City of Minneapolis

Minneapolis Streetcar Feasibility Study

Phase I Screening Report

PUBLIC REVIEW DRAFT

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Table of Contents

Table of Figures

PAGE

Executive Summary

The study is being conducted in conjunction with the Access Minneapolis Ten-Year Transportation Action Plan, which lays the groundwork for transportation improvements that are designed to meet the long-term objectives of the Minneapolis Plan.

The Access Minneapolis Ten-Year Transportation Action Plan recommends a series of Primary Transit Network (PTN) corridors, which can be defined as a network of high-frequency, all-day transit services that are intended to carry the majority of transit ridership in the city. The PTN corridors are designed to be "mode neutral" – that is PTN routes can be operated by any appropriate transit technology (bus, streetcar, light rail, etc.) so long as certain performance quality standards are met. This streetcar feasibility study builds on the work of the Access Minneapolis project by evaluating 14 PTN corridors for potential streetcar operations.

- W Broadway Ave (Robbinsdale Transit Center to downtown)
- Central Ave NE (downtown to Columbia Heights Transit Center)
- Chicago Ave S (downtown to 66th St E)
- 15th Ave SE / Como Ave SE (University Ave to St. Paul)
- Franklin Ave (between Hennepin and 26th Ave S)
- Fremont Ave N/44th Ave N/Osseo Rd (downtown to Victory Memorial Drive)
- Hennepin Ave S (downtown to Lake Street)
- Lake St/Midtown Greenway (SW LRT to St.Paul)
- Nicollet Ave S (downtown to 66th Street)
- University Ave SE/4th Street SE (Hennepin Ave E to Stadium Village)
- Cedar Ave/Riverside Ave (between Washington and 26th Ave S)
- Washington Ave (between Cedar/Riverside and W Broadway Ave)
- Penn Ave N/Highway 55 (downtown to 44th Ave N)
- Lyndale Ave S/Bryant Ave S (downtown to 66th St W)

Figure ES-1 shows the candidate streetcar corridors.

Figure ES-1 Candidate Streetcar Corridors

Source: MetroGIS, Met Council, and the City of Minneapolis

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Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-35 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

The primary goals of the Streetcar Feasibility study are to:

- Evaluate the feasibility of developing streetcar services;
- Identify initial operating segments for streetcar operations to the best advantage of Access Minneapolis and to complement other transit services in the PTN corridors[1]; and
- Prioritize future streetcar investments.

In order to accomplish these goals, the evaluation will be conducted in a series of "iterations" or phases.

- **Phase I** will "screen" each of the 14 candidate corridors to eliminate those corridors (or segments of corridors) with significant physical flaws. Phase I will also screen out corridors where planned land use and existing zoning are clearly not supportive of streetcar investments. This Technical Memorandum focuses just on Phase I of this evaluation.
- **Phase II** will put the remaining corridors through a more rigorous evaluation, focusing on additional criteria that can help prioritize the corridors for streetcar implementation.

Phase I of the evaluation was broken into **Primary** and **Secondary** "screening criteria." **Primary Screening Criteria** are intended to screen corridors based on physical and geometric constraints while **Secondary Screening Criteria** screen the candidate corridors based on planned land use and/or existing zoning that is not generally supportive of streetcar. If a corridor does not pass all Primary Screening Criteria, it was not evaluated using the Secondary Screening Criteria. A summary of the screening criteria used in the Phase I evaluation is provided below:

Primary Screening Criteria

- **Grade.** Corridors with grades that inhibit streetcar operations, or make streetcar operation too expensive, such as those with grades over 6%, are eliminated from further study. Corridors with grades between 4-6% are carried forward to Phase II only if it passes all other screening criteria.
- **Street Geometry.** Identifies whether street geometry would inhibit streetcar operation, or require significant capital investments that make operation infeasible. This includes major modifications to interchanges, exclusive right-of-way needs or

[1] It should be noted that there is some interest in this study to ultimately replace transit services along the entire length of PTN corridors with streetcar service. While there are some advantages to this approach, most of the recent implementations of modern streetcar service (such as Portland, Seattle, Tampa, Charlotte, etc.) have been very short segments between 2 and 5 miles. Therefore, the focus of this study is on priority segments that best meet the goals of Access Minneapolis and best complement PTN service where feasible.

other types of transit priority that would be required (such as bridges, underpasses, etc.). Potential for wheel noise is also identified.

- **Other Physical Barriers.** Evaluates whether other physical barriers besides grade and street geometry inhibit potential streetcar operations without significant capital expenses. Examples include low bridges or skyways, streets that are too narrow and at-grade freight railroad crossings.
- **Terminal Location.** Evaluates whether there is a reasonable location for a streetcar line to terminate where connections to other transit service can be made, such as a transit center, LRT station or major activity center.
- **Utilities.** Corridors that would require relocation of major utilities (such as water, storm and sanitary) would make streetcar operation too costly to be provided cost effectively. Because electronic mapping of utilities was not readily available, this criterion will be applied in the second phase of evaluation.
- **Speed and Reliability.** Corridors with substantial traffic congestion, and where exclusive ROW is not possible, may be unable to meet service standards established for the PTN. Severe traffic congestion, for the purposes of this study, is defined as a street segment where the volume of traffic is greater than the capacity of that roadway operating at Level-of-Service (LOS) E. Traffic volume data is from 2004 or 2005 Average Annual Daily Traffic (AADT) counts.
- **Duplication of Service.** Streetcar service should not be designed to duplicate other major rail investments, such as the planned Central Corridor LRT between downtown St. Paul and downtown Minneapolis.

See Chapter 5 for more detail on each of these criteria.

Secondary Screening Criteria

- **Land Use Types.** Measures "transit supportive" planned land use types (by square footage) within ½ mile (as the crow flies) from each streetcar corridor. A more detailed evaluation of development potential will be completed during the Phase II evaluation. This evaluation is based on the 2020 Planned Land Use dataset available from the Metropolitan Council's DataFinder website.
- **Industrial Zoning.** This criterion evaluates the presence of industrial land within ½ mile of the corridor that could be used for a maintenance facility. A more detailed analysis of possible maintenance facility locations will be conducted in Phase II.

Based on the Primary screening criteria, a number of significant physical constraints were identified that eliminated certain corridors or segments from further study. In addition, a number of corridors, or corridor segments, were eliminated from further study based on incompatible land use and the lack of availability of industrial zoning for a maintenance facility along the corridor. In some cases, "significant issues" were identified that will have

a major impact on streetcar operations and/or cost, but that didn't eliminate a corridor from further study. The corridors, or corridor segments, that are carried forward to Phase II of are summarized in Figure ES-2 and illustrated in Figure ES-3.

Figure ES-2 Candidate Streetcar Corridors Carried Forward to Phase II Evaluation (Table)

Candidate Corridor	Carried Forward to Phase II Evaluation?	Reason for Not Carrying Forward to Phase II Evaluation
W Broadway Ave	Yes, entire corridor	-
Central Ave NE	Yes, south of 29th Ave NE	Railroad crossing at 36th Ave NE
Chicago Ave S	Yes, north of Lake	Low transit-supportive land use south of Lake St
15th Ave SE / Como Ave	No	Low underpass at 8th St SE
Franklin Ave	Yes, between Nicollet Ave S and Chicago Ave S	Steep grade east and west of Lyndale Ave S; low overpass at Hiawatha Ave.
Fremont Ave N / 44th Ave N / Osseo Rd	No	No strong anchor north of 44th Ave N / Penn; Difficult turns at Fremont/Plymouth; Low transit-supportive land use along entire corridor
Hennepin Ave S	Yes, entire corridor	-
Lake St / Midtown Greenway	Yes, west of Hiawatha Avenue	Low transit-supportive land use east of Hiawatha
Nicollet Ave S	Yes, entire corridor	-
University Ave SE / 4th St SE	Yes, entire corridor	-
Cedar Ave / Riverside Ave	No	Turning movements at Seven Corners; possible duplication with Hiawatha and Central LRT
Washington Ave	Yes, entire corridor	-
Penn Ave N / Hwy 55	No	No strong anchor north of 44th Ave N / Penn; Low transit-supportive land use along entire corridor
Lyndale Ave S / Bryant Ave S	Yes, north of Lake	No strong anchor south of Lake St; Low transit-supportive land use south of Lake St

Although Figure ES-2 shows only the corridors carried forward to Phase II evaluation, this does not mean that the eliminated corridors will *never* support streetcar service. The goal of this study is to define a short-term list of PTN segments that can be developed into productive streetcar lines and that can be integrated into Metro Transit's overall network.

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Figure ES-3 Candidate Streetcar Corridors Carried Forward to Phase II Evaluation

Source: MetroGIS, Met Council, and the City of Minneapolis

Nelson|Nygaard consulting associates

Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-35 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

Chapter 1. Introduction

In March 2006, the City of Minneapolis authorized Meyer-Mohaddes Associates and its subconsultants Nelson\Nygaard Consulting Associates, Short, Elliot, Hendrickson (SEH), and Richardson, Richter & Associates to study the feasibility of implementing a streetcar network in Minneapolis. The study is being conducted in conjunction with the Access Minneapolis Ten-Year Transportation Action Plan, which lays the groundwork for transportation improvements that are designed to meet the long-term objectives of the Minneapolis Plan.

The Access Minneapolis project recommends a series of Primary Transit Network (PTN) corridors, which can be defined as a network of high-frequency, all-day transit services that are intended to carry the majority of transit ridership in the city. The PTN corridors are designed to be "mode neutral" – that is PTN routes can be operated by any appropriate transit technology (bus, streetcar, light rail, etc.) so long as certain performance quality standards are met. This streetcar feasibility study builds on the work of the Access Minneapolis project by evaluating 14 PTN corridors for potential streetcar operations.

The primary goals of the Streetcar Feasibility study are to:

- Evaluate the feasibility and cost of developing streetcar services in these corridors;
- Identify initial operating segments for streetcar operations to the best advantage of Access Minneapolis and to complement other transit services in the PTN corridors; and
- Prioritize future streetcar investments.

In order to accomplish the goals of this study, the evaluation will be conducted in a series of "iterations" or phases. Phase I will "screen" each of the 14 candidate corridors to eliminate those corridors (or segments of corridors) with significant or serious physical flaws. Phase I will also screen out corridors where land use and zoning are clearly not supportive of streetcar investments. The list of refined corridors will then be put through a more rigorous evaluation, Phase II, which focuses on additional criteria that can help prioritize the corridors for streetcar implementation.

The result of the Phase II evaluation will narrow the analysis to no more than five high priority corridors. The final part of the study, Phase III, will include a detailed operating and capital plan for those priority corridors, including more refined operating/capital cost estimates and ridership estimates. The final study will also include a more detailed evaluation of economic development potential in each corridor as well as potential funding sources, owner/operator arrangements and integration with the local bus network.

It should be noted that this feasibility study focuses exclusively on modern streetcar operations. Although similar in many ways to historic or replica streetcar vehicles, modern

streetcar vehicles have unique operating characteristics that were considered when evaluating each corridor, such as wider turning radii, overhead clearance and stations that are accessible to people with disabilities. These and other characteristics form the basis of the evaluation criteria presented in Chapter 5.

It should also be noted that there is some interest to ultimately replace all transit services in the PTN corridors with streetcar service. While there are some advantages to this approach, most of the recent implementations of modern streetcar service (such as Portland, Seattle, Tampa, Charlotte, etc.) have been very short segments between 2 and 5 miles. Therefore, the focus of this study is on priority segments that best meet the goals of Access Minneapolis while complementing PTN service with streetcar service where feasible.

Chapter 2. Streetcar Characteristics

More than a dozen North American cities have streetcar systems that have either been expanded or begun operation in the past 15-years. At least twice as many other cities have new systems or new lines under active planning. The primary advantages of streetcars are the ability to add a visible rail system with a capital cost that is less than higher capacity Light Rail, and the ability to create a circulator that connects into a high capacity transit network (such as light rail or commuter rail) without requiring additional extension or expansion of the more expensive high capacity mode. Streetcars are also popular because they are a good fit for densely developed, pedestrian-oriented, urban neighborhoods. Many cities, including Minneapolis, were shaped by early streetcar systems, whose remnants can be seen today in the way streets and neighborhoods are laid out.

Some of the defining characteristics of modern streetcar systems include:

- **Streetcars generally attract at least 15-50 percent more riders than bus routes in the same area.** In many cases, the difference in ridership is much higher. Based on recent North American examples of streetcar implementation, there is a clear ridership boost that can be attributed directly to the implementation of streetcar replacing bus service in a given corridor. In Toronto, on routes where streetcar service replaced a nearly identical bus service, ridership increased between 15-25 percent. A particularly dramatic example can be found in Tacoma, where streetcar service is running on a future light rail transit (LRT) alignment. Transit ridership in the streetcar corridor increased by over 500 percent compared to the bus route that ran previously. The route charges no fares and offers free parking, conditions that were present on the previous bus route as well. San Francisco experienced a three-fold increase over bus ridership on its historic F-line corridor since beginning streetcar service in 1995.
- **Streetcars often attract private funding.** Property owners are often willing to financially contribute to a streetcar system because they realize the value that a streetcar brings to their property and to the neighborhood. In Portland and other cities, private owners were willing to "tax themselves" either through fees, benefit districts, or other forms of exactions to receive the benefits of a fixed streetcar system. Nearly half of the operating costs of Tampa's TECO streetcar line are paid through an endowment created by local business contributors.
- **Similar to other street-running modes, streetcars are generally focused on serving a neighborhood, not just moving through it rapidly.** While streetcars can benefit from many of the same treatments that would be given to improve speed on other modes such as signal preemption, queue jumps, longer stop spacing and exclusive right of way, modern streetcars typically have minimal priorities over other vehicles and are often designed to operate in mixed flow with vehicular traffic. Streetcar

stops are generally spaced closer together than light rail or bus rapid transit; because streetcar service is designed for local circulation and connections to higher capacity services rather than providing high speed or high capacity service themselves. In Minneapolis, because candidate streetcar corridors are intended to provide primary transit network service, it will be critical to provide as much transit priority as is necessary to keep the streetcar moving at least as well as the PTN bus route requires. Streetcars are not inherently faster than buses, and in fact, can be less reliable on streets with heavy congestion or other impediments, since streetcars cannot change lanes or maneuver around a problem.

- **Streetcars provide a visible and easy-to-understand routing which attracts new users.** Rail systems in general provide a physical presence on the street that is easy to comprehend. Riders can stand at a stop and literally see where the line comes from and where it is going. Streetcar routes generally make few deviations from a straight path, giving the user more confidence. Visitors and occasional users are more inclined to use them, since there is less confusion about the streetcar than about taking one of many possible bus routes.
- **Streetcars attract both a visitor market and a local user market to transit.** The fact that streetcars are easy to "understand" and often operate in areas with high visitor populations, helps attract visitors as well as local riders. Modern streetcar operations often use "vintage" vehicles, or may actually use rehabilitated vehicles from earlier eras (such as the existing Como-Harriet Streetcar line). Some systems use very modern, but distinctive vehicles. All of these vehicle types help attract visitors, as well as local riders, to transit.
- **Streetcars catalyze and organize development.** Throughout their history, streetcar lines have been an organizing principle behind new development. Streetcars can help create dense pedestrian environments where access to local streetcar stops is possible by foot. Historically, bus routes are added once an area has developed and the demand is in place. Most of the modern streetcar applications in the United States have been catalyzed by the promise of new development, and in fact, have been championed by local developers who also partially funded the projects.
- **A number of cities with more recent streetcar investments credit the streetcar with catalyzing infill development.** Since the decision to build the streetcar was made, over $3 billion in new development has occurred around Portland's streetcar line including retail, office and housing. In Memphis, 4,000 residential units have been built within a block of the streetcar in a formerly underused industrial area. And in Tampa, over $800 million in new private development has been built along the 2.4 mile TECO line. Although it is difficult to know whether development would have happened at the same pace without the streetcar investment, it appears that the streetcar line provided a "focus" which organized development and assured the transit focus of new development along and spreading out from the streetcar corridor.

- **Streetcar costs are higher than bus infrastructure, but lower than light rail.** The cost for streetcar construction is approximately $20-$40M per mile and $2.5-3M is typical for each car. This price compares to $50 to $75M per mile for LRT implementation and between $3-4 M for a light rail vehicle. Standard 40-foot diesel buses typically cost around $400K, while articulated (65-foot) buses cost approximately $650K each. While lower in cost, bus lines do not typically attract private funding for capital costs.
- **Streetcars in the U.S. generally operate in "single car operation" and cannot be considered "high capacity transit" except at very high frequency.** Although there is a range of streetcar types operating today, the most common streetcars generally have capacities in the range of an articulated bus – around 60 to 70 seated passengers and a maximum of 110 passengers (seated and standing). Unlike LRT service, streetcars are generally not strung together in "trains" with a single operator, but rather, operate as single cars on the track. Therefore, streetcars cannot be considered high capacity transit based on the number of people who can be served at one time with one operator. There are typically minimal or no per hour operating cost savings of operating streetcars in place of buses. Because streetcars can attract new riders, the cost per rider for streetcar service may be less than the cost per rider on equivalent bus service.

Figure 2-1 on the following page compares streetcar operations to both light rail and bus technologies.

Figure 2-1 LRT, Streetcar and Bus Technology Comparison

Characteristic	Light Rail	Streetcar	Bus
Capacity	Highest capacity mode. Cars hold 66 seated passengers plus standing room for 120. Can be strung together in multi-car trains to increase capacity.	Medium capacity, generally comparable to an articulated bus. Seated capacity ranges from about 40 to 66 passengers.	Low to medium capacity, depending on size of bus, which can range from a shuttle to an articulated coach. Seated capacities are typically about 60 passengers for an articulated bus.
Flexibility	Not Flexible – high investment cost requires much longer life span to recover fixed costs.	Medium flexibility – track and wire can be relocated for lower cost than a light rail investment.	Highest flexibility – buses are relatively easy to move.
Right-of-Way	Generally requires dedicated ROW for optimal operations.	Can operate in street or on dedicated ROW.	Can operate in street or on dedicated ROW.
Ability to Attract Choice Riders	High – rail services (including LRT and streetcar) attract at least 15-50% more riders than equivalent bus routes and 25-75% more choice riders in route-by-route comparisons.	High – rail services (including LRT and streetcar) attract 15-50% more riders than equivalent bus routes, and 25-75% more choice riders in route-by-route comparisons.	Low – Standard bus services tend to attract fewer choice riders than rail services.
Optimal Markets	Regional commutes and longer distance routes where speed and capacity are at a premium.	Most effective for short, local trips and to provide connections to regional services. Closer stop spacing, reliability and visibility are more important than high speed or high capacity.	Can be effective for local and long distance commuter trips or other trips that are repeated frequently. Also well suited to areas where travel demand patterns are not yet established.
Capital Costs (infrastructure)	$50 to $75 M per mile. Approximately $60 M per mile for Hiawatha LRT.	$20 - $40 M per mile.	Typically less than $200 K per mile); Bus Rapid Transit - $250K – $4.5 M per mile
Vehicle Costs	$3-4 M per vehicle	$2.5-3 M per vehicle	~ $400 K (40 foot coach) ~ $650 K (60 foot articulated coach) ~ $580 K (40 foot diesel/electric hybrid coach)[2]
Operating Cost[3,4]	Highest operating cost. Ranging from $200 to $250 per hour.	Medium operating cost – ranging from $100 to $150 per hour	Lowest operating cost per hour. Large operators average about $100 per hour.

[2] Based on Metro Transit's experience with hybrid diesel/electric vehicles, it is estimated that the cost differential between hybrid vehicles and regular diesel vehicles is approximately $180,000.
[3] Operating cost per passenger is typically lower for LRT, and somewhat lower for streetcar, compared to bus due to increased capacity and ridership.
[4] Metro Transit's fully allocated cost per platform hour is $93.70

Data sources: Transportation Research Board; American Public Transportation Association (APTA); Federal Transit Administration; various transit agency websites.

Transportation Planning Context in Minneapolis

Streetcars are only one mode being developed as part of a major, multi-modal approach to improving transportation service in Minneapolis and throughout the Twin Cities. Other transit and transportation projects that will impact future streetcar investments are summarized below:

- **Central Corridor.** Light Rail Transit (LRT) is envisioned for the 11-mile Central Corridor between downtown St. Paul and downtown Minneapolis. Traveling mostly along University Avenue, once in Minneapolis the corridor also uses Washington Ave SE, through the University of Minnesota and connects with the Hiawatha LRT corridor between the Cedar/Riverside and Metrodome LRT stations. The Metropolitan Council selected LRT as the preferred alternative in June 2006. Pending federal approvals, Preliminary Engineering is expected to begin in early 2007 and is expected to take approximately 2 years.
- **Southwest Corridor.** This corridor stretches from Eden Prairie to downtown Minneapolis, also serving the communities of Minnetonka, Hopkins and St. Louis Park. An alternatives analysis is currently being conducted that will compare the benefits, costs and impacts of a range of transit alternatives, including Light Rail Transit or Bus Rapid Transit. Although there are numerous routing alternatives on the south end, two possible routing alternatives are proposed for the north end (within Minneapolis). One alignment, called the Kenilworth alignment, would travel along an abandoned rail right-of-way along the west edge of the city before connecting with the planned Intermodal Transit Station on the west edge of downtown via Royalston or Hennepin Avenue. Another alignment would travel in the Midtown Greenway to Nicollet and in a tunnel under Nicollet to Franklin, then traveling at-grade into downtown Minneapolis.
- **Bottineau Boulevard Bus Rapid Transit (BRT).** The Bottineau Boulevard BRT project will offer high-quality bus transit between Rogers and downtown Minneapolis. This project is being conducted at the same time as a major redesign and renovation of Highway 81 by Hennepin County. The project will consist of limited stop and express service along several different alignments. In Minneapolis, limited stop service is planned along existing right-of-way on Lowry/Washington and Broadway/Lyndale, both feeding into 7th Street N to downtown Minneapolis. Seven stations are planned in Minneapolis: Broadway/Lowry, Lowry/Penn, Lowry/Fremont, Lowry/Lyndale, Broadway/Penn, Broadway/Fremont and Broadway/Lyndale. Service is expected to begin in 2009.

- **Northstar Commuter Rail.** The 40-mile Northstar Commuter Rail corridor will include 6 stations and carry an estimate 5,600 passengers per day. Only one station is planned in Minneapolis, the Intermodal Transit Center, on the west edge of downtown. In June 2006, the Minnesota State Legislature approved a $60 M bonding bill. This bill will allow the state to leverage the federal funds required to complete the estimated $307 M project. Service is expected to begin in 2009.
- **I-35W Bus Rapid Transit.** The I-35W Bus Rapid Transit project includes the I-35W corridor from Lakeville to downtown Minneapolis. The project envisions a shared BRT/HOV lane in the I-35W corridor with on-line stations at Lake Street and 46th Street in Minneapolis. Rather than utilize unique vehicles that have the look and feel of rail vehicles, the I-35W BRT concept would utilize the existing fleet and consist of both local station-to-station service and non-stop express routes.
- **Intermodal Transit Center.** A new intermodal transit center is planned on the west side of the Third Street Garage along the Burlington Northern – Santa Fe railroad line. The transit center will be the terminus for the planned Northstar Commuter Rail line as well as the Hiawatha LRT line via a short spur from the current terminus at Hennepin and 5th Street N.

Conditions for Successful Streetcar Implementation

Given the characteristics of streetcars and their comparison to other modes, it is possible to develop a set of conditions for successful streetcar implementation. The conditions below are based on comparing streetcars to other modes and on a review of successful streetcar systems in other cities in North America. While it is not necessary to have all of these conditions to implement a streetcar system, the most successful operations will have the most conditions in place:

- **Demand for relatively short trips where speed is not a critical factor.** Streetcars are an especially good application for point-to-point trips in a dense mixed-use environment. These trips do not necessarily need to be fast, because the distances are not great, and there may be no time advantage to using a faster mode (such as subway) because of the greater distances between stops, resulting in increased walk times. For example a car may be slightly faster, but if time is lost finding and paying for a parking space, the total trip time may be the same.
- **Lack of extreme congestion on streetcar streets and limited competition with high capacity services.** Where streetcars can operate in mixed traffic, reliability will be vastly improved if there is less congestion on the street and limited opportunities for traffic to impede the movement of the streetcar. In addition, because streetcars operate within the traffic lane and generally stop in traffic, streetcar operations

should be separated from other higher capacity or high frequency routes operating on the same street to minimize competition for space between the modes.

- **Demand for high frequency service, but without the capacity demands required for light rail.** Streetcars do not typically use multi-car trains and therefore do not offer the high capacity of a multi-unit light rail train. Streetcar systems operating around the country typically run no less frequently than every 15 minutes, and should be designed to operate reliably at that frequency. For a streetcar system, adding frequency, rather than increasing vehicle size, is the means to increasing total capacity.
- **Mixed uses or a variety of markets.** Streetcars are especially good at serving multiple user markets on a single line, rather than being focused on a single market like commute trips. Short workday trips can be served along with trips for recreation, errands, and tourist activities.
- **Presence of tourists and occasional users.** Streetcars encourage visitors and other occasional users to take transit, especially if it connects local and regional destinations.
- **Desire to accelerate planned development.** A streetcar alone cannot catalyze development in an area that does not meet the economic criteria for change. However, in areas that are likely to develop, a streetcar can act as a catalyst and organize the development, ensuring that it will be transit-oriented from the start.
- **Property owners willing to contribute to the success of the streetcar.** Property owners who are willing to participate in all aspects of the streetcar, especially in its financing, will be more willing to ensure its success, and to orient development to take advantage of the streetcar infrastructure. Most of the recent examples of successful streetcar systems had local "champions" in the private sector who organized support for the system, combined with political support from local governements.

Streetcar Experience in Other Cities

Over a dozen North American cities have streetcar systems that have either been expanded or initiated operation in the past 15 years. In addition, at least twice as many other cities have new systems or new lines under active planning. Streetcars are an attractive transportation mode because of their ability to add a *visible* transit line with minimum capital investment. Streetcars are also being promoted as a way to create a circulator system that connects into a high capacity network (such as LRT or Commuter Rail) without requiring additional extension or expansion of the more expensive high capacity mode. Streetcars are also popular because they are a good fit for densely developed, pedestrian-oriented, urban neighborhoods.

The following section below describes experiences in Toronto, Portland and Memphis. It should be noted that no two cities are exactly alike. When using peer information to project results in a different city, it is important to understand all of the issues that make the cities different, as well as alike.

Toronto, Canada

Toronto has the most extensive network of streetcars in North America. Figure 2-2 is a photo of its typical modern streetcar. The Toronto Transit Commission has 11 streetcar routes, 10 of which run through downtown in mixed traffic. During the 1960s there was considerable interest in abandoning the streetcars in favor of bus service. However, the streetcar system has not only been preserved but has been significantly expanded, with four lines opening in the last decade.

Toronto officials cite three key factors contributing to the success of the expanded streetcar network. These factors are present in Minneapolis as well:

- The continuing strength of downtown as a regional employment, retail, and cultural center;
- The increasing role of downtown as a residential center, and;
- Streetcars work very well with a walkable, mixed-use downtown, in which transit does not need to be fast, but it does need to serve a variety of shorter trip markets.

Toronto's existing network and new extensions helped support the transition of the industrial areas along the lakeshore to redevelop with residential, recreational and cultural uses. The lakeshore area is now active with local residents, making both work related and other types of trips, as well as with the many tourists and visitors from other neighborhoods who come to shop, or recreate in the lakeshore area.

A key finding from Toronto's experience is that streetcar service generates more ridership than equivalent bus service generated in the same corridor. For example, in 1997 the transit agency opened a new streetcar line on Spadina Avenue. This line directly replaced a local bus route that was one of the most heavily used and productive in the system. With no appreciable change in service levels or travel speed, ridership increased by approximately 15 percent with the implementation of streetcars.

One reason for this change is that streetcars clearly attract a wider rider market than bus service in Toronto, including a higher percentage of riders who are not transit dependant. The Toronto Transit Commission estimates that 60 percent of streetcar riders are "choice" riders - that is, those who have a car, but choose to take the streetcar instead. While it is difficult to know exactly why streetcars are so popular, the following feedback was provided from recent rider surveys:

- Residents value the streetcars and consider them an important part of the city's image and heritage.
- Streetcars are popular with Toronto visitors who might not otherwise ride transit.
- Riders like the fact that streetcars don't have to pull out of traffic and then remerge back into traffic at every stop. Riders perceive this as taking too much time and as "letting the traffic control the bus".
- Streetcars provide a smoother ride, with less jostling than buses. Riders report being able to read or work on the streetcar but not on buses.

Figure 2-2 Modern Toronto Streetcar

Memphis, Tennessee

As part of a downtown revitalization effort, Memphis converted a failing downtown pedestrian mall into a streetcar line using vintage streetcars (see Figure 2-3). Buses running down the mall were considered, but rejected as incompatible with high pedestrian volumes. The initial streetcar line began service in 1993. It was 2.5 miles long, mostly double-tracked. Streetcar served the mall, but also ran beyond it on both ends to serve areas that were expecting economic development. Outside the mall the streetcars ran on the street, sharing a lane with automobile traffic. In 1997, the initial line was converted into a loop by adding a parallel line, running mostly on an old railroad track. The addition brought the total system up to a length of five track miles. In 2004, the Madison Avenue extension was completed, adding another 2 miles to the system and connecting the hospitals on Madison Avenue with the Main Street line. All but one of the streetcars are renovated historic vehicles and there are 20 total vehicles.

In 1994, annual ridership on the Memphis streetcar system was around 500,000; by 1999, it was around 900,000, and in 2000 it rose to nearly 1,000,000 riders. By 2004, with the recent Madison Avenue addition, streetcars in Memphis carried nearly 1.5 million passengers/year.

A study of the Memphis streetcar line by Thomas Fox, the system's Director of Planning and Capital Projects, notes that:

- Monday through Thursday ridership is comprised mainly of downtown workers and residents who use the system on a regular basis.
- Friday through Sunday ridership is more dependent on the cultural, recreational and shopping activities that occur downtown.
- Saturday is the highest ridership day, contrary to common transit experience.
- Individual day ridership peaks generally coincide with major events in the downtown area such as the Beale Street Music Festival and Memphis Redbirds (Triple A) baseball games at AutoZone Park, and cultural exhibits at the Cook Convention Center.
- An on-board survey of streetcar riders in Memphis taken in 1994 found that:

  Almost half of the streetcar riders chose streetcar "for the experience" and would otherwise be making their trip by car.

  83 percent of streetcar riders did not ordinarily use public transit, suggesting that streetcars can attract riders that similar bus services cannot.

  36 percent of riders had incomes over $50,000, and a total of 14 percent had incomes below $20,000, which further suggests that streetcars attract a wide range of riders.

Ridership has grown for a variety of reasons, the most important of which is the gradual growth and diversification of development in the areas served by the streetcar. Since 1990, residential population along the line has expanded from fewer than 1,000 to more than 5,000 people. Developments such as AutoZone Park (baseball), Peabody Place (entertainment retail), Gibson Guitar Factory and Museum, and numerous restaurants, clubs, and hotels, have resulted in downtown becoming much more of a cultural and entertainment destination than it was previously.

Interestingly, Memphis is using the success of its streetcar system to plan a more regional light rail system. As planned, the streetcar system will constitute the downtown circulation for the larger system, replicating the system currently in place in cities like Toronto. By starting with streetcars, Memphis city officials believe they established the market for rail transit service at a lower initial investment cost, and created the understanding of how rail could serve regional as well as local needs. Once Light Rail is built, the existing streetcar

will continue to provide a functional downtown circulator that complements the regional system.

Figure 2-3 Memphis Streetcar

Portland, Oregon

The City of Portland, Oregon is noted for the dramatic revitalization of its downtown core. Today, Portland's central city is one of the most admired in North America. Many things contributed to this turnaround, but one key factor was an emphasis on transit and cooperative planning for transportation, parking and land uses. The initial success of the MAX regional light rail system and the downtown transit mall helped instigate the planning and development of a new streetcar system to operate as a downtown circulator. Figure 2-4 is a photo of the streetcars used in Portland.

The Portland Streetcar currently operates on a 6-mile loop, connecting the Pearl and River districts with Downtown, Portland State University and the RiverPlace district. A short extension to the South Waterfront area is currently under construction and scheduled to open in late 2006.

The Streetcar stops every three to four blocks, and operates at 15-minute headways for much of the day and evening. Its primary purpose is to provide short trips to residents, workers, students and visitors.

Like Toronto, Portland uses modern streetcars. Modern streetcars are designed to fit the scale and traffic patterns of the neighborhoods through which it travels. Streetcars are 8 feet

wide and 66 feet long, about 10 inches narrower and 1/3 the length of a standard light rail vehicle. They have a low floor center section for ease of boarding.

In addition to acting as a circulator for dense inner city development, one of the goals of the project is to encourage development in neighborhoods adjacent to downtown, particularly the Pearl District. Prior to the arrival of the streetcar in 2001, the Pearl District was mostly a mix of industrial buildings, small-scale commercial and rail yards. Although redevelopment in the District was underway before the streetcar was built, the streetcar system has helped organize development and create significant incentives for new development. The northern part of the Pearl District, which was mostly abandoned rail yards, has experienced the most dramatic changes. Studies have shown that property values have increased most significantly for those properties closest to the streetcar. Not surprisingly, these properties are developing ahead of those more remote from streetcar service. In its first year, it exceeded ridership projections by more than 10 percent, and increased an additional 10 percent its second year. The success of the initial line has spurred expansion plans; the first extension is currently complete, another extension is expected to open in late 2006 and several more extensions are being contemplated.

Portland's system provides an excellent study in how urban development may be affected by the early implementation of streetcar infrastructure. It is claimed that over $1.5 billion in new development has been added to the streetcar corridor since the decision to build the line. While it can be argued that the Pearl District and adjacent neighborhoods would have developed to some extent with or without a streetcar investment, the streetcar has served as an "organizing principle" catalyzing development closest to the streetcar first, and encouraging development to be transit-friendly.

Figure 2-4 Modern Portland Streetcar

Brief History of Streetcars in Minneapolis

As with most cities in North America, the Twin Cities have a rich streetcar history. Beginning with horse-drawn and eventually steam-powered vehicles, streetcars first arrived in Minneapolis in the 1870's. Electric streetcars were first introduced in the 1880's and by 1890, all streetcar lines in Minneapolis were electric. Although some lighter ridership crosstown lines and long suburban lines were converted to buses, streetcars thrived through the 1920's and carried the majority of transit users in Minneapolis. The 1930's saw a major slump in transit ridership overall as the country slipped into the Great Depression. Although this affected streetcar ridership, the Depression slowed the growth of suburban expansion, which spared many streetcar lines. During and just after World War II, streetcars still played a major role in Minneapolis as ridership rebounded after the Depression. By the late 1940's, however, streetcar ridership was declining again and many streetcar lines were being replaced by buses. By the 1950's many streetcar lines and vehicles were in disrepair and in 1954 streetcar service in the Twin Cities ceased all together.

At its peak, the Twin City Rapid Transit Company (Twin City Lines) had 524 miles of streetcar track in the Twin Cities and owned 704 streetcar vehicles. There were six major streetcar barns in the Twin Cities and many streetcar lines operated 24 hours a day. Service levels on major streetcar routes were very frequent, operating every minute or two

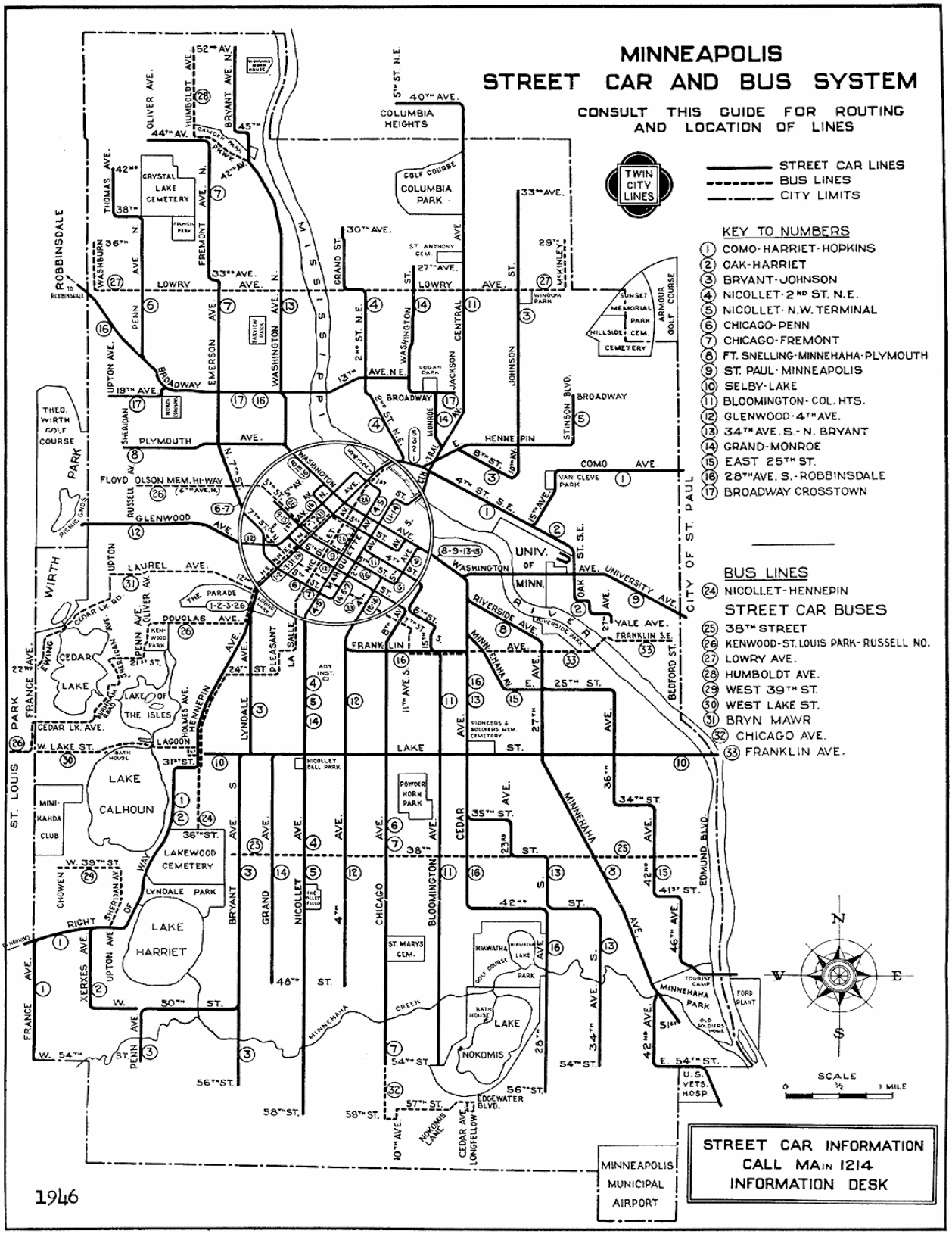
during peak hours. Due to the high frequency operation, transfers between streetcar lines were convenient.

By 1946, Minneapolis' streetcar network was fairly extensive, with service continuing well beyond the city limits, especially to St. Paul. Most major streets in the city had at least one streetcar line and some streets (such as South Nicollet) had three streetcar lines. Very few neighborhoods in the city were more than ½ mile from a streetcar line, and many neighborhoods were much closer. Many of the streetcar lines were "through-routed" in downtown Minneapolis, which means they continued on to another part of the city instead of terminating downtown. In fact, many of the current bus lines are based on the old streetcar routing network, such as Route 6 (from Uptown to the University via Hennepin Avenue and 4th Street SE) and Route 5 (from South Chicago Avenue through downtown to Emerson/Fremont Avenues North).

Figure 2-5 on the following page shows Minneapolis' streetcar network as it existed in 1946[5].

[5] Source: The 1940's, Minnesota Transportation Museum

Figure 2-5 Minneapolis Streetcar and Bus System Map (1946)



Chapter 3. Streetcars and the Primary Transit Network

A critical component of this study is to ensure that any future streetcar investment will provide service that meets the Primary Transit Network (PTN) requirements in every way. Another primary objective of this study is to evaluate candidate streetcar corridors for economic development potential.

The PTN is a permanent network of all transit lines — regardless of mode or operator— that operates at frequencies of every 15 minutes or better all day for at least 18 hours every day, 7 days a week. The PTN can be defined based on performance criteria for five key dimensions of transit quality:

- **Frequency.** PTN services run every 15 minutes. A15-minute headway represents the point at which a transit rider no longer needs to consult a schedule to use the service. It also permits transfers to be made rapidly, even without the timing of transit connections. The threshold frequency of 15 minutes is the point at which the benefits of transit tend to grow exponentially.
- **Span.** The PTN runs a minimum 15-minute frequency for at least 18 hours a day, 7 days a week. This is important because the PTN must reduce auto dependence, allowing all types of trips to be accommodated on transit, not just commuting. The service may operate more than 18 hours a day. Reduced frequencies beyond the 18-hour span would not preclude a line from being a PTN service.
- **Speed.** PTN services have an average operating speed of no less than 30% of the speed limit. This operating speed accounts for stops. Thus, the service transports riders more quickly than most of the conventional transit lines in Minneapolis. It is important that transit speed not be measured relative to average auto speeds, because if the PTN is stuck in congestion, the total person-capacity of the transportation network will decline. To increase person capacity, it is critical that average transit travel speeds approach their theoretical maximum speed. Because this study evaluates the opportunity to replace PTN bus service with streetcars the intent is to maintain PTN service standards, including speed on the corridors that would be served by streetcars.
- **Reliability.** Permanence and reliability are anchors of the PTN. Actual headways between consecutive buses will exceed scheduled headways by a coefficient of variation not to exceed 0.30. Users who know the schedule can expect the PTN services to operate on schedule.

- **Loading.** Standing loads are acceptable, but crush loads are not. Improved frequencies may be required to alleviate crush loads. Appropriate equipment is used to ensure the comfort of passengers and the efficiency of PTN services.

The PTN network was divided into three categories: definite, recommended and candidate corridors. This network was based primarily on the Transit System Plan of the 2030 Transportation Policy Plan produced by the Metropolitan Council. These corridors were then categorized based on existing transit service levels and existing and planned transit-supportive land uses. The "definite" PTN category already has adequate service levels and land uses to support permanent inclusion in the PTN network. The "recommended" corridors are close to meeting service and land use goals and the "candidate" corridors were identified based on their potential to be strong transit corridors in the future.

An important point to make about streetcars and the PTN network is that streetcars can only replace bus service in a PTN corridor if it serves the same market as that bus route. In most cases, PTN corridors consist of multiple bus routes that are long and travel beyond the city limits. Therefore, an important consideration for this study will be whether or not a proposed streetcar service would need to be layered on top of existing bus service, or can it feasibly replace a significant number of buses while still meeting the five performance criteria discussed above. While most streetcar implementations start with very short initial lines, an implementation that is simply layered on top of bus service would only add to capital and operating costs for the transit system and would tend to either degrade or at least not enhance transit operations in the corridor. Streetcar corridor would also be designed to improve circulation downtown, promoting "park once" and pedestrian and transit travel throughout the downtown.

Chapter 4. Candidate Streetcar Corridors

Listed below are the 14 candidate corridors that are part of the "recommended PTN network." Figure 4-1 shows the PTN network and the 14 candidate streetcar corridors.

Definite PTN Corridors:

- W Broadway Ave (Robbinsdale Transit Center to downtown)
- Central Ave NE (downtown to Columbia Heights Transit Center)
- Chicago Ave S (downtown to 60th St E)
- 15th Ave SE / Como Ave SE (University Ave to St. Paul)
- Franklin Ave (between Hennepin and 26th Ave S)
- Fremont Ave N/44th Ave N/Osseo Rd (downtown to Victory Memorial Drive)
- Hennepin Ave S (downtown to Lake Street)
- Lake St/Midtown Greenway (SW LRT to St.Paul)
- Nicollet Ave S (downtown to 66th Street)
- University Ave SE/4th Street SE (Hennepin Ave E to Stadium Village)
- Cedar Ave/Riverside Ave (between Washington and 26th Ave S)
- Washington Ave (between Cedar/Riverside and W Broadway Ave)

Recommended PTN Corridors:

- Penn Ave N/Highway 55 (downtown to 44th Ave N)
- Lyndale Ave S/Bryant Ave S (downtown to 50th St W)

Downtown Streetcar Corridors

Because the evaluation of candidate corridors within and through downtown Minneapolis is more complicated, Figure 4-2 highlights all streets that might accommodate streetcars in this area. *The following corridors were selected because they logically connect with a candidate corridor outside of downtown and do not have an obvious major physical flaw that would eliminate them from further consideration*. All downtown streets that are being considered are listed below:

- Nicollet Ave
- Hennepin Ave
- 9th and 10th St S (between Chicago Ave and Hennepin Ave)
- Washington Ave
- Chicago Ave (between Washington Ave and 14th St S)
- Grant St (between LaSalle Ave and 2nd Ave S)
- 1st Ave N (between 1st Street North and 9th/10th St N)
- 2nd Ave S (between Grant St and Washington Ave)
- 3rd Ave S (between 12th St S and Washington Ave)
- LaSalle Ave (between Grant St and 9th St S)

Figure 4-1 Candidate Streetcar Corridors

Source: MetroGIS, Met Council, and the City of Minneapolis

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Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-5 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

Figure 4-2 Candidate Streetcar Corridors (Downtown Minneapolis)

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Legend

- Candidate Streetcar Corridor
- Hiawatha Corridor Light Rail & Stations (Existing)
- Hiawatha Corridor Light Rail & Stations (Future)
- Central Corridor Light Rail & Stations (Future)
- I-35W BRT (Future)
- Bottineau BRT (Future)
- Southwest Corridor Transitway (Future - alignments still in planning stages)
- Railroad
- Water Features
- Park, Recreationl/Preserve; Golf Course; Agricultural

Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-35 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

N

0 0.25 0.5 Miles

Source: MetroGIS, Met Council, and the City of Minneapolis

Chapter 5. Phase I Screening

Phase I of the evaluation is designed to "screen out" candidate corridors where streetcar operation is either not feasible or streetcars are an inappropriate transit mode based on planned land use and zoning. In some cases, "significant impacts" have been identified that do not necessarily eliminate candidate corridors from consideration but that require special attention before they can be determined to be feasible. Screening criteria may be used to eliminate entire corridors, or to reduce the viable length of a potential streetcar corridor by limiting service to the parts of the corridor where streetcar operations would be feasible.

Phase I of the evaluation was broken into **Primary** and **Secondary** screening criteria. **Primary Screening Criteria** are intended to screen corridors based on physical and geometric constraints while **Secondary Screening Criteria** screen the candidate corridors based on planned land use and/or zoning that is not generally supportive of streetcar. If a corridor did not pass all Primary Screening Criteria, it was not evaluated using the Secondary Screening Criteria. The Primary Screening Criteria are presented in Figure 5-1 and the Secondary Screening Criteria are presented in Figure 5-2.

Figure 5-1 Phase I Primary Screening Criteria

Criteria and Description:	Failing Threshold:
Grade. Corridors with grades that inhibit streetcar operations, or make streetcar operation too expensive, such as those with grades over 6%, are eliminated from further study. A corridor with grades between 4-6% is carried forward to Phase II only if it passes all other screening criteria.	Grades greater than 6% for significant length
Street Geometry. Identifies whether street geometry would inhibit streetcar operation, or require significant capital investments that make operation infeasible. This includes major modifications to interchanges, skyway conflicts, exclusive right-of-way needs or other types of transit priority that would be required (such as bridges, underpasses, etc.). Potential for wheel noise.	Required turns that are less than 90 degrees; Segments with required weaving or curvature that cannot be negotiated by a modern streetcar.
Other Physical Barriers. Evaluates whether other physical barriers besides grade and street geometry inhibit potential streetcar operations without significant capital expenses. Examples include low bridges or skyways, streets that are too narrow and at-grade freight railroad crossings.	Bridges or skyways with less than 14'2" of clearance for combined streetcar and auto operation; clearances between 14'2" and 14'8" would be a tentative pass.[6] Lane widths that cannot be striped to more than 10 feet; At grade freight railroad crossings (at grade crossing of two tracks requires difficult FRA approval and would likely not be allowed without expensive additional signalization or grade separation)
Terminal Location. Evaluates whether there is a reasonable location for a streetcar line to terminate where connections to other transit service can be made, such as a transit center, LRT station or major activity center.	Corridor segments that do not logically connect to a strong terminal location, or are too far away to be reasonable

[6] The minimum clearance was determined based on City of Minneapolis ordinance 503.2.1 which states that the Fire Department must have a minimum of 13 feet six inches of unobstructed vertical clearance. A streetcar line passing under a bridge or skyway would require at least eight inches of clearance for the wire and hanger and at least another six inches of clearance from the high voltage wire. Therefore, the absolute minimum distance determined to be safe for streetcar operation was 13 feet six inches + eight inches, or 14 feet two inches. A clearance less than six inches below the high-voltage wire is considered a significant issue. Thus, the desirable minimum clearance is 14 feet eight inches. This issue was discussed in detail with the Minneapolis Fire Department.

Criteria and Description:	Failing Threshold:
Utilities. Corridors that would require relocation of major utilities (such as water, storm and sanitary) would make streetcar operation too costly to be provided cost effectively.	Presence of major water, storm and sanitary utilities within 3 feet below proposed streetcar trackway Between 3 – 6 feet of proposed streetcar trackway is a tentative pass **Because electronic mapping of utilities was not readily available, this criterion will be applied in the second phase of evaluation.**
Speed and Reliability. Corridors with substantial traffic congestion, and where exclusive ROW is not possible, may be unable to meet service standards established for the PTN. Substantial traffic congestion is defined as a street segment where the volume of traffic is greater than the capacity of that roadway operating at Level-of-Service (LOS) E. Traffic volume data is from 2004 or 2005 Average Annual Daily Traffic (AADT) counts.	Corridors or segments with volume/lane ratios greater than the average plus one standard deviation, which could impact reliability and travel speed of mixed flow corridors. Tentative pass if streetcars can operate in dedicated right of way.
Duplication of Service. Streetcar service should not be designed to duplicate other major rail or BRT investments.	Corridors that directly compete for riders with existing or programmed LRT service. Service would be seen as competitive if it serves the same market as the BRT or LRT service, and would detract from ridership on those services.

Figure 5-2 Phase I Secondary Screening Criteria

Criteria and Description:	Failing Threshold:
Land Use Types. Measures transit supportive land use types (by square footage of land area within ½ mile (as the crow flies) from the streetcar corridor. Evaluation based on the 2020 Planned Land Use dataset available from the Metropolitan Council's DataFinder website.	Significant areas of "Low" transit-supportive land uses – including residential densities below 10 units per acre, industrial land uses, low-scale commercial development and/or no significant area of mixed use development supporting bi-directional service.[7]
Industrial Zoning. Unlike a bus maintenance facility, which can be located wherever land is available, a streetcar garage will need to be located on track connected to the main alignment As a screening measure, this criterion evaluates the presence and potential access to industrial land within ½ mile of the corridor that could be used for a maintenance facility. A more detailed analysis of possible maintenance facility locations will be conducted in Phase II.	No industrial zoning for potential maintenance facility within ½ mile of corridor (or corridor segments) is treated as a fatal flaw.

[7] A more detailed discussion of the methodology used for this criterion is included later in this report.

Chapter 6. Evaluation of Phase I Primary Screening Criteria

The following section provides a discussion of each corridor outside of downtown and what issues were identified with regard to the Primary Screening criteria. Figure 6-1 provides a summary of how each of the corridors performed with regard to the Primary Screening criteria. Figure 6-2 shows the major and significant technical issues on each candidate corridor.

Detailed Review of Each Candidate Corridor (Primary Screening Criteria)

W Broadway Ave (Robbinsdale Transit Center to downtown)

W Broadway is one of the main east-west corridors through North Minneapolis. Broadway is also a major commercial street for most of its length between Lyndale and downtown Robbinsdale.

There are no major issues in terms of grade, street geometry or physical barriers. Although North Memorial Hospital lies just outside of the city limits and is a strong terminus for this corridor, downtown Robbinsdale is continuing to redevelop and is a major transit center, making it a better candidate for an outer terminus.

The only minor issue with this corridor was potential duplication of service with the future Bottineau BRT line. However, streetcars usually serve a local circulation function, whereas the Bottineau BRT would serve a more regional function. For this reason, this was only identified as a minor issue. It should be noted that if streetcar service were initiated on W Broadway Ave, the Bottineau BRT alignment via W Broadway may no longer be preferred and the limited stop portion of this service may be more appropriate on Lowry Ave N. The express alignment of the Bottineau BRT via Hwy 100 / I-394 would remain the same whether streetcar is implemented in this area or not. One significant issue with this corridor is the presence of high traffic volumes between Girard Ave N and Lyndale Ave N.

This entire corridor was carried forward to the Phase I Secondary Screening.

Central Ave NE (downtown to Columbia Heights Transit Center)

Central Ave NE is the major north-south commercial street through Northeast Minneapolis. In addition to the St. Anthony Main area, there is a strong commercial node between 18th and 27th Ave NE.

There are no major grade issues on this corridor, but several minor issues around 8th Street NE. In terms of physical obstructions, there is an at-grade freight rail crossing at 37th Ave NE, which is identified as a major issue. For this reason, the terminus for this corridor would have to be south of 37th Ave NE. Because the Shoreham Yards area is identified as a potential growth area in the City's comprehensive plan, near 29th Ave NE, this was determined as the best terminal location for this corridor.

There is also a low underpass at 16th Ave NE, which is identified only as a minor issue since it is slightly above the 14′ 8″ height needed for streetcar operation.

The portion of this corridor from downtown to Lowry Avenue NE was carried forward to the Phase I Secondary Screening.

Chicago Ave S (downtown to 60th St E)

Unlike Northeast or North Minneapolis, there are several north-south streets though south Minneapolis, spaced approximately 1/3 to 1/2 mile apart. Chicago Avenue is the major north-south corridor east of I-35W, with several neighborhood commercial nodes at Lake Street, 38th Street E and 50th Street E.

There are no major issues in terms of grade, street geometry or physical barriers, except a minor grade issue south of 50th Street E. Because there is not a strong anchor south of Lake Street (until well beyond the city limits), the best intermediate terminal location was determined to be the Lake–Chicago Transit Center and the Midtown Exchange building.

15th Ave SE, Como Ave SE (University Ave to St. Paul)

This corridor connects the U of M Minneapolis campus with the U of M St. Paul campus via Como. Although there are no grade or street geometry barriers, there is a bridge underpass at 15th Ave SE and 8th Street SE that only has a vertical clearance of 13.0 feet. Allowing the vertical space required to hang live high voltage wire would create an overhead clearance that is too low for fast moving fire vehicles and other large trucks.

For these reasons, this entire corridor was eliminated from further study.

Franklin Ave (between Hennepin Ave S and 26th Ave S)

Franklin Avenue is one of south Minneapolis' main east-west streets. It is an urban street, with numerous commercial and high-density residential uses.

There is a grade issue (over 6%) between Hennepin Avenue and Harriet Avenue, which eliminates this section of the corridor from further study. There is also a low bridge at Hiawatha and Franklin at 14′6″. For these reasons, the only section of Franklin that is carried forward to Phase I Secondary Screening is between Nicollet Avenue S and Chicago Avenue S. Because only this section of Franklin Ave is retained, it will only be considered

as a connecting segment between perpendicular corridors (i.e. Nicollet Ave S and Chicago Ave S).

Fremont Ave N, 44th Ave N, Osseo Rd (downtown to Victory Memorial Drive)

Fremont and the Fremont/Emerson couplet (south of 33rd Ave N) is one of two north-south corridors through North Minneapolis. North of 33rd Ave N, the corridor follows 44th Avenue N and Osseo Road, the two major east-west streets in North Minneapolis besides

W Broadway and Lowry. Although this corridor traverses a relatively low-density residential neighborhood, there are numerous neighborhood commercial nodes and some high-density housing.

Although there are numerous minor grade issues, there were no major grade or physical barrier issues along this corridor. The only significant issue that was identified is a set of turns at Fremont/Emerson and Plymouth Avenue N. These turns, although possible, would be difficult to make with a modern streetcar vehicle, and could require taking properties to widen the turning radius.

Another issue with this corridor is the lack of a strong terminal location on the north end. Although the Brookdale Mall in Brooklyn Center is a possible terminus, this would make an initial corridor that is very long and expensive to implement.

Because of the difficult turns at Fremont and Plymouth, and the lack of a strong northern terminal, this entire corridor is eliminated from further study.

Hennepin Ave S (downtown to Lake Street)

Hennepin Avenue is one of Minneapolis' strongest commercial corridors outside of downtown. The street is lined with both commercial and high-density residential from downtown to Uptown.

There are no major grade or physical barrier issues along this corridor. However, a very significant issue was identified at the Lyndale/Hennepin bottleneck, where it would be difficult to incorporate streetcar operations. Another significant issue with this corridor is the presence of high traffic volumes. Finally, this corridor could duplicate rail service if LRT is the preferred mode in the Southwest Corridor.

Although these are significant issues, this entire corridor was carried forward to the Phase I Secondary Screening because no major physical flaws were identified.

Lake St/Midtown Greenway (Southwest LRT to St. Paul)

Lake Street is Minneapolis' most developed and continuous commercial corridor spanning the entire city from St. Louis Park to St. Paul. The Midtown Greenway is a depressed

freight railway corridor that spans the entire city, generally just north of Lake Street. The Midtown Greenway also includes a bike and pedestrian trail between Hennepin and Hiawatha Avenues.

There are no major grade or street geometry issues with Lake Street. However, there is a low bridge crossing at I-35W that is between 14'1" and 14'8" – making this section of Lake Street very problematic. It should be noted that this issue will likely be resolved when the I-35W Access Project is built. Another significant issue along Lake Street is high traffic volumes.

In the Midtown Greenway, however, there are major grade issues related to getting a streetcar to and from street grade. Another significant issue is passenger access to below-grade stations, which would require either an elevator or ramp to meet ADA guidelines.

The Midtown Greenway also presents significant issues with regard to right-of-way, historic bridges and the existing bike/pedestrian trail. In many places, the bridges over the Greenway limit the available right-of-way to two tracks, which would present a conflict with the bike/pedestrian trail. Although possible, it is not recommended to operate a single streetcar track because it is likely that more frequent streetcar service would be needed than could be accommodated with a single streetcar track. Previous studies of the Midtown Greenway have recommended that short segments of single track be used to avoid bridge reconstruction. East of Hiawatha Ave, the Midtown Greenway is about three blocks north of Lake Street, and there are portions of at-grade

There are multiple terminal locations on the west end of Lake Street, including Market Plaza (at Excelsior/Lake) or the Excelsior/Grand development in St. Louis Park. The Uptown area (including the Uptown Transit Station) is another possible terminal location on the west end of this corridor. Terminal locations on the east side of the corridor are less apparent, and the most logical connection would continue well into St. Paul. Multiple terminal locations are possible in the middle of the corridor, with the most obvious being the Hiawatha LRT station, Chicago Avenue or Nicollet Avenue. Because the alignment of the Southwest LRT corridor remains unclear, streetcar service in the Midtown Greenway and/or Lake Street could potentially compete with LRT.

Although there are significant physical challenges in the Lake Street/Midtown Greenway corridor, this entire corridor is carried forward to Phase I Secondary Screening. It should be noted that no decision has been made regarding the feasibility of Lake Street or the Midtown Greenway. For the purposes of this report, there are several options: two-way service on Lake Street, two-way service in the Greenway and one-way service on Lake and one-way service in the Greenway.

Nicollet Ave S (downtown to 66th Street)

Nicollet Avenue has always been one of Minneapolis' most prominent streets. North of Lake Street, Nicollet Avenue is lined with commercial and high-density housing. South of Lake Street, Nicollet is less intensely developed with smaller neighborhood commercial nodes.

There are no major grade, physical barrier or street geometry issues along this corridor, with the exception of the lack of continuity of Nicollet at Lake Street. The K-Mart and other uses between Cecil Newman Lane and Lake Street create a significant barrier to streetcar operations.

Despite the large physical barrier at Lake Street, this would be a good terminal location for streetcar operations. South of Lake Street, the best terminal location is not until 66th Street in Richfield.

Despite some issues, this entire corridor was carried forward to Phase I Secondary Screening.

University Ave SE/4th Street SE (Hennepin Ave E to Stadium Village)

The University and 4th Street one-way couplet between St. Anthony Main and Dinkytown is one of the main east-west corridors through Northeast Minneapolis. In addition to connecting two major commercial nodes, both streets have small neighborhood commercial uses as well as moderate-density housing along most of the corridor. This corridor would connect to downtown Minneapolis via Hennepin Ave or Central Ave.

There are no major grade or physical barrier issues with this corridor. A minor street geometry issue exists because University and 4th are both one-way streets. Although streetcars can operate on one-way streets, it is preferable to operate them two-way on the same street.

Several good terminal locations for this corridor were identified in Dinkytown and at University Village (where a connection with the future Central Corridor LRT can be made).

High traffic volumes were identified as a significant issue at University Avenue and 7th Avenue SE. It should be noted that traffic volumes were much lighter on 4th Street SE, which would make this the preferable streetcar alignment.

This entire corridor was carried forward to Phase I Secondary Screening. It should be noted that both University Ave SE and 4th Street SE are carried forward as possible streets and that no decision has been made regarding which street is more feasible for streetcar operations.

Cedar Ave/Riverside Ave (between Washington Ave and 26th Ave S)

Cedar Avenue and Riverside Avenue (collectively referred to as Cedar/Riverside) bisects one of Minneapolis' most dense residential neighborhoods. Cedar Avenue is lined with commercial development while Riverside borders the U of M West Bank.

Although there are no major grade issues or physical barriers, the Seven Corners intersection (Washington Ave and 15th Ave S) and the Cedar Ave/Riverside Ave intersection would create problematic streetcar turning movements. In addition, the Central Corridor LRT line is planned through this area with a station at UM West Bank, and the existing Hiawatha LRT station is located within ¼ mile of the Cedar/Riverside intersection.

This corridor was eliminated from further analysis because of the serious geometric and traffic issues at the Cedar/Riverside and Seven Corners intersections and because streetcar would duplicate Hiawatha LRT service and future LRT service along the Central Corridor.

Another possible connection between the Washington Avenue corridor and the U of M campus – that avoids the Cedar/Riverside area and could be studied further – is Bridge 9, just east of the 10th Avenue SE /19th Avenue S bridge. This bridge is currently used as a bikeway connecting the east bank and west bank of the university and feeds directly into

the abandoned railway through Dinkytown. It should be noted that even though this connection might be feasible, it could also be a potential duplication of service with Central LRT.

Washington Ave (between Cedar Ave/Riverside Ave and W Broadway Ave)

Washington Avenue traverses the north edge of downtown and connects the Cedar/Riverside area with the North Loop neighborhood. Washington Avenue is lined with high-density residential, commercial, office and warehouses. This street is very much in transition, with significant redevelopment occurring along the entire corridor, especially east of Hennepin.

Because Washington Ave is mostly located in downtown Minneapolis, it will be discussed in a later section that deals exclusively with downtown corridors.

Penn Ave N/Highway 55 (downtown to 44th Ave N)

Penn Avenue is the second major north-south street through north Minneapolis. Highway 55 (Olson Memorial Highway) is a wide six-lane arterial with a median. Penn Avenue bisects a mostly low-density residential neighborhood with small neighborhood commercial nodes at W Broadway, Lowry and 44th Street N.

There are no major issues in terms of grade, street geometry or physical barriers along this corridor. However, like the Emerson/Fremont corridor, there is no strong terminal on the north end of this corridor.

Another minor issue is possible duplication of service with the Bottineau BRT line. As discussed earlier, streetcars typically attract short, local trips while the BRT service focuses on longer, regional trips.

Although this corridor lacks a strong northern terminal, there are no major technical issues and is therefore carried forward to Phase I Secondary Screening.

Lyndale Ave S/Bryant Ave S (downtown to 66th Street W)

Lyndale Avenue S is a major north-south corridor through south and southwest Minneapolis. North of 31st Street, Lyndale is lined with commercial and high-density housing. Bryant Avenue, south of 31st Street, passes through a mostly low-density residential neighborhood with several neighborhood commercial nodes.

There are no major physical barriers along this corridor and only a minor grade issue on Bryant north of 50th Street. And although there are several 90-degree turns at 31st St W, both streets are wide enough to accommodate the turning radius necessary for streetcar. As with Hennepin Avenue, the Hennepin-Lyndale "bottleneck" would make streetcar operations difficult, and is identified as a significant issue.

As with the other north-south streets in south Minneapolis, Lake Street (or 31st Street in this case) was determined to be the best southern terminal location for this corridor. South of Lake Street there is not a strong terminal location until W 66th Street. The most logical terminus, however, would continue further south well beyond the city limits.

Another significant issue with this corridor is high traffic volumes on Lyndale, especially at Franklin Avenue.

Despite some significant issues, this entire corridor is carried forward to Phase I Secondary Screening.

Possible Corridor Connections

Based on the review of the candidate streetcar corridors, several possible connections between the corridors become evident:

Uptown → Hennepin Ave → University Ave SE/4th St SE → U of M

This corridor currently has high-frequency bus service and is the old Como-Harriet-Hopkins streetcar line.

W Broadway Ave → Washington Ave → Downtown

This is the most logical connection between north Minneapolis and downtown. A connection to Hennepin, 1st Avenue N or Nicollet would provide additional service into the core of downtown.

Chicago Ave S → 9th/10th St → Nicollet Ave or Hennepin Ave

Chicago Avenue South feeds directly into 9th and 10th Streets downtown. These streets could feed into Nicollet or Hennepin to provide additional service through the core of downtown.

Figure 6-3 illustrates several possible corridor connections for streetcar.

Figure 6-1 Phase I Primary Screening Comparison of Candidate Corridors

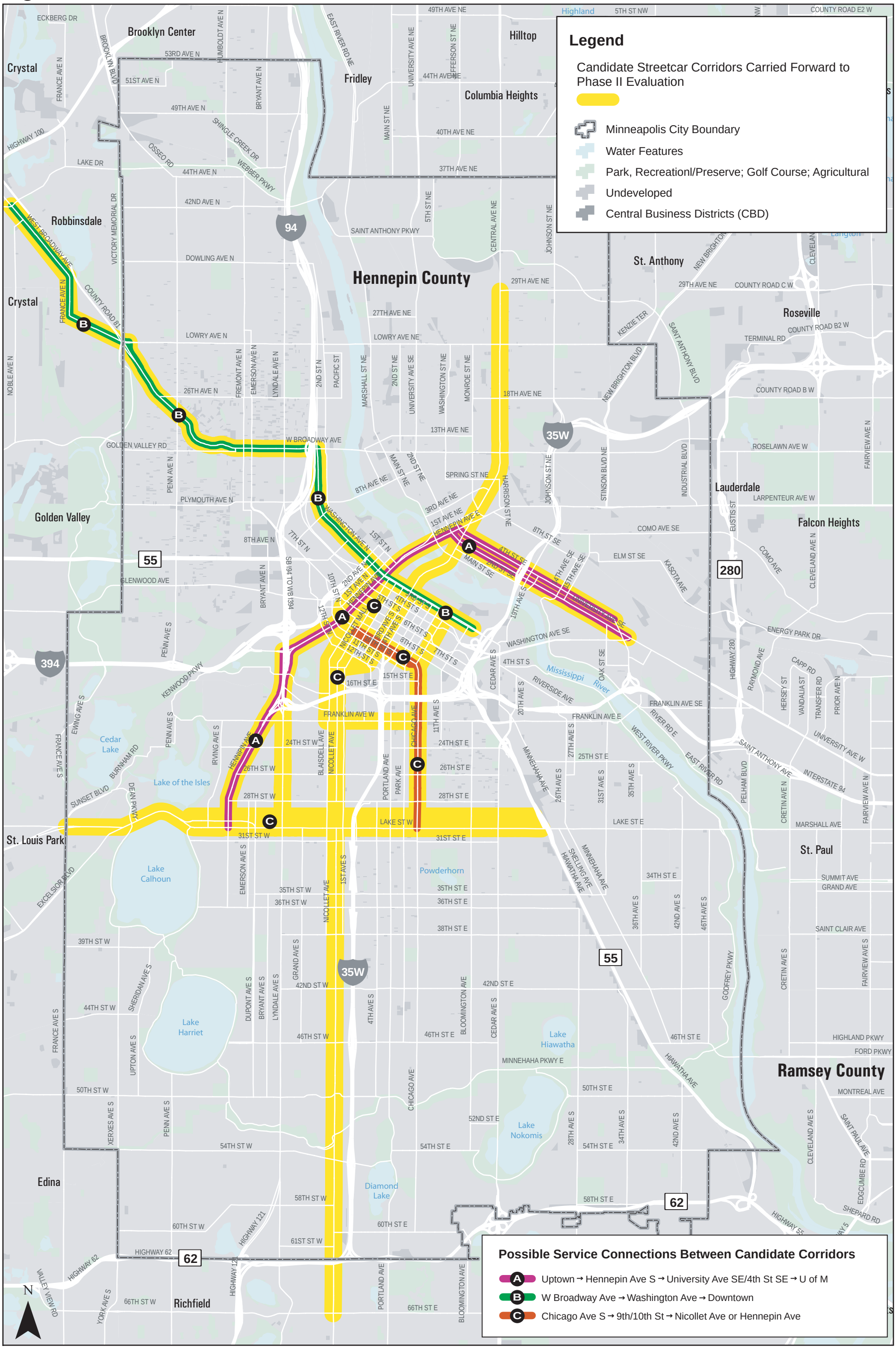
Principal Streets	Broadway	Central	Chicago	15th Ave SE / Como	Franklin	Fremont / 44th Ave N / Osseo	Hennepin	Lake / Midtown Greenway	Nicollet	University / 4th	Cedar / Riverside	Washington	Penn / Hwy 55	Lyndale / Bryant
From...	Robbinsdale Transit Center	Columbia Heights Transit Center	66th St E	University/SE 4th St	Hennepin Ave S	Victory Memorial Drive	Lake St	SW LRT	66th St	Downtown via Hennepin	Washington	W Broadway	44th Ave N	66th St W
To...	Downtown	Downtown	Downtown	St. Paul	Hiawatha LRT	Downtown	Downtown	St. Paul	Downtown	Stadium Village	26th Ave S	Cedar / Riverside	Downtown	Downtown
Grade	No grade issues	Minor issues at 8th Street NE	MINOR ISSUE: turning movements at 9th/10th and Chicago.	No grade issues	MAJOR ISSUE: Significant grade issues east and west of Lyndale	No grade issues	No grade issues	SIGNIFICANT ISSUE: Grade issues between Hennepin and at least Chicago along the Midtown Greenway; SIGNIFICANT ISSUE: Passenger access to below-grade stations.	No grade issues	No grade issues	No grade issues	No grade issues	No grade issues	MINOR ISSUE: Grade issues on Bryant north of 50th
Street Geometry	No major issues	No major issues	No major issues	Difficult right turn at 15th Ave SE and Como	No major issues	MAJOR ISSUE: Difficult turns at Fremont/Plymouth	SIGNIFICANT ISSUE: Configuration of streetcar operations through Hennepin/Lyndale bottleneck.	No major issues	SIGNIFICANT ISSUE: Difficult turning movements around Lake Street	MINOR ISSUE: One-way configuration of both streets.	MAJOR ISSUE: turning movements at Seven Corners	No major issues	No major issues	SIGNIFICANT ISSUE: Configuration of streetcar operations through Hennepin/Lyndale bottleneck. Difficult turning movements at 50th/Bryant and 50th/Lyndale
Physical Barriers	No major issues	MAJOR ISSUE: Railroad crossing at 37th Ave NE MINOR ISSUE: Low overpass at 16th Ave NE - 14'11"	No major issues	MAJOR ISSUE: Low underpass at 8th Street 13'0"	SIGNIFICANT ISSUE: Low overpass at Franklin and Hiawatha - 14'6"	No major issues	No major issues	SIGNIFICANT ISSUE: Historic bridges in Midtown Greenway could limit use of double-track alignment. SIGNIFICANT ISSUE: Low underpass at I-35W - 14'1".	SIGNIFICANT ISSUE: K-Mart is a huge physical barrier at Lake and Nicollet.	No major issues	No major issues	No major issues	No major issues	No major issues
Possible Terminal Location	Downtown Robbinsdale	Retail core between 18th and 27th Ave NE	Lake and Chicago TC in Midtown. SIGNIFICANT ISSUE: No strong anchor for southern layover/terminal south of Lake.	No strong anchor for eastern layover/terminal location difficult - would need to continue well into St. Paul.	Hiawatha LRT Franklin Station	SIGNIFICANT ISSUE: No strong anchor for northern layover/terminal location	Lake/Lagoon in Uptown	Multiple layover/terminal possibilities on west end of corridor (Market Plaza or Excesior/Grand in SLP). Fewer layover/terminal possibilities on east side besides Hiawatha LRT - east of Hiawatha, would need to continue well into St. Paul	MINOR ISSUE: No strong anchor for southern layover/terminal south of Lake.	In and around Dinkytown or University Village (Central LRT)	Franklin or Cedar/Riverside LRT Station	North end (as far as N 10th Ave); South end (Cedar/Riverside or Chicago)	SIGNIFICANT ISSUE: No strong anchor for northern layover/terminal location	SIGNIFICANT ISSUE: No strong anchor for southern layover/terminal south of Lake.
Volume/Capacity Ratio	SIGNIFICANT ISSUE: High traffic volumes between Girard and Washington Ave N.	No major issues	No major issues	SIGNIFICANT ISSUE: High traffic volumes @ 15th Ave SE/5th St SE and Como/16th Ave SE	No major issues	No major issues	SIGNIFICANT ISSUE: High traffic volumes between Franklin and Lake	SIGNIFICANT ISSUE: High traffic volumes between Hennepin Avenue and Hiawatha Ave.	MINOR ISSUE: High traffic volumes at 26th St	No major issues	No major issues	SIGNIFICANT ISSUE: High traffic volumes @ 1st Ave N	No major issues	SIGNIFICANT ISSUE: High traffic volumes @ 24th and 28th St W
Duplication of Service	MINOR ISSUE: Potential duplication of service with Bottineau BRT	No major issues	No major issues	No major issues	MINOR ISSUE: Potential duplication of service with Hiawatha LRT on east end of corridor	No major issues	No major issues	MINOR ISSUE: Potential duplication of SW LRT.	No major issues	MINOR ISSUE: Potential duplication with Central LRT at east end (station proposed at University Village)	SIGNIFICANT ISSUE: Duplication with Central LRT (station proposed for the West Bank) and existing Cedar/Riverside LRT station.	MINOR ISSUE: Potential duplication of service with Bottineau BRT	MINOR ISSUE: Potential duplication of service with Bottineau BRT	No major issues
Continue Further Study in Phase I Secondary Screening?	Yes	Yes, but only south of 37th Ave NE	Yes	No	Yes, but only segments between Blaisdell and Chicago	No	Yes	Yes, but only between SW LRT and Hiawatha LRT.	Yes	Yes	No	Yes	Yes	Yes

Figure 6-2 Candidate Corridors and Major Technical Issues

Source: MetroGIS, Met Council, and the City of Minneapolis

Nelson|Nygaard consulting associates

Figure 6-3 Possible Service Connections



Source: MetroGIS, Met Council, and the City of Minneapolis

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Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-35 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

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Chapter 7. Evaluation of Phase I Secondary Screening Criteria

The following section provides a discussion of each corridor outside of downtown (that was carried forward from Primary Screening) and how they performed using Secondary Screening criteria (transit-supportive land use and industrial zoning for a potential maintenance facility). A summary table (Figure 7-4) is provided at the end of this section.

Because the process used to determine "transit-supportive" land use is more detailed than the industrial zoning criteria, the methodology for the land use analysis is discussed below.

Methodology for Determining "Transit Supportive" Land Use

The first step in this process was to obtain the most recent planned land use dataset for the Twin Cities. This information was available from the Metropolitan Council, and is based on each community's comprehensive plan that includes a depiction of what each community expects or is planning for their land use in the year 2020.

This dataset includes many major land use classifications, ranging from agricultural to high-density housing. Within Minneapolis, there are 39 different land use types. These land use types were categorized into low, medium and high "transit-supportive" land uses, as shown in Figure 7-1 on the following page:

Figure 7-1 Transit-Supportive Land Uses

Low	Medium	High
Airport General Area	Commercial Small Scale	Commercial General
Golf Course	Commercial Small Scale	Downtown Edge
Industrial General	Downtown Secondary Office	Downtown Entertainment
Industrial Light	Office- Residential Medium Density	Downtown Primary Office
Institutional (Cemetery)	Mixed Use - Residential Medium	Downtown Retail
Institutional Uses	Office- Residential Medium Density	Light Rail Hiawatha Line
Minneapolis Parks	Office / Convertible Space	Live Work Units
Water	Residential Medium Density	Residential High Density
Protected Open Space (Public or Private)		Mixed Use - Residential High
Railway		Mixed Use with Retail on Ground Floor
Residential Low Density (Institutional Vet's Home)		Office- Residential High Density
Retail Single Story		Residential High Density
Trolley Railway		Residential Highest Density
United States Army Reserve		Transit Oriented Use
Vehicular Right-of-Way		
United States Army Reserve		

The entire land use dataset was then coded based on one of the three categories (either 1, 2 or 3 with 1 being "low," 2 being "moderate" and 3 being "high). Next, a ½ mile buffer was drawn around each of the candidate corridors. Since downtown will be analyzed separately, any section of the ½ mile buffer that included downtown was eliminated from that corridor.

Based on land uses within this ½ mile buffer, the total land area that fell within the low, medium and high transit-supportive land use categories was calculated. Based on this, an "average transit-supportive land use score" was developed for each candidate corridor. Many of the longer corridors were then broken into smaller segments, such as Nicollet Avenue south of Lake Street and Nicollet Avenue North of Lake Street.

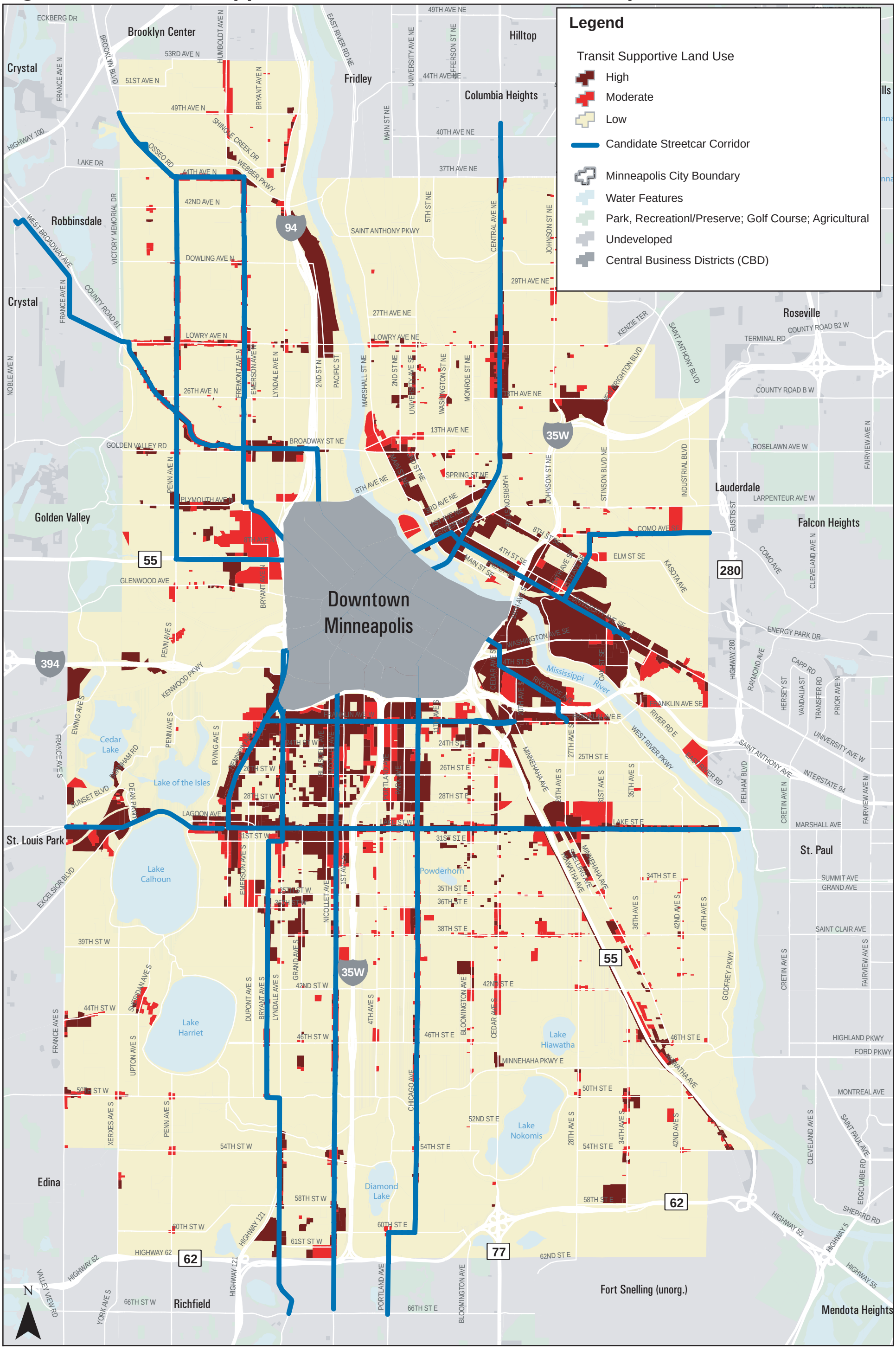
Finally, an average transit-supportive land use was calculated for all candidate streetcar corridors combined. Like the analysis of each candidate corridor, this figure excluded downtown land uses.

Next, the score for each corridor (or segment), was compared with the average score for all corridors combined. Any corridor (or segment) with an average score higher than the

average for all corridors plus or minus 10% is considered passing and carried forward to the Phase II Evaluation. A corridor (or segment) with score less than the average for all corridors plus or minus 10% was eliminated from further study. A corridor (or segment) with a score within 10% of the average for all corridors was continued to the Phase II Evaluation, but it was noted that planned land uses are not likely to be appropriate for that corridor (or segment).

Figure 7-2 shows transit-supportive land use in Minneapolis based on this methodology.

Figure 7-2 Transit Supportive Planned Land Use in Minneapolis



Source: MetroGIS, Met Council, and the City of Minneapolis

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Detailed Review of Each Candidate Corridor (Secondary Screening Criteria)

Broadway (North Memorial Hospital to downtown)

Land Use

Although Broadway itself is lined with commercial and moderate- to high-density residential housing, the surrounding neighborhoods are primarily low-density residential. As a result, the entire Broadway corridor (which includes the section of Washington between Plymouth and Broadway) did not score well compared to the average for all corridors. When just the section west of I-94 is evaluated, the score improves somewhat, but still below the average for all corridors.

Although it would be recommended to discontinue this corridor from further study based on land use, it is the strongest corridor in north Minneapolis, and there are significant redevelopment plans for this area. In addition, this corridor logically feeds into the Washington Avenue N corridor which would serve the burgeoning North Loop area. Therefore, this corridor, west of I-94, is recommended for further analysis.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor for a maintenance facility.

Central (Columbia Heights TC to downtown)

Land Use

Primarily due to the industrial land uses in northeast Minneapolis, the entire Central Avenue corridor scored below the average for all corridors. However, when isolating the segment south of Lowry, this corridor scored well above the average for all corridors. The segment north of Lowry, however, scored very poorly compared to all corridors.

The segment of Central north of Lowry is eliminated from further study.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor for a maintenance facility between 18th Avenue NE and Hennepin Avenue.

Chicago (downtown to 66th Street E via 60th Street E and Portland)

Land Use

Chicago Avenue as a whole scored just below the average for all corridors. When isolating the segment north of Lake Street, Chicago Avenue scored much higher. The segment south of Lake Street scored much poorer when separated from the segment north of Lake Street, and is therefore eliminated from further study.

Industrial Zoning for Maintenance Facility

There is adequate light industrial zoning for a potential maintenance facility along the Midtown Greenway in the vicinity of the Midtown Exchange building.

15th Ave SE, Como Ave (east to St. Paul)

This corridor was eliminated from further study in the Primary Screening round of the evaluation.

Franklin (between Hennepin and 26th Ave S)

Land Use

This corridor scored well above the average for all corridors.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor in the vicinity of the Hiawatha corridor (and the existing LRT maintenance facility).

Hennepin (between Lake St. and St. Anthony Main via downtown)

Land Use

Despite a significant amount of parkland, vehicular right-of-way and some low-density residential, this corridor scored well above the average for all corridors.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor within the vicinity of the Midtown Greenway, as well as downtown in the North Loop area.

Lake/Midtown Greenway (SW LRT to St.Paul)

Land Use

The entire Lake Street corridor scored well compared to the average for all corridors. When looking at the segments individually, the section between St. Louis Park and I-35 scored the highest, followed by the section between I-35W and Hiawatha Avenue. The segment between Hiawatha Avenue and St. Paul was just below the average for all corridors, and it is recommended that it be eliminated from further study.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor along the Midtown Greenway.

Nicollet (downtown to 66th Street)

Land Use

Due to being surrounded by transit-supportive land uses, the entire Nicollet Avenue corridor scored well above the average for all corridors. Isolating just the segment north of Lake Street, this segment achieved the highest score of any corridor or segment. The segment south of Lake Street did not perform quite as well, with an average just below the average for all corridors.

None of the candidate corridors south of Lake Street (Nicollet, Lyndale/Bryant and Chicago) scored high in terms of transit-supportive land use. Still, it is recommended that at least one corridor in south Minneapolis be carried forward to the Phase II evaluation. Although Lyndale Ave/Bryant Ave scored slightly higher than Nicollet Avenue, there is somewhat more redevelopment potential between Lake and 66th Street on Nicollet than Lyndale Ave/Bryant Ave or Chicago Ave. It is likely that if streetcar is implemented on Nicollet Avenue south of Lake Street, it would occur a line north of Lake Street.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor within the vicinity of the Midtown Greenway.

University/4th Street (Hennepin to Stadium Village)

Land Use

This corridor scored the second highest of any corridor or segment.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor south of University Avenue along Main Street SE between Central and I-35W.

Cedar/Riverside (between Washington and 26th Ave S)

This corridor was eliminated from further study in the Primary Screening round of the evaluation.

Washington (between Cedar/Riverside and Broadway)

This corridor will be evaluated later in the section dealing with downtown.

Penn/Highway 55 (between downtown and 44th Ave N)

Land Use

Like the Fremont/Emerson, 44th, Osseo corridor, the Penn and Highway 55 corridor largely bisects a neighborhood dominated low-density residential land uses. Therefore, this corridor did not score well when compared to the average of all corridors. When looking just at the segment of this corridor south of Lowry, it scored better but was still well below the average for all corridors.

It is recommended that this entire corridor be eliminated from further study based on planned land use and previously identified physical constraints.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor east of I-94 in the North Loop area.

Lyndale/Bryant (between downtown and 66th Street W)

Land Use

As with the Nicollet corridor, the entire Lyndale/Bryant corridor scored above the average for all corridors. Isolating just the segment north of Lake Street, this corridor scored the fifth highest of all corridors or segments. The segment south of Lake Street scored much poorer, just below the average for all corridors.

It is recommended that the corridor south of Lake Street be eliminated from further study based on planned land use and previously identified physical constraints.

Industrial Zoning for Maintenance Facility

There is adequate industrial zoning for a potential maintenance facility within ½ mile of this corridor within the vicinity of the Midtown Greenway.

Figure 7-3 on the following page summarizes how each of the corridors (or corridor segments) scored compared to the average for all corridors.

Figure 7-3 "Transit-Supportive" Average Land Use Score

Corridor and/or Corridor Segment	Average Land Use Score
Nicollet (north of Lake only)	2.11
Henn/Univ/4th (entire corridor)	1.93
Chicago (north of Lake)	1.87
Cedar/Riverside (entire corridor)	1.81
Lyndale/Bryant (north of Lake)	1.78
Franklin (entire corridor)	1.75
Lake (btwn St. Louis Park and I-35)	1.57
Hennepin (entire corridor)	1.52
Nicollet (entire corridor)	1.49
Lyndale/Bryant (entire corridor)	1.45
Lake (entire corridor)	1.43
Lake (btwn I-35 and Hiawatha LRT)	1.36
Central (south of Lowry)	1.35
Average for all corridors	*1.31*
Lyndale/Bryant (south of Lake)	1.28
Central (entire corridor)	1.26
Lake (btwn Hiawatha LRT and St. Paul)	1.25
Chicago (entire corridor)	1.25
Penn/Hwy 55 (south of Lowry)	1.22
Nicollet (south of Lake only)	1.21
Broadway (west of I-94)	1.19
Broadway (entire corridor)	1.16
Penn/Hwy 55 (entire corridor)	1.15
Chicago (south of Lake)	1.11
Central (north of Lowry)	1.07
Penn/Hwy 55 (north of Lowry)	1.06

Figure 7-4 Candidate Corridors and Major Technical Flaws

Principal Streets	Broadway	Central	Chicago	15th Ave SE / Como	Franklin	Fremont / 44th Ave N / Osseo	Hennepin	Lake / Midtown Greenway	Nicollet	University / 4th	Cedar / Riverside	Washington	Penn / Hwy 55	Lyndale / Bryant
From...	Robbinsdale Transit Center	Columbia Heights Transit Center	66th St E	University/SE 4th St	Hennepin Ave S	Victory Memorial Drive	Lake St	SW LRT	66th St	Downtown via Hennepin	Washington	W Broadway	44th Ave N	66th St W
To...	Downtown	Downtown	Downtown	St. Paul	Hiawatha LRT	Downtown	Downtown	St. Paul	Downtown	Stadium Village	26th Ave S	Cedar / Riverside	Downtown	Downtown
Summary of Primary Screening Evaluation (Major Technical Issues)	.	Railroad crossing at 37th Ave NE	.	Low underpass at 8th Street SE	Grade issue east and west of Lyndale Ave S; low overpass at Hiawatha Ave.	Difficult turns at Fremont/Plymouth; No strong anchor north of 44th Ave N / Penn;	.	.	.	.	Turning movements at Seven Corners; possible duplication with Hiawatha and Central LRT	.	.	.
Section of Corridor Carried Forward from Primary Screening	Entire corridor	Only south of 37th Ave NE	Entire corridor	Entire corridor eliminated	Only between Nicollet and Chicago	Entire corridor eliminated	Entire corridor	Entire corridor	Entire corridor	Entire corridor	Entire corridor eliminated	Entire corridor	Entire corridor	Entire corridor
Adequate Transit Supportive Land Use?	Moderate, west of I-94 No, east of I-94	Moderate, south of Lowry No, north of Lowry	Yes, north of Lake No, south of Lake		Yes, entire corridor		Yes, entire corridor	Yes, west of I-35 Moderate, between I-35 & Hiawatha LRT No, east of Hiawatha LRT	Yes, north of Lake No, south of Lake	Yes, entire corridor		Yes, entire corridor	No, entire corridor	Yes, north of Lake Moderate, south of Lake
Industrial Zoning for potential maintenance facility within 1/2 Mile?	Yes (along Washington between Broadway and 4th Ave N)	Yes, at Shorham Yards and multiple locations between 8th St SE and 18th Ave NE	Yes (along Midtown Greenway east of Chicago, light industrial only) None south of Lake Street.		Yes (between Minnehaha Ave and Hiawatha Ave)		Yes (along Midtown Greenway between Hennepin and Lyndale)	Yes (mix of industrial and light industrial along Midtown Greenway)	Yes (along Midtown Greenway at Lake Street; along 61st St between Nicollet and Lyndale)	Yes (south of University along Main St SE between Central and I-35W)		Yes (between Broadway and 4th Ave N; east of Chicago in Downtown East area)	Yes (east of I-94 in North Loop area)	Yes (along Midtown Greenway). None between Midtown Greenway and 50th St W.
Phase II? (may include corridor segments)	Yes, entire corridor	Yes, south of 29th Ave NE (Shoreham Yards)	Yes, north of Lake	No	Yes, between Nicollet and Chicago	No	Yes, entire corridor	Yes, but only between SW LRT and Hiawatha LRT.	Yes, entire corridor	Yes, entire corridor	No	Yes, entire corridor	No	Yes, north of Lake

Chapter 8. Downtown Streetcar Corridors

Due to the complexities involved with potential streetcar operation in downtown Minneapolis[8], this area will be evaluated separately from the corridors outside of downtown. For the purpose of this Screening report, all downtown corridors are being carried forward to Phase II of the evaluation. From an operational standpoint, *only corridors that logically connect with a corridor outside of downtown were considered for streetcar operation*. Those streets include the following:

- Nicollet Ave
- Hennepin Ave
- 9th and 10th Streets South (between Chicago and Hennepin)
- Washington Ave
- Chicago Ave (between Washington and 14th Street South)
- Grant (between LaSalle and 2nd Ave South)
- 1st Ave North (between 1st Street North and 9th/10th Street North)
- 2nd Ave South (between Grant and Washington)
- 3rd Ave South (between Grant and Washington)
- LaSalle (between Grant and 9th Street South)

There are a number of unique issues in downtown Minneapolis that will be considered when evaluating potential streetcar corridors:

- **Centrality to the core.** As with any type of transit service, it is important that any future streetcar line operate as close to the "core of activity" as possible. In downtown, this was defined as the "inner core," which is located between Hennepin Avenue, 3rd Street S, 10th Street S and 3rd Avenue S. This is especially important if the proposed streetcar service is intended to replace significant amounts of bus service, which, under the PTN plan will all serve the central downtown core.
- **Skyway Clearance.** Downtown Minneapolis is unique in that it has the most extensive network of overhead skyways in the country. Although clearance is generally not a problem, streetcars, like light rail, require overhead power lines. Because streetcars typically share a lane with other vehicles (i.e., does not have an exclusive right-of-way), a height greater than 14 feet 8 inches is necessary for safety

[8] Downtown is generally defined as the area bound by I-94, Plymouth Avenue North, the Mississippi River and I-35W.

purposes. Although many of the skyways are at least 16 feet high, at least one skyway is below 14 feet 8 inches and many are less than 16 feet high.

- **Severe Traffic Congestion.** As mentioned above, streetcars typically share lanes with other vehicles, similar to a bus. And unlike buses, streetcars can't go around obstructions (such as delivery vehicles, double-parked cars) that are typical in highly congested urban environments. Because streetcars are exposed to the same level of delay as other vehicles, and can't pass obstructions, it is important from a reliability standpoint to operate in streets without severe congestion. Likewise, the high number of entry and exit lanes to parking ramps could create unique issues if a streetcar line is introduced.
- **Current and Future Bus Volumes.** As discussed in the Access Minneapolis project, the volume of buses entering and exiting downtown is very high, especially during peak hours. In order to justify an investment in a transit-only facility, those bus volumes were consolidated into several corridors traversing downtown. Although those transit facilities have been sized to handle these bus volumes, by 2030 those facilities may be at capacity. Therefore, any future streetcar line will need to consider these projected volumes so as not to compromise the speed and reliability of transit operations through downtown. For example, if streetcar were implemented on Hennepin Avenue, it would likely need to replace buses *one-for-one* since this corridor would be over capacity if streetcar service were layered on top of existing bus service. Streetcars can feasibly replace buses because of their local-stop nature, compared with Light Rail Service, which generally has long stop spacing and does not fully eliminate the need for parallel local bus service.
- **Conversion of One-Way Streets to Two-Way Streets.** The City of Minneapolis is currently considering converting several streets from one-way to two-way. The most prominent street is Hennepin Avenue where it turns one-way from 12th Street S to 2nd Street N. The conversion of 1st Avenue N would logically follow as another conversion to a two-way street. Potential operation of streetcar on either of these streets will need to take into account plans to convert the flow of traffic.
- **Turning Movements.** Modern streetcars are required to make relatively wide turns, and do not handle well with alternating curves, such as those on Nicollet. These curves, and other that are less than 90 degrees will need to be considered when evaluating potential routing through downtown.
- **Competition with Existing Hiawatha LRT and Future Central LRT.** Because the Hiawatha LRT line (and future Central LRT line) is aligned through downtown east on 4th and 5th Streets, streetcar service has the potential to be duplicative of LRT rail service on the east side of downtown. This is especially true with the Washington Avenue corridor, which runs parallel to the LRT line. The primary reason the Washington Avenue corridor was not considered east to the U of M campus was competition with the future Central LRT line.

Chapter 9. Corridors Carried Forward to Phase II

Based on the screening evaluation above, a number of candidate corridors have been eliminated from further study. All of the candidate corridors and whether they will be carried forward to a more detailed evaluation in Phase II, is summarized below in Figure 9-1. Figure 9-2 on the following page shows a map of the remaining candidate corridors.

Figure 9-1 Candidate Streetcar Corridors Carried Forward to Phase II Evaluation (Table)

Candidate Corridor	Carried Forward to Phase II Evaluation?	Reason for Not Carrying Forward to Phase II Evaluation
W Broadway Ave	Yes, entire corridor	-
Central Ave NE	Yes, south of 29th Ave NE	Railroad crossing at 36th Ave NE
Chicago Ave S	Yes, north of Lake	Low transit-supportive land use south of Lake St
15th Ave SE / Como Ave	No	Low underpass at 8th St SE
Franklin Ave	Yes, between Nicollet Ave S and Chicago Ave S	Steep grade east and west of Lyndale Ave S; low overpass at Hiawatha Ave.
Fremont Ave N / 44th Ave N / Osseo Rd	No	No strong anchor north of 44th Ave N / Penn; Difficult turns at Fremont/Plymouth; Low transit-supportive land use along entire corridor
Hennepin Ave S	Yes, entire corridor	-
Lake St / Midtown Greenway	Yes, west of Hiawatha Avenue	Low transit-supportive land use east of Hiawatha
Nicollet Ave S	Yes, entire corridor	-
University Ave SE / 4th St SE	Yes, entire corridor	-
Cedar Ave / Riverside Ave	No	Turning movements at Seven Corners; possible duplication with Hiawatha and Central LRT
Washington Ave	Yes, entire corridor	-
Penn Ave N / Hwy 55	No	No strong anchor north of 44th Ave N / Penn; Low transit-supportive land use along entire corridor
Lyndale Ave S / Bryant Ave S	Yes, north of Lake	No strong anchor south of Lake St; Low transit-supportive land use south of Lake St

Although Figure 9-1 shows only the corridors carried forward to Phase II evaluation, this does not mean that the eliminated corridors will never support streetcar service. The goal of this study is to define a short-term list of PTN segments that can be developed into productive streetcar lines and that can be integrated into Metro Transit's overall network.

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Figure 9-2 Candidate Streetcar Corridors Carried Forward to Phase II Evaluation

Source: MetroGIS, Met Council, and the City of Minneapolis

Nelson|Nygaard consulting associates

Future transit corridor sources:

1. Central Corridor LRT: Metropolitan Council
2. I-35 BRT: MnDOT
3. Southwest Transitway: Southwest Transitway.org
4. Bottineau BRT: Metro Transit

Chapter 10. Preview of Phase II Evaluation

Phase II of this evaluation will put the remaining corridors through a more rigorous review including more quantitative criteria. Because one potential source of capital funding for streetcar service in Minneapolis is the Small Starts program, the Phase II evaluation criteria are organized according to the following categories which can be used to support funding decisions for FTA Small Starts projects:

- Transit Supportive Land Use;
- Transit Operations;
- Transit Ridership;
- Cost-Effectiveness;
- Economic Development;
- Qualitative Measures.

To adequately evaluate the candidate corridors carried forward from Phase I, a conceptual operating plan will be developed for each corridor using a standard service frequency and span of service that meets the basic criteria of the PTN network (15 minute service, 18 hours/day). Following this evaluation, the corridors will be measured against each other in a comparative analysis, and up to five highest potential corridors will be identified for high priority implementation.

The final part of the study will include a detailed operating and capital plan, including more refined operating/capital cost estimates and ridership estimates. The final study will also include a more detailed evaluation of economic development potential in each corridor, potential funding sources, owner/operator arrangements and how the a streetcar line would integrate with the local and regional transit network.