re	emoval from Furth	er Evaluation	
Intersection ID	Traffic Control	# Ped Crashes (2007-2016)	Further Eval. Rational		Recently Improved	Planning or Design Underway Separately	Impacted by Existing Project	Similar/ Nearby Intersection Selected	Larger Study Needed
	-			destrian Crash Study. The study identified 32 unique intersections that v destrian Crash Rates <sup>(2)</sup> . Note that the pedestrian crash rate was based of			-	ections with Hig	hest Pedestrian
1. Lake St W / Lyndale Ave S <sup>(1)(2)</sup>	Signal	24	Yes	<ul> <li>Most crashes in 2017 study,</li> <li>Potential for additional pedestrian improvements</li> <li>High housing density, restaurants, bars, theaters, etc. make evening hours significant</li> <li>Intersection near a potential future Metro Transit B-Line Arterial BRT stop</li> </ul>					
2. West Broadway Ave N / Lyndale Ave N $^{\rm (1)(2)}$	Signal	23	Yes	<ul> <li>Highest crash rate in 2017 study</li> <li>Potential for additional pedestrian improvements</li> <li>Busy commercial area with auto-oriented sites,</li> <li>Close proximity to I-94 (which is a significant pedestrian barrier)</li> </ul>					
3. Franklin Ave W / Nicollet Ave S <sup>(1) (2)</sup>	Signal	21	Yes	<ul> <li>Larger corridor study is needed along Franklin Avenue to identify major improvements such as a "road diet". However, a feasibility study is 10 years out so interim improvements are justified.</li> <li>Use the Franklin Avenue/Nicollet Avenue intersection as an example intersection for other intersections along the Franklin Avenue corridor</li> </ul>					1
10. 26th St W / Lyndale Ave S <sup>(1) (2)</sup>	Signal	15	Yes	<ul> <li>New development is under construction in SE corner which will increase pedestrian activity,</li> <li>Restaurants and bars generate pedestrian traffic in the evening hours</li> </ul>					
11. Lake St E / Bloomington Ave S <sup>(1) (2)</sup>	Signal	13	Yes	- Lake Street corridor location in Midtown area (highest number of pedestrian crashes in that area of the City) - Powderhorn/Phillips Neighborhood commercial hub - Use the Lake Street/Bloomington Avenue intersection as an example intersection for other intersections along the Lake Street corridor - Intersection near a potential future Metro Transit B-Line Arterial BRT stop					
13. Franklin Ave E / 3rd Ave S <sup>(1) (2)</sup>	Signal	11	Yes	<ul> <li>Priority intersection noted by Minneapolis PAC</li> <li>Larger corridor study is needed along Franklin Avenue to identify major improvements such as a "road diet".</li> </ul>					~
23. Lake St E / 28th Ave S <sup>(1)(2)</sup>	Signal	8	Yes	- County/City, Longfellow Neighborhood commercial center, Hennepin County Library, Lake St location east of Hiawatha Ave					
26. Franklin Ave E / Mid-Block Driveway btwn 13th Ave S and 14th Ave S <sup>(2)</sup>	Signal	6	Yes	<ul> <li>Major shopping center in Phillips neighborhood</li> <li>Atypical signalized intersection</li> <li>Intersection along Franklin Ave location east of 35W (no other projects in this area)</li> </ul>					
27. Cedar Ave S / Mid-Block Driveway btwn 24th St E and EM Stately St <sup>(2)</sup>	Signal	6	Yes	There is a pedestrian bridge just to the north of the signal, however, the crossing distance is significantly longer than crossing at the signal - Opportunities to improve the pedestrian signal timing (e.g. Broadway/5th Street in northeast where the pedestrian signal is quickly activated after pushed) - Near Little Earth Community					
31. 6th St S / Cedar Ave S <sup>(2)</sup>	Signal	6	Yes	- Geography - only intersection in the Riverside Neighborhood. - High residential density and pedestrian activity					

# **Appendix A – Intersection Evaluation Matrix**

					Reason for Removal from Further Evaluation					
Intersection ID Traffic Control Control (2007-2016) Further Eval. Rational		Recently Improved	Planning or Design Underway Separately	Impacted by Existing Project	Similar/ Nearby Intersection Selected	Larger Study Needed				
4. Lake St W / Hennepin Ave S <sup>(1)</sup>	Signal	20	No	Intersection is included in City's C.I.P.,application for funding to be included in Met Council's 2018 regional solicitation Intersection near a potential future Metro Transit B-Line Arterial BRT stop		~				
5. Lake St W / Pillsbury Ave S $^{(1)}$ (2)	Signal	17	No	- Traffic signal added approximately 2009/10	~			~		
6. Lake St W / Blaisdell Ave S $^{(1)(2)}$	Signal	17	No	<ul> <li>Intersection included in MnDOT I-35W project</li> <li>The Lake Street/Bloomington intersection can be used as an example intersection for improvements at this intersection</li> </ul>			~	$\checkmark$		
7. 4th St S / Cedar Ave S $^{(1)(2)}$	Signal	16	No	- Roadway and pedestrian improvements were made at this intersection in 2014.	~					
8. Franklin Ave E / Chicago Ave S <sup>(1)(2)</sup>	Signal	16	No	<ul> <li>Pending Highway Safety Improvements Project (HSIP) project</li> <li>Intersection near a proposed Metro Transit D-Line Arterial BRT stop; pedestrian improvements will be identified as part of that project</li> <li>The Franklin Avenue/Nicollet Avenue was selected due to the high pedestrian crash occurrences at the intersection and can be used as an example intersection for improvements at this intersection.</li> </ul>		~		~		
9. Franklin Ave E / Portland Ave S $^{(1)(2)}$	Signal	16	No	Intersection impacted in MnDOT I-35W project     The Franklin Avenue/Nicollet Avenue was selected due to the high pedestrian crash occurrences at the intersection and can be used as an example intersection for improvements at this intersection.     Included on County's recent enhanced bikeway network     Further traffic analysis needed for full treatment options			~	$\checkmark$	*	
12. Lake St E / 1st Ave S <sup>(1)(2)</sup>	Signal	11	No	- Intersection included in MnDOT I-35W project			~			
14. Lowry Ave NE / Central Ave NE <sup>(1) (2)</sup>	Signal	11	No	- Future County project already under development internally, application to for funding to be included in Met Council's 2018 regional solicitation		~				
15. Lagoon Ave W / Hennepin Ave S <sup>(1)(2)</sup>	Signal	11	No	Included in City's C.I.P., application for funding to be included in Met Council's 2018 regional solicitation     Intersection near a potential future Metro Transit B-Line Arterial BRT stop		~				
16. Franklin Ave W / Lyndale Ave S <sup>(1) (2)</sup>	Signal	11	No	Franklin Ave west of Lyndale included in City's C.I.P.,     Potential bikeway connection to area north of 94 may be considered in the future. Recommended to hold off on intersection design until bikeway is more thoroughly developed     The Franklin Avenue/Nicollet Avenue was selected due to the high pedestrian crash occurrences at the intersection and can be used as an example intersection for improvements at this intersection.     Further study needed to determine bikeway connection along Lyndale to Loring Greenway		~		✓	~	
17. Lake St E / Chicago Ave S <sup>(1)</sup>	Signal	10	No	- The Lake Street/Bloomington intersection can be used as an example intersection for improvements at this intersection - Intersection near a potential future Metro Transit B-Line Arterial BRT stop		~		$\checkmark$		
18. Lowry Ave N $/$ Penn Ave N $^{(1)(2)}$	Signal	9	No	- Intersection near a proposed Metro Transit C-Line Arterial BRT stop; pedestrian improvements will be identified as part of that project		~				

# **Appendix A – Intersection Evaluation Matrix**

					Reason for Removal from Further Evaluation					
Intersection ID	tersection ID Traffic Crashes (2007-2016) Further Eval. Rational		Recently Improved	Planning or Design Underway Separately	Impacted by Existing Project	Similar/ Nearby Intersection Selected	Larger Study Needed			
19. 4th St SE / 15th Ave SE <sup>(1)</sup>	Signal	9	No	<ul> <li>Potential regional solicitation project - protected intersection being considered</li> <li>60% plans for protected bike lanes for 15th.</li> </ul>		~				
20. 24th St W / Lyndale Ave S $^{(1)}$	Signal	9	No	- The Lyndale Ave/26th St intersection was selected due to high number of pedestrian crashes and can be used as an example intersection for improvements at this intersection				~		
21. Franklin Ave E / Park Ave S <sup>(1)</sup>	Signal	9	No	Intersection currently used as a detour route for the I-35W MnDOT project (will be difficult to modify intersection with detour for next four years)     The Franklin Avenue/Nicollet Avenue was selected due to the high pedestrian crash occurrences at the intersection and can be used as an example intersection for improvements at this intersection.     Included on County's recent enhanced bikeway network     Further traffic analysis needed for full treatment options			~	V	~	
22. Lake St E / Cedar Ave S <sup>(1)</sup>	Signal	9	No	Pending Highway Safety Improvements Project (HSIP) project     The Lake Street/Bloomington intersection can be used as an example     intersection for improvements at this intersection     Intersection near a potential future Metro Transit B-Line Arterial BRT     stop		~		~		
24. Lake St W / Bryant Ave S $^{(1)}$	Signal	8	No	High ped activity at intersection of commercial corridor and bicycle boulevard.     City reconstruction project along Bryant partially overlaps     Signal treatment opportunities.		~				
25. 38th St E / Minnehaha Ave S <sup>(1)(2)</sup>	Signal	8	No	- Roadway and pedestrian improvements were made at this intersection in 2016/2017.	~					
28. Cedar Ave S / Mid-Block Crossing btwn Riverside Ave and 6th St S <sup>(2)</sup>	RRFB	3	No	<ul> <li>Roadway and pedestrian improvements were made at this intersection in 2014 including a RRFB and median island refuge</li> </ul>	~					
29. 27th St E / Cedar Ave S <sup>(2)</sup>	TWSC	6	No	Unsignalized intersection     Located in lower-density area.     Further traffic analysis needed for full treatment options at unsignalized     intersection					~	
30. 9th St S / Park Ave S <sup>(2)</sup>	Signal	4	No	Elliot Park Neighborhood location near new clinic     Recently reconstructed corner with development     Curb extensions might still be a possibility     Included on County's recent enhanced bikeway network	~					
32. 15th St E / Portland Ave S $^{(2)}$	Signal	5	No	Near Franklin Steel Park and high density housing     Intersection currently used as a detour route for the I-35W MnDOT     project (will be difficult to modify intersection with detour for next four     years)     Included on County's recent enhanced bikeway network		~				

## **Appendix B – Draft Implementation Matrix**

The scope of this study included developing a comprehensive toolkit for addressing high pedestrian crash locations as well as developing specific intersection level concepts for 10 high crash locations on County roadways in the city. Implementation of these concepts will require continued coordination between the City and County to identify funding sources, address maintenance responsibilities, and evaluate the effectiveness of new treatments. Metro Transit will also continue to be an active partner at all locations where changes are proposed to existing bus stop locations, and where coordination is required with future Arterial Bus Rapid Transit projects.

Many of the concepts in this study propose lane reductions or traffic operations changes on County facilities. Assessing the operational impacts of these proposed changes was not within the scope of the current study and will require additional analysis through modeling or real-world testing. Additionally, some location concepts may require exploring the feasibility of making lane geometry changes along a larger corridor segment. An independent corridor study might be needed along corridors with multiple nearby high-crash intersections, or where corridor-wide improvements, such as bike facilities, are proposed.

The table on the next page outlines a draft prioritization plan for the concepts identified in the previous section. This table is meant for general reference only in may aid in identifying funding and programming opportunities across multiple locations.

## **Appendix B – Draft Implementation Matrix**

Location		Treatment Type								
	Project Coordination (May affect timeline for geometric changes)	Interim pilot treatments (left/right turn bollards, and temporary medians)	Signing, striping & lighting maintenance treatments (Durable Crosswalks/ Stopbar, Signing, & Street Lighting, "No Right-turn-on- red" (RTOR) signage	<ul> <li>Signal operations strategies</li> <li>Protected-only left turn phase (POLT),</li> <li>Lead Pedestrian Interval (LPI),</li> <li>Rapid Pedestrian Actuation (RPA),</li> </ul>	4-to-3 Lane Street Safety Conversions (Needs further operations study/test to determine potential impacts)	Curb changes & signal infrastructure (signal replacement, curb extensions, ped ramp upgrades, APS, permanent medians & geometric changes)	Crash assessment for all modes and by maneuver type and crossing leg, multimodal counts, compliance assessments			
Lake Street at Lyndale Ave S	B-Line BRT (Metro Transit)	Left/right turn bollards	Crosswalks, lighting	POLT, <mark>LPI</mark>	Lake Street	Signal, Bumpouts, Medians				
Lyndale Ave N at West Broadway Ave	HSIP (County)	Left/right turn bollards	Crosswalks, lighting	POLT, <mark>LPI</mark>	Lyndale Ave N	Signal, Bumpouts				
Franklin Ave at Nicollet Ave	Transitway Study (City)	Left/right turn bollards	Crosswalks, lighting	POLT, <mark>LPI</mark>	Franklin Ave	Signal, Bumpouts				
Lake Street at Bloomington Ave	B-Line BRT (Metro Transit)	-	Crosswalks, stopbar, lighting	POLT, <mark>LPI</mark>	Lake Street	Signal, bumpouts				
Franklin Ave at 3rd Ave S	Corridor Study (County)	Left/right turn bollards	Crosswalks, RTOR, lighting Crosswalks,	LPI	Franklin Ave	Signal, bumpouts Signal,	Follow-up reporting on treatment effectiveness			
Lyndale Ave S at 26th St E		Median	stop bar, lighting, RTOR	LPI	Lyndale Ave S	bumpouts, median Bikeway on	by 2029			
Lake Street at 28th Ave S		-	Crosswalks, stop bar, lighting	Rapid ped actuation	Lake Street	Lake Street, Signal, Bumpouts				
Franklin Ave at midblock/ 13th Ave S	-	Median	Crosswalks, stopbar, lighting	Rapid ped actuation	-	Signal, Median				
Cedar Ave at midblock (24th -Stately St)	-	-	Crosswalks, stop bar, lighting	Rapid ped actuation	-	Signal				
Cedar Ave at 6th St S	-	-	Stop bar, lighting	LPI	-	Signal, Bumpouts				

#### **Potential Implementation Phase**

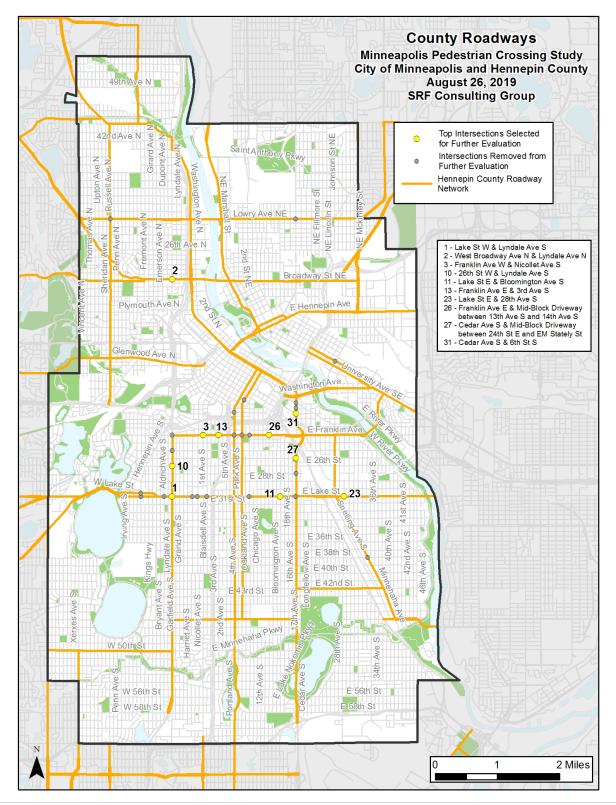
1–3 Year Implementation

3-5 Year Implementation

5+ Year Implementation

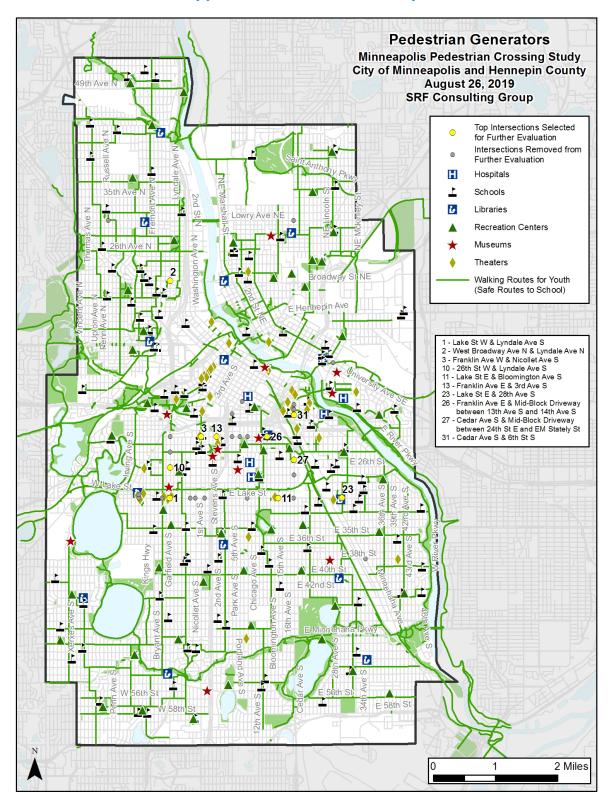
### DRAFT TABLE – Subject to change

This table was produced to summarize concept treatments across multiple locations and is meant for reference only. No funds have been identified for implementation at the time of this published report and some proposed treatments may require further detailed study and engineering.



## **Appendix C – Additional Maps**

76 | Page



### **Appendix C – Additional Maps**