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Hi-Lake Intersection Study

PHASE 2

Minneapolis
City of Lakes

Hennepin

Kimley»Horn

Hi-Lake Phase 2 Final Report

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Chapter One: Intersection Overview

NEED

The Hiawatha-Lake Interchange (also called the Hi-Lake Intersection) is an intermodal hub, despite its origins as an efficient, auto-oriented interchange. An estimated 1 in 5 people at the Hi-Lake Intersection arrive or depart on foot, by bicycle, or via transit. Thousands of people utilizing a variety of transportation modes traverse the Hi-Lake interchange on a daily basis:

- 6,800 pedestrians and bicyclists
- Over 2,000 Metro Transit bus riders
- Over 400 Metro Transit buses
- 40,000 motor vehicles
- 5 freight trains
- 3 Metro Transit bus routes

An additional 220 light rail trains carrying another 2,500 transit passengers on the METRO Blue line and 37,000 vehicles per day travel overhead on Hiawatha Avenue (Trunk Highway 55).

The current configuration of the Hi-Lake Intersection poses many access and safety challenges for people traveling on all modes. The interchange is confusing, acts as a barrier obstructing flow between neighborhoods, and is difficult to navigate especially for non-motorized modes. There is a growing need to enhance the movements for all travel modes. Improved connections are needed for all users traveling to Lake Street or Hiawatha Avenue at the interchange in an efficient and safe manner. This becomes particularly important as the area immediately surrounding the Hi-Lake interchange continues to see significant investments in multimodal transportation (such as planned BRT on Lake Street) and transit-oriented developments.

STUDY PURPOSE & OVERVIEW

This study examined potential near- and long-term solutions for improving the multimodal environment at the Hi-Lake Intersection. The study is being led jointly by the City of Minneapolis and Hennepin County, in partnership with the participation of Metro Transit and the Minnesota Department of Transportation (MnDOT).

Relationship between Phase 1 & Phase 2

In 2016, the City and County completed the Hi-Lake Phase 1 Study. The study documented existing conditions, key transportation issues at the intersection, and included a technical analysis which identified several potential short and long-term treatments at the intersection. Although the original purpose of the Phase 1 study was "to develop potential solutions to improve the pedestrian and bicycle environment", it became clear that other modes such as transit and vehicular traffic also needed to be considered.

Several multimodal goals emerged from Phase 1 of the Study, including:

- Improve pedestrian and bicyclist comfort, safety, and security, and minimize crossing delays at signals
- Ensure the roadway configuration supports all transit movements and facilitates efficient transit operations
- Reallocate right-of-way to expand 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
- Improve the geometrics of the interchange area to provide better vehicular guidance and clearer sight lines.

Many strategies to improve the Hi-Lake Intersection were examined. These strategies fell into one of three Tiers, generally based on timing and implementation cost:

- Tier 1: The most cost-effective solutions that could be implemented in the current interchange configuration in a relatively prompt manner.
- Tier 2: Solutions that require more extensive revisions such as curb modifications or removal of right turn lanes but continuing to maintain the current single point urban interchange (SPUI) configuration
- Tier 3: Long-term interchange reconfiguration possibilities that significantly change the geometrics and better manage movements of the various travel modes. The Tight Diamond configuration became the preferred long-term design after extensive staff evaluations and stakeholder input.

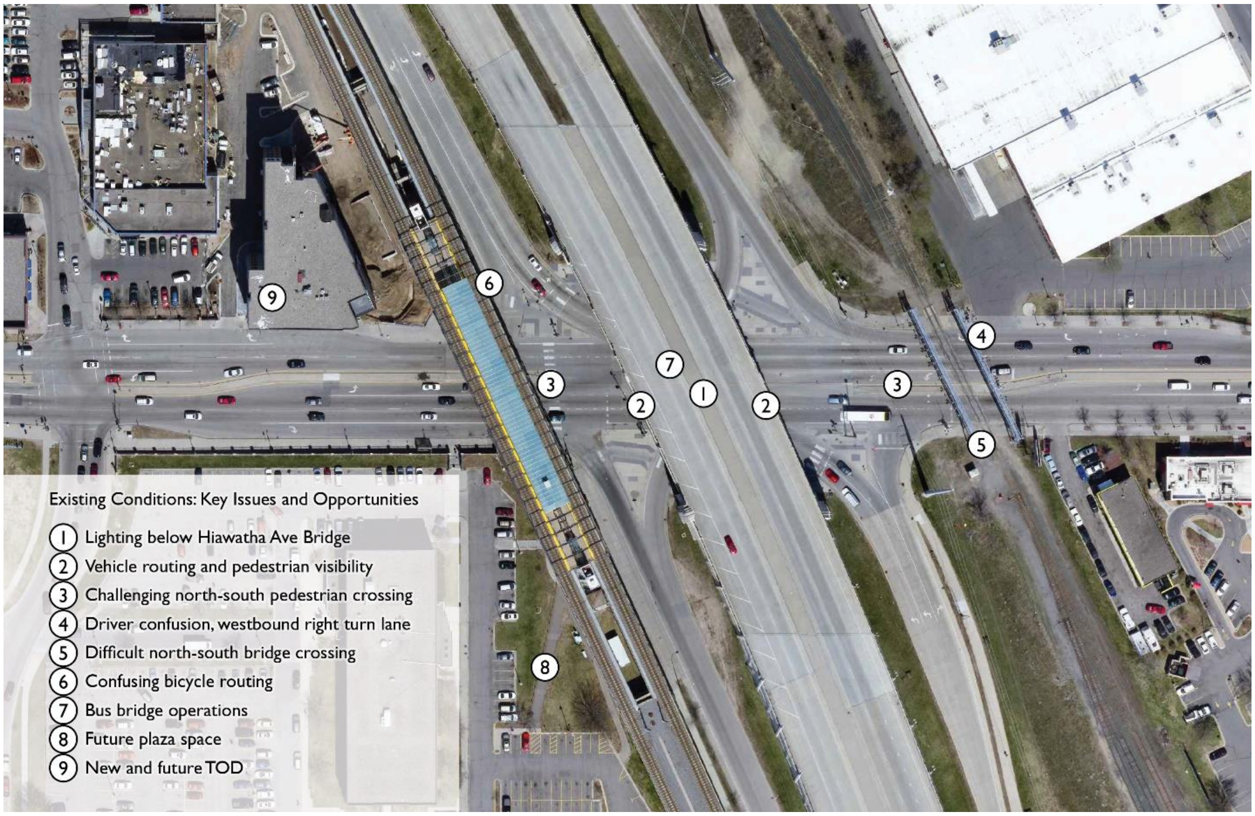
While the Phase 1 study brought together stakeholders and started the conversation around improving the intersection, the study did not address the feasibility of many suggested solutions and did not identify a recommended set of improvements.

Phase 2 Purpose

The City of Minneapolis, in partnership with Hennepin County, began Phase 2 of the study in fall of 2017. Phase 2 of the Study focused on:

- Developing a phased action plan for the implementation of the interim Tier 1 and 2 improvements
- Additional technical analysis to confirm feasibility
- Additional refinement of the preferred long-term concept (Tight Diamond)
- Public engagement around these items

EXISTING CONDITIONS



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. While effective for moving vehicles quickly through an interchange, the SPUI design at Hi-Lake creates a very auto-oriented environment that does not fit within the urban context of Lake Street and creates challenging site lines and geometries.

Geometry

Lake Street is generally a four-lane median-divided, two-way roadway, widening in the Hi-Lake interchange area with designated left- and right- turn lanes in three of four quadrants. 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). There are no designated bicycle facilities on Lake Street.

GEOMETRIC CHANGES SINCE THE PREVIOUS STUDY

There are designated right turn lanes in three of four quadrants because the eastbound right-turn lane of the southwest quadrant has been removed following the Phase 1 Hi-Lake Interchange Study. In place of that previous right turn lane is additional pedestrian space outside the new Hennepin County Service Center, as well as a modernized bus platform suitable for use as part of planned bus rapid transit service on Lake Street. . Additionally, the adjacent pork chop refuge island was reconstructed with new pedestrian curb ramps.

ONE INTERSECTION, MANY PARTNERS

The street design process is complicated. It involves many agencies with various jurisdictions, objectives, and demands. While the City of Minneapolis and Hennepin County are currently leading the pre-design planning efforts of this Hi-Lake Phase 2 Study, those two agencies are not the sole agencies that have a stake in moving forward transportation improvements at Hi-Lake. Ultimately the future state of the area will be a product of the partnerships between the affected agencies involved in the road design process.

Agencies and Stakeholders

Hi-Lake is not only complex in its geometry, but also complicated by the numerous agencies and stakeholders that are involved. The area is adjacent to three Minneapolis neighborhoods, and the streets are owned and operated by three different agencies. Coordination amongst the various jurisdictions is critical in moving forward with improvements at Hi-Lake.

The jurisdictional agencies and community stakeholders involved with the Hi-Lake Intersection include:

- **MnDOT**: As a Trunk Highway, MnDOT has jurisdiction over Hiawatha Avenue and its entrance and exit ramps onto Lake Street.
- **Hennepin County**: As a designated County State-Aid Highway, Hennepin County has jurisdiction over Lake Street including prime responsibilities for operating and maintaining Lake Street.
- **Metro Transit**: Via the Metropolitan Council, Metro Transit owns and operates the METRO Blue Line light rail stop, has jurisdiction of the bridge housing the LRT station and tracks above Lake Street, operates Metro Transit bus routes 21, 27, and 53, and maintains the current bus stops at the northwest and southwest quadrants of the interchange.
- **City of Minneapolis**: While the City of Minneapolis does not have direct roadway jurisdiction at Hi-Lake, the City of Minneapolis has a key role in stakeholder identification, design coordination, advocating for people in all the ways they travel, development/redevelopment approvals, and comprehensive planning and visioning. As the agency with land use authority, the City of Minneapolis has led transportation planning and community engagement efforts in Phases 1 and 2 of intersection redesign. Additionally, the City of Minneapolis has jurisdiction over the minor streets connecting to Lake Street, such as 22nd Avenue and Snelling Avenue, and owns and operates the traffic signals in the area.
- **Community Stakeholders**: Several community groups have been involved in both phases of the Hi-Lake Study, including:
  - Longfellow Community Council
  - Corcoran Neighborhood Organization
  - Lake Street Council
  - Our Streets Minneapolis
  - Sierra Club North Star Chapter
  - YWCA – Midtown
  - Wellington Management
  - City of Minneapolis Pedestrian & Bicycle Committees
  - Hennepin County Bicycle Advisory Committee

Street Design Process

Each agency and their jurisdictional responsibility matters during the various stages of the street design process, and some agencies are more involved at different stages of the process. A very high-level overview of the street planning and design process is shown in Figure 1. While the City of Minneapolis and Hennepin County have led and are leading the Vision and Refinement stages of the Hi-Lake Intersection Study, the Preliminary Engineering and Final Design stages (Design), as well as Construction, Operation, and Maintenance (Implementation), could be led by another agency. Typically, the lead agency at each stage of the process is based on funding.

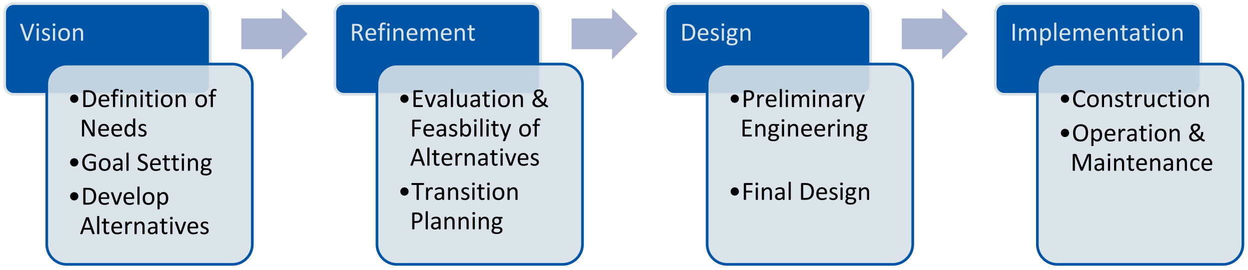


Figure 1: The Street Design Process

The visioning process was shaped by community engagement and resulted in the Phase One report. That Vision process developed concepts and project alternatives for the wholescale redesign of the area to better reflect who uses the area and the future needs of the Hi-Lake Intersection.

The refinement process also includes community engagement, the result of which is this Hi-Lake Intersection Phase 2 Report. This refinement process provides planners with additional details regarding improvement feasibility and near-term project alternatives.

With additional funding commitments and action from relevant agencies, the project will be able to move into the preliminary engineering and eventual final design and implementation phases.

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Chapter Two: Community Engagement

ENGAGEMENT PROCESS OVERVIEW

The City of Minneapolis and Hennepin County have worked directly with many stakeholders on the Hi-Lake Study. Engagement in Phase 2 focused on seeking feedback on the draft Action Plan and sharing project updates. From summer 2017 through fall 2018, staff hosted and attended a series of engagement activities to gather feedback on Phase 2 of the Hi-Lake study.

- **Open Streets:** City and County staff hosted a booth sharing information about the Hi-Lake Study at the 2017 and 2018 Open Streets events on Lake Street and Minnehaha Avenue.
- **Stakeholder Working Group:** City and County staff engaged a group of community stakeholders on the Phase 2 scope of work and project updates. The stakeholder working group met twice during Phase 2 and was comprised of staff following organizations:
  - Corcoran Neighborhood Organization
  - Longfellow Community Council
  - Lake Street Council
  - East Phillips Improvement Coalition
  - Wellington Management, Inc.
  - YWCA
  - Our Streets Minneapolis
  - The Sierra Club North Star Chapter
  - Our Streets Minneapolis
  - Metro Transit Police
  - Minneapolis Ward 9 Council Office
- **Policymaker meetings**: City and County staff also convened a group of policymakers to share information about the Hi-Lake Study and feedback heard from stakeholders. This group included representatives and leadership from the City of Minneapolis Public Works, Hennepin County Public Works, Metro Transit, MnDOT Hennepin County District 4, City of Minneapolis Wards 2, 9, and 12.
- **Presentations at public meetings:** City and County staff engaged residents and staff about the Hi-Lake Study at the following public meetings where community members could voice their concerns and solutions for Hi-Lake.
  - May 30, 2017: Corcoran Neighborhood Association meeting
  - July 6, 2017: Corcoran Neighborhood Association meeting
  - January 18, 2017: Longfellow Community Council meeting
  - February 27, 2017: Community meeting hosted by Longfellow Community Council
  - November 13, 2018: Community meeting hosted by Longfellow Community Council

FEEDBACK

Feedback from these engagement activities uncovered many key themes:

- Pedestrian comfort and personal safety are a major concern
- A desire to improve bicyclist access and wayfinding through Hi-Lake
- A growing desire to see improvements at Hi-Lake in the near-term
- A desire to study how street design could improve personal safety issues at Hi-Lake
- Overall support for action plan and long-term Tight Diamond design
- Desire to continue to pursue opportunities to fund the Tight Diamond
- A desire to explore ways to activate the Hiawatha Avenue Bridge underpass space with improved lightening or the installation of public art or even allowing commercial activities.

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Chapter Three: Near-Term Improvements

The Hi-Lake Action Plan presented is intended to serve as a roadmap for implementing transportation improvements at the Hi-Lake Intersection. The Action Plan lists the possible improvements and compares those improvements to show which options provide the most benefits and are the most feasible to implement.

POSSIBILITIES

Benefits-Challenges Matrix

The matrix in Table 1 frames the potential improvements that will implement short-term change and/or advance the Hi-Lake Intersection towards the tight diamond intersection configuration. It outlines the benefits, technical considerations, cost, and lead time estimates for each improvement.

Projects are divided into three broad categories, as outlined below:

GEOMETRIC IMPROVEMENTS

Projects in this category show the treatments that would provide the most benefits. These include temporary and permanent curb extensions, removing right turn lanes, a temporary westbound bus platform, speed tables and sidewalk buffer space. These proposed changes would create immediate improvements in the pedestrian environment, especially where visibility and exposure to vehicles are concerned. However, most of these treatments are incompatible with an optional tight diamond configuration. If the entire interchange were redesigned, it is likely that these improvements would need to be replaced. However, the benefits provided by these treatments (even if short term) could outweigh their costs for eventual replacement.

OPERATIONAL IMPROVEMENTS

Other engineering improvements include pedestrian median refuge islands, high visibility crosswalks, accessible pedestrian push buttons, leading pedestrian intervals, and new pedestrian ramps. These changes would require lesser coordination effort than other geometric improvements and vary in cost and lead time requirements. Most of these improvements would need also to be reconstructed or reconfigured in an optimal tight diamond layout. However, the benefits provided by these treatments (even if short term) might still outweigh their costs for eventual replacement.

PUBLIC SPACE IMPROVEMENTS

Improvements related to public space require the longest lead time and most coordination effort. Projects include landscaping, lighting, public art, and reconsidering auto access points. These projects focus on improving the pedestrian realm and urban form outside of the curb lines.

Table 1 Potential Hi-Lake Improvements

	IMPROVEMENT	IMPLEMENTATION		BENEFITS					OTHER CONSIDERATIONS	
	Details	Estimated Costs (2018)	Lead Time	Reduces Vehicle Speeds	Reduces Pedestrian Exposure to Vehicles	Increases Pedestrian Visibility to Vehicles	Improves Pedestrian Realm/ Urban Form	Total Benefits	Consistency with Tight Diamond	Coordination Effort/ Implementation Challenges
Space Allocation or Geometry Improvements	**PERMANENT CURB EXTENSION** Permanent reconfiguration of sweeping vehicle movements to pedestrian space using concrete at free right-hand turns	Medium $20k	✗ 1-2 years	✓	✓	✓	✓		No – Would likely need to be reconstructed in full build-out	Most – May have impact on snow plows, emergency response vehicles, drainage, and the disability community
Space Allocation or Geometry Improvements	**REMOVE RIGHT TURN LANES** Permanently covert vehicle space to pedestrian space. Could occur at westbound transit boarding area and/or near southbound Hiawatha entrance	High $150k	✗ 2+ years	✓	✓	✓	✓		No – Would likely be reconfigured in full build-out	Some – Traffic impacts should be evaluated and justify pedestrian benefits
Space Allocation or Geometry Improvements	**TEMPORARY WESTBOUND BUS PLATFORM** Procured plastic or other heavy materials to temporarily improve westbound Metro Transit bus boarding area into existing right turn lane	Medium $40k	✓ 1 year or less	✓	✓	✓	✓		No – Would be utilized elsewhere upon full build-out	Little – Need to coordinate with Metro Transit to procure proper products
Space Allocation or Geometry Improvements	**TEMPORARY CURB EXTENSION** Temporary transformation of sweeping vehicle movements to pedestrian space using bollards or paint at free right-hand turns	Low $5k	✓ 1 year or less	✓	✓	✓	✓		No – Although it would be removed in full build-out, improvement has low fiscal impact with high benefit	Some – May have impact on snow plows and emergency response vehicles
Space Allocation or Geometry Improvements	**SPEED TABLES** Raised pedestrian crossings at free right-hand turns	Medium $25k	✗ 1-2 years	✓	✗	✓	✗		No – Would certainly be removed in full build-out	Most – May have impact on snow plows, emergency response vehicles, drainage, and the disability community
Space Allocation or Geometry Improvements	**SIDEWALK BUFFER SPACE** Temporarily covert vehicle space to pedestrian space using bollards, paint, and planters	Low $15k	✓ 1 year or less	✓	✓	✓	✓		No – Would certainly be reconfigured in full build-out	Some – Safety concerns will need to be addressed if solution is not permanent
Other Engineering Improvements	**PEDESTRIAN MEDIAN REFUGE ISLAND** Concrete or bollard-created refuge island on Lake Street crossings to improve pedestrian crossings	Low $12.5k	✗ 1-2 years	✗	✓	✓	✓		No – Would likely need to be reconstructed in full build-out	Little – Additional engineering should ensure truck and bus movements are not impacted
Other Engineering Improvements	**HIGH VISIBILITY CROSSWALKS** Visible markings designate a safe crossing location and alert drivers to pedestrians	Medium $40K	✓ 1 year or less	✗	✗	✓	✓		No – Would likely be reconfigured in full build-out	Little – Requires periodic maintenance
Other Engineering Improvements	**ACCESSIBLE PEDESTRIAN PUSH BUTTONS** Audible notifications to pedestrians that corresponds to visually available signal information, such as countdown timers	High $90k	✗ 1-2 years	✗	✓	✓	✗		No – Would likely need to be reconstructed in full build-out	Little – Most effective when paired with other crossing improvements
Other Engineering Improvements	**LEADING PEDESTRIAN INTERVAL** Gives pedestrians priority in an intersection with a few seconds head start before vehicles	Low $5k	✓ 1 year or less	✗	✗	✓	✗		Yes – Familiarity with LPI would carry through to full build-out	Little – Traffic impacts should be evaluated and justify pedestrian benefits
Other Engineering Improvements	**NEW PEDESTRIAN RAMPS** New detectable warning surfaces and reconfigured slopes at pedestrian ramps	High $110k	✗ 1-2 years	✗	✓	✗	✗		No – Would likely need to be reconstructed in full build-out	Little – Requires periodic replacement
Public Space Improvements	**LANDSCAPING** Landscaping or street trees, potentially in planters to be semi-mobile	Medium $27.5k	✗ 2+ years	✓	✗	✓	✓		Possibly – Depending on planter and street choice these could be maintained in full build-out	Most – Special assessment for installation and regular maintenance may be required
Public Space Improvements	**RECONSIDER AUTO ACCESS POINTS TO RETAIL** Evaluate vehicle access to southwest corner of the Target site to reduce heavy vehicle traffic before railroad tracks	Low Staff time	✗ 2+ years	✗	✓	✗	✓		Yes – Benefits of reducing conflict points would carry forward to full build-out	Most – Private business will need alternative access routes
Public Space Improvements	**LIGHTING** Enhanced lighting under the Hiawatha bridge	High $175k	✗ 1-2 years	✗	✗	✓	✓		Yes – Benefits in public realm would carry forward to full build-out	Most – Increased fixture replacements and power costs
Public Space Improvements	**PUBLIC ART** Public art under the Hiawatha bridge	Medium $30k	✗ 2+ years	✗	✗	✗	✓		Yes – Benefits in public realm would carry forward to full build-out	Most – Additional time is needed to incorporate local art creation and public input

ACTION PLAN

Table 1 identifies technical benefits and challenges of each improvement. Major feasibility considerations included agency coordination needs, technical challenges, lead time and material availability, possible variations, and consistency with the tight diamond configuration. Phasing for these improvements is a product of the total benefits of each improvement and how feasible that improvement is to implement. A Feasibility Matrix (Figure 1) and project timeline diagram (Figure 2) are a result of those characteristics.

The matrix in Figure 1 plots potential improvements according to a relative scale of benefits and challenges, with reasonable timeline expectations denoted by symbol color. Improvements can be prioritized according to where they fall on this matrix, with the most promising projects rising to the top.

Near-term suggestions include projects with fewer implementation challenges and a wide range of benefits. This category includes leading pedestrian intervals, high-visibility crosswalks, a temporary westbound bus platform, temporary curb extensions, pedestrian median refuge islands, and lighting changes.

Long-term improvements come with greater implementation challenges and a range of benefits. These suggestions consist of additional lighting solutions, sidewalk buffer space, public art, permanent curb extensions, landscaping, reconsidering auto access points to adjacent properties, and speed tables.

Some of the long-term suggestions include the most sizable barriers or produce the smallest benefits. Improvements in this category include accessible pedestrian push buttons and ramps, public art, and replacing the right turn lanes with a widened walkway and pedestrian space.

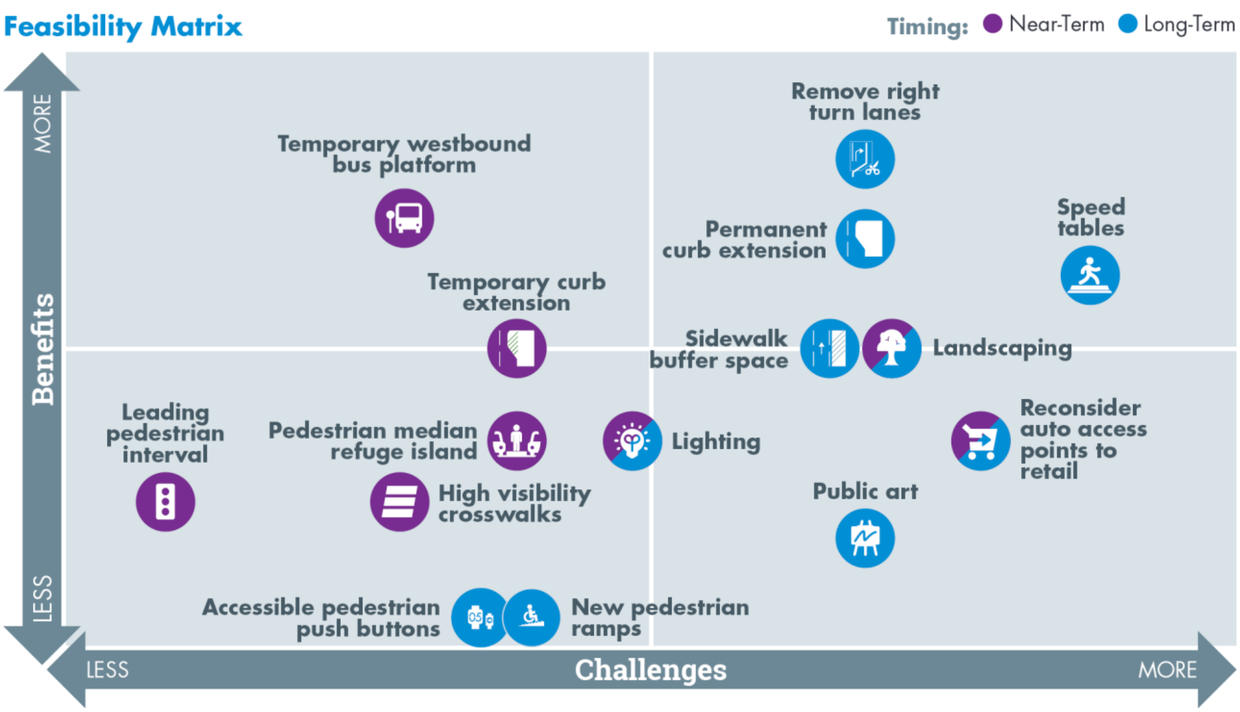

Figure 1 Matrix prioritizing the feasibility of various intersection improvements.

Timeline

The timeline in Figure 2 prioritizes high-impact and low-challenge solutions in suggesting near-term improvements. The graphic also organizes proposed improvements according to which type of change is required by each – whether it affects the space allocation or geometry, other engineering, or urban form of the intersection.

Figure 2 indicates how suggested improvements evolve through multiple intersection changes, incrementally contributing to a tight diamond configuration. For example, the temporary westbound bus platform will turn into sidewalk buffer space, which eventually enables right turn lane removal.

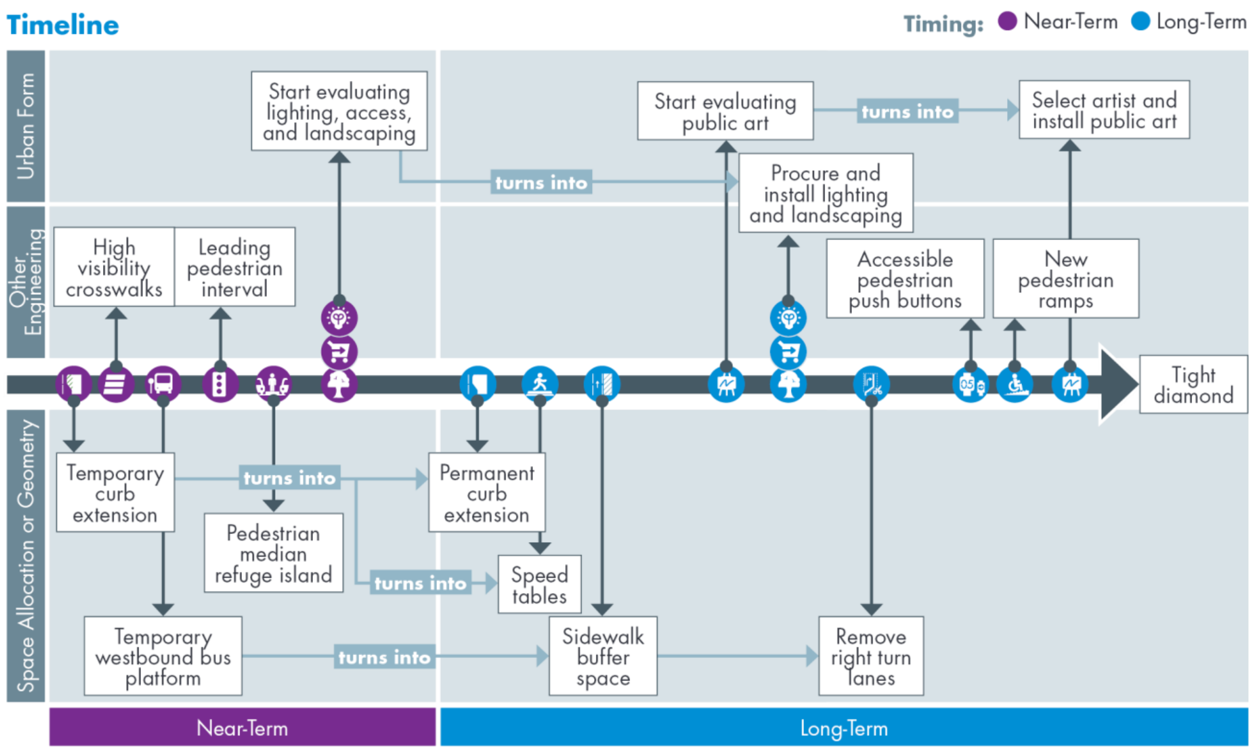

Figure 2 Timeline showing the progression of implementation steps towards a tight diamond intersection configuration.

Near Term Improvements

Hennepin County and the City of Minneapolis have entered into an agreement to construct several treatments identified in the Action Plan that align with the longer-term vision of the intersection in 2019. Improvements will include curb extensions, installing high visibility crosswalks, pedestrian median refuge islands, and enhanced sidewalk buffer space. The estimated cost is $400,000 with City and County each allocating $200,000. The County is leading the development and construction of the project. Construction of the treatments is anticipated in late 2019.

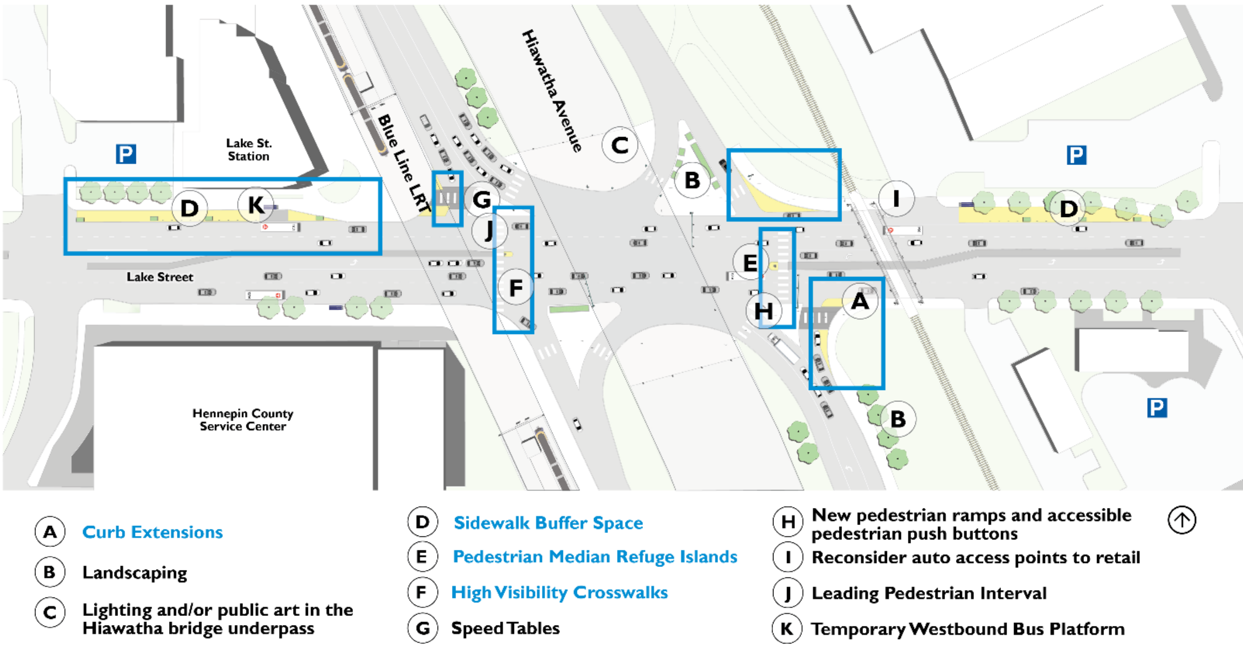

Figure 3 Upcoming Improvements

REMOVAL OF WESTBOUND LAKE STREET RIGHT-TURN LANE

The westbound right turn lane on Lake Street at 22nd Avenue could be removed to improve pedestrian and transit rider comfort and safety. The additional sidewalk space from the right turn lane removal will facilitate placement of a modernized bus platform, , as well as improve circulation for people waiting for transit or people walking to access the retail and housing at Lake Street Station. However, at this time the reconfiguration of the westbound turn lane would not fully align with the longer-term vision of the intersection (Tight Diamond) due to geometric constraints with the current design of the intersection.

Initial analysis and modeling project that a removal of the westbound right turn lane would not significantly impact motor vehicle or transit operations. However, concerns were raised by stakeholders about vehicle turn volumes and the potential for conflicts related to pedestrian crossings at 22nd Avenue. Options for a partial turn lane removal or a pilot test of a temporary bus platform are being studied further as an alternative. Further evaluation, as part of the ultimate tight diamond design, should also be conducted to determine the ultimate design of this specific area.

Appendix A: Northwest Quadrant Tech Memo addresses the technical concerns and opportunities raised by stakeholders in more detail.

CURB EXTENSIONS

Curb extensions will reduce turn radii at critical pedestrian crossing locations throughout the intersection. These small changes will slow turning vehicles and reduce the crossing distance, creating a safer crossing for pedestrians to navigate.

PEDESTRIAN MEDIAN REFUGE ISLANDS

Median refuge islands provide pedestrians crossing Lake Street a safe place to wait mid-intersection if they cannot cross in a single signal cycle. They improve pedestrian comfort by reducing the crossing distance and exposure to vehicle traffic.

HIGH VISIBILITY CROSSWALKS

High visibility crosswalks will better alert drivers to where pedestrians cross Lake Street while encouraging pedestrians to cross in a more predictable manner.

Future Improvements

In 2022, MnDOT will be repaving Hiawatha Avenue, including the four ramps at the Hi-Lake intersection. MnDOT has committed an additional $1.5M to improvements at the interchange. This provides an opportunity for additional collaboration between agencies to implement the long-term vision at Hi-Lake in 2022.

NEXT STEPS

Construct planned improvements in 2019

The City and County plan to construct several treatments in 2019. These treatments will improve the pedestrian environment at Hi-Lake substantially. This installation of the planned treatments in 2019 and future treatments at Hi-Lake will require continued collaboration between agencies and engagement with stakeholders.

Continue Agency Collaboration

MnDOT plans to invest $1.5M in pedestrian improvements at Hi-Lake as part of standard repaving and ADA improvements along Hiawatha in 2022. Continued coordination between the agencies, policymakers, and the public will be critical to fund and implement the long-term vision at Hi-Lake in 2022.

Design Collaboration

Additional collaboration will be necessary to work out the design details of upcoming improvements. Final design should commence before extending curb lines and/or pouring concrete to ensure that the geometric changes are as compatible with the long-term tight diamond configuration as possible.

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Chapter Four: Tight Diamond

Based on stakeholder and community feedback between Phase One and Phase Two of the Hi-Lake Study, the Tight Diamond configuration was selected as the preferred long-term solution for the Hi-Lake Intersection.

TIGHT DIAMOND RECONFIGURATION OVERVIEW

The Tight Diamond reconfiguration would convert the existing single-point urban interchange (SPUI) to a diamond interchange (see Figure 1). Although this conversion makes the interchange more comparable in scale to two intersections, the two signals at the two ramp intersections would be controlled with one controller to minimize any vehicle queuing on Lake Street between the ramps.

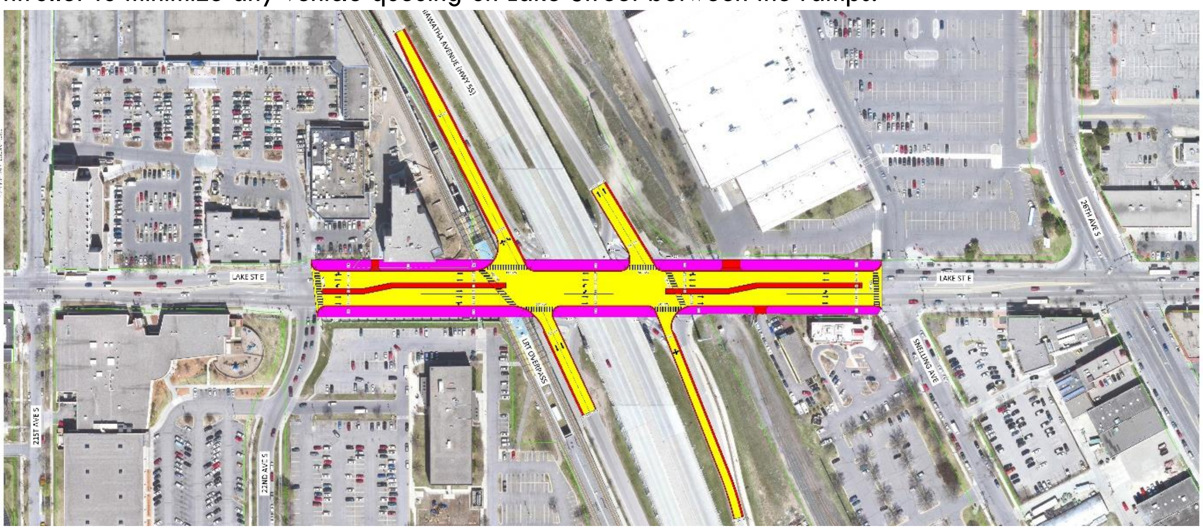

Figure 1: The Tight Diamond Configuration

This Tight Diamond design would provide several benefits and improve conditions at the intersection. These benefits align with the City of Minneapolis Complete Streets Policy, which prioritizes pedestrian needs first, followed by bicycles and transit, then by automobiles.

- Reduces pedestrian exposure to vehicles:
  - Reducing pedestrian crossing distances crossing east/west and north/south on Lake Street
  - Minimizing number of times a pedestrian needs to cross vehicle traffic
- Increases pedestrian comfort:
  - Minimizing traffic signal delay and pedestrian wait times at traffic signals
  - Reduces vehicular turning radii at curbs, which slows down turning vehicles
  - Widening sidewalk space and providing opportunities for a boulevard buffer between pedestrians and vehicles at many locations
  - Includes pedestrian median refuge islands to improve pedestrian safety and comfort while crossing north/south on Lake Street
- Better guides vehicular movements through the interchange area
  - Removal of the "free" right turns and improves sight lines between drivers and pedestrians
  - The overall area of the intersection for vehicle travel would be reduced, helping to minimize vehicle wandering

- Improves transit operations:
  - Minimizes transit user transfer distance between the LRT station and bus stop boarding platform
  - Creates space for modernized bus platforms and amenities
  - Maintains bus-bridge operations
- Designs for improved traffic safety:
  - Narrows travel lane widths
  - Reallocates right-of-way from vehicle lanes to pedestrian space where feasible
  - Reduces turning radii to slow down turning vehicles

DESIGN REFINEMENT

Several design elements of the Tight Diamond have been refined since Phase 1:

Pedestrian Median Refuge Islands

Currently Lake Street has 6-foot wide pedestrian refuge islands on Lake Street that do not extend past the crosswalk. The Tight Diamond configuration would widen these pedestrian refuge islands to 9 feet wide and would include noses past the crosswalk.

Lane Widths

Currently, Lake Street has 12-foot wide interior travel lanes and 14-foot wide lanes adjacent to the outside curb and gutter. The current Tight Diamond configuration would narrow the interior travel lanes to 11 feet and the outside travel lanes to 13 feet. These refined lane widths are consistent with County State Aid Highway (CSAH) design standards, which requires 1-2-foot curb reaction distance on outside travel lanes where parking does not exist.

Curb Radius

The corner radii of the Tight Diamond configuration vary from 15 to 60 feet. These corner radii enable efficient turning movements for the large vehicles and freight moving between Hiawatha Avenue and Lake Street. Specifically, the corner radii enable a WB-62 (the MnDOT design vehicle for Trunk Highways[1]) to make turning movements without mounting the curb or encroaching into space in which pedestrians may be waiting (see Appendix B). Additional reductions in the curb radius – which would allow for more reduction in pedestrian crossing distances and improved pedestrian comfort and safety – may be feasible and warranted when the Tight Diamond is further refined in the future.

Table 1 shows the Tight Diamond's pedestrian crossing distances at each ramp leg given several possible design vehicles. The pedestrian crossing distances decreases significantly when the Hi-Lake interchange is designed to accommodate the WB-40 vehicle. Selecting the appropriate design and control vehicles will need to be a continued conversation as design progresses[2].

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[1] The MnDOT Road Design Manual Section 2-3.02 calls for the WB-62 as a design vehicle and recognizes that the designer may encounter locations and situations where the use of a smaller design vehicle should be considered (such as County State Aid Highways). Additionally, the MnDOT's 2018 *Performance-Based Practical Design Guidelines Technical Memo* denotes that the single unit truck (SU-30) could be an appropriate design vehicle and the WB-40 could be an appropriate control vehicle in some urban contexts.

[2] Access Minneapolis, the City's current transportation action plan, designates Lake Street as a Commerce Street. The City of Minneapolis Design Guidelines for Streets and Sidewalks calls for a Transit Bus or Single Unit Truck as the design vehicle and a Transit Bus or a WB-50 as the control vehicle on Commerce Streets. Those guidelines also recommend a typical turning curb radius of 10-15' on streets with high pedestrian volumes. Access Minneapolis and

Table 1: Pedestrian Crossing Distances by Ramp and Potential Design Vehicle

Design Vehicle	NW Ramp	NE Ramp	SE Ramp	SW Ramp
Existing Conditions*	90’	120’	105’	105’
WB-62	85’	50’	55’	50’
WB-40	60’	30’	35’	30’
Articulated Bus	60’	35’	35’	30’
Single-Unit Truck	60’	30’	35’	30’

*Existing Condition pedestrian crossing distances includes the travel lanes and the pork chop island

Pedestrian Zones & Sidewalk Widths

Access Minneapolis designates this portion of Lake Street as a Commerce Street, and Commerce Streets warrant a pedestrian zone of 15 to 20 feet according to the City of Minneapolis Design Guidelines for Streets and Sidewalks. The Tight Diamond configuration meets this design guideline by including pedestrian zone widths between 15 and 20 feet on all quadrants. These pedestrian zones could accommodate the Hennepin County design standard of an 8-foot of sidewalk with a 6-foot boulevard.

Entrance and Exit Ramp Width

The entrance and exit ramps at the Hi-Lake Intersection are 16 feet wide, which include a 12-foot travel lane with a two-foot curb and gutter on each side. Ramp geometry was chosen to be consistent with MnDOT Trunk Highway standards[3], to match existing conditions, and to minimize reconstruction along the ramps. By reducing the number of turning and receiving lanes, the overall width of each exit ramp can be reduced in the Tight Diamond configuration. While narrowing the ramp width benefits pedestrians by reducing crossing distance, narrowing these ramps to a 16-foot throat mid-ramp where only one lane is needed has some drawbacks:

- Many heavy vehicles need more than a 16-foot throat to complete turning movements onto and from Hiawatha Avenue due to the skew of the ramp legs relative to Lake Street.
- Even if ramps can be necked down closer to Lake Street, the ramp ends near 32nd Street and near 28th Street will need to widen back out to tie into existing curb.
- Ultimately, necking the ramps increases construction costs without much added pedestrian benefit (as there are no pedestrians on the ramps regardless of lane width)

Bicycle & Greenway Connectivity

A 2016 report from Hennepin County, City of Minneapolis, the Midtown Greenway Coalition, and Lake Street Council identified the need for a trail connection between the Midtown Greenway and Lake Street along Hiawatha. In 2018, the City of Minneapolis installed a bikeway on the east side of Hiawatha. Even with this improvement, people on bicycles that approach from the west would still have to cross Hiawatha twice to reach destinations on the west side of the interchange. To address this need, Hennepin County is considering a possible new trail connection on the west side of the southbound Hiawatha exit ramp.

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the Design Guidelines for Streets and Sidewalks are being updated in 2019/2020 as a part of the Minneapolis Transportation Action Plan.

[3] This ramp cross-section is typical for single-lane ramps in order to allow for a disabled vehicle to park without blocking other ramp traffic.

People bicycling on the west side of Hiawatha currently ride on the sidewalk, the wide shoulder on Hiawatha, or on the Hiawatha travel lanes proper to navigate between the Greenway and the Hiawatha LRT trail.

Hiawatha Avenue west sidewalk and shoulder at 28th Street (Looking North)

Southbound Hiawatha Avenue Exit Ramp, before metal in-concrete fence (Looking North)

Southbound Hiawatha Avenue Exit Ramp at Lake Street (Looking North)

Those choosing to ride on Hiawatha's shoulder or travel lanes are exposed to fast traveling vehicles. In winter conditions, shoulder bicyclists face additional hurdles when the shoulder is unplowed or used as snow storage. Sidewalk bicyclists must navigate a low bridge deck and in-sidewalk metal fence/guardrail.

Low bridge deck

In-sidewalk metal fence/guardrail

Additionally, the City of Minneapolis is currently updating its Bicycle Master Plan as part of the Minneapolis Transportation Action Plan. The City may include a bikeway connecting the east and west side of the Hi-Lake Intersection in the underpass area. Further coordination is needed, however, the large amount of additional space in the underpass area in the Tight Diamond design would accommodate a low-stress bikeway.

GEOMETRIC CONSIDERATIONS

The northwest Hiawatha Avenue exit ramp would have enough width to accommodate some form of bikeway. This could be achieved by narrowing the exit ramp travel lane width and eliminating a left-turn lane on the southbound exit ramp. The addition of a bikeway on the northwest Hiawatha Avenue exit ramp is operationally consistent with the Tight Diamond configuration. Figure 2 shows the left turn lane of the proposed ramp lining up with the east side of the existing ramp. The reconfiguration of the exit ramp allows for an additional eight to fifteen feet of trail width that potentially could be added to the existing sidewalk on the west side under the LRT bridge. The blue hatch seen in Figure 2 highlights the additional space created for a trail on this ramp near the Lake Street. Further engagement about this and study of feasibility should be accomplished as part of the Tight Diamond preliminary design.

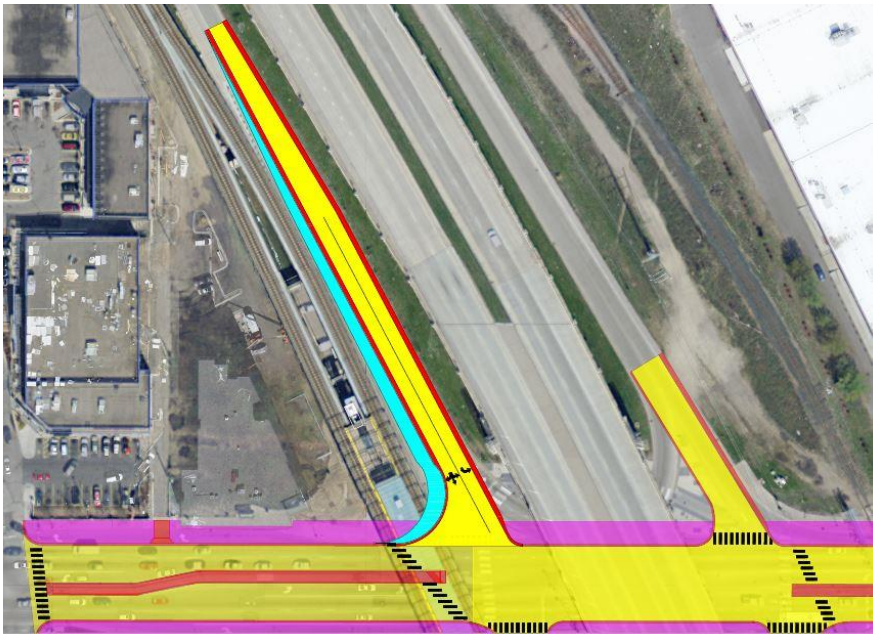


Figure 2: Potential Trail Space on Northwest Ramp Legs

Space under the Hiawatha Overpass

The sidewalk space along Lake Street underneath Hiawatha is currently seen as unwelcoming to pedestrians. Community members have expressed public safety concerns around lighting, crime, and the length of the underpass. Multiple public art initiatives have proposed art installations under the bridge that reflect the surrounding community and bring a positive sense of identity to the interchange. While these projects are promising, a more significant and/or permanent use of space may be warranted with the Tight Diamond configuration. In the Tight Diamond configuration, the vehicular travel paths under the Hiawatha Avenue bridge are consolidated and the area becomes usable pedestrian space. Ultimately, the pedestrian space under the Hiawatha Avenue bridge would increase to over 12,000 contiguous square feet on each side of Lake Street, as shown in Figure 3. This results in a 45% increase in the overall usable pedestrian space under the bridge. The size of this space creates an opportunity for creative use (for context, 12,000 square feet is large enough to house two full-size basketball courts).

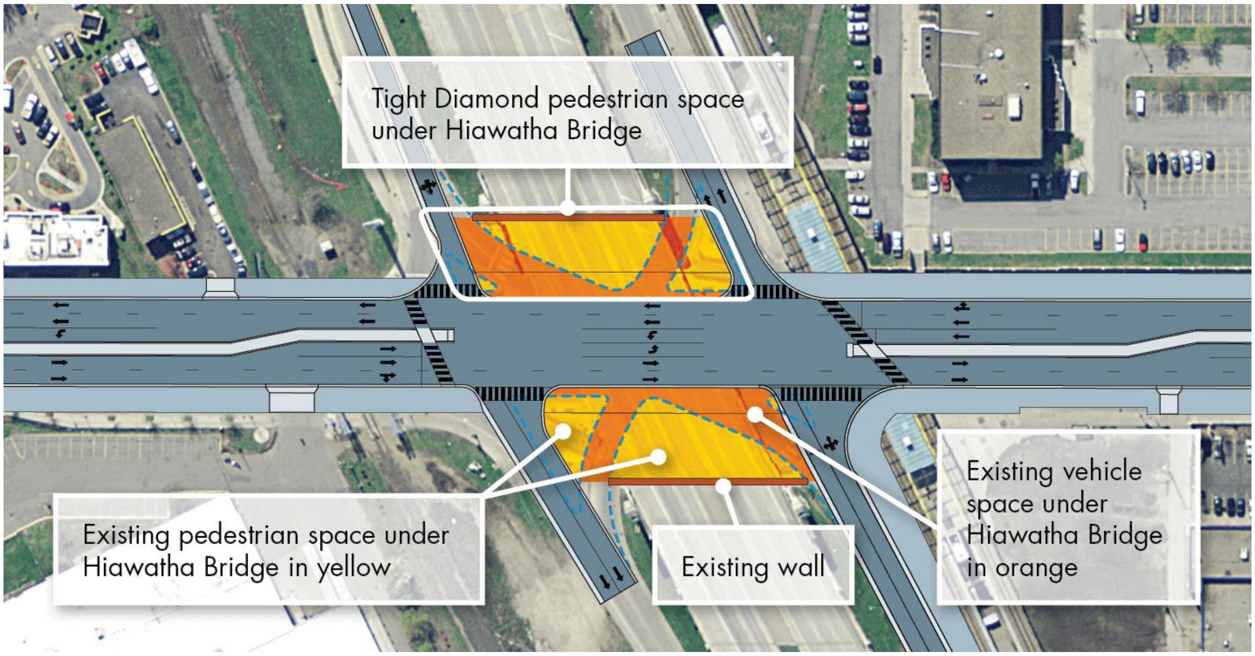
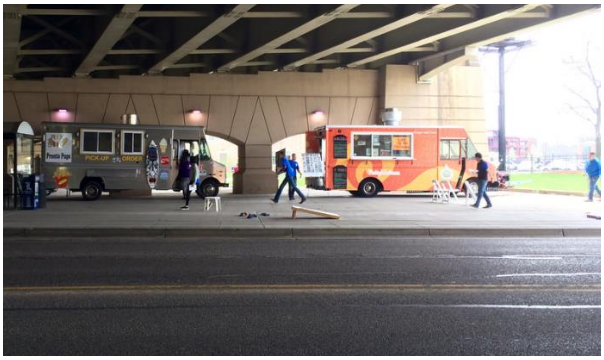


Figure 3: Pedestrian space under the Hiawatha bridge

There are many ways the additional pedestrian space could be utilized in the future, and if done creatively, the space could become a destination. A public engagement process with involvement from the stakeholders including the public agencies, neighborhood groups, and general public would help identify the best use for this future space. Some initial ideas that could be pursued for the space include:

- Art installations that lower the ceiling height or use obstructions as design such as hanging lights or bollard artwork
- Installations that have a complementary educational outcome such as a pop-up library or musical applications
- Commercial installations such as semi-permanent vendors
- A low-stress bikeway connection



Pictured: Food trucks in Grand Rapids, MI

Pictured: a flowershop in the Netherlands

These installation concepts would need to be vetted thoroughly and considerations for safety, separation from traffic, and cost would need to be made.

TIGHT DIAMOND TRAFFIC OPERATIONS

A traffic sensitivity test was completed to inform how much traffic growth the proposed Tight Diamond configuration could handle and whether that traffic growth could be accommodated by the current SPUI design. The traffic sensitivity test evaluated traffic operations at increasing levels of traffic growth to assess the level at which the two interchange configurations would begin to fail.

Results show that while both interchange options can handle large and atypical increases in traffic growth, the proposed Tight Diamond configuration provides more flexibility to respond to future growth than the current SPUI.

- The existing SPUI will see some vehicular queue spillback onto mainline Hiawatha at 10 percent traffic growth and will approach failure and queue spillback at 15 percent traffic growth.
- The Tight Diamond interchange would operate acceptably (with no failing movements or traffic spillback onto Hiawatha) until 25 percent traffic growth is reached.

Annual growth rates in heavily developed urban areas such as Hiawatha Avenue and Lake Street are typically very low, and are sometimes negative. The generally accepted annual growth rate in dense developed urbanized areas in Minneapolis is 0.5 percent. Based on this growth rate, it would take approximately 45 years to reach 25 percent traffic growth.

Methodology and more detailed traffic analysis results are available in Appendix C.

CAPITAL COST OF THE TIGHT DIAMOND (2018$)

An engineer's opinion of probable cost for the Tight Diamond configuration is $**4,250,000**. Because the design is at a conceptual level of the engineering, the estimate includes a 20 percent construction contingency and a 25 percent allocation for indirect costs. As detailed in Appendix D, this capital cost estimate includes:

- Removal and replacement of concrete, asphalt, and curb and gutter, including:
  - Pedestrian ramp reconstruction
  - APS push button procurement and installation
  - Crosswalk markings and medians
  - Turn lane removals and ramp reconfiguration
- Lighting improvements

- Traffic signals
- Street trees and landscaping

Next Steps

Hennepin County and the City of Minneapolis have entered into an agreement to construct several treatments identified in the Action Plan in the year 2019. Improvements will include reconstructing curb radii, installing high visibility crosswalks, pedestrian median refuge islands, and enhanced sidewalk buffer space. The estimated cost is $400,000 with City and County each allocating $200,000. The County is leading the development and construction of the project. Construction of the treatments is planned for 2019.

As discussed in Chapter 4, the following decisions will need to be made to complete the Tight Diamond configuration:

- *Select Design and Control Vehicles:* The selection of a design and control vehicle informs the curb radii design, which has implications on the pedestrian crossing distance and travel lane width. Evaluate how large vehicles are accommodated at the intersection while prioritizing the needs of pedestrians.
- *Select a Cross-Section:* Travel lane widths and pedestrian zone widths will need to be selected by the funding agency in partnership with the agency that has jurisdiction.
- *Determine Entrance & Exit Ramp Demand:* Travel lane widths, curb reaction distance, and trail infrastructure demand will all need to be considered in the design of the Hiawatha entrance and exit ramp legs between Lake Street and Hiawatha Avenue.
- *Incorporate decisions and updated conversations:* Decisions on public art, bikeway connections, and BRT will need to be included in preliminary engineering.

As discussed throughout the report, securing funding to design and construct the Tight Diamond will be a critical next step. With additional funding commitments and action from relevant agencies, the Tight Diamond project will be able to move into the preliminary engineering and eventual final design and construction phases.

Appendices

- Appendix A: NW Quadrant Memo
- Appendix B: Tight Diamond Configuration
- Appendix C: Traffic Sensitivity Test
- Appendix D: Cost Estimates (2018$)

Appendix A:
NW Quadrant Memo

Northwest Quadrant Tech Memo

The Northwest Quadrant of the Hi-Lake study area is the future site of a B Line Bus-Rapid Transit station. As such, Metro Transit's future needs and those of surrounding pedestrian and vehicle movements should help inform Tier I and Tier II improvements to the area.

Existing Conditions

Pedestrian space is constrained between westbound right turn lane and a concrete wall or buildings with retail development along Lake Street.

Figure 1 Above: Northwest quadrant of 22nd Avenue and Lake Street, looking east at existing right turn lane.

Figure 2 Above: Northwest quadrant of Lake Street & private alley, looking east at existing right turn lane & transit infrastructure (photos taken in Winter 2017)

Existing passenger boarding and alighting area is limited, and the space is grade separated from the Blue Line boarding area.

Figure 3 Above: Northwest quadrant of Lake Street & private alley, looking west at taper into existing right turn lane & transit infrastructure (photo taken in October 2015 & Winter 2017).

OPPORTUNITIES

Create optimal transfer at busy transit location

There are over 2,500 light rail boardings per day at the Lake Street Blue Line station. Another 1,100 bus boardings and alightings occur on the westbound Lake Street bus stop. The bus stop (and future B Line boarding location) should be *as far east on the quadrant as possible* to optimize transit transfer with the Lake Street station.

Expand pedestrian area and improve circulation

Moving the bus shelter *farther south from the building face* will better accommodate the large numbers of pedestrians, high retail activity, and hundreds of daily transit customers in the quadrant. Transit-oriented housing and retail developments in this quadrant are marketed for their accessibility, and a welcoming pedestrian environment is needed to ensure the success of these developments at this interchange.

Northwest Quadrant Configuration

One possible BRT station configuration that would also create additional pedestrian space at the quadrant is shown in *Figure 4*. This configuration of the northwest quadrant removes the right turn lane at 22nd Avenue and moves transit infrastructure into this right turn lane space. The west end of the BRT station starts at the edge of the Lake Street Station building. With a 120’ platform length, this configuration leaves just under 70 linear feet between the east end of the platform and the start of the exit ramp curve from Hiawatha Avenue.

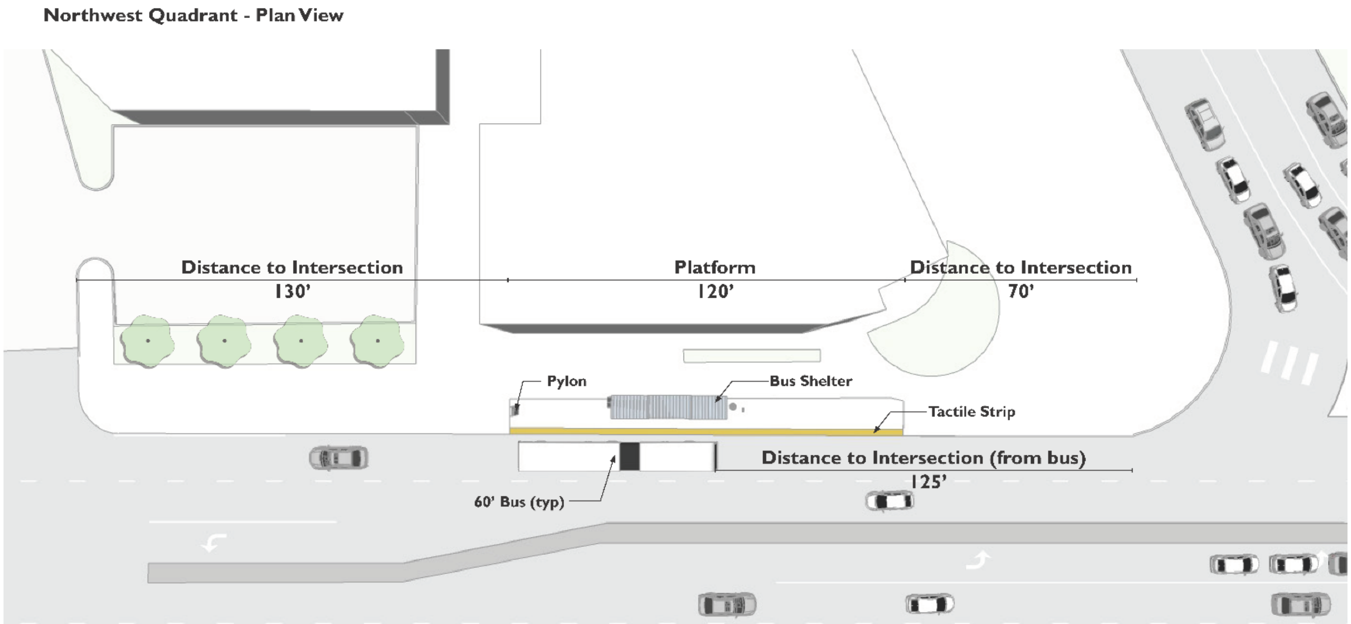


Figure 4 Initial Northwest Quadrant Configuration

CONCERNS

The following concerns with the quadrant configuration were raised by stakeholders during Phase II technical advisory committee meetings. The concerns pertain to the potential issues from buses loading passengers while in the westbound Lake Street travel lane and traffic impacts from the removal of the dedicated right turn lane at 22nd Avenue.

- *Hiawatha Avenue Southbound Right Movement*:
  - Sight Lines: Will drivers of right turning vehicles be able to see buses boarding passengers in the through lane? Are there any sight-line concerns that should inform where the station infrastructure is placed?
  - Approach speed & sight stopping distance: Does the approach speed enable safe stopping behind a bus? How close can the end of the bus be to the radius before this is an issue?
  - Ramp Queuing: Will vehicles back up onto mainline Hiawatha because of the presence of the bus in the travel lane?
- *Other Upstream Traffic Operations*
  - Merge Distances: What merge distance is necessary when a bus is boarding passengers in the travel lane?
- *Right Turn Lane Removal at 22nd Avenue*
  - Traffic and Transit Operations: Will the removal of a right turn lane create a long vehicle queue that extends into the bus boarding zone, leading to increased bus delay because the bus cannot access the boarding area until turning vehicles clear?
  - Pedestrian Impact: Will westbound pedestrians at 22nd Avenue exacerbate this issue?
  - Driveway Removal: What is the feasibility of removing access to the private alley east of 22nd Avenue South to allow for additional transit station placement options?

Resolution of these concerns are discussed in detail in the following sections.

Preliminary Analysis

HIAWATHA AVENUE SOUTHBOUND RIGHT MOVEMENT

Sight Lines

Figure 5 Southbound Exit from Hiawatha, Preparing to Turn Right onto Lake

There are significant bridge piers at the start of the turning radius on this quadrant which may affect a driver's sight line, meaning that right-turning southbound vehicles exiting Hiawatha may not be able to see and be aware of a BRT vehicle stopped in traffic on Lake Street through the whole turn. Additionally, these southbound right-turning motorists are likely looking left at the approach rather than forward towards a stopped bus in their lane. This can be hazardous if a gap in oncoming traffic causes them to speed up or turn without a significant pause. Therefore, the required sight stopping distance should be allocated upstream of the bridge column and pedestrian crosswalk.

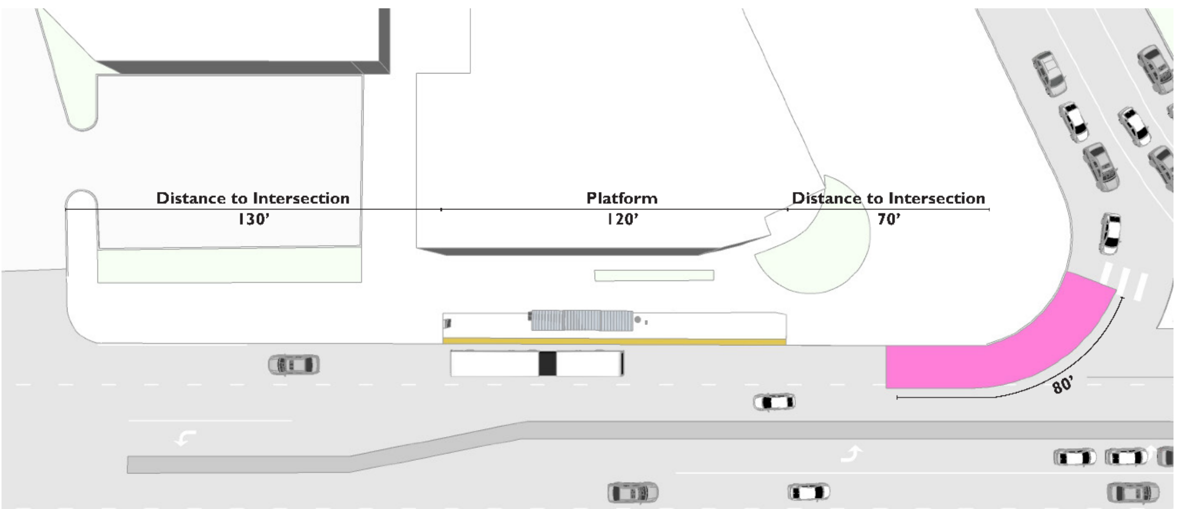
Figure 6 View from Lake, Looking Back at Hiawatha Exit (Left); View from Right Turn Lane Exiting Hiawatha (Right)

Approach Speed

The posted speed on Hiawatha Avenue is 40 miles per hour. According to the AASHTO Green Book, vehicles travelling at 40 miles per hour have a sight stopping distance of approximately 300 feet. However, the southbound vehicles turning right onto westbound Lake Street are yield-controlled (see Figure 7). Drivers must merge into traffic without an acceleration lane, which slows vehicles down from the design speed in order to evaluate gaps in westbound cross-traffic. Additionally, by the time vehicles are turning on to Lake Street, speeds will likely have dropped even farther to evaluate pedestrians in the crosswalk. This idea is reinforced by the AASHTO Green Book, which assumes that vehicles at yield-controlled right-turn maneuvers will slow down to a turning speed of 10 miles per hour. Therefore, southbound right-turning vehicle speeds at Hiawatha Avenue & Lake Street are likely under 15 miles per hour. The AASHTO Green Book lists for 15 MPH vehicles a design stopping sight distance on level roadways of **80 feet**.

Since there are significant permanent sight line obstacles as described in the previous "Sight Lines" section, the stopping sight distance will start after the crosswalk. *Figure 7* shows this 80 foot distance after the crosswalk.

Northwest Quadrant - Plan View



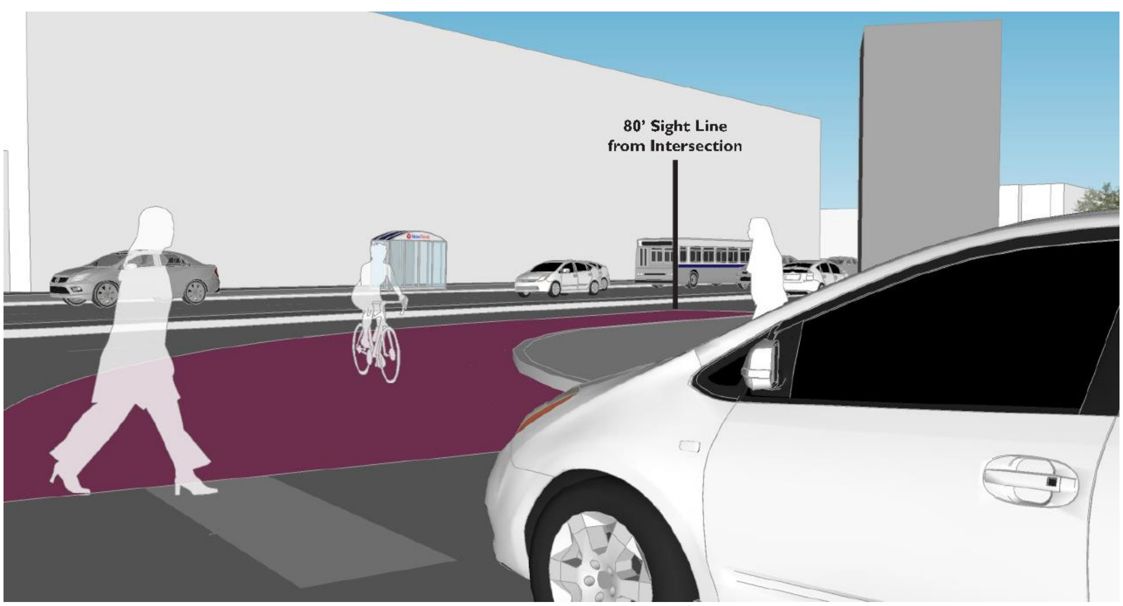


Figure 7: 80' of Sight Stopping Distance

Ramp Queuing

Stakeholders expressed concern over traffic queues from the Hiawatha southbound right movement backing up onto mainline Hiawatha Avenue. Based on high-level engineering judgement of the traffic volume and length of the exit ramp at this location, excessive queuing is not anticipated to be a problem.

- According to analysis done in the Phase 1 Interchange Study, this right turning movement currently has an average volume of 145 vehicles and experiences a 30-foot queue during peak PM hour in the existing conditions. The exit ramp is just over 800 feet, thus it is highly improbable that a queue would reach Hiawatha Avenue.
- Analysis of the proposed tight diamond layout produced similar results. The right turn volume would be the same (145 vehicles), with a queue of 290 feet. While the estimated queue is longer than with the current SPUI configuration, it still falls short of spilling onto mainline Hiawatha Avenue.

The Synchro/SimTraffic models developed previously do not have the ability to account for a bus stopping in a travel lane. A Vissim traffic model would be necessary to determine the exact queuing ramifications from such a situation. This Vissim model will likely be completed at key intersections along Lake Street and Marshall Avenue when the B-Line BRT proceeds to its design phase. This model will be more complex and able to support more specific traffic scenarios, such as right-turn variations. However, the findings from that model are expected to be consistent with the high-level engineering review outlined here, for both current conditions and the future tight diamond configuration.

OTHER UPSTREAM TRAFFIC OPERATIONS

Stakeholders expressed concern that a downstream bus stopped in the travel lane boarding passengers may cause issues for northbound left-turning vehicles and westbound through-moving vehicles. However, this condition is not likely to cause major operational issues in either the current interchange or future tight diamond configuration due to the adequate merge distances (in a lane drop condition), successful examples of far-side bus stop operations, and the low traffic volumes.

Merge Distances

Lake Street has a speed limit of 30 miles per hour, so using a rate of 30:1 (speed:1), the merge distance for a single lane drop (11-foot lane) on Lake Street would be 330 feet. Both northbound left-turning vehicles and westbound through vehicles waiting at their respective stop bars have a clear line of sight to the northwest quadrant (and the future bus platform). Both of these movement's stop bars are more than 330 feet from the end of the bus in the initial BRT platform location (see *Figure 8*). Vehicles from both movements should be able to anticipate a bus in the lane and merge upstream if they deem necessary.

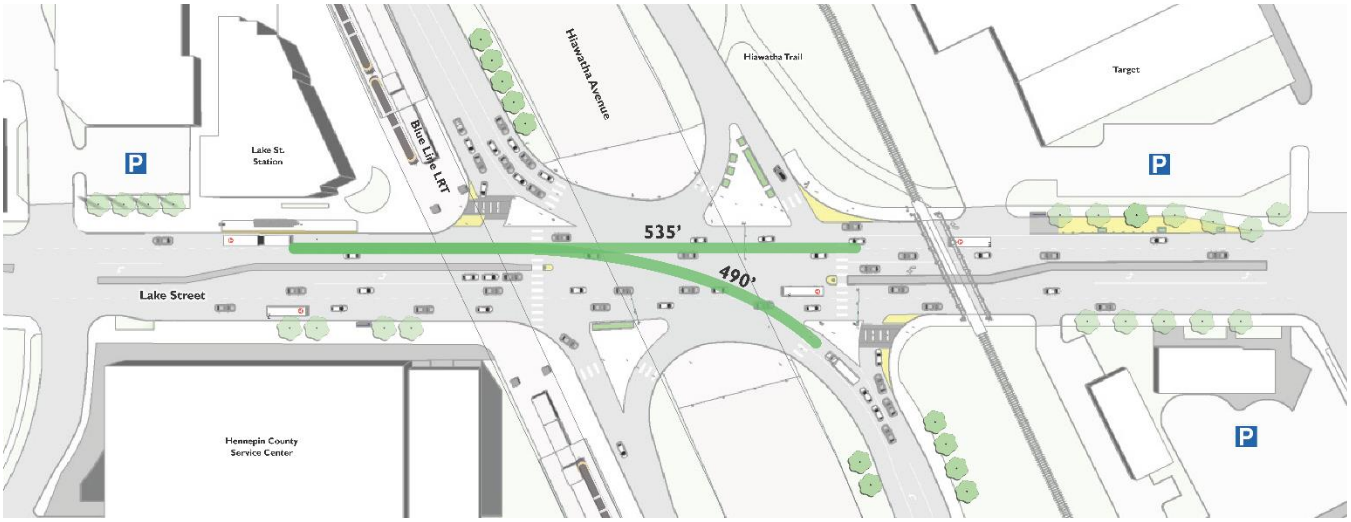


Figure 8: Distance from back of bus to stop bars

Existing Farside Bus Stop Operations

Although there is adequate distance to do so at this location, traffic operations at many comparable current farside bus stops and BRT stations show that it is not necessary for every vehicle to merge behind the bus stopped in the travel lane. This farside bus stop is not an uncommon intersection configuration, and there are many local examples of similar conditions without significant issues:

- Snelling Avenue & St. Clair Avenue (A Line)
- Snelling Avenue & Randolph Avenue (A Line)
- Ford Parkway & Fairview Avenue (A Line)
- Lake Street & Grand Avenue (Route 21)

A key difference between these locations and a farside stop at westbound Lake & Hiawatha is the tight intersection spacing to the next downstream traffic signal (at 22nd Avenue). Technical considerations with removing the right turn lane at 22nd Avenue is discussed in the "Right Turn Lane Removal at 22nd Avenue" section of this memo.

Low Volumes

HIAWATHA AVENUE NORTHBOUND LEFT-TURN VOLUMES

The current northbound exit from Hiawatha has two left turn lanes that feed vehicles into two westbound lanes on Lake Street. There are 60 vehicles that use the northbound left turn lanes during the weekday PM peak hour, and 100 vehicles during the Saturday peak hour. Removing one of the left turn lanes, as was simulated in the Modified SPUI alternative and in the Tight Diamond alternative, yields a moderate but manageable increase in queue distances and delay per vehicle (Table 1). Because these peak hour volume conditions could be accommodated by a single left-turn lane, removing one of the northbound left turn lanes should be considered alongside BRT station placement on the northwest corner. Additionally, removing this lane would be consistent with the eventual tight diamond layout and would simplify left turn movements. This action could be accomplished with minimal cost with striping changes on the approach.

Table 1: Hiawatha Avenue Northbound Left-Turn Demand, Queue, and Delays in Various Interchange Alternatives from Phase 1 Study

Interchange Option (number of lanes)	Peak Condition	Northbound Left Demand (Vehicles per Hour)	Queue (95th Percentile)	Delay (Seconds per Vehicle)
Existing SPUI Condition (2 Northbound left-turn lanes)	Weekday	60	60	55
Existing SPUI Condition (2 Northbound left-turn lanes)	Saturday	100	80	58
Modified SPUI Condition (1 Northbound left-turn lane)	Weekday	60	110	43
Modified SPUI Condition (1 Northbound left-turn lane)	Saturday	100	160	53
Tight Diamond (1 Northbound left-turn lane)	Weekday	60	120	55
Tight Diamond (1 Northbound left-turn lane)	Saturday	100	230	60

LAKE STREET WESTBOUND THROUGH MOVEMENT

Westbound Lake Street has two through lanes that accommodate 920 vehicles in the weekday PM peak hour and 720 vehicles in the Saturday peak hour. Although there is enough distance for the vehicles to merge into a single lane, it is not expected that this will be necessary based on current operations at comparable volume intersections with far-side stops (e.g. Snelling & Randolph, etc.).

RIGHT TURN LANE REMOVAL AT 22ND AVENUE

What impact would the removal of the dedicated right turn lane on 22nd Avenue into the Hi-Lake Shopping Center have on vehicle and transit operations?

Traffic Operations

Table 2 shows the existing through and right-turning queuing distances and vehicle delays. The marginally increased queuing distances and vehicles delays do not present major operational concerns when considering automobile traffic operations alone.

Table 2: Vehicle Queues for Westbound Through and Right Movements at 22nd Avenue and Lake Street

Movement	Measure	Existing Conditions	Right Turn Removed
Westbound Through	PM Peak Hour Average Queue (feet)	125' (5 vehicles)	155' (6 vehicles)
Westbound Through	PM Peak Hour 95th Percentile Queue (feet)	215' (8.5 vehicles)	250' (10 vehicles)
Westbound Through	PM Peak Hour Vehicle Delay (seconds)	17 seconds	21 seconds
Westbound Right	PM Peak Hour Average Queue (feet)	35' (1 vehicle)	155' (6 vehicles)
Westbound Right	PM Peak Hour 95th Percentile Queue (feet)	80' (3 vehicles)	250' (10 vehicles)
Westbound Right	PM Peak Hour Vehicle Delay (seconds)	9 seconds	19 seconds

Transit Operational Impact

Today, the westbound Route 21, 27, and 53 buses board passengers at the stop located approximately 150 feet east of the stop bar at 22nd Avenue. Based on the 95th percentile queue from the existing PM peak hour conditions, a bus would be "boxed in" to the boarding zone until traffic clears with the signal: there is an 80' right-turning queue in front of the bus and a 215' through queue adjacent to the bus.

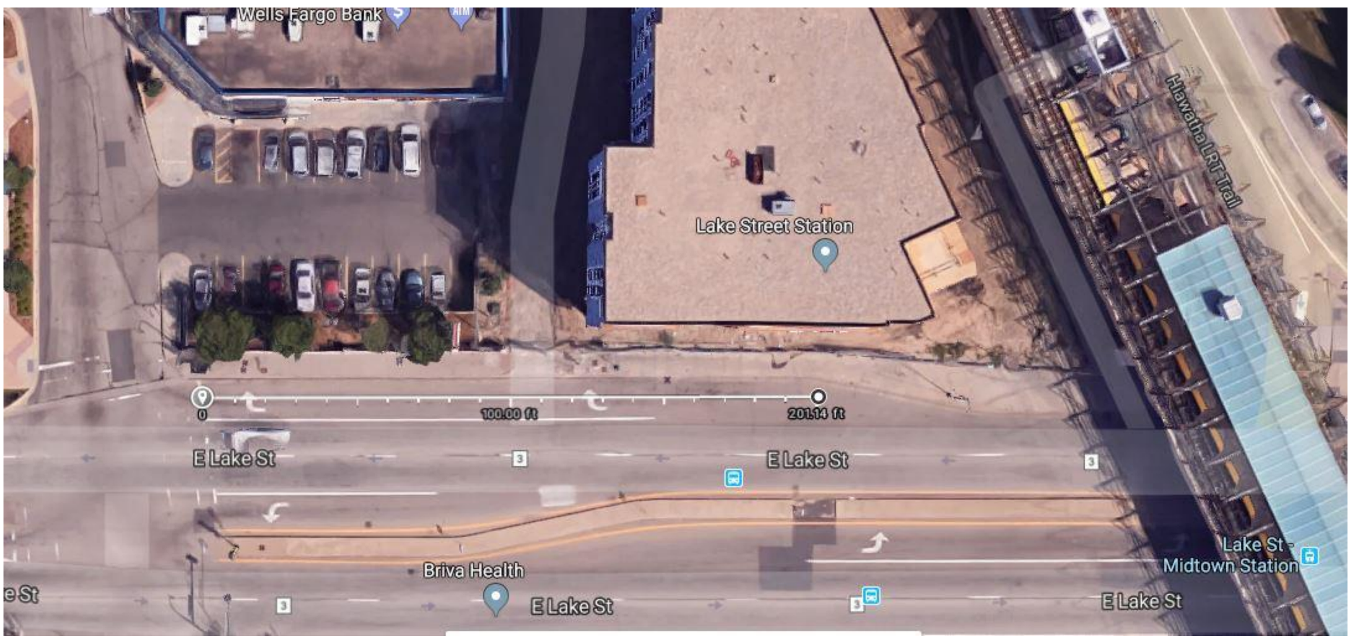


Figure 9: Current Bus Boarding Zone Distance from 22nd Avenue Intersection

In future conditions where the right-turn lane is removed, the model predicts that the through queue would spillback into the current bus boarding zone (assuming that that bus boarding zone does not move any farther east than its current location).

However, this operational challenge would only be expected to happen within the peak hour of the day because traffic volumes are lower at other periods (*Figure 10*). Outside of the peak hour, queues would be significantly lower than the PM peak hour queue distances and would not be expected to cause operational concerns for bus boarding.

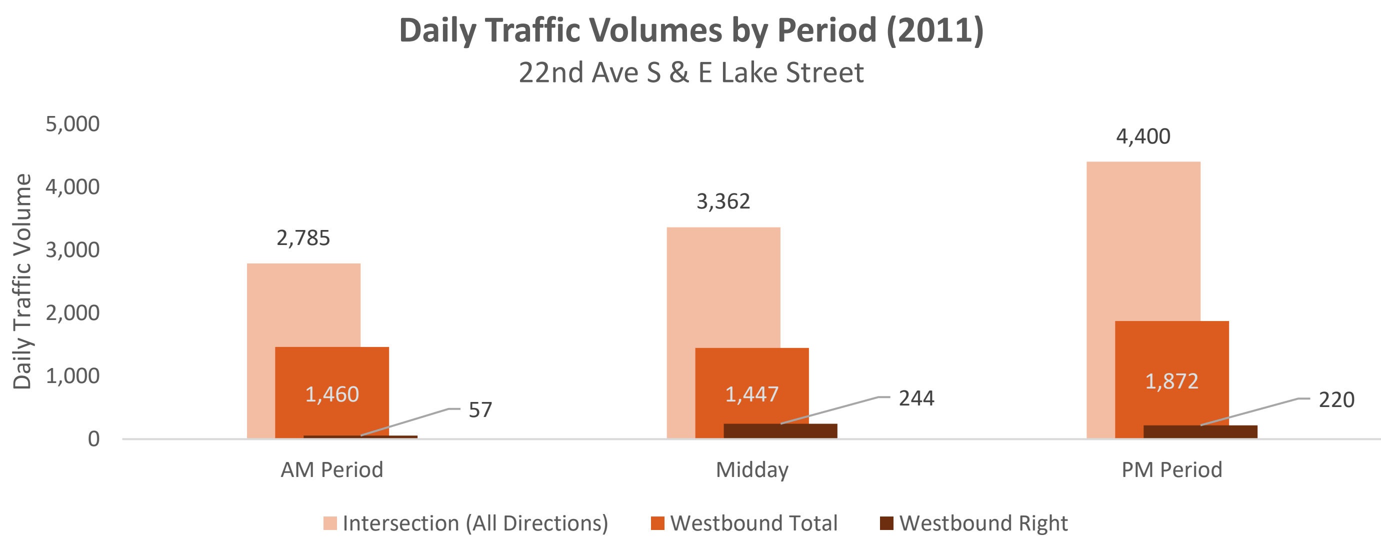


Figure 10: Vehicular Volume Profile at 22nd Avenue S and E Lake Street (2011 Traffic Counts)

However, to completely eradicate this operational issue, the bus boarding zone in the through lane should be more than 250 feet east of the 22nd Avenue intersection. This dimension, as well as the sight stopping distance and merge distances are shown in *Figure 11*.

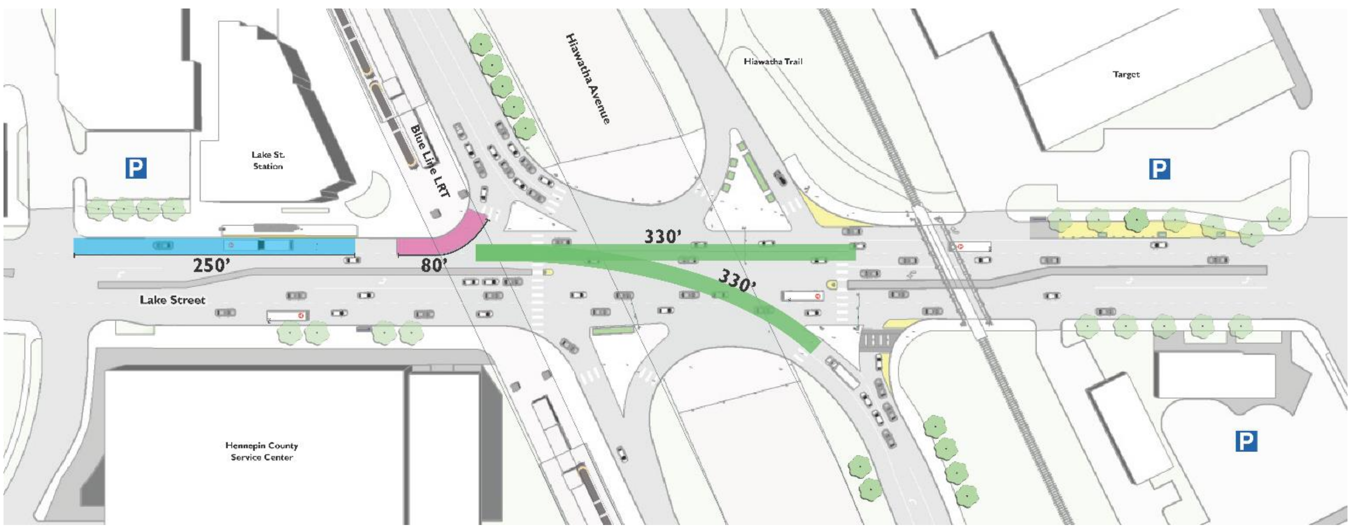


Figure 11: Dimensional considerations for BRT station placement

The culmination of all these dimensions does not allow for a full 120' platform length that meets each previous constraint. It is recommended that the BRT station be placed within the 250' 95 percentile queueing zone, as this condition only exists for a small portion of the day.

Pedestrian Impact

A sensitivity analysis was performed to determine the impacts that pedestrian activity on the north leg of the intersection would have on the westbound vehicle and traffic operations if the dedicated right turn lane was removed. Pedestrian volumes of 25, 100, and 260 pedestrians per hour were analyzed during the PM peak hour of traffic. These incremental numbers were chosen because in Fall 2017 there were on average 257 PM peak period weekday boardings at the westbound bus stop on Lake Street between 22nd Avenue South and Hiawatha Avenue.

Inclusion of any pedestrians in the traffic model does impact operations marginally, but heavily increased numbers of pedestrians does not appear to have a proportional impact on traffic operations. Even the heaviest pedestrian activity on the north leg of the intersection would not be expected to increase westbound vehicular delays or queue lengths.

- In the PM Peak hour, all westbound movements (right turn, through, and left turn) increased delay by 1 second and queue by less than one vehicle length.
- The model assumes pedestrians will cross only during their signal phase, while in reality this is not always the case. However, this is not expected to notably alter the outcomes predicted by the model.

Table 3: Sensitivity Test Results for Pedestrian Activity at 22nd Avenue

Model	Number of Pedestrians in Model	Movement	PM Peak Hour Average Queue (feet)	PM Peak Hour 95th Percentile Queue (feet)	Vehicle Delay (Seconds)
Existing SPUI Conditions	0	Westbound Through	125’	215’	17
Existing SPUI Conditions	0	Westbound Right	30’	80’	9
Right Turn Removed	0	Westbound Through	170’	280’	21
Right Turn Removed	0	Westbound Right	170’	280’	20
Right Turn Removed	25	Westbound Through	160’	260’	20
Right Turn Removed	25	Westbound Right	160’	260’	21
Right Turn Removed	100	Westbound Through	160’	260’	21
Right Turn Removed	100	Westbound Right	160’	260’	20
Right Turn Removed	260	Westbound Through	155’	250’	21
Right Turn Removed	260	Westbound Right	155’	250’	21

Driveway Removal

Although removal of the right turn lane does not have a noticeable effect on traffic delay and queues, the City should be aware of legal considerations in removing the driveway to the east of 22nd Avenue South. Wellington Management is the current taxpayer on both the retail and residential properties surrounding the driveway, and both properties appear to be owned by the Hi-Lake Limited Liability Company. One question to consider is whether the mixed-use property (Lake Street Station) would face significant economic impact with the removal of the driveway access. In other words, does any lost value out-weigh the benefits gained from that specific infrastructure arrangement? Another question is whether the revised access is still reasonably convenient for the property owner.

The 2013 Travel Demand Management Plan for Lake Street Station anticipated a total of 86 vehicles entering and exiting per day from the senior housing facility, with an additional 93 vehicles per day from the first-floor retail. An alternative plan for these vehicles would need to be developed to ensure access is still available.

Conclusion

The above considerations provide a framework for technical items to consider while improving the northwest quadrant of the Hi-Lake intersection. Placing the BRT station platform will be a balancing act between pedestrian improvements and safety, transit operations, and safety and operational considerations for vehicles turning, merging, and safely navigating around buses stopped in traffic. Most of the aforementioned issues would be eliminated with a complete tight diamond intersection implementation.

The following table summarizes the steps that could be undertaken at the quadrant today, with the timeline implications, near-term benefits, and technical considerations that the action does or does not resolve.

Table 4: Next Steps for Northwest Quadrant

Step That Could Be Taken	Lead Time Needed	Near-Term Benefit(s)	Missed Opportunities	Outstanding Technical Issues
1. Remove the Right Turn Lane at 22nd Avenue	Design: 1 month Construction: 1 month City or County Public Works crews could complete	Widened Pedestrian Space	Full BRT Station Coordination – will need to demolish & re-pour entire quadrant when B Line design is complete Shelter far from boarding zone Will likely be reconstructed in Tight Diamond	None (assuming bus stops 250' upstream of 22nd Avenue)
2. Remove 2nd Northbound Left Turn Lane	Design: 1 month Construction: 1 month City or County Public Works crews could complete	Simplified northbound left turn movement	n/a	n/a
3. Add detectable warning strip along full length of 9" high curb	Procurement time for DWS	Less curb rework	Partial BRT Station Coordination – will need to demolish & re-pour some of the quadrant when B Line design is complete Shelter far from boarding zone Will likely be reconstructed in Tight Diamond	None (assuming bus stops 250' upstream of 22nd Avenue)

Step That Could Be Taken	Lead Time Needed	Near-Term Benefit(s)	Missed Opportunities	Outstanding Technical Issues
4. Conduct Vissim Modeling	Design: 1-2 months Construction: 1 month	n/a	n/a	n/a
5. Construct B Line Station	Design: 3-6 months Construction: 2 month	No station rework Ideal Transfer location	Quadrant will likely be reconstructed in Tight Diamond	None
6. Build Tight Diamond	Design: 2+ Years Construction: 6 months	No rework whatsoever Ideal Transfer location Many more: see Phase 1 report & Chapter 4.	None	None

Appendix B:
Tight Diamond Configuration

JULY 2018

Kimley»Horn

Minneapolis
City of Lakes

SCALE IN FEET

LEGEND
- EXISTING GIS ROW
- PROPOSED ROADWAY IMPROVEMENTS
- PROPOSED PEDESTRIAN ZONE
- PROPOSED PEDESTRIAN CROSSWALK
- PROPOSED CONCRETE MEDIAN / CURB / DRIVEWAY

HI-LAKE INTERSECTION STUDY - PHASE 2
TIGHT DIAMOND CONCEPT

JULY 2018

Kimley»Horn

Minneapolis
City of Lakes

LEGEND
EXISTING GIS ROW

HI-LAKE INTERSECTION STUDY - PHASE 2
TIGHT DIAMOND CONCEPT
WB-40 TURNING MOVEMENTS

JULY 2018

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LEGEND
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HI-LAKE INTERSECTION STUDY - PHASE 2
TIGHT DIAMOND CONCEPT
WB-62 TURNING MOVEMENTS

Appendix C:
Traffic Sensitivity Test

Traffic Sensitivity Test

PURPOSE

Determine how much automobile growth the interchange can accommodate and whether that increase in traffic effects pedestrian Level of Service (LOS).

METHODS

To approximate risk with the No Build (SPUI) and Build (Tight Diamond) scenarios, each concept had various growth rates applied to determine if and when any approaches fail.

Tools & Assumptions

PHASE 1/SYNCHRO MODEL INPUTS

A SPUI Synchro model and a Tight Diamond Synchro model were developed in Phase 1 to provide intersection-level average delay and enable comparison between several interchange configurations. These models used HCM 2000 methodology[1] and assumed a 140 second cycle length.

PHASE 2/SIMTRAFFIC SIMULATION

Synchro does not capture the effects of queueing at tightly spaced intersections, or the effects of queue spillback from turning lanes. The queueing impacts on the mainline (Hiawatha Avenue) from nearby intersections and within the interchange ramps becomes worse with traffic growth and ultimately becomes the critical factor causing failure of the ramps. The interchange alternatives were modeled in SimTraffic to capture the impacts of queueing at the interchange.

[1] HCM 2010 methodology is unable to analyze SPUIs and was therefore not utilized.

RESULTS

Vehicle Impacts

TIGHT DIAMOND

The Tight Diamond concept would be expected to operate acceptably with no failing movements or queue spillback until 25% growth is reached. At 25% growth, the west intersection (southbound Hiawatha Avenue ramps) operates at LOS D, but the southbound approach specifically reaches LOS F. The 95th percentile queue on that southbound approach would be expected to extend beyond the storage capacity of the off-ramp into Hiawatha Ave.

Table 1: Tight Diamond Interchange SimTraffic Results

Growth Scenario	Approach	Southbound Ramp (West Intersection)			Northbound Ramps (East Intersection)		
		LOS	Left Turn Lane 95th Queue	Ramp/ Storage Length	LOS	Left Turn Lane 95th Queue	Ramp/ Storage Length
No Growth	EB	A	--	--	A	105	250
	WB	A	55	250	A	--	--
	SB	D	295	1000	--	--	--
	NB	--	--	--	D	155	850
	Intersection	B	--	--	A	--	--
10% Growth	EB	B	--	--	A	115	250
	WB	B	65	250	B	--	--
	SB	D	315	1000	--	--	--
	NB	--	--	--	D	215	850
	Intersection	B	--	--	A	--	--
15% Growth	EB	B	--	--	B	130	250
	WB	B	75	250	C	--	--
	SB	E	535	1000	--	--	--
	NB	--	--	--	D	180	850
	Intersection	C	--	--	B	--	--
20% Growth	EB	B	--	--	B	135	250
	WB	B	90	250	C	--	--
	SB	E	770	1000	--	--	--
	NB	--	--	--	D	210	850
	Intersection	C	--	--	C	--	--
25% Growth	EB	C	--	--	C	135	250
	WB	B	165	250	C	--	--
	SB	F	1585	1000	--	--	--
	NB	--	--	--	D	215	850
	Intersection	D	--	--	C	--	--

SPUI

The SPUI concept experiences failing approaches sooner than the Tight Diamond concept. At 10% growth, the eastbound and westbound queues begin to produce spillback, and at 15% growth eastbound and southbound approaches operate at LOS F.

Table 2: SPUI Interchange SimTraffic Results

Growth Scenario	Intersection	Approach	LOS	Left Turn Lane 95th Queue	Ramp/Storage Length
No Growth	Lake Street & Hiawatha Avenue	EB	D	225	250
		WB	D	145	150
		NB	C	90	850
		SB	D	395	1000
		Intersection	D	--	--
10% Growth	Lake Street & Hiawatha Avenue	EB	E	330	250
		WB	D	155	150
		NB	C	90	850
		SB	D	495	1000
		Intersection	D	--	--
15% Growth	Lake Street & Hiawatha Avenue	EB	F	365	250
		WB	D	160	150
		NB	C	90	850
		SB	F	880	1000
		Intersection	E	--	--

Traffic Growth

The traffic growth rates presented in this analysis reflect a direct percentage growth from existing traffic volumes. In order to estimate the number of years that would be associated with each percentage growth, we must assign an annual growth rate for the vehicular volumes. Annual growth rates are developed based on historical volume trends, as well as projected future changes in development and infrastructure. Annual growth rates in heavily developed urban areas are typically very low, and are sometimes negative. The generally accepted annual growth rate in dense developed urbanized areas of Minneapolis is 0.5%. Based on an exponential annual growth rate of 0.5%, the following approximate numbers of years would be associated with each percent growth scenario shown in the analysis:

Growth Scenario	Number of Years
5%	10
10%	19
15%	28
20%	37
25%	45

Both interchange options are anticipated to provide more than enough capacity to accommodate high levels of growth at the Hiawatha-Lake Interchange, and the Tight Diamond concept provides an even higher level of risk-mitigation than the SPUI option.

Pedestrian Impacts

According to the Highway Capacity Manual 2010 methodology, pedestrian LOS is mainly driven by crosswalk geometry and pedestrian delay at the signals. Geometry and signal delay was evaluated in Phase 1 as a differentiator between different interchange configurations. Increased traffic growth rates yield no difference in pedestrian LOS when the interchange geometry and traffic signal timings are held constant.

Most important to pedestrians is their comfort, experience, and perception of the intersection as a safe place to be and traverse, which can be aided by refuge islands, curb extensions, wider sidewalks, lighting/landscaping, etc. These types of improvements are being recommended as near- and mid- term solutions to the SPUI concept before the full transition to the Tight Diamond.

Appendix D: Cost Estimates

ENGINEER'S OPINION OF PROBABLE COST - HI-LAKE - TIGHT DIAMOND

Contract:
Owner: CITY OF MINNEAPOLIS / HENNEPIN COUNTY
Project: HI-LAKE INTERCHANGE STUDY PHASE 2
Date: **Nov-18**

Schedule: A
Description: HI-LAKE - DIAMOND

Item No.	Item Description	Unit	Contract Quantity	Unit Price	Amount
1	MOBILIZATION	LUMP SUM	1	$ 130,000.00	$ 130,000.00
2	REMOVE PAVEMENT	SQ YD	17,000	$ 6.50	$ 110,500.00
3	REMOVE CURB AND GUTTER	LIN FT	6,500	$ 5.00	$ 32,500.00
4	REMOVE CONCRETE WALK	SQ FT	38,000	$ 1.00	$ 38,000.00
5	REMOVE CONCRETE DRIVEWAY	SQ FT	1,000	$ 2.00	$ 2,000.00
6	MISCELLANEOUS REMOVALS	LUMP SUM	1	$ 50,000.00	$ 50,000.00
7	COMMON EXCAVATION	CU YD	20,000	$ 8.00	$ 160,000.00
8	AGGREGATE BASE, CLASS 5 (10")	CU YD	3,800	$ 26.00	$ 98,800.00
9	SELECT GRANULAR BORROW	CU YD	7,500	$ 15.00	$ 112,500.00
10	TYPE SP WEARING COURSE MIXTURE 4" THICK	TON	850	$ 75.00	$ 63,750.00
11	TYPE SP NON-WEARING COURSE MIXTURE 6" THICK	TON	1,400	$ 75.00	$ 105,000.00
12	CONCRETE PAVEMENT (10")	SQ YD	7,000	$ 50.00	$ 350,000.00
13	CONCRETE DRIVEWAY PAVEMENT	SQ YD	200	$ 70.00	$ 14,000.00
14	CONCRETE WALK	SQ FT	35,000	$ 5.00	$ 175,000.00
15	CONCRETE CURB & GUTTER	LIN FT	6,500	$ 31.00	$ 201,500.00
16	CONCRETE MEDIAN	SQ YD	750	$ 72.00	$ 54,000.00
17	LIGHTING	LUMP SUM	1	$ 150,000.00	$ 150,000.00
18	TRAFFIC CONTROL	LUMP SUM	1	$ 50,000.00	$ 50,000.00
19	SIGNING	LUMP SUM	1	$ 20,000.00	$ 20,000.00
20	STRIPING	LUMP SUM	1	$ 25,000.00	$ 25,000.00
21	SIGNALS	EACH	2	$ 250,000.00	$ 500,000.00
22	LANDSCAPING	LUMP SUM	1	$ 50,000.00	$ 50,000.00
23	STORM SEWER PIPE	LIN FT	2,400	$ 75.00	$ 180,000.00
24	DRAINAGE STRUCTURES	EACH	22	$ 5,000.00	$ 110,000.00
25	EROSION CONTROL	LUMP SUM	1	$ 50,000.00	$ 50,000.00
			Schedule A Subtotal:		$ 2,833,000.00

COST SUMMARY

Schedule	Description		Amount
A	HI-LAKE TIGHT DIAMOND		$ 2,833,000
		20% Contigency	$ 567,000
		25% Indirect Costs	$ 850,000
		Total	$ 4,250,000

Opinion of Probable Cost Assumptions:

1) 2' OF COMMON EXCAVATION OVER AREA OF PAVEMENT AND CURB REMOVALS.
2) ROADWAY PAVEMENT SECTION OF 10" CONCRETE, 10" AGGREGATE BASE, 2' SELECT GRANULAR.
3) RECONFIGURATION OF EXISTING INTERSECTION WILL REQUIRE RECONSTRUCTION OF STORM SEWER WITHIN CONSTRUCTION LIMITS.
4) EXISTING PAVEMENT WILL BE USED WHERE FEASIBLE ON RAMPS AND WILL NOT BE RECONSTRUCTED.
5) DRAINAGE STRUCTURES ASSUMED TO BE PLACED AT 200 FOOT SPACING.
6) UNIT PRICES BASED OFF OF THE 2017 MnDOT AVERAGE BID PRICES WITH EXCEPTION OF LUMP SUM UNIT ESTIMATES.
7) 4" CONCRETE WALK WITH 10" AGGREGATE BASE CLASS 5
8) 8" CONCRETE DRIVEWAY