# Hi-Lake Interchange Study

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Hennepin

Minneapolis
City of Lakes

Kimley»Horn

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## Contents

# 1.0 OVERVIEW OF STUDY

## 1.1. Need

The Hiawatha-Lake (Hi-Lake) interchange serves approximately 34,000 vehicles, 2,500 pedestrians and bikes, 350 Metro Transit buses, and 5 freight trains per day. An additional 220 light rail trains and 37,000 vehicles per day travel overhead on Hiawatha Avenue (Trunk Highway 55). Serving all of these modes and improving the pedestrian and bicycling environment through the area has been a growing priority, particularly given the significant investments in transit and transit-oriented development over the last decade.

In response to recent constituent concerns, a group of policy makers from the City of Minneapolis, Hennepin County, and MnDOT visited the interchange and met with neighborhood residents to discuss the pedestrian and bicycle environment. The group agreed that while the pedestrian environment clearly needs improvement, there is no simple or obvious solution to do so. The intersection is busy, large, and currently auto-oriented, despite good transit connectivity and high pedestrian volumes. All modes need to be considered as various improvements are evaluated.

## 1.2. Purpose

The purpose of this study is to develop potential solutions to improve the pedestrian and bicycle environment of the Hi-Lake interchange while maintaining vehicle operations on Lake Street and Hiawatha Avenue. Although the study is being led by the City of Minneapolis and Hennepin County, Metro Transit and the Minnesota Department of Transportation also played crucial roles providing insight on the potential improvement alternatives. At the time of this study, no participating agencies have programmed projects or improvements in their capital improvement programs.

While improving the pedestrian environment was the primary driver of the study, several multimodal goals emerged through the process, as summarized below:

- Improve pedestrian and bicyclist comfort, safety, and security, and minimize delay at signals
- Ensure the roadway configuration supports all transit movements and facilitates efficient transit operations
- Reallocate right-of-way from vehicle lanes to sidewalk space where feasible to accommodate improved transit infrastructure, including arterial bus rapid transit stations
- Create a dedicated connection between nearby bicycle trails and the Blue Line Lake Street Station

The neighborhood has also expressed a goal of improving the aesthetics of the interchange area through public art and streetscape. This report presents the technical analysis of transportation options that were studied and identifies new pedestrian spaces that could be created by those options. However, a more detailed study and public process would be needed to explore how existing and new pedestrian spaces may be activated through art or other treatments.

This report outlines the existing conditions that drive the need for improvements and identifies a menu of improvements that can be implemented in phases without significant interchange reconstruction, as well as evaluating five alternatives that would significantly reconfigure the interchange. The study documents the key technical considerations for a variety of solutions in the area; informing potential improvements, funding sources, and implementation timeline.

## 1.3. Previous Studies

### Historical summary

The Hiawatha Avenue/Lake Street intersection was grade separated in the 1990s. The single point urban interchange (SPUI) that currently exists was constructed at that time.

### Hi-Lake Pedestrian Connectivity Project (2006-2007)

This study recommended multiple modifications to improve the pedestrian experience, including

- shortening crossings by adding or enlarging islands
- public art
- lighting

While the implementation of the modified islands shortened the crossing distances in some cases, the pedestrian routes became less direct and pedestrians remain exposed while waiting on the islands, contributing to the overall perception of poor safety in the area.

### Hiawatha LRT Trail Extension Study (2012)

This study identified improvements to connect the Midtown Greenway to Lake Street, planned for construction in 2018.

### Arterial Transitway Corridor Study (2011-2012)

Metro Transit studied Lake Street and other urban corridors with high-ridership bus routes that connect major destinations for implementation of enhanced bus service. The interchange at Lake Street and Hiawatha Avenue was identified as a station location for the Lake Street Arterial Bus Rapid Transit (arterial BRT) Line in this study. The arterial BRT Line is scheduled to open by 2022, but the project is not yet funded.

### Midtown Corridor Alternatives Analysis (2012-2014)

This transit alternatives analysis identified streetcar on the Midtown Greenway and enhanced bus on Lake Street as the preferred alternative of the several studied alternatives.

### Others

Hennepin County is involved in the development of the property in the southwest quadrant of the interchange, which will include a Hennepin County Service Center as well as housing and office space. Metro Transit is also participating in this work and is looking to improve street access from the site and LRT/bus access on Lake Street. There is a proposed bicycle facility through the development.

## 1.4. Study Process

The Hi-Lake Interchange Study took place over four months from October 2015 to January 2016. Three Project Management Team (PMT) meetings were held during the course of the study to discuss technical analysis, including data, improvement alternatives, evaluation of alternatives and cost estimates. The goal of the study was to conduct the technical analysis and design needed to evaluate the feasibility of improvement alternatives. From there, input from policy makers and the public will be needed on the feasible alternatives to determine the phasing of improvement implementation.

# 2.0 EXISTING CONDITIONS

## 2.1. Operations

The existing interchange at Hiawatha Avenue (Trunk Highway 55) and Lake Street (Hennepin County Road 3) is referred to as a Single Point Urban Interchange (SPUI). Unlike more traditional diamond interchanges that include two closely spaced intersections where the ramps intersect the arterial street, SPUI interchanges combine all movements into one intersection and have one signal that controls all movements. The SPUI design is a particularly effective for minimizing vehicle delays at high-volume interchanges with significant left turn demand, as opposing left turn movements operate concurrently. The wide, gradual turns also better accommodate heavy vehicles when compared to a tight diamond interchange. However, the size of the interchange makes it auto-oriented and requires longer yellow and red phase times than typical intersections, leading to some operational inefficiencies in terms of lost green time.

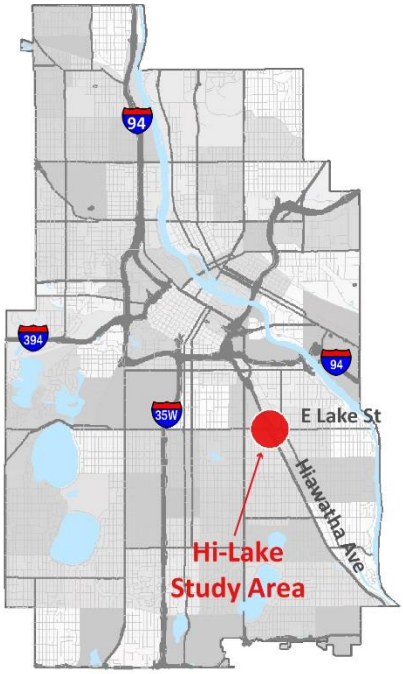



*Figure 2-1: The Hi-Lake interchange study area within the City of Minneapolis*

As SPUIs are typically installed in the context of large freeways, accommodating pedestrian and bicycles is not a typical priority. In fact, it is common for SPUIs to only serve pedestrians along the arterial, and unlike the Hi-Lake interchange, where a pedestrian phase is provided to cross Lake Street, several other SPUIs in the Twin Cities area at I-494/Penn Avenue and I-494/Lyndale Avenue do not provide a pedestrian phase to cross the arterial. Even with a pedestrian phase, however, the size and complexity of the design typically creates an uninviting pedestrian and bicycling environment.

## 2.2. Geometry

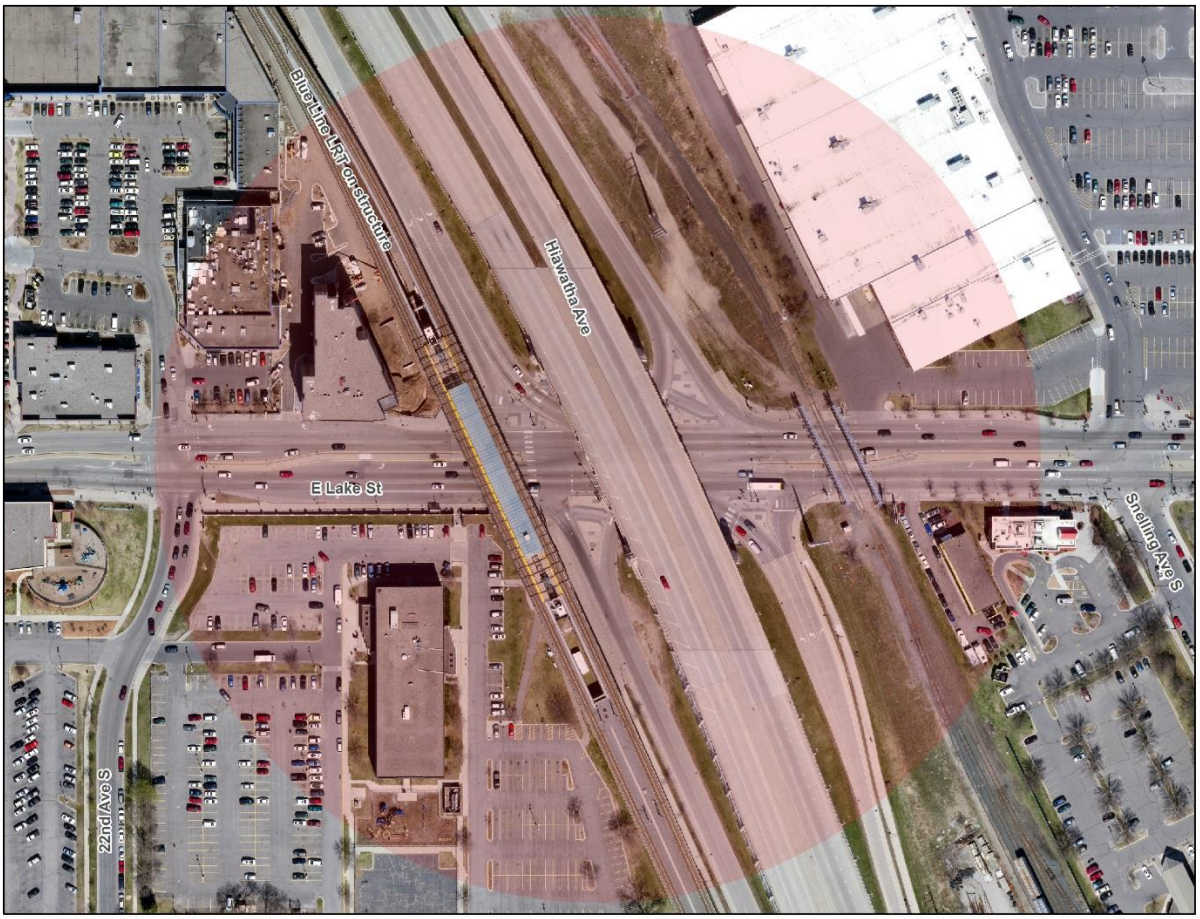



*Figure 2-2: Existing geometry at the HiLake interchange*

Lake Street is generally a four-lane, two-way roadway, widening in the Hi-Lake interchange area with designated left- and right- turn lanes in both directions. Two bridges span over Lake Street at the interchange: Hiawatha Avenue and the Blue Line LRT. Lake Street has traffic separating medians, but the medians are not wide enough for pedestrian refuge. Lake Street has a speed limit of 30 miles per hour (mph).

Running above Lake Street, Hiawatha Avenue is a four-lane median-separated 40 mph highway. To get to Lake Street, southbound and northbound traffic exits from Hiawatha Avenue in a single lane, widening into two-left turn lanes and one right turn lane at the intersection with Lake Street. The left- and right-turn lanes are separated by pedestrian refuge islands. The islands reduce the length of the pedestrian crossings along Lake Street and prevent vehicular through movements, including transit vehicles[1]. The right turn lanes from Hiawatha onto Lake are unsignalized free right-turns (not controlled by the traffic signal).

[1] Although no regular service routes perform a through movement, during periods of LRT disruption Metro Transit operates a "bus bridge" of articulated buses to replace Blue Line service; preventing north-south through movements at the interchange therefore impacts bus bridge operations.

There are two bus stops and one Blue Line (LRT) station at the interchange. The westbound bus stop is located approximated 200 feet west of the intersection, connected to a new affordable housing development called Lake Street Station. The eastbound bus stop is located approximately 100 feet west of the intersection, built adjacent to a retaining wall. Both bus stops are farther away from the LRT station than preferred by Metro Transit, and neither bus stop is visible from the LRT station.

Freight train tracks run at-grade on the east side of the intersection. The railroad crossing has overhead signing and flashers that may limit sightlines for approaching westbound traffic. Minnesota Commercial Railway (MNNR) operates approximately 4-6 trains per day through the Lake Street crossing.

For reference, a layout of existing geometric conditions can be found in **Appendix A.**

## 2.3. Demand

Passenger vehicle, heavy vehicle, pedestrian, and bicycle counts were taken at the 28th Street, Lake Street, and 32nd Street intersections along Hiawatha Avenue in October 2015. The counts were conducted for 24 hours on a weekday and 24 hours on a Saturday. Field visits were also conducted to document existing conditions. Weekend and weekday totals for each mode can be found in **Appendix I**. A summary of peak hour demand for vehicles, pedestrian, and bicycles is provided in **Figures 2-3** through **2-5**.

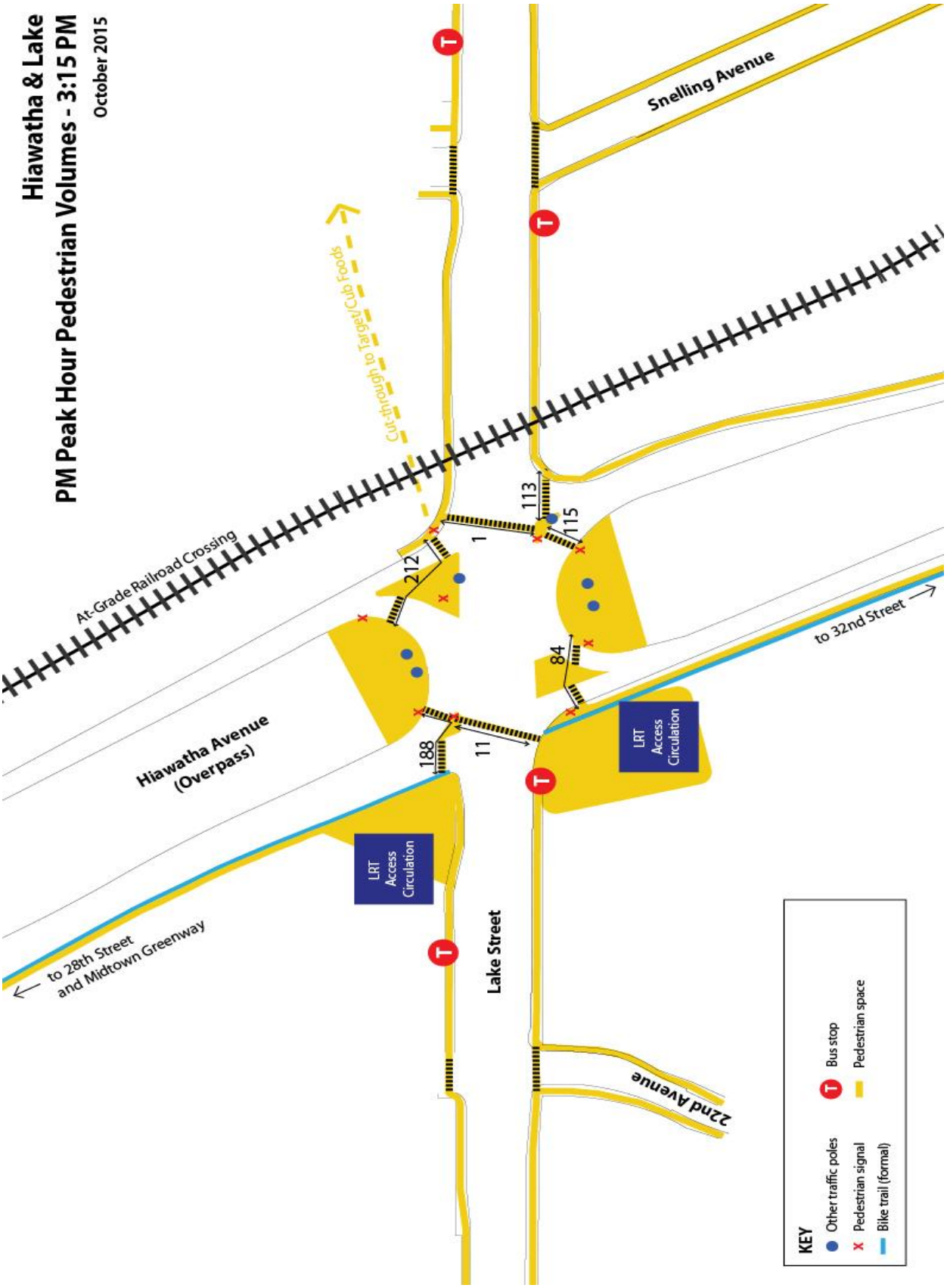



*Figure 2-3: Weekday PM peak hour pedestrian counts*

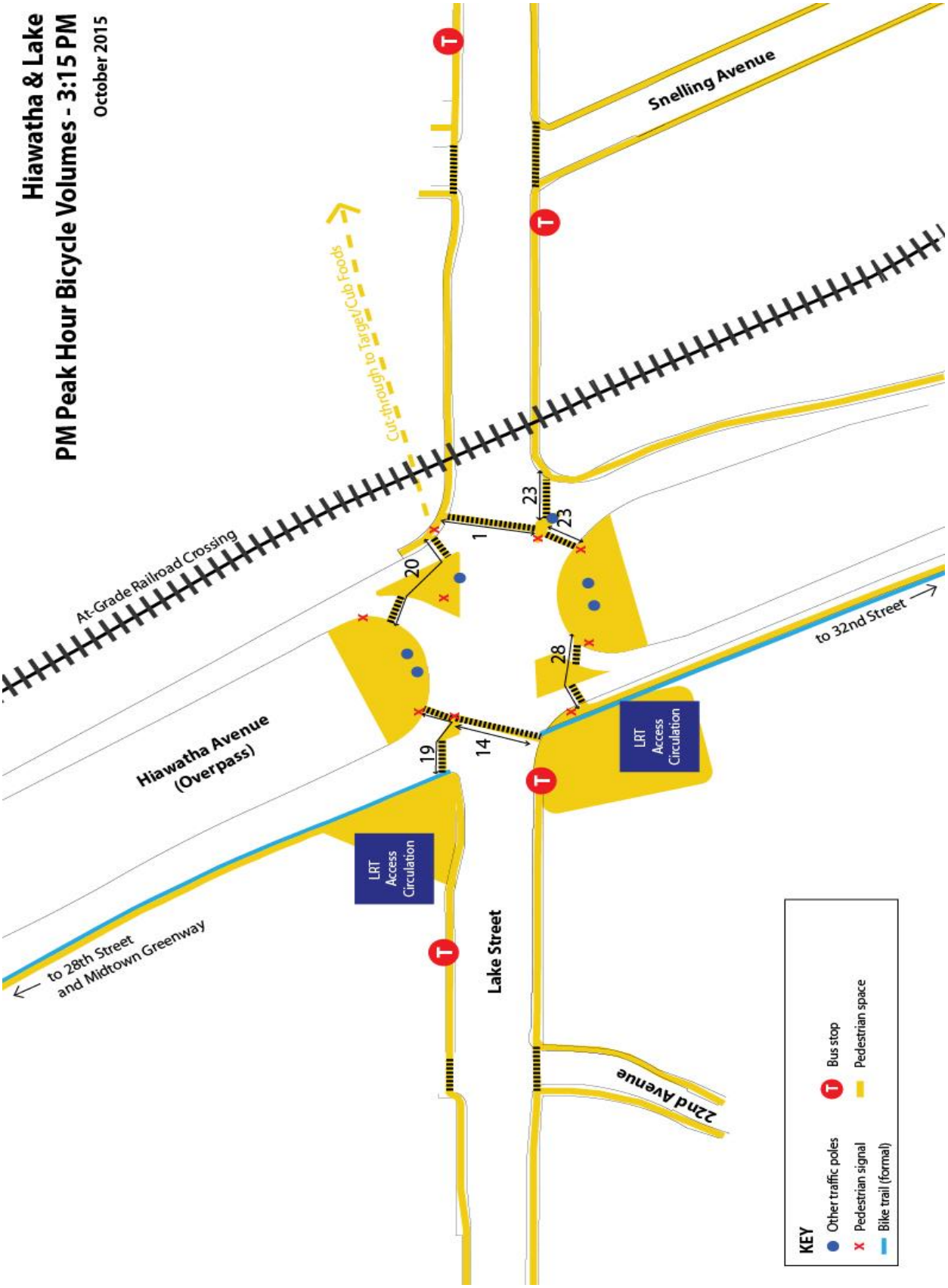



*Figure 2-4: Weekday PM peak hour bicycle counts*

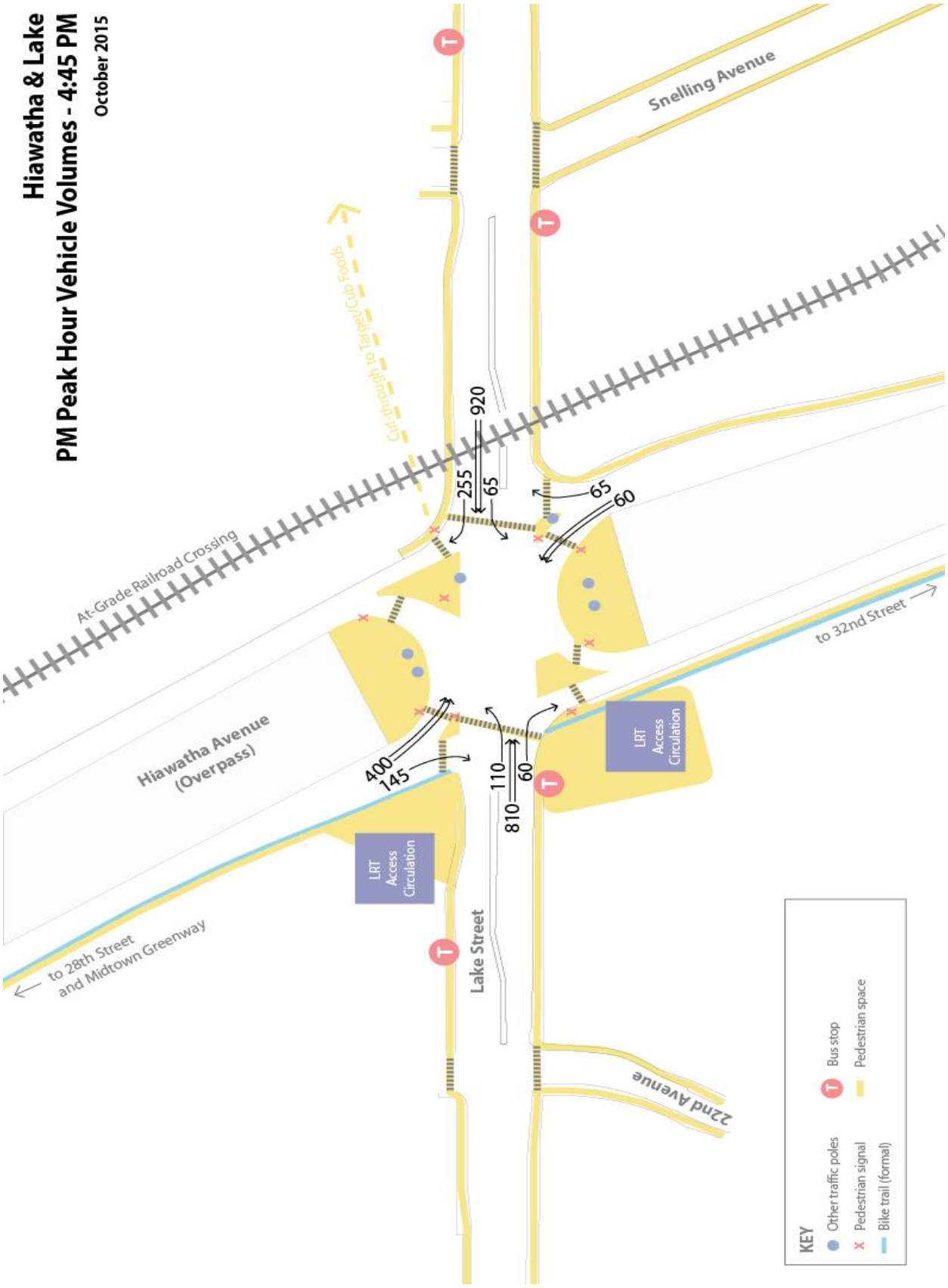



*Figure 2-5: Weekday PM peak hour vehicle counts*

## Pedestrian

Lake Street's heavy traffic volumes and long crossings with no center median refuge presents an uninviting pedestrian environment. Perhaps as a result, only around 120 pedestrians were observed crossing Lake Street at this location in a 24-hour weekday period. By contrast, nearly 2,400 pedestrians crossed east-west within the area over the same weekday time period, traveling to and from the light rail station and various other destinations in the area.

## Bicycle

With no specific bicycle facilities within the intersection, many bicycles share the pedestrian infrastructure. Similar to pedestrians, the east-west movement along Lake Street has higher volumes than the north-south movements across Lake Street. Around 275 bicycles were observed crossing Lake Street at this location in a weekday 24-hour period, and over 400 bicycles crossed east-west within the area over the same weekday time period.

## Auto

Similar to bicycle and pedestrian movements, the heaviest automobile movement at the Hi-Lake Interchange is east-west along Lake Street. Over 14,000 automobiles were observed travelling westbound and nearly 12,000 automobiles were observed travelling eastbound. The southbound movement from Hiawatha entering Lake Street served nearly 6,000 vehicles. The northbound movement from Hiawatha to Lake Street was the lowest volume with around 2,300 vehicles observed.

| | Weekday Daily Total | | | | |
|---|---|---|---|---|---|
| Direction | *U Turns* | *Left Turns* | *Straight Through* | *Right Turns* | **Total** |
| Southbound | 0 | 3,900 | 0 | 1,900 | **5,800** |
| Westbound | <10 | 1,100 | 9,100 | 3,800 | **14,000** |
| Northbound | <10 | 1,000 | 0 | 1,300 | **2,300** |
| Eastbound | <50 | 1,800 | 8,900 | 1,000 | **11,700** |
| | | | | | **33,800** |

## Transit

Three bus routes (Route 21, 27, and 53) and one METRO Line (METRO Blue Line) serve the Hi-Lake Interchange. The eastbound bus stop peaks with over 600 daily alightings and the westbound bus stop peaks with over 800 boardings. There are approximately 120 daily transfers between LRT and the WB Route 21 bus. The Lake Street Blue Line Station is one of the busiest METRO stations outside of a downtown with over 2,600 daily boardings.

| | | Weekday Boardings (Alightings) | | |
|---|---|---|---|---|
| Mode | *Direction* | *AM Peak* | *PM Peak* | **Daily Total** |
| Bus | Eastbound | 30 (80) | 90 (130) | **410 (610)** |
| | Westbound | 50 (60) | 210 (100) | **840 (400)** |
| Blue Line LRT | Northbound/Southbound | 170 (*) | 380 (*) | **2,660 (*)** |

*LRT alightings not available

## 2.4. Key Issues and Opportunities

The Hi-Lake Interchange is clearly a busy intersection for all modes. The existing design creates a few key issues and opportunities for pedestrians and bicycles in particular.

### (1) Lighting

The area below the Hiawatha Bridge has insufficient lighting. The lack of natural light is uncomfortable for pedestrians and diminishes perceived safety and personal security. The contrast in lighting between the area under the bridge and the street makes visibility difficult when entering and exiting the area under the bridge.

*Figure 2-6: Shadows and lighting contrast under bridge*

### (2) Vehicle-Routing, Pedestrian Visibility, and Non-Compliance

Pedestrians frequently cross on the Don't Walk indications when they perceive a gap in traffic. However, the large intersection makes it difficult for pedestrians to see and recognize the approaching left-turn vehicles. The Hiawatha bridge over the interchange compounds the issue by blocking natural light and making the intersection dark.


*Figure 2-7: Left-turning vehicles approaching the pedestrian crosswalk*

### (3) Challenging North-South Pedestrian Crossing

To cross Lake Street, pedestrians have to traverse six lanes of traffic (including turn lanes) without a pedestrian refuge area. Shown below is a pedestrian using the center median as a refuge area. The existing median is approximately four feet wide, which is not wide enough to provide an accessible refuge. A long cycle length at the traffic signal, which can creating long pedestrian delays, is a likely cause of pedestrians deciding to cross the intersection when there are any gaps in traffic.

*Figure 2-8: North-south crossing on East end of interchange*

### (4) Driver Confusion within Westbound Right Turn Lane

There is no stop bar for westbound traffic on Lake Street, and the at-grade railroad crossing occurs prior to the traffic signal. This creates inefficient or unsafe queuing: some vehicles do not proceed over the tracks because it is unclear where to stop; others queue on the tracks. In addition, while the pedestrian crossing of this lane is controlled with Walk/Don't Walk indications, the vehicle indications are not very visible and therefore most drivers treat the movement as a "free" right.


*Figure 2-9: View of control for westbound right turn lane (Photo Credit: Google Streetview)*

### (5) Challenging North-South Bicycle Crossing

The intersection is a key midpoint between the Midtown Greenway to the north and the Hiawatha Trail to the south. With no bicycle-specific infrastructure or right-of-way (and with no through-movements allowed for vehicles), bicyclists are forced to use pedestrian paths to cross Lake Street.

*Figure 2-10: Bicyclist waiting on the island to cross Lake Street*

### (6) Confusing Bicycle Routing

For bicyclists approaching Lake Street from the Midtown Greenway along the west side of Hiawatha Avenue, it is unclear how to access Lake Street. Some bikes use the narrow, unmarked, and unsigned shoulder and others use the sidewalk.

*Figure 2-11: Southbound approach to Lake Street from bicyclist's perspective*

### (7) Bus Bridge Operations

Prior to the installation of pedestrian refuge islands, two signs below the Hiawatha bridge would illuminate during Blue Line outages to allow buses to make a through movement. With the pedestrian refuge islands in place, buses cannot make through movements. Instead, southbound bus bridges access the Lake Street Station by traveling on Cedar Avenue to Lake Street. This creates inefficiencies in the bus operations.


*Figure 2-12: View of bus bridge message sign*

### (8) Future Plaza Space

The Corcoran Parklet on the southwest corner of the intersection is the future site of a permanent one-acre plaza that will be home to the Midtown Farmers Market. It offers yard furniture and green space in an otherwise bustling intersection.

*Figure 2-13: Corcoran Parklet*

### (10) New and Future Transit-Oriented Development

The intersection has a new transit-oriented senior and affordable housing development called the Lake Street Station apartments. Proximity to transit, Nice Ride, shopping, and restaurants is an integral part of the building's marketing. Additionally, Hennepin County is redeveloping the former light rail park and ride lot on the southwest quadrant of the interchange, and the development will include a Hennepin County Service Center as well as housing and office space.


*Figure 2-14: Lake Street Station Apartments*

# 3.0 EVALUATION MEASURES

## 3.1. Development

In order to evaluate the potential improvement alternatives against the existing conditions, several evaluation measures were generated. These measures, broken into seven categories (Pedestrian, Bicycle, Vehicles, Transit, Livability & Sustainability, and Costs), attempt to address the issues and opportunities identified in the existing conditions. The criteria are based on existing conditions and are generally measurable (e.g. east-west crossing distance), and the goal of each criteria (e.g. to decrease the east-west crossing distance) was based on the Humanize Hi-Lake petition and the National Association of City Transportation Officials (NACTO) Urban Street Guide. While the goals of the evaluation measures lay the foundation for all improvements, they were primarily used to evaluate the Tier III Alternatives (discussed in **Section 6.0**) in order to objectively compare the large-scale, long-term improvements.

## 3.2. Base Conditions

The evaluation measures and the base condition per measure is shown in the table below. A full description of each measure including the evaluation methodology is provided in **Appendix C**. Several measures, identified in *italics*, would likely not change with geometric improvements, or the impacts cannot be estimated. For these measures, the existing condition is noted, if available, and the footnote identifies other measures that partially capture the objective of the measure in some form.

Evaluation Measures for Tier III Improvements

| No. | Evaluation Measure | Notes | Base Condition |
|---|---|---|---|
|  | **Pedestrians** | | |
| P1 | East-West Crossing Distance | The distance that a pedestrian on Lake Street is in a crosswalk | 200 feet |
| P2 | East-West Signal Delay | The average time a pedestrian waits for a walk signal | 56 seconds |
| P3 | East-West Crossing Time | The average time a pedestrian on Lake Street is in a crosswalk | 57 seconds |
| P4 | East-West Total Time | The total time needed to travel from eastbound bus stop to the railroad crossing on the north side of Lake Street | 199 seconds |
| P5 | East-West Lane Crossings | The number of vehicle lanes a pedestrian on Lake Street crosses | 5 |
| P6 | Count of Vehicle Free Rights | The number of non-signalized turns allowed | 2 |
| *P7*[1] | *Number and severity of pedestrian crashes* | *2 pedestrian/vehicle crashes since 2010 (4% of total collisions), both at crash severity C (possible injury). Full report available.* | |
|  | **Bicycles** | | |
| B1 | Bicycle Crossing Distance | Evaluated using pedestrian crosswalk distance across Lake Street on west side of intersection | 140 Feet |

Evaluation Measures for Tier III Improvements

| No. | Evaluation Measure | Notes | Base Condition |
|---|---|---|---|
| B2 | Average Bicycle Delay | Evaluated using average pedestrian signal delay across Lake Street on west side of intersection | 91 seconds |
| B3 | Opportunity to connect trails and Blue Line station | Geometry would allow for bicycle connection between the Hiawatha Trail extension and LRT station | No |
| *B4*[2] | *Number and severity of bicycle crashes* | *2 bicycle/vehicle crashes since 2010 (4% of total collisions), both at crash severity PDO. Full report available.* | |
| *B5*[2] | *Number of people biking to/from transit* | *This data was not available from Metro Transit or the counts conducted for this study* | |
|  | **Vehicles** | | |
| V1 | Peak Hour Delay Per Vehicle | Weighted average per vehicle for the entire intersection | 35 seconds |
| V2 | Approaches with Spillback | Total number of approaches with spillback during peak hour | 1 |
| V3 | Queue Length | Maximum 95th percentile queue length | 510 feet |
| V4 | Cut-Through Potential | Likelihood that vehicles will use interchange to avoid traffic on Hiawatha | 0 |
| V5 | Maximum Volume/Capacity Ratio | Maximum value at Lake & Hiawatha during the peak hour; the threshold is less than one | 0.64 |
| V6 | Volume/Capacity Ratio Sensitivity Test | Increase in traffic volumes required to surpass a volume to capacity ratio of 1 at the intersection | 25% |
| V7.1 | Effect on adjacent intersections: 28th St. | Maximum Volume/Capacity ratio at 28th Street | 0.95 |
| V7.2 | Effect on adjacent intersections: 32nd St. | Maximum Volume/Capacity ratio at 32nd Street | 0.90 |
| *V8*[3] | *Prevalence of speeding* | *Lake Street (West of intersection): 85 percent of vehicles travel at or below 29-30 MPH in 2010; no data available for ramps* | |
| *V9*[3] | *Number and severity of automobile crashes* | *50 auto/auto crashes since 2010 (92% of total collisions) with the majority being rear-ends. Full report available.* | |
|  | **Transit** | | |
| T1 | Bus Movements Allowed | The number of ramps used during "bus bridge" operations | 2 (South ramps only) |
| T2 | Incorporates arterial BRT Station Footprint | Whether or not geometry could include a full arterial BRT station | No |
| T3 | Distance between bus stop and LRT Station | Distance between LRT station and bus stop sign (120 feet minimum assumed for arterial BRT) | WB: 140 ft. EB: 50 ft. |
| T4 | Delay due to merging back into traffic | Number of times the bus experiences delay from merging back into the travel lane after boarding passengers | Multiple |

Evaluation Measures for Tier III Improvements

| No. | Evaluation Measure | Notes | Base Condition |
|---|---|---|---|
| | **Livability and Sustainability** | | |
| L1 | Diverted Vehicles | Number of vehicles from Hiawatha that use other routes to access Lake Street per day | 0 |
| L2 | Pavement Removal/Opportunity Space | Area re-allocated from transportation to other uses | 0 |
| L3 | Livability Aesthetics | Geometry could decrease areas of shadow, include additional street lights, or incorporate public art | Minimal |
| L4 | Opportunity for Shade & Trees | Geometry could include new medians with planters, street trees, and/or boulevards | Minimal |
| L5 | Wayfinding (Decrease Pedestrian Confusion) | Geometry is simple and pedestrian space is obvious | None |
| *L6*[4] | *Presence of garbage/debris* | *Common* | |
| *L7*[4] | *Crime rates* | *Over the past year, 7 incidents of robbery, 1 motor vehicle theft, 1 homicide, and 1 aggravated assault was reported to Minneapolis Police Department near the intersection* | |
| *L8*[4] | *Surveillance/camera coverage* | *Unknown* | |
| **Costs** | | | |
| C1 | Capital Costs | Estimated capital costs (2015 dollars) | $0 |

[1] Not carried forward as an evaluation measure. Captured by P1, P5, and P6.

[2] Not carried forward as an evaluation measure. Captured by B1, B2, and B3.

[3] Not carried forward as an evaluation measure. Captured by P6, V2, V3, and V5.

[4] Not carried forward as an evaluation measure. Captured by L3

# 4.0 TIER I IMPROVEMENTS

## 4.1. Overview

As discussed in the Introduction, this study discusses three categories of improvements: Tier I, Tier II, and Tier III. Tier I improvements are those that are most easily implemented and have the smallest capital costs. Tier I improvements could occur more quickly, but have a smaller impact in terms of the scale of the improvements. Tier I improvements include surface level enhancements and no geometric changes.

## 4.2. Improvement Types

Potential Tier I improvements are listed below, categorized by the general goal of the strategy. Each of these improvements have been shown to improve the pedestrian and bicycle environment and would be expected to have a minor or negligible impact on average vehicle delays and queue lengths. Locations for potential implementation of the Tier I improvements are shown in **Figure 4-1**.

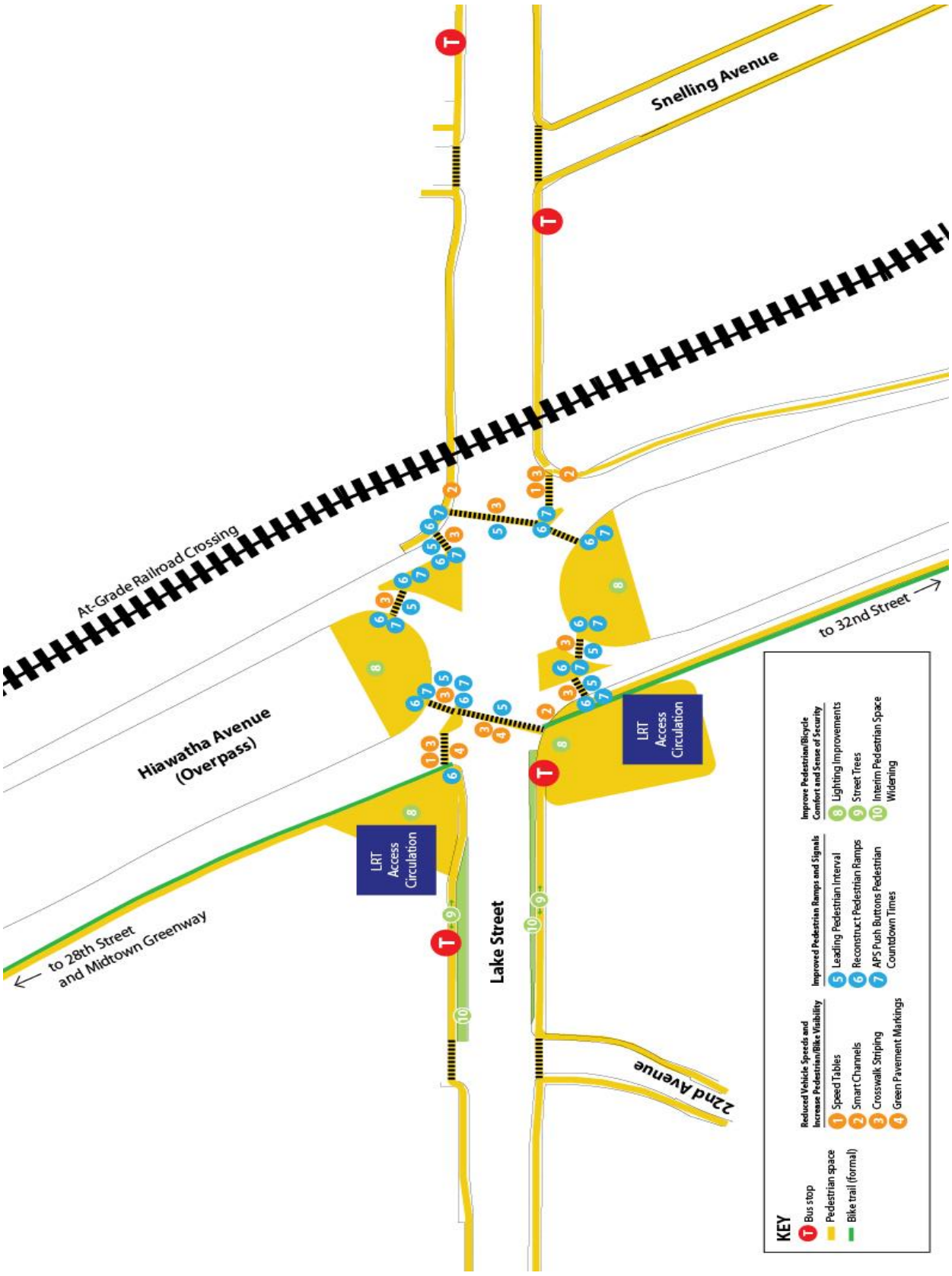


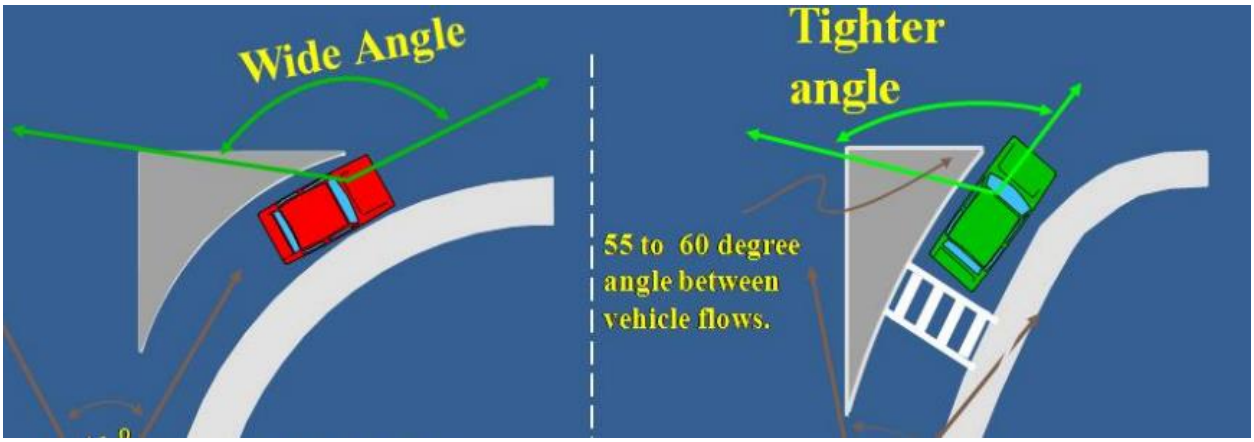

*Figure 4-1: Potential locations for Tier I Improvements*

## Reduce Vehicle Speeds and Increase Ped/Bike Visibility

- **Speed Tables** – A speed table is a flat-topped speed hump intended to slow vehicles down in an area with high volumes of pedestrians. Speed tables are proven effective at reducing vehicle speeds and by reducing curb cuts, makes for an easier pedestrian crossing (particularly for persons in wheelchairs).


*Source: SCDOT Traffic Calming Guidelines*

- **Smart Channels** – Wide, sweeping turns are well suited for heavy vehicles and also allow for higher-speed movements. Smart channels help to tighten the geometry of right turns, allowing drivers to have a better view of both pedestrians as well as oncoming traffic while still allowing for large vehicles to turn. By slowing vehicles and bringing drawing additional attention to crosswalks, smart channels help to enhance pedestrian visibility and reduce rear-end collisions.




*Source: Fairfax County, VA*

- **Crosswalk Striping** – Visible crosswalk markings designate a safe crossing location and alert drivers to pedestrians. Ground-in markings are more durable and require less maintenance.

*Source: FHWA*

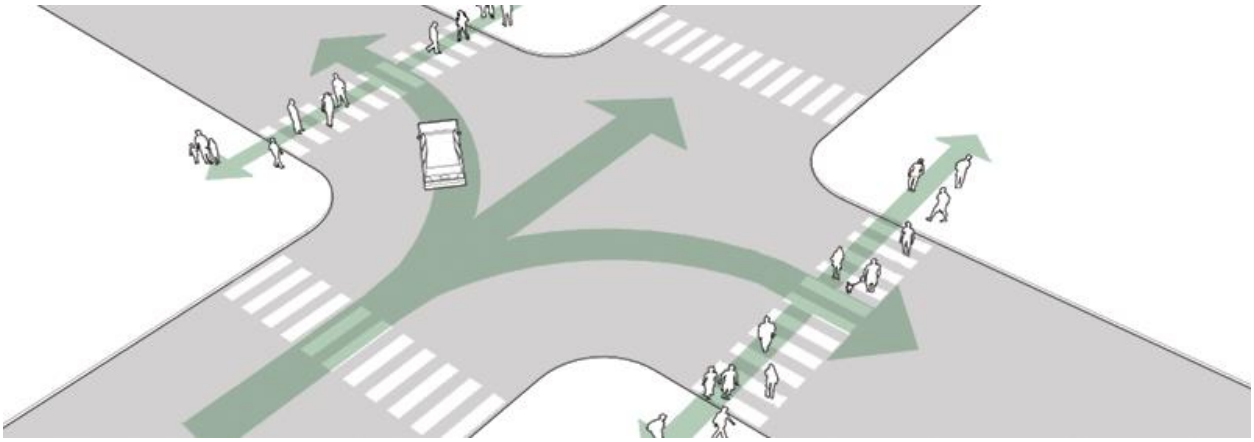
- **Green Pavement Markings** – Green block pavement markings alert drivers to the presence of bicyclists. The markings help reinforce that the roadway is a shared space between modes.


*Source: Seattle Bike Blog*

## Improve Pedestrian Ramps and Signals

- **Leading Pedestrian Interval** – Leading pedestrian intervals increase the visibility of pedestrians at an intersection by giving them priority in an intersection with few seconds head start before vehicles. Leading pedestrian intervals have been shown to reduce pedestrian vehicle collusions as much as 60% at treated intersections[2].

[2] NACTO Urban Street Design Guide, 2013



*Source: NACTO*

- **Reconstruct Pedestrian Ramps** – reconstructing the pedestrian ramps of the interchange will bring the area up to Americans with Disabilities (ADA) standards. New detectable warning surfaces and reconfigured slopes will make the area more easily traveled for all users. All 16 ramps were assumed to be reconstructed.

*Source: FHWA*

- **Accessible Pedestrian Signal (APS) Push Buttons** – APS push buttons provide audible information to blind or visibility impaired pedestrians that correspond to the display of the pedestrian indications at the intersection. The audible sounds help the pedestrian navigate to the push button and indicates the status of the pedestrian indication, as well as the name of the street and/or intersection to be crossed.


*Source: Minneapolis Pedestrian Master Plan*

- **Pedestrian Countdown Timers** – APS pushbuttons are typically installed in conjunction with pedestrian countdown timers, which help to inform pedestrians of the amount of time remaining to cross the street. Countdown timers give pedestrians more knowledge of their available crossing time, allowing them to make a more informed decision regarding whether it is safe to cross. *Some signal heads with countdown timers are already installed at the interchange, but did not appear to be functioning correctly during the field observations. If installed in conjunction with APS improvements, combined APS/countdown timers would allow for an audible message of the available remaining crossing time.*


*Source: Minneapolis Pedestrian Master Plan*

## Improve Pedestrian/Bicycle Comfort and Sense of Security

- **Lighting Improvements** – Lighting plays a large role in how safe a pedestrian feels. Lighting will also improve pedestrian/bicycle visibility.
- **Street Trees** – Street trees and other street-adjacent elements can slow traffic down while enhancing the overall pedestrian environment.

*Source: FHWA*

- **Interim Pedestrian Space Widening** – Street parking, or in the case of Hi-Lake, a right turn lane on Lake Street, could be temporarily transformed into additional pedestrian space to highlight how the road could be activated for other uses. This interim strategy uses temporary materials to expand the pedestrian space without modifying existing curb lines. The additional space can be used to establish a wider buffer between pedestrians and motor vehicles and help relieve the existing sidewalk space of furnishings and other uses.

*Source: Minneapolis Parklet Application Manual*

## 4.3. Costs

The costs for Tier I improvements could vary depending on design and scope. High level estimates based on similar projects are shown below. The total estimated combined cost for all of the Tier I improvements is $432,000 (2015 dollars). There is not currently any funding programmed to implement the Tier I improvements.

| Tier I Improvement Costs | | | | | |
|---|---|---|---|---|---|
| **Item** | **Estimated Unit Cost** | **Quantity** | **Design + Contingency (25-30%)** | **Estimated Total Cost (2015 dollars)** | **Notes** |
| **Reduce Vehicle Speeds and Increase Ped/Bike Visibility** | | | | | |
| Install Speed Tables at free right turns | $5,000 each | 2 | $3,000 | $13,000 | Assumes one speed table per free right turn movement. |
| Smart Channels | $25 per sq. ft. | 400 | $3,000 | $13,000 | Assumes ground-in durable markings to channelize vehicles |
| Crosswalk Striping*** | $25 per sq. ft. | 1,200 | $8,000 | $38,000 | Assumes ground-in durable marking. |
| Green Block Pavement Markings | $25 per sq. ft. | 200 | $1,000 | $6,000 | Assumes ground-in durable marking adjacent to one pedestrian crossing across Lake Street. |
| **Subtotal** | | | | **$70,000** | |

| | | | | | |
|---|---|---|---|---|---|
| **Improve Pedestrian Ramps and Signals** | | | | | |
| Leading Pedestrian Interval* | $2,500 each | 1 | $500 | $3,000 | Costs include staff time. Assumes no equipment changes needed. |
| Reconstruct pedestrian ramps | $5,000 each | 16 | $20,000 | $100,000 | Assumes median island reconstruction is not required. |
| APS Push Buttons | $3,000 each | 16 | $14,000 | $62,000 | Assumes push buttons to be installed at all locations with pedestrian indications. Will require pedestrian push button stations to be installed. |
| Pedestrian Countdown Timers*** | $1,200 each | 16 | $4,800 | $24,000 | Assumes same number of existing pedestrian indications. |
| Subtotal | | | | **$189,000** | |
| **Improve Pedestrian Comfort and Sense of Security** | | | | | |
| Lighting Improvements*** | $12,000 each | 10 | $30,000 | $150,000 | Assumes low (pedestrian level) lighting design. |
| Street trees | $400 each | 20 | $2,000 | $10,000 | Assumes a coniferous tree. |
| Interim Pedestrian Space Widening*** | $10,000 as a lump sum | 1 | $3,000 | $13,000 | Cost will vary significantly based on scope of design and installation. |
| **Subtotal** | | | | **$173,000** | |
| **Tier I Total Costs** | | | | **$432,000** | |

*Improvement that is consistent with NACTO Intersection Design Principles
**Improvement that is supported by the Humanize Hi-Lake petition
***Improvement that is consistent with both NACTO & Humanize Hi-Lake

## 4.4. Expected Outcomes

Implementing all the Tier I improvements would make the interchange more manageable for pedestrians and bicyclists. Average vehicle speed would likely be reduced in part due to speed tables, smart channels, and street trees. Pedestrians and bicyclists would have a more visible presence in the interchange through crosswalk striping and green pavement markings. Leading Pedestrian intervals would help establish the pedestrian right of way to turning vehicles. New accessible ramps and improved signals would help pedestrians access the intersection, know how much time they have to cross, and what street they are crossing. Lighting, street trees, and interim pedestrian space widening would make the space more livable and inviting to all users.

There are many more ways to improve the pedestrian environment that Tier I improvements do not address. Tier I improvements do not reduce pedestrian delay or walk distance, improve transit access, or create any additional bike connectivity. A more advanced level of design and partnership as demonstrated in improvements in Tiers II and II will be required to improve these elements of the pedestrian and bicycle environment.

# 5.0 TIER II IMPROVEMENTS

## 5.1. Overview

Tier II improvements include modest geometric modifications within the existing vehicle right-of-way to reclaim space for pedestrians, bicycles, and transit infrastructure. While these improvements would not significantly modify the geometry of the existing interchange, they could serve as an initial phase prior to a more major infrastructure project. Locations for the proposed Tier II improvements are shown in **Figure 5-1**.

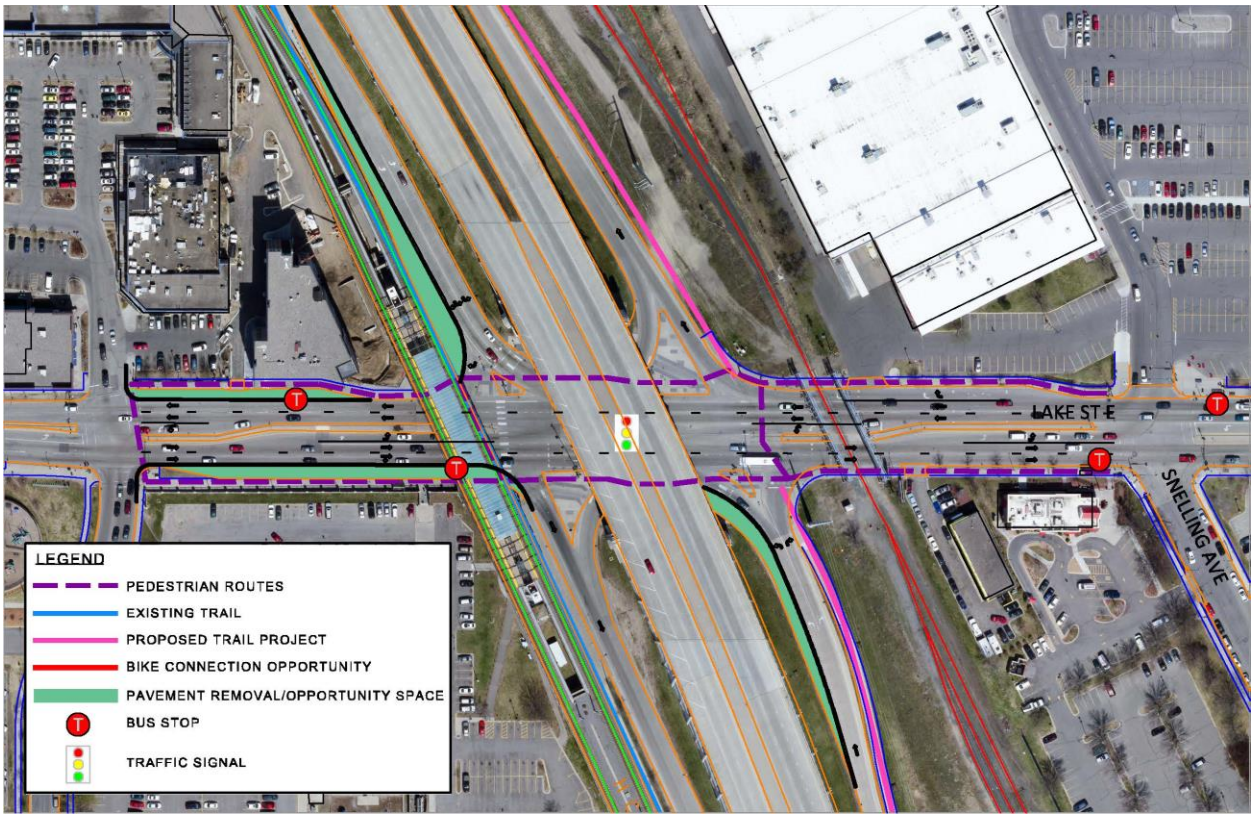



*Figure 5-1: Potential locations for Tier II Improvements*

## 5.2. Improvement Options

### (1) Westbound Right Turn Lane Removal at Lake Street & 22nd Avenue

The westbound approach to 22nd Avenue on Lake Street includes two through lanes, a 150-foot left turn lane (including taper), and a 250-foot right turn lane (including taper). In general, right turn lanes are very uncommon on Lake Street, and most cross sections in this area have on-street parking with a curb extension at the intersection instead of a right turn lane. By removing the right turn lane and extending the curb to the edge of the current through lane, this improvement would create a wider sidewalk and boulevard space (approximately 20 feet), allowing for additional streetscape enhancements such as lighting and landscaping. Additionally, the modification would allow the westbound bus stop to be moved closer to the LRT station, provide sufficient space for a future arterial BRT station, and would eliminate the need for buses to pull out of traffic and merge back into the through lane after picking up and dropping off passengers, improving transit reliability.

**Weekday PM Peak Hour Traffic Impacts**

| | |
|---|---|
| RT Demand: | 110 veh./hr. |
| Queue Increase: | +10 feet |
| Delay Increase: | Negligible |
| Volume/Capacity: | < 0.40 |

As shown on the right, the traffic impacts at the Lake Street/22nd Avenue intersection associated with the modification would be minimal, with no significant increases in queuing or delay expected for the through movement even in peak hours. Even if right-turn volumes were to double, a shared through/right lane would be expected to continue to operate acceptably. A planning-level capacity analysis completed at Hiawatha Avenue/Lake Street for this study indicated that westbound local bus routes stopping in the through lane may have some effect on intersection operations in the PM peak hour, which should be analyzed further in the design phase of this improvement or the arterial BRT project.

Although the improvement does not directly impact pedestrians and bicyclists at the Hi-Lake interchange, the transit and pedestrian benefits help to address neighborhood desires for the area.

**Key Benefits**

- Enhanced pedestrian space
- Reduced north-south pedestrian crossing distance at Lake Street and 22nd Avenue
- Opportunities for streetscape improvement
- Opportunities for transit station enhancements
- Improved transit reliability

**Potential Impacts**

- Increased vehicle delay during passenger pick-up/drop-off at the bus stop
- Construction impacts

*Figure 5-2: View of westbound right turn lane at 22nd Avenue*

### (2) Eastbound Right Turn Lane Removal at Lake Street & Southbound Hiawatha Avenue Entry Ramp

The eastbound approach on Lake Street at Hiawatha Avenue includes two through lanes, a 300-foot left turn lane (including taper), and a 350-foot right turn lane (including taper). As discussed above, right turn lanes are very uncommon on Lake Street, and this particular right lane serves only 60 vehicles during the weekday PM peak hour. By removing the right turn lane and extending the curb to the edge of the existing through lane, additional space could be reclaimed for pedestrians around a heavily used bus stop and light rail station, while also slowing vehicles and shortening the north-south crossing distance. Additionally, the modification would allow the eastbound bus stop to be moved closer to the LRT station, provide sufficient space for a future arterial BRT station, and would eliminate the need for buses to pull out of traffic and merge back into the through lane after picking up and dropping off passengers, improving transit reliability.

**Weekday PM Peak Hour Traffic Impacts**

| | |
|---|---|
| RT Demand: | 60 veh./hr. |
| Queue Increase: | Negligible |
| Delay Increase: | Negligible |
| Volume/Capacity: | ≈ 0.60 |

The traffic impacts associated with the modification would be minimal, with no significant increases in queuing or delay in the peak hours under current volumes. Development in the area is expected to increase peak hour demand on the eastbound approach by 140 vehicles by 2025, of which 20 vehicles would make the right-turn. Under these conditions, a shared through/right lane would be expected to continue to operate acceptably. If traffic demands increased more than expected, eastbound queues could extend back to the 22nd Avenue intersection during limited periods in the PM peak hour. A capacity level analysis completed for the bus operations showed that eastbound local buses stopping in the through lane would not be expected to have a significant impact on vehicle delays. However, this should be analyzed further in the design phase of the arterial BRT or Hi-Lake projects.

**Key Benefits**

- Enhanced pedestrian space
- Reduced north-south pedestrian crossing distance
- Reduced vehicle speeds
- Opportunities for streetscape improvement
- Opportunities for transit station enhancements
- Improved transit reliability

**Potential Impacts**

- Increased vehicle delay during passenger pick-up/drop-off at the bus stop
- Potential for queue spillback during peak hours if traffic demand increases by more than projections
- Construction impacts

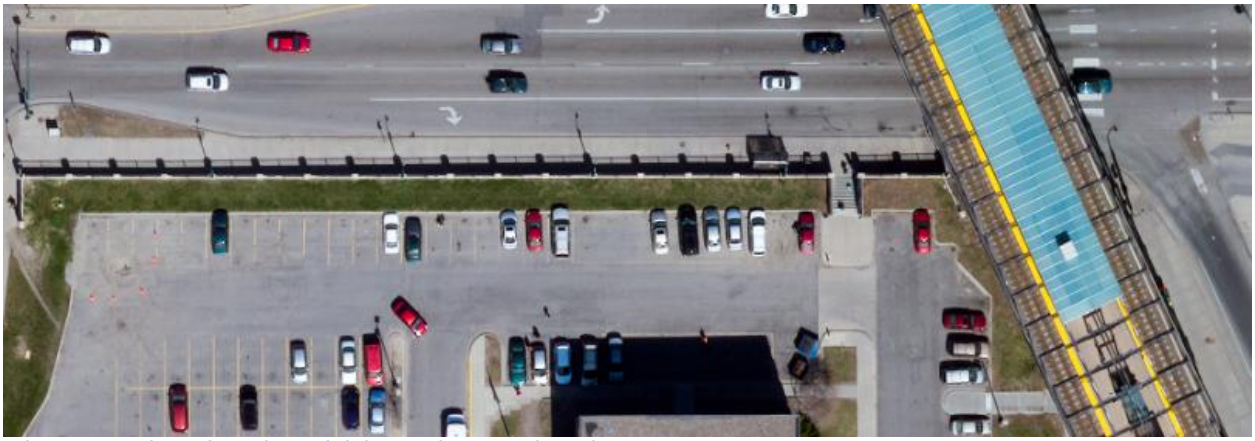


*Figure 5-3: View of eastbound right turn lane at Hiawatha Avenue*

## (3) Northbound Left Turn Lane Removal at Lake Street & Northbound Hiawatha Avenue Exit Ramp

The northbound approach to Lake Street from Hiawatha Avenue includes two left turn lanes and a right turn lane, widening from a single exit lane to the three lanes at approximately 350 feet upstream of the Lake Street intersection. This geometry is very similar to the southbound approach to Lake Street even though vehicle demands are less than 25 percent of the southbound approach during the PM peak hour. Because the approach lanes provide significantly more capacity compared to actual vehicle traffic demand, the west curb could be relocated to remove one of two northbound left turn lanes without impacting traffic operations. This improvement would reclaim space for pedestrians on the east end of the interchange and reduce the east-west crossing distance within the roadway.

As shown on the right, the traffic impacts associated with the modification would be minimal, with no significant increases in delay expected for the movement in the current weekday PM peak hour. The queues on the ramp would increase simply because all vehicles would be in one lane, but would not have any impacts on mainline Hiawatha Avenue. Development in the area is expected to increase demand for the left-turn movement by up to 20 peak hour vehicles by 2025. The approach is currently operating well under capacity, however, and even if demands double the approach would continue to operate acceptably.

**Weekday PM Peak Hour Traffic Impacts**

| | |
|---|---|
| LT Demand: | 60 veh./hr. |
| Queue Increase: | +50 feet |
| Delay Increase: | Negligible |
| Volume/Capacity: | < 0.30 |

*Figure 5-4: View of double northbound left turn lane from Hiawatha Avenue to Lake Street*

**Key Benefits**

- Enhanced pedestrian space
- Reduced east-west pedestrian crossing distance in roadway
- Reduced vehicle speeds
- Opportunities for streetscape improvement

**Potential Impacts**

- Construction impacts

## (4) Southbound Right Turn Lane Reduction at Lake Street & Southbound Hiawatha Avenue Exit Ramp

The southbound approach to Lake Street from Hiawatha Avenue includes two left turn lanes and a right turn lane, widening from a single exit lane to the three turn lanes at approximately 500 feet upstream of the Lake Street intersection. With vehicle traffic demands of around 400 left-turns and 150 right-turns during the PM peak hour, the dual-left turn lanes should be preserved to prevent potential queue spillback under future growth in traffic volumes. However, the extended right turn lane is provided primarily to allow right turning vehicles to bypass queues from the left turn lanes, which is only a potential issue during peak periods. By relocating the west curb line and removing the right turn lane until just upstream of the channelizing island, additional space could be reclaimed for pedestrians around a heavily used light rail station, while also slowing vehicles and providing additional space for an improved biking route from the Midtown Greenway. If a mountable curb is installed as part of the curb modification, Metro Transit could also potentially utilize the space as a temporary bus stop during 'bus bridge' operations.

As shown on the right, the traffic impacts associated with the modification are expected to be minimal. It should be noted that the high-level capacity analysis conducted does not fully capture the impacts associated with turn lane blockage, and the results shown may underestimate the actual impacts. A more detailed microscopic analysis should be used to estimate the impacts with greater reliability. However, the average delay for the left turn movement is estimated to be approximately 50 seconds, so even if right-turn vehicles had the same delay as the left-turning vehicles, these delays would still be considered acceptable during peak hours. Development

**Weekday PM Peak Hour Traffic Impacts**

| | |
|---|---|
| RT Demand: | 145 veh./hr. |
| Queue Increase: | +40 feet |
| Delay Increase: | +2 s |
| Volume/Capacity: | < 0.30 |

in the area is expected to increase PM peak hour demand for the right-turn movement by up to 30 vehicles by 2025. However, even if right-turn demands double compared to projections, the approach would be expected to operate acceptably.

**Key Benefits**

- Enhanced pedestrian space
- Reduced vehicle speeds
- Opportunities for streetscape improvement
- Opportunities for improvements to bus bridge operations
- Opportunities for bicycle connection improvements

**Potential Impacts**

- Additional right turn delay and potential driver frustration
- Construction impacts

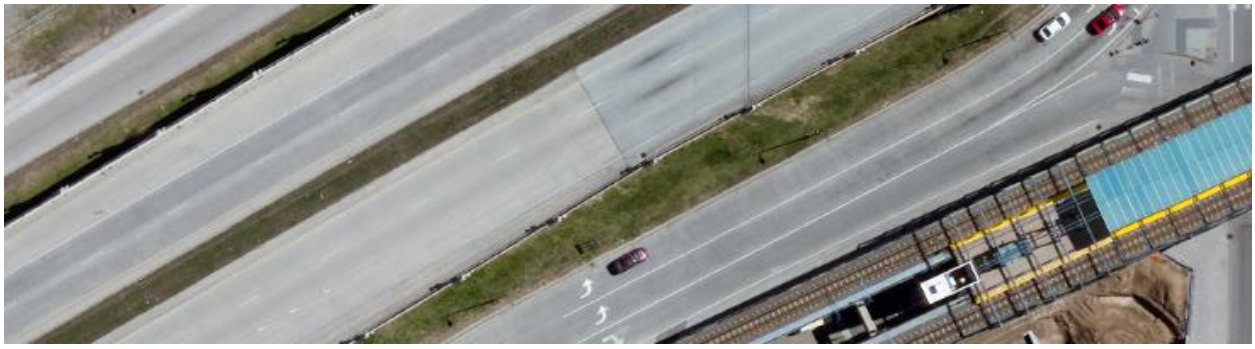


*Figure 5-5: View of southbound right turn lane from Hiawatha Avenue*

## 5.3. Costs

High level estimates for the Tier II improvements based on similar projects and preliminary design concepts are shown below. The total estimated combined cost for all of the Tier II improvements is $660,000. There is not currently any funding programmed to implement the Tier II improvements.

**Tier II Improvement Costs**

| Item | Estimated Cost | Indirect Costs (25%) | Construction Contingency (20%) | Estimated Total Cost (2015 Dollars) |
|---|---|---|---|---|
| Westbound Right Turn Lane Removal at 22nd Avenue | $120,000 | $36,000 | $24,000 | $180,000 |
| Eastbound Right Turn Lane Removal at Hiawatha Avenue | $170,000 | $51,000 | $34,000 | $255,000 |
| Northbound Left Turn Lane Removal at Lake Street | $70,000 | $21,000 | $14,000 | $105,000 |
| Southbound Right Turn Lane Reduction at Lake Street | $80,000 | $24,000 | $16,000 | $120,000 |
| **Subtotal** | | | | **$660,000** |

## 5.4. Expected Outcomes

Implementing all the Tier II improvements would improve the pedestrian and bicycle environment and allow for improved transit operations and station area amenities. Average vehicle speed would likely be reduced, and crosswalk distances would be reduced. Additionally, more space would be allocated to the pedestrian and bicycle realm, allowing for potential investments in streetscaping enhancements.

Despite these benefits, not all neighborhood goals would be addressed with these improvements. While bicycle improvements could be made on the southbound approach, the existing islands would prevent bicycle north-south through movements on the west side of the intersection. While some crossing distances would be reduced, overall pedestrian delay would remain largely unchanged as the general footprint of the interchange and the traffic operations would not change significantly. Addressing more neighborhood goals for the area would require significant interchange modifications, as discussed in the Tier III improvements.

# 6.0 TIER III IMPROVEMENTS

## 6.1. Overview

Tier III improvements incorporate many of the Tier I and Tier II improvements, but advance the concepts further by reconfiguring the basic geometrics of the interchange. These improvements have the greatest potential to address the pedestrian and bicycle goals for the area, but come at the highest cost and therefore would take longer to achieve consensus and obtain funding.

Five concept alternatives were developed in the Tier III category. These alternatives were compared against a no-build alternative (existing condition) using the evaluation measures discussed in section 3.0. The alternatives were developed at a conceptual level only, so many of the design details would need to be further developed through engineering design and public input. In addition, each of the alternatives has both benefits and impacts that necessitate input from stakeholders and the public. Therefore, the key features and technical merits of each alternative are presented along with potential benefits and impacts, and no preferred alternative has been identified. Refer to **Appendix A** to see the conceptual drawings of the Tier III improvements and **Appendix B** for a detailed evaluation matrix that includes quantitative results for all evaluation measures.

An engineer's opinion of probable cost is presented along with each alternative. The costs include a 25 percent allocation for indirect costs as well as a 20 percent construction contingency, which are necessary at this stage due to the conceptual level of the engineering at this stage of the project development. The cost listed includes many of the items described in both Tier I and Tier II, including lighting improvements, street trees, APS pushbuttons, pedestrian ramp reconstruction, crosswalk markings, and turn lane removals. The total cost of the Tier III improvements could potentially be reduced if some of these items were implemented in an earlier phase (e.g., turn lane removals). However, some of the Tier I improvements such as pedestrian ramps would need to be redone along with the full intersection reconstruction. It should also be noted that the feasibility of lower cost construction techniques such as pavement mill and overlay, instead of pavement reconstruction, were not able to be assessed at this stage. Detailed survey and engineering would be needed to determine if and how the cost of the improvements could be reduced.

## 6.2. Modified SPUI

### Geometric Changes

The modified SPUI reduces the northbound exit ramp to a single lane (from 3 lanes) and reduces the southbound exit ramp to 2 lanes (from 3 lanes). In addition, the eastbound right-turn lane at Hiawatha Avenue and the westbound right-turn lane at 22nd Avenue are eliminated. The modifications are similar to a full implementation of several Tier I and all Tier II improvements, with additional island and geometric modifications.

### Pedestrian and Bicycle Improvements

Pedestrians realize the most benefit on the south side of Lake Street with this alternative. A slightly reduced crossing distance and reduced average travel time occurs when pedestrians use the south side of Lake Street to travel east-west through the interchange. However, there is still not sufficient space for a bicycle connection across the interchange to be provided. On the north side, pedestrians and bicyclists would experience longer average delays due to the increased percentage of time needed to serve vehicles on the southbound approach. In addition, the free right-turns from Hiawatha Avenue to Lake Street would still exist.

### Transit Improvements

As discussed in the Tier II improvements, removing the right turn lanes on the west side of the interchange would allow more space for transit station amenities and allow buses to stop within the travel lane instead of having to pull out and merge back into traffic. However, the islands at the interchange would not allow for any improved bus bridge operations.

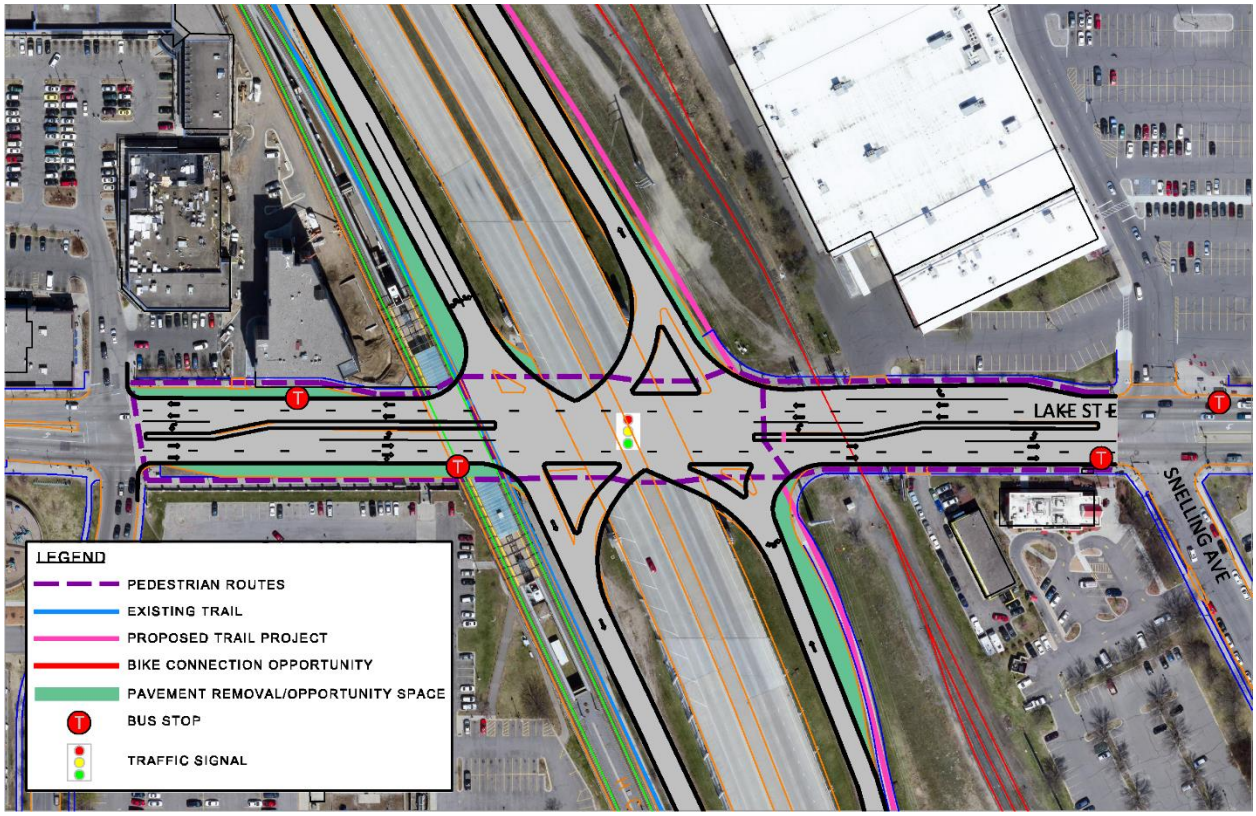



*Figure 6-1: Tier III Alternative 1 (Modified SPUI)*

## Traffic Impacts

With the various geometric modifications on the northbound and southbound approaches, these approaches would require additional green time to clear peak hour vehicle queues. This reallocation of green time to the side street approaches would have the effect of adding some east-west pedestrian delay during peak hours. Vehicle traffic would continue to operate acceptably, but with increased delays and increased volume to capacity (v/c) ratios, limiting the overall amount of traffic growth that could be accommodated in the area.

Because the northbound left turn movement volumes are relatively low and can likely be accommodated by a single lane, MnDOT indicated support for a single northbound left turn lane.

A sub-alternative was analyzed with a single southbound left turn lane, and the results are provided in **Appendix D**. However, because of the large volumes in this movement, this single southbound left turn lane would lead to queues of approximately 500 feet during peak hours, and volumes would begin to reach capacity with anticipated growth in the area. During the study process MnDOT indicated that any alternative which impacts the number of left turn lanes or left-turn storage capacity such that ramp traffic queues onto mainline Hiawatha is unacceptable and would not be supported. Therefore a conceptual layout was not developed for this sub-alternative.

## Key Benefits

- Reclaimed pedestrian space
- Reduced pedestrian/bicycle crossing distances
- Reduced vehicle speeds
- Opportunities for streetscape improvements
- Opportunities for transit station enhancements
- Improved transit reliability

## Key Issues

- 3 of 4 islands remain
- Straightening of the east-west crossing would result in additional exposure to vehicles
- Increased east-west pedestrian delay
- Increase in vehicle delays, queuing, and v/c ratios
- No improvement to bus bridge operations

## Cost

- $2,415,000 (2015 dollars)

## 6.3. Tight Diamond

### Geometric Changes

The Tight Diamond alternative converts the SPUI to a diamond interchange (**Figure 6-2**). This allows the northbound exit ramp to be reduced to a single lane and the southbound exit to two lanes. The right-turn lanes eastbound at Hiawatha Avenue and westbound at 22nd Street were removed, similar to the Modified SPUI. The westbound right-turn lane at Hiawatha Avenue was also removed in this alternative. The space under the bridge is limited, so the eastbound and westbound left-turn lanes to the Hiawatha Avenue ramps would need to be side-by-side without a median.

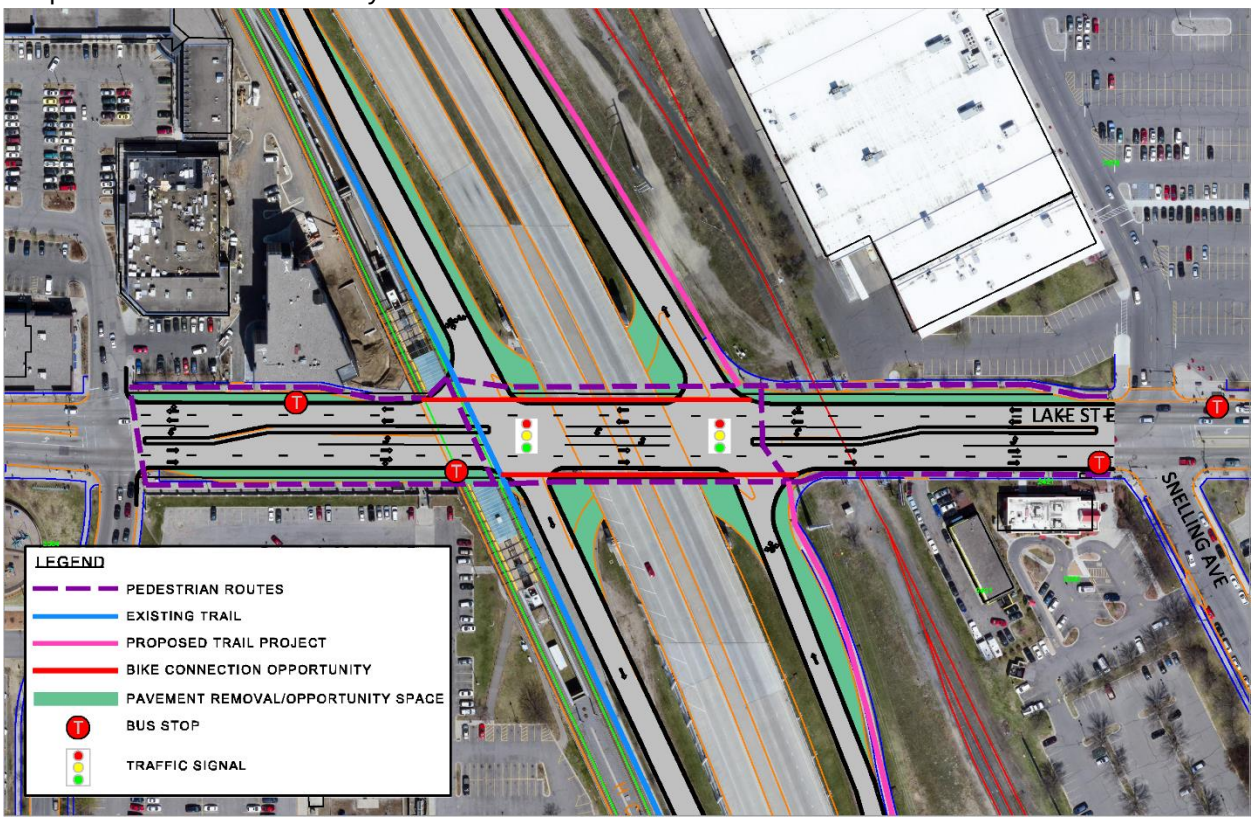



*Figure 6-2: Tier III Alternative 2 (Tight Diamond)*

The signals at the two ramp intersections would need to be controlled with one signal controller in order to minimize any vehicle queuing on Lake Street between the ramps. Due to the angle of the ramp intersections and the need to accommodate truck turning movements, the intersection radii are still somewhat large. The details of the intersection corners in terms of radii and pedestrian ramps would need to be explored further if the alternative were to move into final design.

A sub-alternative was also explored that connects the ramps at an angle closer to 90 degrees (**Figure 6-3**, next page). This would create an offset between the entrance and exit ramps, which would discourage cut-through traffic. Articulated buses can make it through the intersection in this revised alternative.

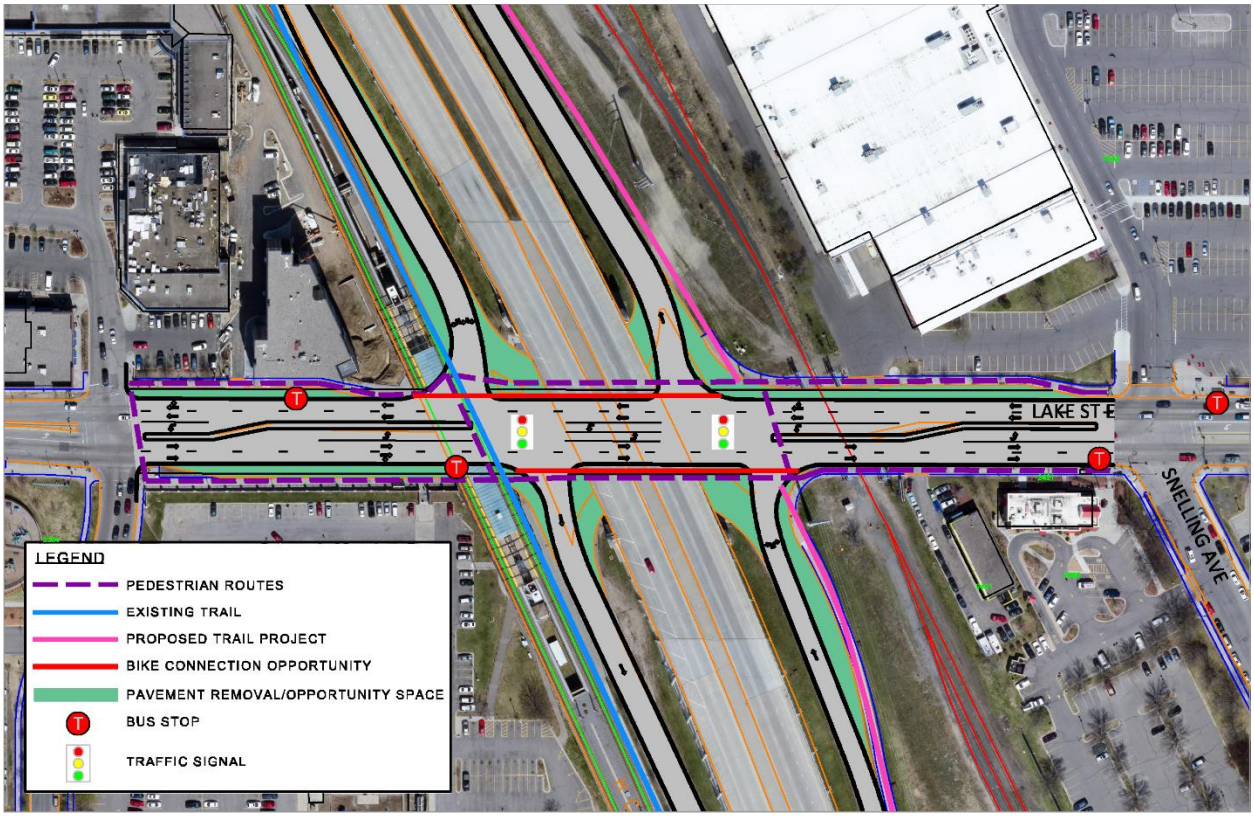



*Figure 6-3: Tier III Sub-Alternative 2 (90-Degree Tight Diamond)*

## Pedestrian and Bicycle Improvements

The Tight Diamond alternative allows the pedestrian/bicycle crossings of the ramps to be shortened significantly, the pedestrian/bicycle routes to be direct, and there would be space for a dedicated east-west bicycle connection on the south side of the intersection. The crossings would be simplified, and median refuge could be provided for the crossings of Lake Street. All pedestrian evaluation measures are improved compared to the base condition. The removal of the islands would also allow for a southbound bicycle through movement. As with the Modified SPUI, this alternative would reclaim space for pedestrians, but an additional full lane in the northeast quadrant could also be reallocated to pedestrian space.

## Transit Improvements

All benefits identified in the Tier II improvements would be maintained, and the elimination of the islands would allow for full use of all four ramps during bus bridge operations.

## Traffic Impacts

The Tight Diamond design would generally maintain or improve traffic operations due to the flexibility in left-turn phasing on Lake Street, the reduced yellow and all red times at the intersection, and the opportunity to shorten the green time on the northbound approach. If the current peak hour turning movement percentages continued, this interchange design could accommodate more overall growth than the baseline condition. Due to the short distance between intersections, some queuing between the two ramp intersections would be expected, but this could be minimized through optimized signal coordination. With the elimination of the islands, no physical barrier would prevent vehicles from using the interchange

to bypass congestion on Hiawatha Avenue, unless the 90 degree interchange sub-alternative were chosen.

Because the northbound left turn movement volumes are relatively low and can likely be accommodated by a single lane, MnDOT indicated support for a single northbound left turn lane.

As within the Modified SPUI, a sub-alternative was analyzed with a single southbound left turn lane, and the results are provided in **Appendix D**. However, because of the large volumes in this movement, this single southbound left turn lane would lead to queues of approximately 600 feet during peak hours with volumes nearing capacity under existing volumes. During the study process MnDOT indicated that any alternative which reduces the number of left turn lanes on this approach would not be supported due to the high demands and concern over queue spillback onto mainline Hiawatha with increased volumes. Therefore a conceptual layout was not developed for this sub-alternative.

### Key Benefits

- Reclaimed pedestrian space
- Reduced pedestrian/bicycle crossing distances
- Potential for improved bicycle connection to the LRT station
- Potential for median refuge crossing Lake Street
- More direct pedestrian routing
- Reduced vehicle speeds
- Opportunities for streetscape improvements
- Opportunities for transit station enhancements
- Improved transit reliability
- Improved bus bridge operations

### Key Issues

- Increased potential for cut-through traffic from Hiawatha

### Cost

- $4,005,000 (2015 dollars)

## 6.4. Half-Diamond with Promenade

### Geometric Changes

The Half-Diamond alternative includes the same improvements as the Tight Diamond alternative, but removes both ramps on the south side of the interchange (**Figure 6-4**). These ramps were identified to be removed because the daily traffic volumes are relatively low (2,000-2,500 vehicles per day) compared to the ramps on the north side which carry 5,000-6,000 vehicles per day. By eliminating the ramps on the south side, a very wide pedestrian and bicycle space could be created. This would provide a dedicated pedestrian space with no vehicle conflicts and allow for a separate dedicated bicycle space between the two north-south bike facilities.

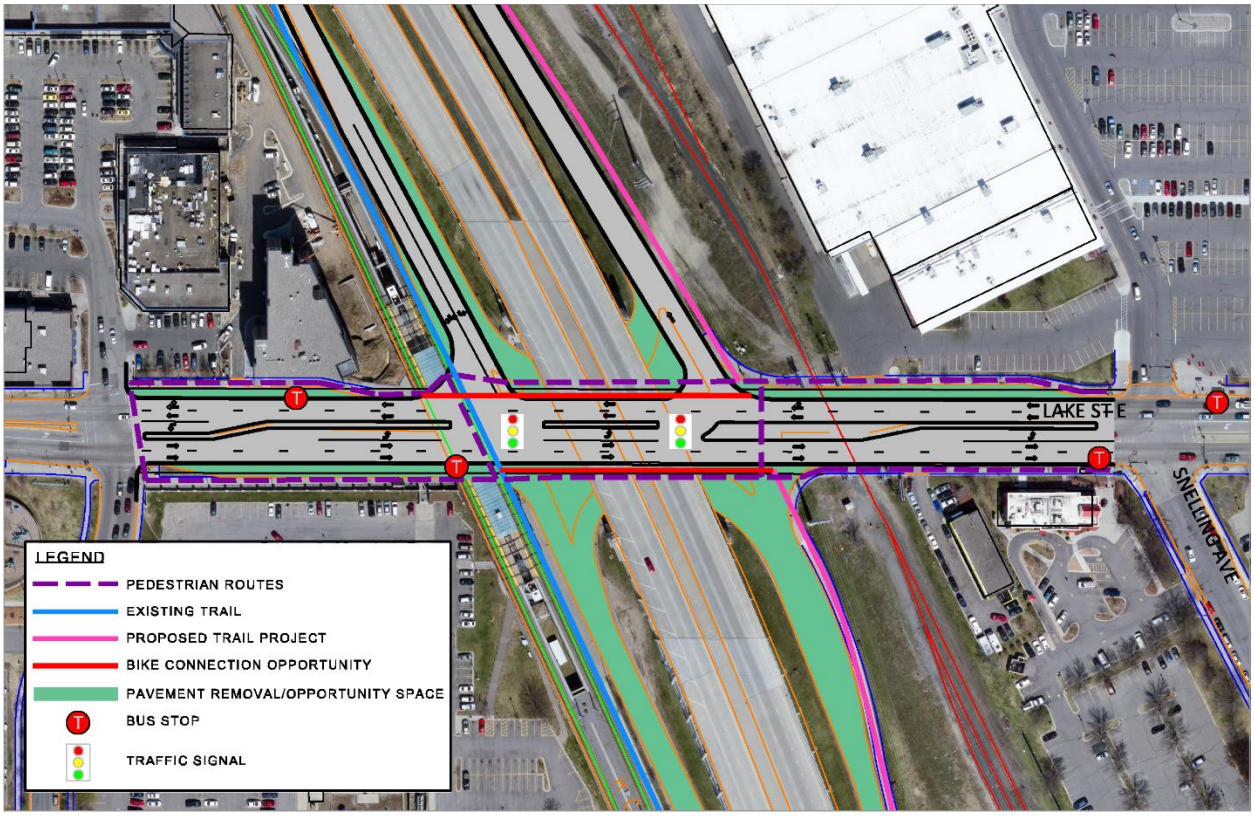



*Figure 6-4: Tier III Alternative 3 (Half-Diamond with Promenade)*

Although the signal on the east side of the interchange could feasibly be eliminated based on traffic operations, the alternative maintains two signals in order to provide a signalized north-south pedestrian crossing on the east side of the interchange.

### Pedestrian and Bicycle Improvements

The Half-Diamond alternative allows the pedestrian/bicycle crossings of the ramps to be shortened significantly, with the added benefit of eliminating east-west crossings altogether on the south side of the interchange, and the pedestrian/bicycle routes would be more direct than in the base condition. The space gained from the ramp removals on the south side of the interchange could be enhanced in a variety of ways. Overall, all pedestrian evaluation measures are improved with the alternative, and the removal of the islands would also allow for a southbound bicycle through movement on the west side of the interchange.

### Transit Improvements

All benefits identified in the Tier II improvements would be maintained. However, the elimination of the south legs of the interchange would require alternative routing during bus bridge operations, degrading transit reliability during these times. Additionally, when the freight rail crossing is blocked, eastbound transit vehicles would no longer have the option to use the south ramps to bypass the blockage.

### Traffic Impacts

The Half-Diamond design would generally maintain or improve traffic operations at the interchange, primarily due to the elimination of several vehicle movements. If the current turning movement percentages continued, this design could accommodate more overall growth than the baseline condition or any other alternative. Due to the short distance between intersections, some queue spillback between the two ramp intersections would be expected, but this could be minimized through optimized signal coordination.

In order to serve the heavy southbound left turn demand, the Half-Diamond with Promenade includes two southbound left turn lanes. On the northbound approach, however, a single left turn lane is sufficient to serve the relatively low volumes during peak hours. Upon review of the traffic analysis, MnDOT confirmed this approach and indicated a left turn lane reduction would be acceptable on the northbound approach but not on the southbound approach..

The elimination of the south legs of the interchange would divert approximately 4,400 vehicles per day to other roadways, likely along north-south local streets such as Minnehaha Avenue or 22nd Avenue. This would increase the left turn demand at 32nd Street and Hiawatha Avenue, causing the peak movement to operate near or at capacity. For the screening level of analysis conducted in this study, traffic operations on the surrounding roadway network and the traffic/LRT interactions at Hiawatha Avenue/32nd Street were not analyzed in detail. MnDOT expressed concern that eliminating any existing ramps at the intersection will cause greater than anticipated operational impacts at 32nd Street (and potentially 28th Street), compounded by impacts associated with LRT operations and uncertain diversion rates.

### Key Benefits

- Reclaimed pedestrian space
- Reduced pedestrian/bicycle crossing distances and potential for median refuge on Lake Street
- Potential for improved bicycle connection to the LRT station
- More direct pedestrian routing
- Reduced vehicle speeds
- Opportunities for streetscape improvements
- Opportunities for transit station enhancements
- Improved transit reliability (during normal operations)
- Elimination of two roadway crossings on the south side of the interchange

### Key Issues

- Degraded bus bridge operations
- Elimination of potential escape route for eastbound buses during railroad crossing events
- Increased vehicle diversion through neighborhoods
- Increased vehicle delays and v/c ratios at 32nd Street and Hiawatha Avenue, and uncertainty regarding potential operational impacts due to estimated diversion rates and LRT operations

### Cost

- $4,650,000 (2015 dollars)

## 6.5. Two-Way Ramps

### Geometric Changes

The Two-Way Ramps alternative includes the same right-turn removals as noted in the Tight Diamond alternative. However, both exit ramps from Hiawatha Avenue are removed and the entrance ramps are converted to two-way roadways (**Figure 6-5**). This would require drivers to use the intersections at Hiawatha Avenue & 28th Street and Hiawatha Avenue & 32nd Street to access the two-way ramps. For southbound traffic at 28th Street, there is not space to create a left-turn lane due to the LRT bridge pier, and therefore a through lane would need to be converted to a left-turn lane to provide for the movement to the two-way ramp. In addition, the existing northbound left-turn movement from the ramp to 28th Street would need to be eliminated. At 32nd Street, a northbound left-turn lane already exists so only the island in the northwest quadrant would need to be modified. It was assumed that the southbound left-turn movement from the ramp and the southbound right-turn movement from Hiawatha Avenue would continue to be restricted, as in the base conditions. It was noted during the evaluation of this alternative that the movements from Hiawatha Avenue onto the two-way ramps would not be intuitive to drivers and would have both safety and operational concerns. This is a very unusual intersection type and would have safety and operational concerns for all modes.

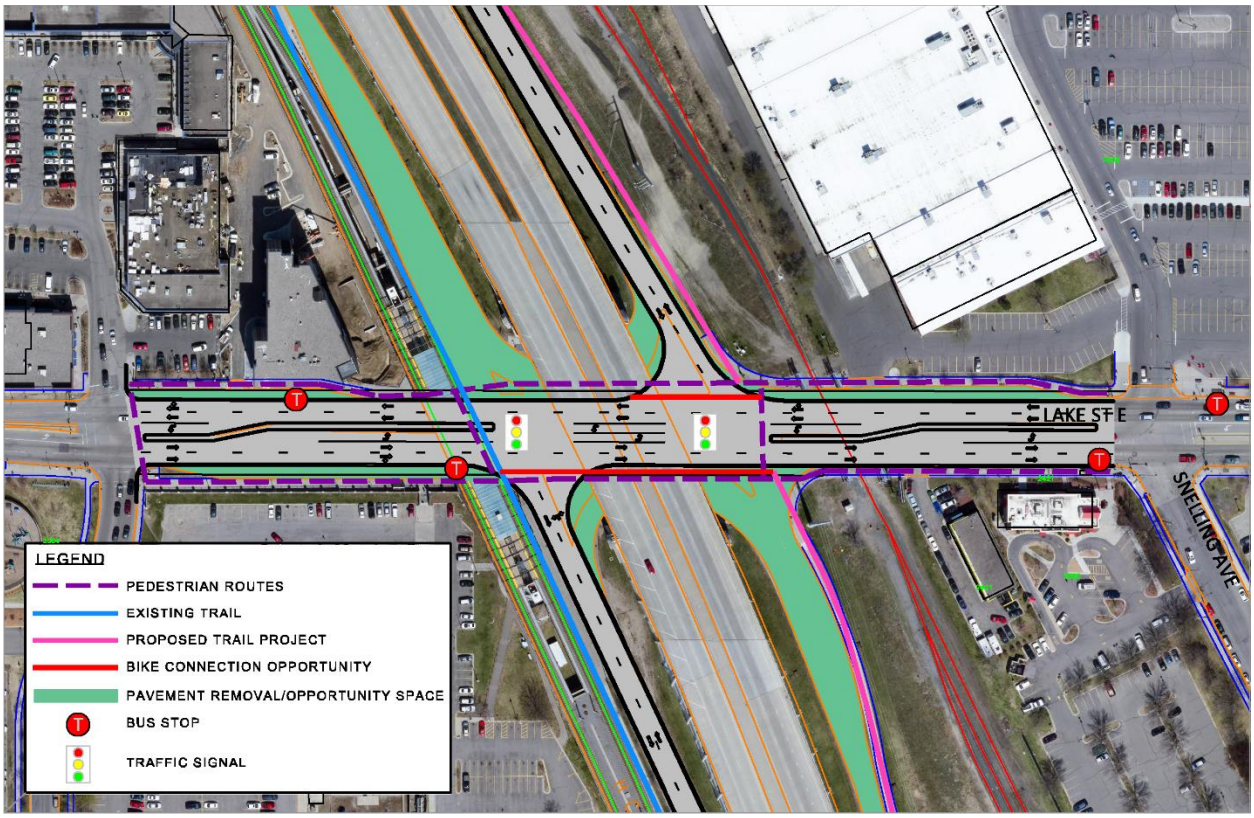



*Figure 6-5: Tier III Alternative 4 (Two-Way Ramps)*

### Pedestrian and Bicycle Improvements

The Two-Way Ramps alternative allows the pedestrian/bicycle crossings of the ramps at Hiawatha/Lake to be shortened significantly, with the added benefit of eliminating two east-west roadway crossings altogether on the northwest and southeast sides of the interchange. This space could be enhanced in a

variety of ways. Overall, all pedestrian evaluation measures are improved with the alternative, and the removal of the islands would also allow for a southbound bicycle through movement.

At 32nd Street, the roadway crossing would be lengthened to accommodate the additional vehicle lane. At both 28th Street and 32nd Street, the pedestrian and bicycle crossings would be complicated as there would be added conflicts and more vehicle traffic.

### Transit Improvements

All benefits identified in the Tier II improvements would be maintained. The alternative could potentially improve bus bridge operations compared to the base conditions, but would require buses to stop on the southbound approach to the intersection to pick up and drop off passengers at a temporary stop.

### Traffic Impacts

The Two-Way Ramps design would generally maintain or improve traffic operations at the Hi-Lake interchange. However, due to the capacity constraints of a single southbound left-turn exit lane, some vehicle diversion would be expected; this was estimated to be around 2,100 vehicles per day. These vehicles would be expected to instead exit southbound Hiawatha at 26th Street or choose another route, rather than attempt to turn left at 28th Street to access Lake Street. Although the impacts to 26th Street were not analyzed, this is a congested, constrained intersection that is preempted by LRT, and adding left turning volume to this intersection would likely degrade operations, potentially to unacceptable levels, and therefore require improvements.

At 28th Street, a southbound through lane would need to be restriped to a left turn lane due to the bridge supports in the median, a new left turn phase would need to be added, and the left turning movement from the ramp to 28th Street (less than 20 vehicles during the PM peak hour) would need to be eliminated in order to accommodate this new phase. Even with optimized phasing and assumed vehicle diversion, the southbound left turn lane demand would exceed capacity.

At 32nd Street, signs would need to be installed to direct drivers to the northbound left turn lane for vehicles headed to 32nd Street as well as to Lake Street. Although no new phases would need to be added to allow two-way operations on the Lake Street access segment, additional delay and queuing would be expected. At the screening level of analysis conducted, light rail operational impacts on vehicle traffic are not captured, and therefore vehicle delays may be greater than reported.

Given the proposed single southbound left turn lane at Lake Street and the geometrics and operations at 28th Street and 32nd Street, compounded by light rail operations and uncertainty regarding potential diversion rates, MnDOT does not support the Two-Way Ramp concept as proposed. As noted previously, MnDOT expressed significant concerns with any concept that includes a southbound left turn lane reduction or eliminates existing ramps from the Lake Street interchange due to the potential operational impacts on Hiawatha Avenue.

### Key Benefits

- Reclaimed pedestrian space
- Reduced pedestrian/bicycle crossing distances
- Potential for improved bicycle connection to the LRT station
- Potential for median refuge crossing Lake Street
- More direct pedestrian routing
- Reduced vehicle speeds
- Opportunities for streetscape improvements
- Opportunities for transit station enhancements

- Improved transit reliability
- Elimination of two roadway crossings

## Key Issues

- Increased vehicle diversion through neighborhoods
- Anticipated operational impacts at 26nd Street; no improvements included in cost estimate
- Significant operational impacts at 28th Street, with volumes exceeding capacity, and uncertainty regarding potential operational impacts due to estimated diversion rates
- Increased delays and queuing at 32nd Street, and uncertainty regarding potential operational impacts due to estimated diversion rates and LRT operations
- Increased crossing distance and potential pedestrian/bicycle conflicts at 32nd Street and at 28th Street near the Midtown Greenway

## Cost

- $5,655,000 (2015 dollars)

## 6.6. Diamond with Two-Way Ramps

### Geometric Changes

One final alternative was created based on a combination of the Tight Diamond and Two-Way Ramps alternatives. This alternative maintains both ramps to the north but combines the ramps to the south into one two-way ramp (**Figure 6-6**). On the north side of the Hiawatha/Lake interchange, the same geometric modifications would be applied as discussed for the Tight Diamond alternative. On the south side, the same geometric modifications at 32nd Street would be applied as discussed for the Two-Way Ramps alternative.

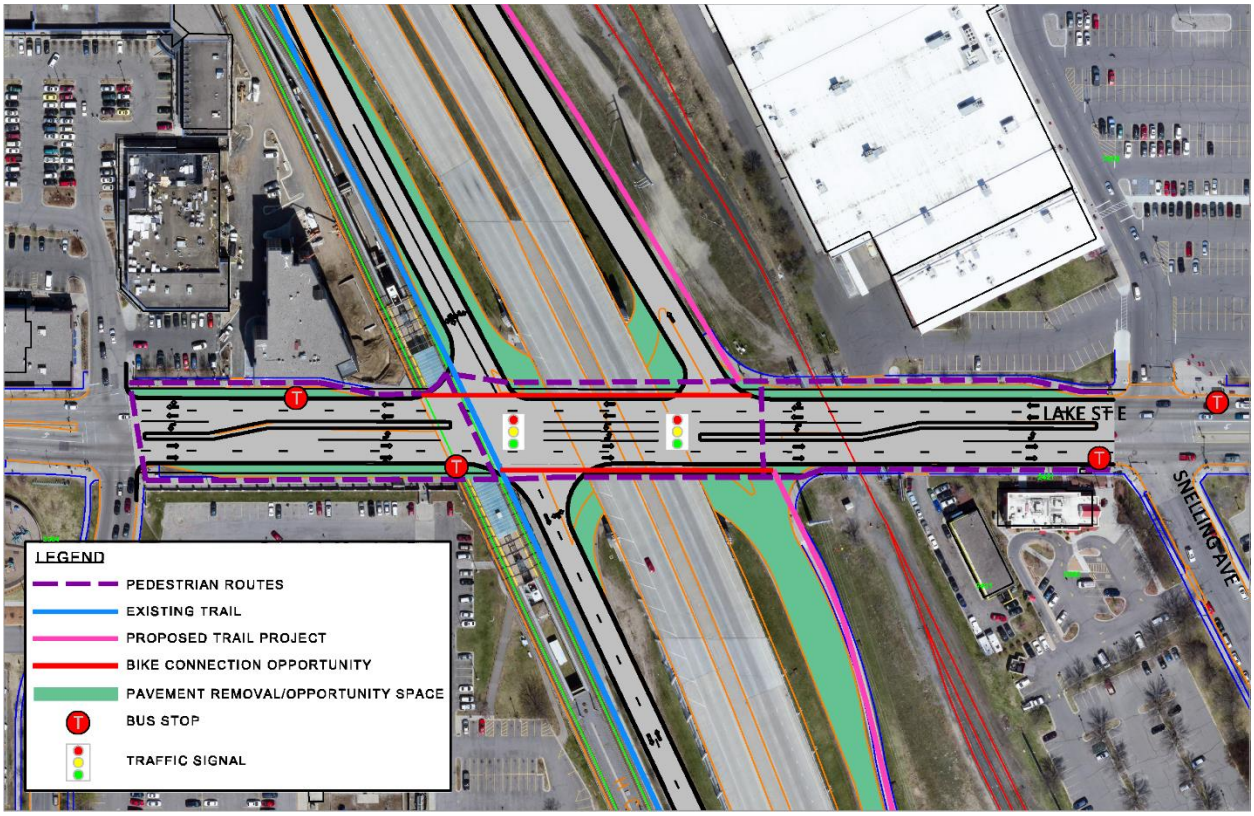



*Figure 6-6: Tier III Alternative 5 (Diamond with Two-Way Ramps)*

The signal operations of the two-way ramp at Lake Street would need to be split phased for northbound and southbound, which would be inefficient. It was assumed that the southbound left-turn movement from the two-way ramp onto 32nd Street and the southbound right-turn movement from Hiawatha Avenue to 32nd Street would not be allowed; these movements are not allowed in the existing conditions. It was noted that this option (and the Two-Way Ramps option) would widen the crossings of Hiawatha Avenue at 32nd Street. The additional vehicle movements at 32nd Street would be unexpected from a pedestrian and bicycle perspective and would make the crossings of Hiawatha Avenue and 32nd Street more difficult. This alternative has some of the same issues as the Two-Way Ramps alternative relative to drivers making unusual movements at complex intersections. This is a very unusual intersection type and would have safety and operational concerns for all modes.

### Pedestrian and Bicycle Improvements

The Diamond with Two-Way Ramps alternative allows the pedestrian/bicycle crossings of the Hiawatha/Lake ramps to be shortened significantly, while also eliminating one east-west roadway crossing altogether on the southeast side of the interchange. This space could be enhanced in a variety of ways. Overall, all pedestrian evaluation measures are improved with the alternative, and the removal of the islands would also allow for a southbound bicycle through movement.

At 32nd Street, as discussed for the Two-Way Ramps alternative, the roadway crossing would be lengthened to accommodate the additional vehicle lane. The pedestrian and bicycle crossings would be complicated as there would be added conflicts and more vehicle traffic

### Transit Improvements

All benefits identified in the Tier II improvements would be maintained. The alternative could potentially improve bus bridge operations as well by allowing buses to stop on the southbound approach to the intersection to pick up and drop off passengers at a temporary stop.

### Traffic Impacts

The Diamond with Two-Way Ramp design would generally maintain or improve traffic operations at the Hi-Lake interchange. However, in order to maintain two left turn lanes on the southbound approach, the northbound and southbound approaches would need to operate using split phasing, which is less efficient than the operations discussed for the other alternatives, and less growth could be accommodated compared to other alternatives. Additionally, with the elimination of the islands, no physical barrier would prevent vehicles from using the interchange to bypass congestion on Hiawatha Avenue.

At 32nd Street, signs would need to be installed to clarify that the northbound left turn lane would serve vehicles headed to 32nd Street as well as Lake Street. Although no new phases would need to be added to allow two-way operations on the Lake Street access segment, additional delay and queuing would be expected. At the screening level of analysis conducted, light rail operational impacts on vehicle traffic are not captured, and therefore vehicle delays may be greater than reported. As noted previously, MnDOT expressed concern that eliminating any existing ramps at the intersection will cause greater than anticipated operational impacts at 32nd Street (and potentially 28th Street), compounded by impacts associated with LRT operations and uncertain diversion rates.

### Key Benefits

- Reclaimed pedestrian space
- Reduced pedestrian/bicycle crossing distances and potential for median refuge on Lake Street
- Potential for improved bicycle connection to the LRT station
- More direct pedestrian routing
- Reduced vehicle speeds
- Opportunities for streetscape improvements
- Opportunities for transit station enhancements
- Improved transit reliability
- Elimination of one roadway crossing

### Key Issues

- Increased potential for cut-through traffic from Hiawatha
- Increased delays and queuing at 32nd Street and uncertainty regarding potential operational impacts due to LRT operations
- Increased crossing distance and potential pedestrian/bicycle conflicts at 32nd Street

### Cost

- $5,010,000 (2015 dollars)

## 6.7. Summary

The benefits and issues discussed above represent a high level summary of a more detailed screening level analysis of each alternative. For a direct comparison al all five alternatives, **Appendix B** includes a completed evaluation matrix that quantifies the measures discussed. **Appendix D** provides detailed summary tables of the traffic analysis performed to allow for a comparison of alternatives.

As noted previously in this section, the outcome of this study was not to identify a preferred alternative. Additional stakeholder input and technical analysis/design should be conducted to recommend the improvements that will move into the design and implementation phase. However, there is not currently any funding programmed to implement the larger Tier III improvements or the more modest Tier I and II improvements.

Additional agency coordination will be needed to determine the full impacts of any alternative that moves forward. Though partner agencies were involved in this study, some alternatives may have broader system impacts and trade-offs that may not be supported once more detail is known.

# 7.0 APPENDICES