CITY OF MINNEAPOLIS

Downtown Transit Circulation Concept

FINAL REPORT

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10-YEAR TRANSPORTATION ACTION PLAN

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About this Report

This report, the "Downtown Transit Circulation Concept," presents a plan for establishing an adequate transit infrastructure downtown to accommodate the next several decades of growth. This report represents one layer of the *Access Minneapolis* downtown plan. Other elements of the downtown plan will address the needs of other modes.

Introduction and Approach

Downtown Minneapolis is the densest activity center in the region, and will continue to be for the foreseeable future. For this reason, it will require a greater emphasis on transit circulation than the rest of the city.

As cities grow more dense, a natural shift occurs away from automobile dependence. Land becomes more valuable, so parking costs naturally rise. Streets become more congested up to a point where the congestion itself discourages further auto trips. At this point, further growth in travel demand can only be accommodated through growth in alternative modes, primarily walking (for short trips) and public transit (for longer ones). Fortunately, density also encourages the development of these modes. Dense communities naturally generate more pedestrian activity at the expense of auto trips, because so many of the necessities of life are within walking distance. Transit ridership rises dramatically with density, so that higher-quality transit service is both needed and justified.

A successful plan for a growing downtown must give particular emphasis to these two modes – transit and pedestrians, while also retaining automobile access and accommodating other key alternative modes such as cycling. One need only look at any denser urban core in North America to see the rough shape of Minneapolis's future: automobile access is always accommodated, but transit takes on a rising share of trips as density increases. And since neither autos nor transit can deliver customers to the front door of every downtown destination, pedestrian infrastructure also becomes increasingly critical. Indeed, pedestrian activity is one of the most widely accepted indicators of a healthy urban core.

There are many ways to describe the transit circulation problem through downtown, including:

- Insufficient downtown street capacity to handle growth in transit demand.
- Slow and unreliable transit service, due in part to downtown street configurations.
- Need for transit services that stimulate economic development
- Need to reduce conflicts between transit and other modes.
- Need for better intra-downtown circulation service.
- Need for better service to edge-of-downtown neighborhoods.

To solve these problems within the limited physical space and financial resources, it is important to find solutions that address several problems at once. Most good transit solutions do address multiple transit needs. For this reason, the most fruitful line of thought will begin with the quantitatively largest problem, the one that is likely to require the largest actions to solve it. By tackling the biggest problem first, and ensuring we have a solution to it, we will find the other problems easier to address. In fact, the solution to the biggest problem may also be a solution to some of the others.

The biggest challenge (and opportunity) that downtown faces is its extreme popularity as a transit destination, for trips from throughout the city and the region. Even if all planned rail corridors are built, the number of buses passing through downtown will continue to rise just to meet the growing demand for access to downtown. The intra-downtown market is also important, but the market for travel into downtown from outside of downtown is the dominant demand pattern. For this reason, it makes sense to begin by tackling the challenge of service into and out of downtown. This report outlines solutions to that problem, and then considers how to meet the important intra-downtown and edge-of-downtown needs in light of that solution. This approach ensures that we are not just creating separate services for each separate market – a recipe for inefficiency in transit planning – but rather creating a system of services that are useful for many possible needs, and can therefore achieve the highest ridership with the greatest efficiency.

The Current Services

There are three major kinds of transit in the downtown, with significantly different needs.

- **Local Two-Way, including the Primary Transit Network lines.** These lines mostly serve dense urban corridors of Minneapolis and St. Paul, extending into inner-ring suburbs but not much further. They are currently concentrated on Nicollet Mall, Hennepin, and on several east-west streets. They tend to be relatively few routes, but very frequent, so they account for many buses and a consistent all-day demand. For the most part, they are easily recognized by route numbers below 90.
- **Peak Commuter Express.** During rush-hour, hundreds of buses flow through downtown bringing commuters from every corner of the region. These peak-only routes are concentrated on Marquette, 2nd Ave S, and to some extent 3rd Ave S. Because they are peak-only, they could be accommodated by peak-only facilities. These routes are the most complex part of the system, because there are so many of them catering to many specialized markets all over the region. An additional complexity to the commuter market is the number of transit agencies involved, though all rely on the Metropolitan Council for their funding.
- **Regional Two-Way.** Some long-distance regional routes run throughout the day, typically connecting larger regional centers. Light rail falls into this category, but so do several key bus lines. *This is a rapidly-growing category*, because as urban regions grow the peak grows longer, and more want to travel throughout the day. These lines are often the basis for future rapid transit corridors. For example, Line 94 (Minneapolis – St. Paul nonstop) is part of the market for Central LRT, while Line 535, which runs all day on I-35W South, is the basis for future growth of Bus Rapid Transit in this corridor.

Figure 1 summarizes the distinction among the three types.

Figure 1 Comparison Between Major Downtown Transit Services

	Local Two-Way	Regional Two-Way	Peak Commuter Express
Market area	Minneapolis, St. Paul, and inner-ring suburbs	Entire region.	Entire region.
Directionality	Two-way	Two-way	One-way. Peak direction only.
Period of service	All-day, 7 days	All-day, 7 days	Peak commute hours only.
Stop spacing	Close, usually < 1/4 mi.	Wide, up to 1 mile on arterials and longer on express segments.	Usually nonstop between origin Park-and-Rides and downtown.
Reliance on downtown transit connections	High	High	Low
Reliance on transit connections outside downtown	High	High	Low
Primary mode of access outside downtown	Walk, transfer	Transfer, Park-and-Ride	Park-and-Ride, dropoff
Part of Primary Transit network?	Yes, where frequency and span are adequate.	Yes, where frequency and span are adequate.	No.
Existing examples	Most lines numbered under 90.	Light Rail, lines 94, 535.	Most other lines numbered over 100 and serving downtown.
Possible future technologies	Streetcars	Light Rail, regional Bus Rapid Transit (e.g. Bottineau, I-35W south)	
Current downtown alignments	Nicollet, Hennepin, several East-West streets.	Marquette, 2nd Ave S, 4th St S, 7th/8th St S.	Nicollet, Marquette, 2nd/3rd Aves S.

For the purpose of downtown, it is important to note the very different nature of one-way Peak Commuter Express services, compared to the other types. In particular, the Peak Commuter Express services …

- … run only one direction at a time. Buses run "not in service" in the other direction. Peak Commuter Express buses may be "not in service" for up to half of the total time the bus is operating.
- … rely much less on transfers at either end of the trip. Other types of service depend on being part of an integrated system, with connections to other lines. Peak Commuter Express service benefits from transfers, but its main market is taking people directly from Park-and-Rides to worksites.
- … are designed to capture a *very large share of a very narrow market*. A peak commuter service is useful only for people traveling (a) during the peak commute hour, (b) into a dense urban core, and (c) from a particular Park-and-Ride. By contrast, two-way services aim for a *moderate share of a very broad market*. Two-way services run all day and tend to serve more destinations along the way.

As a result, two-way service is useful to a much broader market, though it tends not to capture as large a share of that market.

In general, Peak Commuter Express markets occur in areas where the peak demand is very high but there is little or no midday demand, and little or no demand for travel in the reverse-peak direction (e.g. out of downtown in the morning). Newer outer-ring suburbs tend to have an especially strong demand of this type. As a region grows denser, the market begins to demand midday and reverse-peak service. These demands, combined with the existing peak commuter demand, add up to the need for service running two-way, and all-day, i.e. Regional Two-Way service. As a result, regional densification tends to cause Regional Two-Way service to grow faster than Peak Commuter Express service, though the market for the latter never disappears. Two-way service running all day also has the potential to grow into more permanent infrastructure, such as rapid transit or streetcars, while Peak Commuter Express service does not.

Speed and Capacity: Overview

Why Focus on Speed and Capacity?

Transit has an almost unlimited ability to fuel downtown's growth, but it has three significant needs:[1]

- **Speed and reliability.** Where general-purposes lanes are subject to severe congestion, transit must have a protected way through or around this congestion. Note: *Speed is not about achieving high top speeds, i.e. it is not about "speeding."* Instead, efforts to improve and protect transit speed are about reducing the causes of delay. Transit does not need to go faster than the speed limit, but it does need to operate at a consistent and reasonable speed.
- **Passenger information and environment.** Transit must be clear and easy to use, an obvious and welcoming part of the civic infrastructure. Transit facilities must be civilized environments, including reasonable weather protection, security, etc.
- **Street capacity.** During peak periods, the number of buses that need to flow through the downtown is determined by the regional demand for travel to the downtown. There needs to be room for these buses if the demand is to be served. Much of this report deals with quantifying this need.

At this level of planning, *we recommend focusing first on capacity and speed.* Reliability is important but usually benefits from the same improvements that benefit speed. Passenger information and amenity is a more detailed issue, but in general, it benefits from concentrating more customers at fewer stops, thereby justifying better amenities at each.

The Speed Challenge

Throughout the downtown, all-day transit speed averages less than 10 mph across all of downtown, and many segments drop below 5 mph during the peak period (See **Figures 2 and 3**). As speeds slow down …

- … operating costs go up, consuming resources that could otherwise be spent on frequency or new service.

[1] In addition to these, transit also requires terminal and layover facilities, discussed in greater detail below.

- … ridership is discouraged.
- … capacity is reduced further due to bus congestion.[2]

How bad is the problem? Currently, peak hour transit moves at:

- under 4 mph on Nicollet Mall
- under 6 mph on Marquette and 8th Street South
- under 7 mph on Hennepin, 6th Street S, and 7th Street S.

The section on Transit Lanes later in this report provides more detail on these speeds and their causes. In general, though, we recommend aiming for downtown speeds of at least 8 mph. More important, an effective plan needs to hold the line against further loss of speed. In the absence of planning, gradual loss of speed can be expected as traffic and bus volumes both increase within the constrained space of downtown.

The Capacity Challenge

Figure 4 shows Metro Transit's projection for 2030 growth in bus volumes, with and without the planned rail corridors. This projection is reached by dividing the 2030 expected ridership by the capacity of a bus. All buses are therefore assumed to be full in the peak direction.

The bottom line is that the total bus trips flowing into downtown during one AM peak hour rises from 495 in 2000 to 824 in 2030 if no rail projects are built. If all proposed rail projects are built (Northstar, Southwest Corridor, Central Corridor), then this number drops to 718, still a 45% increase over current levels.

Of course, this is just a count of peak-direction trips, i.e. inbound in the case of the AM peak. What goes in must come out, so the total number of one-way bus trips across downtown would be double this (1,436).

However, many of these reverse-direction trips will be out-of-service runs, trips between the downtown end-of-line and the garage or another piece of work[3]. These buses are easier to accommodate because they are not making passenger stops. They are sensitive to congestion, but the signalization that works for autos also works for them. For now, we assume that the general purpose traffic system will be adequate to move these out-of-service buses, especially since they are generally moving in the reverse-peak direction.

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[2] As noted in a later section, speed and capacity affect each other both ways, producing a downward or upward spiral. Capacity problems create congestion which reduces speed. Lower speed, whatever the cause, means that fewer buses can move through a facility in a given time, because each one is taking more space.

[3] Of course, service flowing outward from Minneapolis, to suburban jobs, will also grow dramatically, and this growth is accounted for in this analysis. However, the demand for inbound commutes will always exceed that for outbound commutes, because of the intrinsic incentives to transit use, and disincentives to driving, that are unique to extremely dense destinations such as downtown.

Still, we do need to count service that is two-way by design, and account for these trips to operate in the reverse-peak direction. Most local routes, including the entire Primary network, needs to run two-way during the peak, as they do all day. Bus Rapid Transit (BRT) corridors, and some other major regional express links, also run two-way. When we count up these services, we estimate that **the ultimate number of one-way, in-service trips across downtown, during one peak hour, with all three rail corridors completed, is approximately 800 in 2030**. The details of this figure appears below in the section "Identification of Downtown Transit Spines."

Note on Unit of Analysis: Peak Hour vs. Peak 15 Minutes

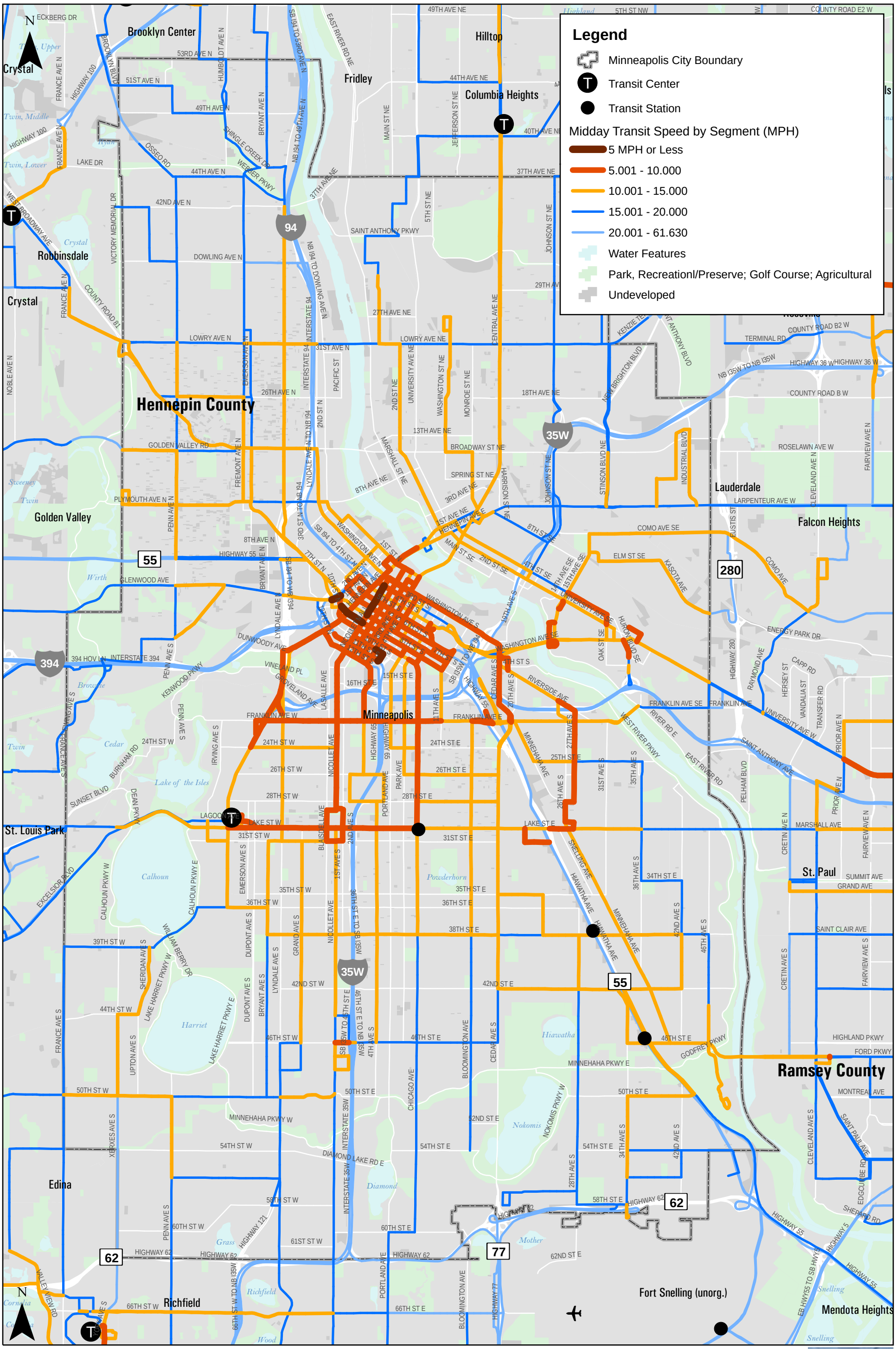
This report describes the demand for downtown bus capacity in terms of buses per peak hour. This unit denotes the number of bus trips flowing one way across downtown during the one busiest hour of each peak commute period.

It can be argued that the proper unit of analysis is really buses per peak 15 minutes. Passenger demand during the peak hour is uneven; it tends to be determined by the prevailing times when people start and leave work. Thus the demand for trips departing downtown between 5:05 and 5:20 PM, for example, is typically higher than for trips in the 15 minutes following. The general rule used by Metro Transit is that the peak 15 minutes has about 1/3 of the demand of the peak one hour, even though it is only ¼ of the duration.

This is a valid guideline that reflects existing experience, but it reflects a largely unconstrained demand. In other words, the existing system tries to serve passengers exactly when they want to travel.

However, when sizing downtown facilities that may have significant costs and side effects, the question inevitably arises: "Doesn't this need to be useful for a fairly long period in order to be justified?" It can reasonably be argued that the peak one hour is a long enough period; widths of highways, for example, are often justified largely based on the need at peak periods that can be as little as an hour long. It is harder to argue that a facility should be sized to accommodate a higher demand that lasts only 15 minutes. At some point, it will simply be necessary for more commuters to leave a few minutes later, to spread themselves out more evenly around the peak hour, as highway commuters already learn to do. Where facilities are constrained, it is common to see commuters make these minor adjustments, and we recommend assuming this level of flexibility in the transit commuter of the future.

Figure 2: Midday Transit Speed by Segment - (Ten-Year Transportation Action Plan)



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

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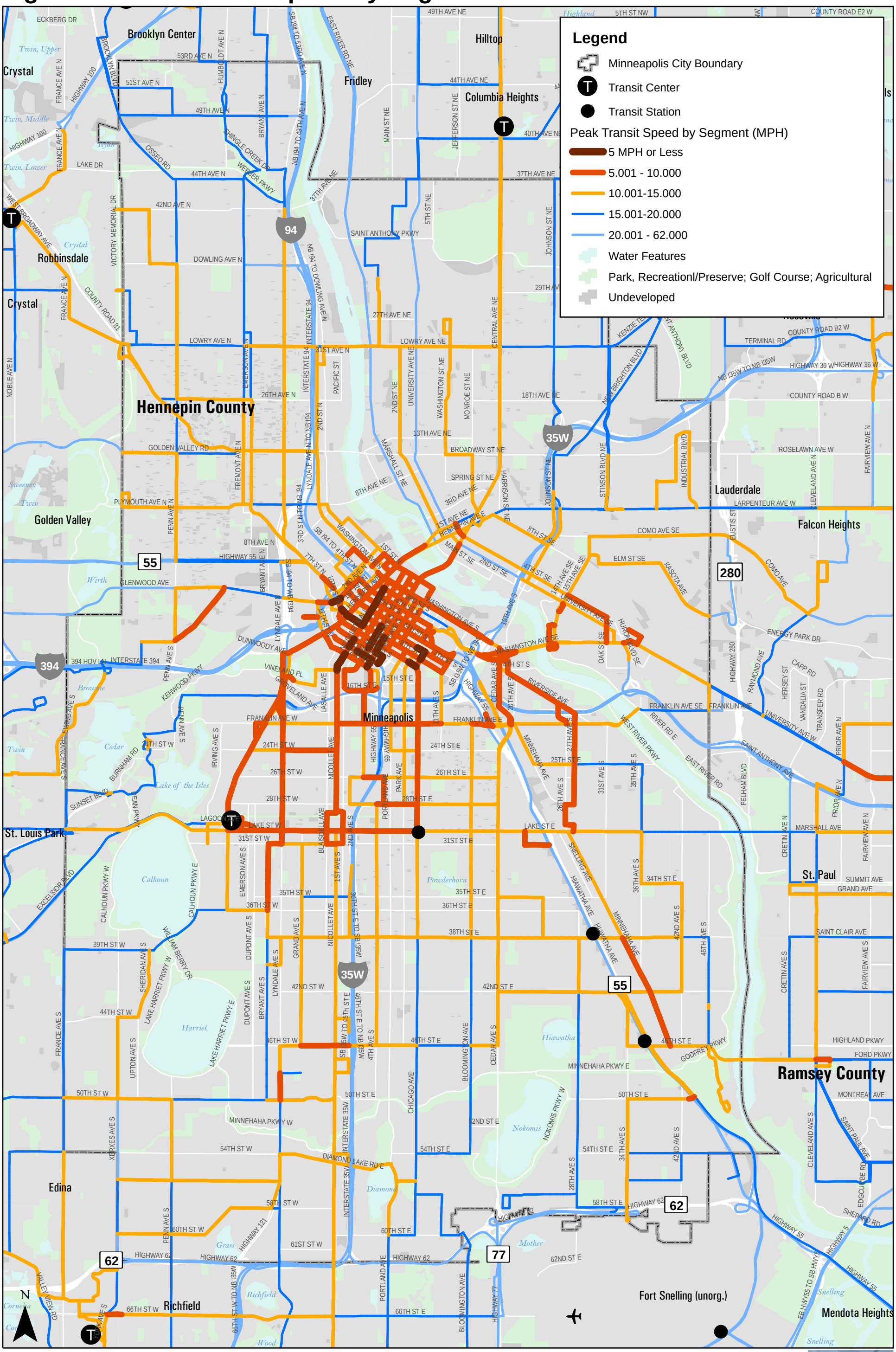
Figure 3: Peak Transit Speed by Segment - (Ten-Year Transportation Action Plan)



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

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Figure 4 Estimated Transit Vehicle Trips (Inbound AM Peak Hour)

2030 Transportation Policy Plan "Doubling Ridership Goal"

1. TRAVEL CORRIDOR	Projected Ridership Growth (1) (Inbound AM Peak Hour) 2000	2030	Increase	Change	Transitways Included
I-35W South	2,269	4,708	107%	2,439	I-35W BRT, Cedar Ave BRT
I-394	2,645	5,427	105%	2,782	
I-94 NW (252 & 694)	3,129	6,322	102%	3,193	Bottineau Blvd BRT
I-35W (& Hwy 36) North	1,043	2,301	121%	1,258	
I-94 East	275	1,063	286%	788	
Sub-Total	**9,362**	**19,821**	**112%**	**10,460**	
Local Service	9,095	15,325	69%	6,230	Central BRT
Total	**18,456**	**35,146**	**90%**	**16,690**	

2030 TPP Goal Adjusted to Account for Rail Vehicle Impact

3. TRAVEL CORRIDOR	Projected Ridership Growth (Inbound AM Peak Hour) 2000	2030	Increase	Change	Transitways Accounted For (6)
I-35W South	2,269	4,228	86%	1,959	Hiawatha LRT Expansion (2)
I-394	2,645	3,987	51%	1,342	Southwest LRT (3)
I-94 NW (252 & 694)	3,129	5,122	64%	1,993	Northstar CR (4)
I-35W (& Hwy 36) North	1,043	2,301	121%	1,258	
I-94 East	275	1,063	286%	788	
Sub-Total	**9,362**	**16,701**	**78%**	**7,340**	
Local Service	9,095	13,885	53%	4,790	Central LRT (5)
Total	**18,456**	**30,586**	**66%**	**12,130**	

2. TRAVEL CORRIDOR	Projected Vehicle Growth (Inbound AM Peak Hour) 2005 (8)	2030 (7)	Increase	Change	Transitways Included
I-35W South (9)	68	105	54%	37	I-35W BRT, Cedar Ave BRT
I-394	73	121	65%	48	
I-94 NW (252 & 694)	54	140	160%	86	Bottineau Blvd BRT
I-35W (& Hwy 36) North	25	51	105%	26	
I-94 East (10)	10	24	136%	14	
Sub-Total	**230**	**440**	**92%**	**210**	
Local Service	197	383	94%	186	Central BRT
Total	**427**	**824**	**93%**	**397**	

4. TRAVEL CORRIDOR	Projected Vehicle Growth (Inbound AM Peak Hour) 2005 (8)	2030	Increase	Change	Transitways Accounted For
I-35W South	68	94	38%	26	Hiawatha LRT Expansion
I-394	73	89	21%	16	Southwest LRT
I-94 NW (252 & 694)	54	114	111%	60	Northstar CR
I-35W (& Hwy 36) North	25	51	105%	26	
I-94 East	10	24	136%	14	
Sub-Total	**230**	**371**	**61%**	**141**	
Local Service	197	347	76%	150	Central LRT
Total	**427**	**718**	**68%**	**291**	

(1) Assume 52 percent of AM Peak Period ridership occurs during the AM Peak Hour as compared to 45 percent of AM Peak Period vehicle trips occuring during the AM Peak Hour.
(2) Assume a 960 a.m. peak hour ridership reduction based on 8 peak hour, 3-car trains, each with a passenger capacity of 360. Assume 50 percent new rider and 50 percent bus rider to rail rider conversion.
(3) Assumes 2,880 a.m. peak hour ridership reduction based on 8 peak hour, 3-car trains, each with a passenger capacity of 360. Assume 50 percent new rider and 50 percent bus rider to rail rider conversion.
(3) This would replace 19 peak bus trips fron SW Metro area. However, If an LRT alignment that is not time-competative were chosen, up 19 peak hour bus trips should be planned for in the downtown system
(4) Assume a 2,400 a.m. peak hour ridership reduction based on 4 peak hour, 4-car trains, each with a passenger capacity of 600. Assume 50 percent new rider and 50 percent bus rider to rail rider conversion.
(5) Assume a 2,880 a.m. peak hour ridership reduction based on 8 peak hour, 3-car trains, each with a passenger capacity of 360. Assume 50 percent new rider and 50 percent bus rider to rail rider conversion.
(6) Assumes LRT travel time adequate to eliminate express service.
(7) Assumes an average peak hour load goal of 45 passengers on suburban routes and 40 passengers on urban routes.
(8) There are 518 in-service trips, 91 (18%) of these are outbound trips on non-through routes. These 91 trips are not include below.
(9) Trips on limited stop/express routes 133, 135 and 156 which serve primarily the City of Mpls are accounted for in local service.
(10) Trips on limited stop/express routes 94, 134 and 144 which serve the City of St. Paul and Mpls are accounted for in local service.

Factors that Could Reduce Bus Volumes

Before considering the impacts of the projected volumes of buses through downtown, it is important to also identify any strategies or factors that could make this volume lower. This section discusses the three most significant:

- Peak Spreading.
- Changes to criteria for peak commuter service.
- Peak Interception

Peak Spreading

Peak Spreading is a natural response to increasing peak congestion. It can be described in two ways:

- As the city grows dense, demand for midday service will increase faster than for peak service. Cities significantly denser than Minneapolis usually show a much higher midday demand. There are still peaks, but there is a large high "plateau" between them.
- As cities grow denser and traffic congestion becomes more acute. People will naturally begin to adjust commute schedules so that commutes occur over a longer period. In very dense urban areas on both coasts, a sustained peak lasts for as much as three hours. These estimates do not account for this effect, which tends to put a limit on demand in the peak one hour.

The basic idea of Peak Spreading – that midday demand grows faster than peak as urban areas grow more dense – is easy to observe in the history of many urban transit systems. However, there does not appear to be any useful research on quantifying Peak Spreading on transit, and in the absence of this we do not recommend *assuming* that Peak Spreading would mitigate the rise of peak bus volumes.

Changes to Criteria for Peak Commuter Service

One other strategy that could reduce bus volumes is to change the criteria for which peak-only services are designed. The current approach of Metro Transit, and the other suburban operators, is to optimize the travel time to downtown for the suburban commuter. These services typically run from many scattered Park-and-Ride facilities, and the prevailing view is that they all need to run directly downtown.

Another approach, which could save roughly 50 peak buses,[4] would be to replace peak commuter service with connections to a light rail line in the same corridor so as to create a less duplicative and more efficient network, *even if this increases the travel time for certain existing customers*.

[4] **Figure 4** above ("Estimated Transit Vehicle Trips") estimates that the I-94 East corridor would have 24 peak buses even with Central LRT. Since that category counts only buses running beyond St. Paul, all such buses could potentially be replaced by feeders to Central LRT at St. Paul. Another 25 peak buses could almost certainly be replaced by rail feeders along the Southwest LRT corridor, though the 2030 projections are too aggregated to identify these specifically.

Many agencies have taken this more aggressive approach when introducing light rail. In Portland, for example, each new light rail line was accompanied by deletion of all commuter expresses from downtown to the rail line's catchment area, even though this meant longer trips for some riders, so as to make maximum use of the rail service's capacity and advantages. There were several justifications for this approach:

- The rail line, with its high capacity, moves customers much more efficiently. In figuring out how to be useful to the maximum number of riders, the cost-effective solution is to require customers from the light rail area to use the light rail, rather than running buses for them alongside it to save them from transferring. The result is to free up bus hours that can be used to serve other productive markets.
- One way to use the bus hours saved is by running increased frequency on the feeder lines that connect residential areas to light rail. As a result, a commuter's trip was slightly longer, but the same commuter benefited from being able to make the same trip more frequently, and over a longer span.
- Downtown Portland, like downtown Minneapolis, had limited capacity to absorb a flood of peak-only buses. It made sense to give all-day transit services the priority in access to downtown transit facilities, because they use the same facilities over a longer period and therefore expand their overall usefulness.
- Finally, transit ridership is related not just to quality of service, but also to driving disincentives. When serving a destination that has high parking costs and congestion on its routes of access, as big downtowns inevitably do, transit can afford to be slightly less specialized, and potentially less convenient for some users, without a net loss in patronage.

At Tri-Met, the replacement of express services with feeders to rail was extremely unpopular with the affected commuters and their elected representatives, but in the end, the result was a system that carried far more people at a lower cost per rider. While it is easy to believe that such a locally unpopular move would be politically impossible, it has been achieved in other agencies. The key to achieving this level of change is to articulate a consistent set of standards and goals that make the overall benefit clear to policymakers.

This strategy needs to be worked out as the rail lines are being planned. It would require a guideline for the range of acceptable impacts on existing commuters, though of course this must be weighed against the size of the market affected and the degree of potential savings from diverting these commuters to rail. Federal criteria reward lines that carry existing passengers more efficiently, so it often makes sense to show this strategy in the DEIS process because it produces higher rail ridership and higher productivity overall.

Obviously, this strategy does not apply in cases where rail capacity is inadequate to handle the additional demand. However, the justification of rail capacity expansions, such as longer trains, may benefit from the assumption that Peak Commuter Express service could be consolidated once this capacity was in place.

The same strategy could be applied to trunk BRT services. Here, the challenge of commuter acceptance is more difficult, because it is harder to justify the newly required transfer in terms of an improved amenity experience (i.e. light rail) for the trip into downtown. Requiring

commuters to transfer to LRT also gives them a protected right-of-way (the LRT line) that parallel bus services generally lack. By contrast, peak express services in the I-35W corridor will have access to the BRT facility as it is completed, so requiring those passengers to transfer to a trunk BRT bus does not give them access to a more reliable service than they already have. Still, some agencies do require transfers to BRT, especially as their downtown space fills up.

Peak Interception

Definition and National Experience

Much of the downtown bus volume is created by specialized Peak Commuter Express routes, which typically run from suburban Park-and-Ride lots to a downtown hub. There is some precedent, in other agencies, for bringing these services only to a terminal on the edge of downtown, rather than all the way through the downtown core. Examples include:

- **Denver.** In Denver, regional express service operates only to terminals on the edge of downtown, rather than through the center of downtown. From these terminals, a very frequent shuttle connects the terminals to each other and to the core downtown, though many passengers can also walk to downtown destinations from the terminals.
- **Manhattan.** Commuter buses from New Jersey that enter Manhattan via the Lincoln Tunnel all operate to a single stop at the Port Authority Bus Terminal, on the west edge of Midtown next to Penn Station. From here, passengers connect to local buses and subways to reach their Manhattan destinations.
- **San Francisco.** Buses entering San Francisco from the Bay Bridge (serving Oakland, Berkeley, and eastern suburbs) all arrive at a single stop at the Transbay Terminal, which is on the south edge of downtown. From here, passengers can walk a block to the single subway line, or take other local buses to their downtown destinations.

Two of these examples are associated with bridgeheads, where all buses funnel into downtown by one route and have an expedited bus-only routing directly into the terminal. Commute buses have a market advantage in these cases not just because of the cost of parking in the downtown, but also because of tolls on the bridge or tunnel in question. Denver is the one system that uses Peak Interception in the absence of these disincentives to driving. We should note that downtown Minneapolis is larger than downtown Denver, and considerably more concentrated, so the potential for viable Peak Interception may be greater than in Denver.

Three points, in particular, argue that Peak Interception might be more efficient in Minneapolis than in Denver. **Figure 5** shows the configuration of downtown employment in Denver, as compared with Minneapolis. Several key points stand out:

- Denver's downtown core is spread out along a line, centered roughly on 16th Street, with several distinct employment areas, and significant walking distances between them. Minneapolis's downtown core is more rounded and compact. Average walking distances between major downtown activity centers are therefore lower in Minneapolis.
- The Minneapolis Skyway system provides a weather-protected route from throughout the core to most of the likely terminal locations. Denver has no such system, so weather remains a disincentive

to walking within the downtown there. The economic activity at the Skyway level testifies to the system's crucial role in the downtown transportation system.

- Some facilities for Peak Interception already exist in Minneapolis. Downtown has several garage transit centers (Leamington, Gateway, and the three garages over I-394), all of which were intended for Peak Interception, though they have not been used for that purpose in practice and would need substantial remodeling and expansion to be used for Peak Interception on a large scale.

In comparing Minneapolis to Denver, it is important to separate the Denver approach into its two parts: Peak Interception – the policy of ending peak commuter buses at edge-of-downtown terminals, and the downtown shuttle concept. In Denver, these two elements work together to some degree, but they also work separately. Denver's 16th Street Mall shuttle serves to distribute many commute passengers to downtown destinations, but that is not its only purpose, and many peak commuters also reach downtown destinations in other ways.

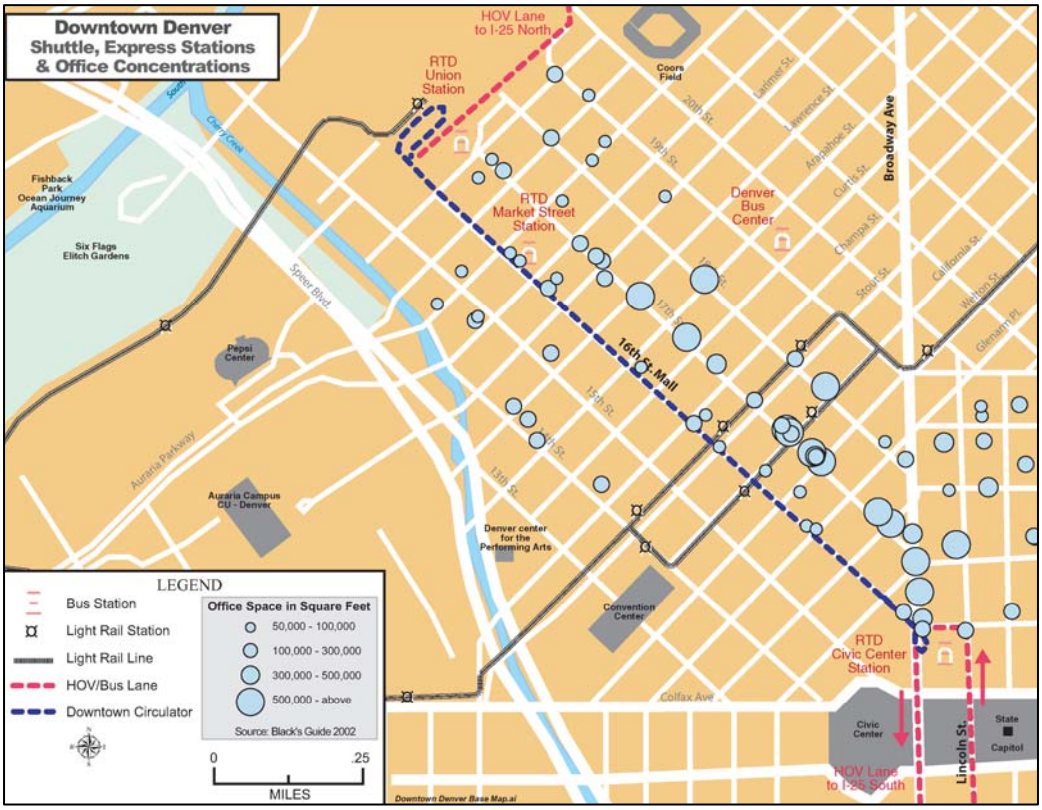
In Minneapolis, Peak Interception may *benefit* from a downtown shuttle but probably does not *require* it to the same degree, for the reasons similar to the ones listed above:

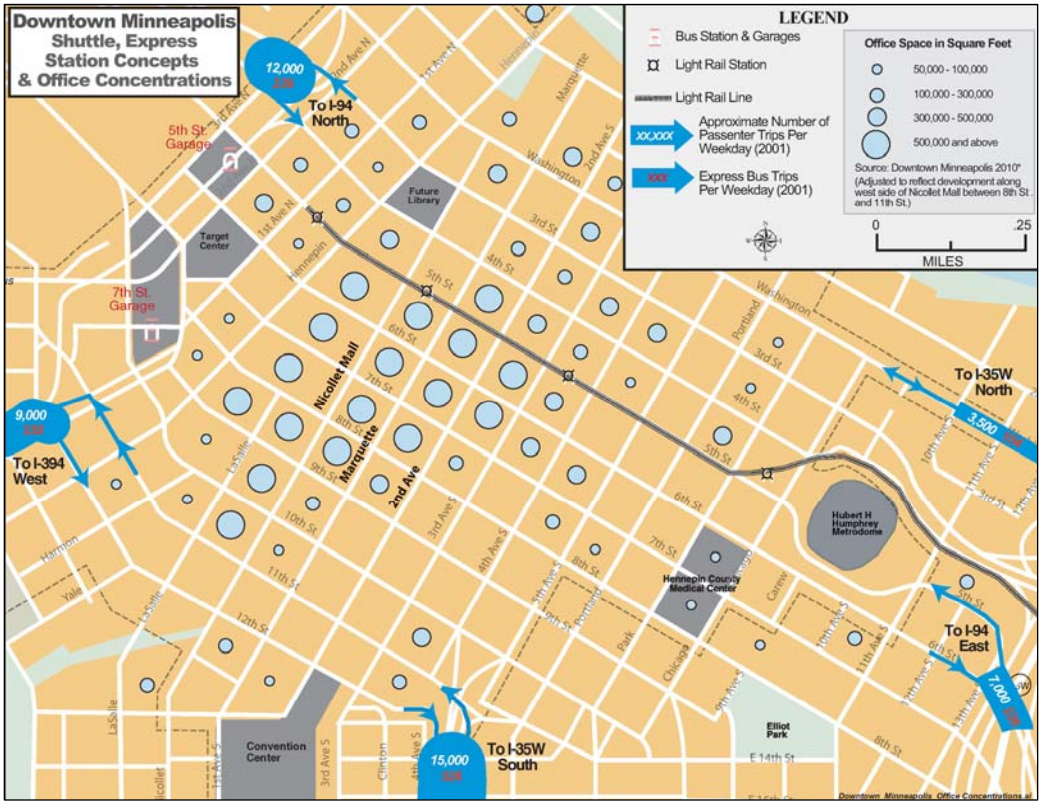
- Denver's downtown core is very linear, so that one mall street serves almost all of it. This is not the case with the core of Minneapolis.
- In Denver, logical regional express corridors reach downtown right at the terminal stations, which in turn are located at opposite ends of the mall street. In Minneapolis, the regional express corridors do not line up with opposite ends of the same street.
- Though all-day buses do run through downtown in Denver, there are fewer of these lines than in Minneapolis, partly because in Denver it is geographically easier to connect many of these routes to light rail instead of bringing them all downtown.[5] As a result, the 16th Street Mall shuttle does not compete with high-frequency concentrations of local bus service on an adjacent street, as would be the case in Minneapolis.

These points do not argue against a downtown shuttle in Minneapolis, but they do suggest that Peak Interception does not depend on the downtown shuttle to the same degree as in Denver. There may still be arguments for a downtown shuttle based on intra-downtown circulation needs, and these are explored further in a later section.

[5] Hiawatha LRT runs at an angle such that for much of south Minneapolis, it is out of direction to use it for trips to downtown, though it is in-direction for some trips from southern St. Paul, and areas south of the rivers in Dakota County. For this reason, it does not replace the large volumes of local service needed on the main north-south corridors such as Bloomington, Chicago, Nicollet, Lyndale and Hennepin.

Figure 5 Comparison of Downtown Denver with Downtown Minneapolis Geography





Applying Peak Interception in Minneapolis

Figure 6 shows how Peak Interception might be applied to Minneapolis.

Peak Interception requires a position on the edge of the core, but also a logical position relative to the freeway or arterial system, so that express buses can enter and exit rapidly from their suburban destinations.

For the I-35W corridor, Leamington is the obvious site for Peak Interception. It is right on the edge of the employment core, with ready Skyway access to the core as well as the Convention Center area.

A single new terminal at the north end of Nicollet Mall – already proposed for one of three possible sites – would serve commute buses from three directions: I-394, I-94 West, and I-35W North. This terminal, located at one of three sites indicated on the map, would include a new access to the Skyway system and would also be a logical northern terminus for many local routes as well as any north-south shuttle route.

I-394 buses approaching this terminal would also stop at the existing flyer stops on I-394 under the 5th and 7th Street Transit Centers. These are not ideal in their configuration, but they would provide a more direct route into the Skyway for I-394 commuters destined to the west side of the downtown core.

Alternatively, I-394 buses could approach the north terminal via 3rd and/or 4th Streets N bringing them more directly to a north-end terminal but without the ability to stop at the 7th Street or 5th Street flyer stops.

The North-South Alternatives Analysis section later in this report evaluates the impact Peak Interception would have on bus volumes downtown.

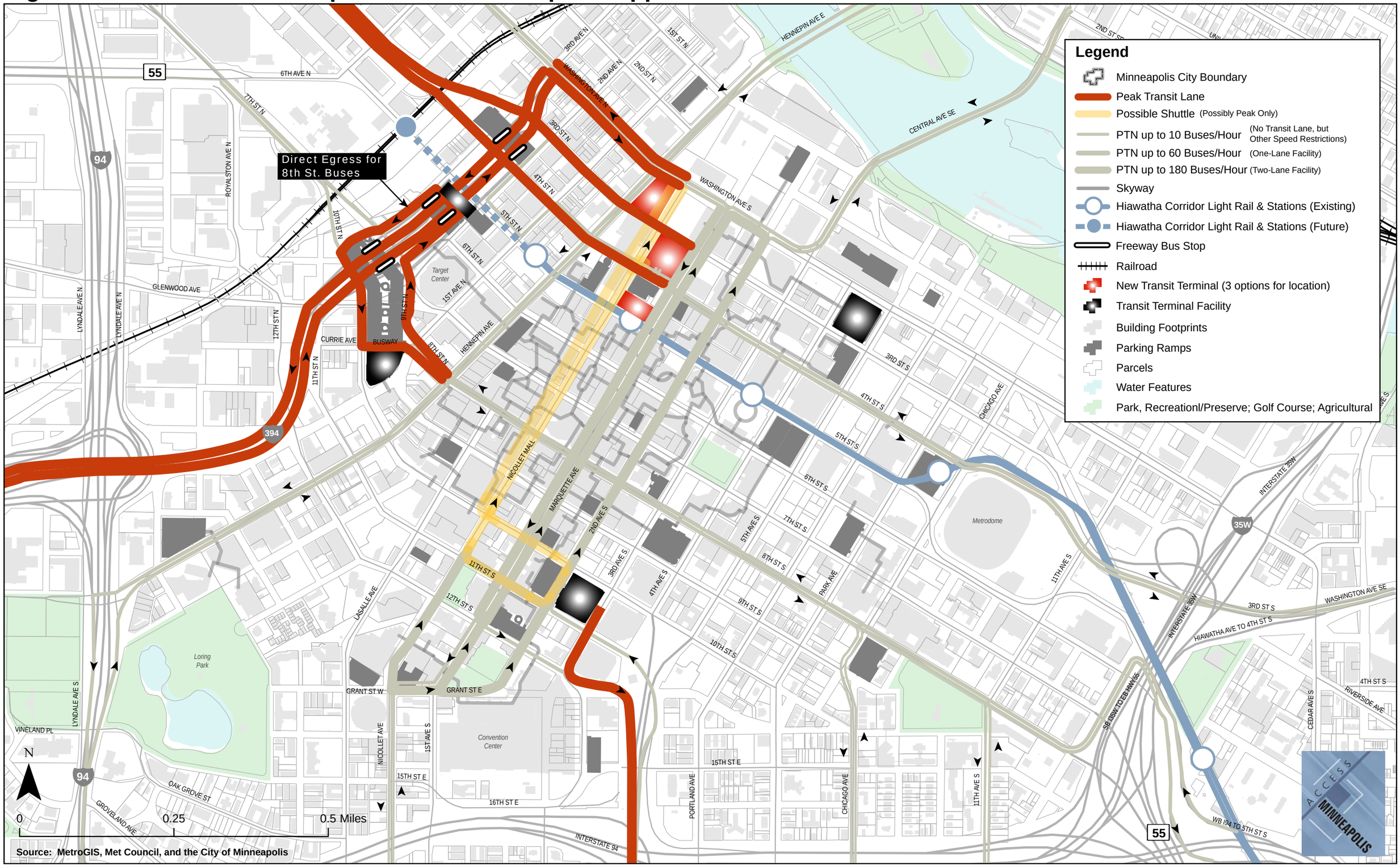
Summary

The strategies that could reduce downtown bus volumes all apply primarily to the Peak Commuter Express category. Peak Spreading's impact cannot be quantified, but is unlikely to reduce peak volumes by more than 100 buses. Changing the criteria for Peak Commuter Express service, could reduce peak volumes by 50. Peak Interception, applied to all corridors, could reduce volumes by just over 100 buses per peak hour, but that savings is not additive with the others, since the reduction affects the same category of service that the others affect as well.

Peak Interception is thus one of these strategies that reduces peak bus volumes enough to affect the range of likely solutions (more than a peak volume of 100 buses). Without Peak Interception, the other strategies discussed above would have roughly a 10% impact; in other words, they do not change the overall magnitude of the challenge. For this reason, Peak Interception is carried forward as an option in the more detailed analysis later in this report.

Figure 6: Downtown Minneapolis - Peak Interception Approach to Peak Period Service

Nelson|Nygaard consulting associates



Downtown Transit Lane Toolbox

Previous sections have identified the overall volume of bus trips per peak hour through downtown that would be needed to meet 2030 demand (roughly 800), and has also explored strategies for reducing it. The most extreme of these strategies, Peak Interception, reduces the demand to about 658 buses per peak hour, still higher than the existing level of about 500.

New strategies will be needed, then, to:

- Accommodate the projected volume of buses.
- Increase speed and reliability to reasonable levels, and protect them from further degradation.
- Improve the attractiveness of transit in the downtown.
- Reduce the overall interference between transit and other modes.

Although this discussion primarily proceeds in terms of accommodating volume, these other objectives are equally important. The other objectives explain why the current downtown configuration of downtown transit operations would need to be rethought, even if downtown volumes were not going to be much higher than they are today.

In downtown Minneapolis, bus service is typically in one of two environments:

- Mixed flow with autos.
- Single-width transit lanes, with no passing capability (e.g. Nicollet Mall lanes, and contraflow lanes on Marquette, 2nd Avenue S, and Hennepin).

This study also considers two others:

- With-flow transit lanes (where transit has exclusive use of the right lane but can pass via an auto lane).
- Double-width transit lanes (two lanes in the same direction exclusively for buses).

The following are some of the key tradeoffs among these facility types. The capacity figures are from the *Transit Capacity and Quality of Service Manual*, based on research in Manhattan where examples of all of these lane types are numerous. [6]

[6] TCRP *Transit Capacity and Quality of Service Manual*, 2nd ed., p. 4-37, citing Levinson, Lennon, and Cherry: "Downtown Space for Buses – The Manhattan Experience" in *Transportation Research Record 1308*, TRB, National Academy Press, Washington, DC (1991).

Figure 7 Capacities and Speed Issues for Transit Lane Types

Transit Lane Type	Maximum Capacity (buses/hr)	Exposure to Auto Congestion	Exposure to Bus-Bus Interference
Mixed flow with autos	60	High	Moderate
Single-width lane (no passing capability)	70	None	High
With-flow lane	100	Moderate	Moderate
Double-width lane	180	None	None

Maximum capacity is not the same as recommended capacity, which may need to be lower to avoid speed and reliability problems. The following sections explore these tradeoffs in detail.

Mixed Flow

Mixed flow – buses sharing lanes with auto traffic – is the historic "default" arrangement for downtown bus operations. So long as the purpose of the downtown system is to move vehicles, a transit bus is just another vehicle and deserves nothing better than mixed flow. If the goal is to maximize the movement of people, however, then transit must achieve a level of reliability and speed that is often impossible in mixed flow, especially in the downtown context. For example, the current downtown transit speeds in mixed flow – as exemplified by 6th, 7th, and 8th Streets S, range from 5.6 mph to 6.6 mph.

In general, the problems with the mixed flow arrangement, from a transit standpoint, are that:

- Transit cannot operate faster and more reliably than auto traffic.
- Transit speed declines over time as auto congestion increases.
- Events that create congestion (not just rush hour, but sporting events, festivals, etc.) have the potential to disrupt the transit service.

Outside of downtown, mixed flow often works well for transit. On a neighborhood arterial, for example, transit can often be given adequate protection even in mixed flow, by providing "queue bypasses" at signals and other localized treatments. Downtown, however, signals are so numerous and interdependent, and bus and auto volumes are both so high, that it is almost impossible to protect transit from auto-related congestion in mixed flow. Generally, mixed flow is consistent with reliable transit operations only when the auto traffic volumes, and the potential for congestion, are low. In a downtown where travel demand for all modes is growth, this typically means a street that is not especially useful to through auto traffic. For example, arterials that lead directly to or from freeway ramps are likely to be problematic for mixed flow.

Mixed flow may also be the default solution where bus volumes are too low to justify an exclusive lane. A key focus of the proposed strategy is to consolidate bus service onto fewer streets, so that bus volumes are high enough to justify adequate lanes there; the effect is to increase the percentage of bus services that can use an exclusive lane, while eliminating bus impacts from other streets so that they can be optimized purely for autos and other modes.

Single-Width Transit Lanes without Passing Capability

Where transit lanes have been provided downtown, they are generally single-width. In other words, they do not provide the capability for buses to pass each other. Most transit lanes are contraflow – a single transit lane running in the opposite direction from other traffic. The lanes on Nicollet Mall are identical to contraflow lanes in terms of their operations. In either case, passing is impossible in normal operations, so the speed of operations in the lane is determined by the slowest bus. Random minor delays affecting one bus[7] are compounded, since they affect all the buses in the lane.

Single-width lanes are currently carrying 60-70 buses per peak hour, but they are operating very slowly, with total operating speeds[8] well below 10 mph. The *Transit Capacity and Quality of Service Manual*, based on research in Manhattan, suggests that the maximum capacity of a one-lane facility exclusively for buses, with no passing opportunity, is 70 buses/peak hour, [9] but the speed impacts of crowding that many buses into a single-lane are severe. A study of bus-bus interference in TCRP Report 26[10] led to a series of proposed factors for how much speed should be expected to fall as a result of buses blocking one another, as bus volumes rise. If we apply these factors to the proposed maximum capacity of a single-width transit lane, we get the following figure:

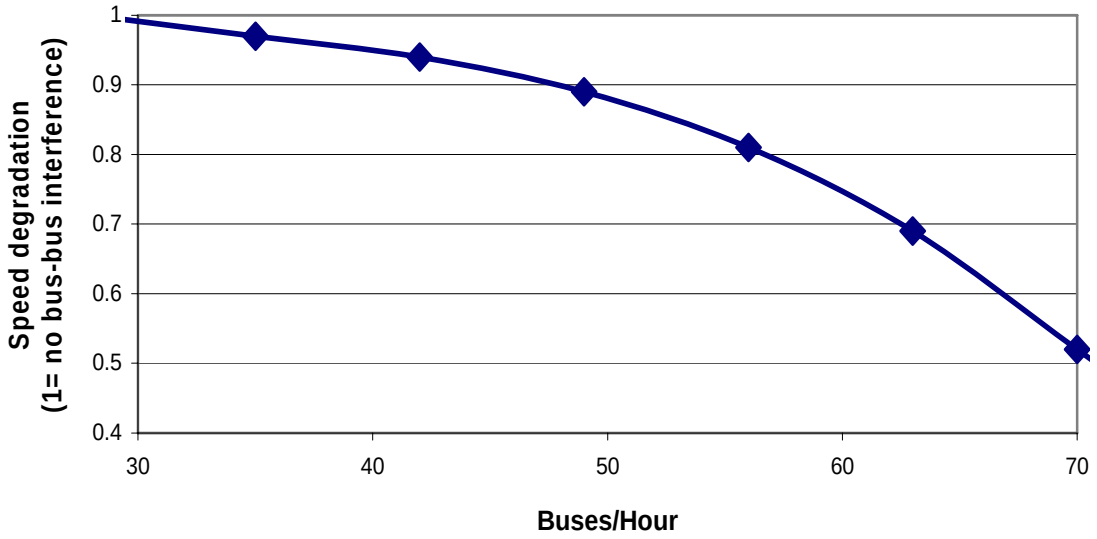
[7] Common causes of minor disruption include wheelchair boardings, passenger requests for information, and disputes with passengers. These create tolerable delays, typically 1-3 minutes, when applied to a single bus, but quickly compound when they affect an entire lane.

[8] Operating speed in this report always refers to the total speed including all sources of delay. In other words, it is the total transit travel time for a segment divided by the length of that segment.

[9] TCRP *Transit Capacity and Quality of Service Manual*, 2nd ed., p. 4-37, citing Levinson, Lennon, and Cherry: "Downtown Space for Buses – The Manhattan Experience" in *Transportation Research Record 1308*, TRB, National Academy Press, Washington, DC (1991).

[10] TCRP Report 26, *Operational Analysis of Bus Lanes on Arterials*, p.40, Table 3-7.

Figure 8 Impact of Bus-Bus Interference on Operating Speed, in a Single-Width Transit Lane



In **Figure 8**, a speed degradation factor of 1 means that buses can freely pass each other as needed, so that they are not blocking each other at all. The lower numbers show how much speed is lost due to bus-bus blocking in the single-width lane. Although the theoretical optimal capacity of a single-width lane is 70 buses/hour (from the Manhattan research), bus-bus interference cuts operating speed in half by the time this volume is reached. The effect of bus-bus interference is moderate at lower volumes, costing only 20% of speed at 56 buses/hour, but as volumes rise further the problem is quickly compounded.

Throughout this report, we refer to the capacity of a single-width lane as roughly 50 buses/hour – the level at which bus-bus interference causes about a 20% loss in operating speed. Beyond this volume, speed impacts of bus-bus interference begin to compound. Current single-lane operations on Nicollet, Marquette, and 2nd Avenue S already exceed this level, and are operating at very low speeds as a result.

With-Flow Transit Lanes

One useful middle-ground between pure mixed-flow and the single-width transit lane is to provide an exclusive curb lane for transit but also give transit the capability to pass using an adjacent auto lane. This typically requires careful design, so that the transit stops, where buses are most likely to need to pass, occur at points where there is typically a break in traffic (not just near-side of a signal, for example). Transit must also interact with right-turning traffic in this configuration, and this must be optimized with careful signalization.

Double-Width Transit Lanes

While they represent a large commitment of downtown space, double-width transit lanes are the most space-efficient tool for moving large volumes of buses through a core. Like a single-width lane, it is impervious to auto congestion. But while a single-width lane begins to experience severe speed degradation beyond about 50 buses/peak hour, a double-width lane – in which buses can pass one another – can accommodate 180 buses per peak hour with comparable speed and reliability. In other words, *doubling the* space given to transit on a street can yield *3.6 times* the capacity.

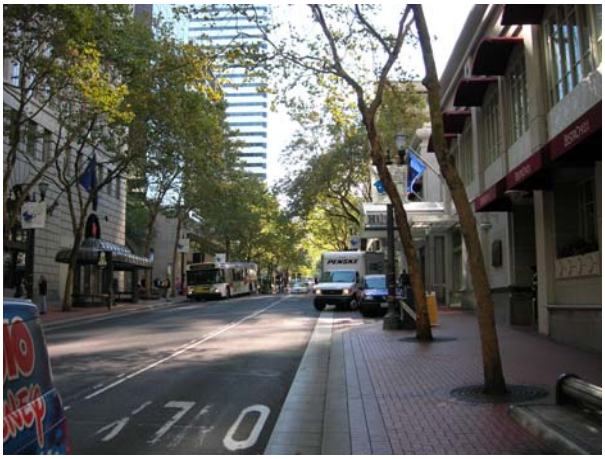
This high efficiency makes the double-width lane an attractive tool for consolidating transit on fewer streets, and thereby opening up more streets to purely non-transit use. For these reasons, double-width lanes should be considered as an alternative to single-width lanes, wherever bus volumes are high enough to require them.

Portland Mall, two lane section

Fortunately, double-width lanes can also be designed as interesting urban environments, and appealing "front door" facilities to a transit system that welcomes a wide range of customers.

While double-width lanes are common in Manhattan, a double-width lane at the Minneapolis scale is best exemplified by Portland's downtown transit mall, which was created in 1978. An example of double-width bus lanes in both directions on the same street can be found on Seattle's 3rd Avenue; this arrangement was created in September 2005.

The Portland Mall consists of two streets through the very center of downtown: 6th Avenue, where transit runs northbound, and 5th Avenue to the east of it, where transit runs southbound. This "inside couplet" configuration means that passengers can often walk from a stop on one street to a stop on the other without crossing the street. The street is narrower than most downtown streets in Minneapolis, a mixture of two-lane and three-lane sections with wide sidewalks. Where the third lane is present, it is a local-access auto lane, but the streets do not serve through auto traffic.



Portland Mall, three lane section with Hilton entrance.

Buses on the mall are assigned to four groups, which stop at different stops. There are two stops per block, so over the course of two blocks there are stops for all four groups, for a net two-block spacing for any group. The right lane is always for stopping, the left lane for proceeding. As a result, two buses going down the mall at the same time, serving different stops, will leapfrog, each passing the other when it is stopped. As a result, buses rarely obstruct each other.

An important option is to tolerate wider stop spacing so that local access auto lanes can be inserted every other block. Where there are no stops, there is no need for buses to be in the right lane, so that can be used for other purposes. On Seattle's 3rd Avenue, the left lane of the transitway is continuous but the right lane, where stopping occurs, is reserved for transit only every other block. There are two stops in each of those blocks, and four groups of routes, so the result is a four block spacing for each group. In the blocks where there are no stops, there are auto lanes, permitting right-in access from the preceding cross street and requiring right-out egress at the next street. These fit logically into the one-way street grid, beginning at a street going to the left from the point of view of the bus, and ending at a street going to the right.

Seattle's 3rd Avenue. Side lanes are for auto access in foreground block only. In background block, buses stop in this lane.

In both cities, the four groups provide common stops for buses going the same general direction. In Portland, the signs at some stops also identify major edge-of-downtown destinations that all buses from that stop serve, such as Union Station, on the north edge of downtown, or Portland State University, on the south edge. Since the combined frequency of all the transit lines is usually very high, it is fairly easy to step out on the mall, go to the appropriate stop, and quickly get a bus to the destination indicated.

Another use of the multiple stop pattern in Minneapolis would be to isolate, at one or two stops, the lines that operate on a pay-as-you-exit policy, primarily peak commuter lines. This would help accommodate the faster loading of these buses, permitting them to proceed without being stuck behind slower-loading pay-as-you-board services, as happens now in the single contrflow lanes.

Overall, there is considerable flexibility in the way that stops are used in this pattern. For example, Portland has a group of stops solely for

A typical sign on Portland's transit mall.

arriving buses that are going only to the terminal at the end of the mall. This stop does not need a shelter, because few people are boarding to go such a short distance. On the other hand, the sign makes clear that you can board there if you only want to go that far. The result is that Portland's mall, while served by regular Primary bus routes, is also a local shuttle corridor, offering frequent service for trips up and down the street, without the expense of a designated shuttle route.

Identification of Downtown Transit Spines

Having identified the range of tools available for accommodating bus volumes through downtown, the next step is to look at how they would logically be applied in Minneapolis.

The most important principle in downtown transit planning is to concentrate transit service on the fewest possible streets. There are several reasons for this:

- When transit is dispersed on many parallel streets, transit-auto conflicts occur everywhere. Concentrating transit on few streets means that in just a few places, transit needs priority, while all other streets can be optimized for autos and other modes.
- Facilities to protect transit from congestion are expensive – either in dollars or right-of-way. Once such a facility is created, its benefit needs to be maximized through intensive use.
- Fewer streets mean fewer bus stops, and more passengers gathered at each. This makes it easier to justify better stop facilities, resulting in a better waiting experience for all customers. Security at bus stops also benefits from having more passengers.

Currently, transit is very spread-out in the downtown. *Some transit service operates on every street* with the sole exception of LaSalle. Some of this spread is justified by the need to serve various corners of the downtown, and this service will be retained. However, some of it represents the fact that transit volumes are still growing while the core transit streets are either at capacity or running too slowly to be useful. Consolidating service on fewer streets is the key to creating a reasonable operating environment for transit that is consistent with its market potential, while freeing up most streets in downtown for the use of other modes.

Each transit line entering the core needs to (a) connect with other lines, and (b) provide the best possible access to the core. (Peak Interception envisions a very high quality transfer for Peak Commuter Express trips for access to the core, but otherwise, we assume direct service to the core on all downtown transit lines.)

Collectively, the transit lines downtown also need to form a pattern that is useful for some intra-downtown trips. However, to the extent that there are gaps in downtown local coverage, such as in the residential areas on the edge of downtown, these can be served with special circulator routes, discussed later in this report.

Considering downtown Minneapolis with these principles in mind, it appears that service could be organized into as few as three major two-way streets (or couplets). We refer to these as *spines*, because they are like spinal cords in some respects, concentrated bundles of lines that converge from various directions and share this crucial common segment.

- **A North-South spine** somewhere in the band of streets from Nicollet through 3rd Avenue S. This would be used by many local routes running both north and south through downtown. It would also be heavily used by regional express service, including the I-35W South BRT and express services in the I-35W North, I-94 West, and I-394 corridors.[11]
- **A Hennepin spine**, for local routes approaching from the southwest along Hennepin. These routes cannot reasonably be deviated to run through the North-South spine, because the deviation required (via 10th or 11th, say) is just too indirect. For this reason, we assume that the group of lines to/from Uptown on Hennepin will remain on Hennepin, though 1st Avenue N could also be used, in theory. Certain routes going north out of downtown are through-routed to Hennepin routes, and would therefore be on Hennepin as well.
- **An East-West spine** through the core, somewhere in the band between 6th and 9th Streets. Used by local routes extending northwest and southeast of downtown, and also for I-94 East express services.
- **A 4th Street spine**, for east-west service across the north side of downtown.

At the ends of each spine, buses would diverge onto various routings out of downtown. Some of those streets will also have speed-protection needs, and are discussed in a separate section below. However, identifying the spines, and their capacity needs, is the first order of business.

2030 Bus Volumes by Spine

If we take the projected 2030 bus volumes from **Figure 4** above, assuming the rail corridors, and tentatively assign them to these spines according to the most likely way they would run, we get **Figure 9** that provides an estimate of 2030 peak hour buses, by spine. Note that these tables arbitrarily describe the AM peak hour. The PM peak hour figures would be similar, but with the two directions of each spine reversed. Thus each spine must be designed, in both directions, for the higher of the two directional volumes indicated.

[11] Express service in the 94 West and I-35W North directions currently enter downtown from opposite sides along 3rd / 4th Streets. These would need to turn southward into the North-South Spine in order to provide reasonably direct access to the core, except in a "Peak Interception" scenario.

Figure 9 Estimated Buses per AM Peak Hour, by Spine
(2030, assuming Hiawatha, Central, and SW LRT; Northstar; I-35W and Bottineau BRT)

Travel Corridor	North-South Spine *Nbd*	North-South Spine *Sbd*	Hennepin *Nbd*	Hennepin *Sbd*	East-West Spine *Ebd*	East-West Spine *Wbd*	4th St Spine *Ebd*	4th St Spine *Wbd*	Total all Spines
I-35W North	6	51	0	0	0	0	0	0	57
I-35W South	111	11	0	0	0	0	0	0	122
I-394	99	13	0	0	0	0	0	0	112
I-94 Northwest	8	114	0	0	0	0	0	0	122
I-94 East	0	0	0	0	0	29	9	16	54
Sub-total	224	189	0	0	0	29	9	16	467
Local Service	48	42	58	56	44	40	19	26	333
Total	272	231	58	56	44	69	28	42	800

Source: Metro Transit

*Note: I-394 includes Rts 755, 756; North-South Spine totals include Nicollet and Main North-South Spine; Service on Nicollet includes 20 vehicles per peak hour to account for shuttle (see North-South Alternatives Analysis section later in this report); East-West Spine includes 6th/7th and Main East-West Spine.

With Peak Interception – where all Peak Commuter Express service terminates at edge-of-downtown garages – these numbers go down by just over 100 buses, as shown in **Figure 10** below.

Figure 10 Estimated Buses per AM Peak Hour, by Spine, with Peak Interception
(2030, assuming Hiawatha, Central, and SW LRT; Northstar; I-35W and Bottineau BRT)

Travel Corridor	North-South Spine *Nbd*	North-South Spine *Sbd*	Hennepin *Nbd*	Hennepin *Sbd*	East-West Spine *Ebd*	East-West Spine *Wbd*	4th St Spine *Ebd*	4th St Spine *Wbd*	Total all Spines
I-35W North	6	51	0	0	0	0	0	0	57
I-35W South	52	12	0	0	0	0	0	0	64
I-394	87	13	0	0	0	0	0	0	100
I-94 Northwest	6	43	0	0	0	0	0	0	49
I-94 East	0	0	0	0	0	29	9	16	54
Sub-total	151	119	0	0	0	29	9	16	324
Local Service	68	63	58	56	44	40	19	26	374
Total	219	182	58	56	44	69	28	42	698

Source: Metro Transit

*Note: I-394 includes Rts 755, 756; North-South Spine totals include Nicollet and Main North-South Spine; Service on Nicollet includes 20 vehicles per peak hour to account for shuttle (see North-South Alternatives Analysis section later in this report); East-West Spine includes 6th/7th and Main East-West Spine.

While downtown transit lanes are logically sized for peak-only demand, it is also important to understand their all-day usage. **Figure 11** below shows an estimate of all-day bus volumes in 2030.

Figure 11 Estimated Buses per Midday Hour, by Spine
(2030, assuming Hiawatha, Central, and SW LRT; Northstar; I-35W and Bottineau BRT)

Travel Corridor	North-South Spine *Nbd*	North-South Spine *Sbd*	Hennepin *Nbd*	Hennepin *Sbd*	East-West Spine *Ebd*	East-West Spine *Wbd*	4th St Spine *Ebd*	4th St Spine *Wbd*	Total all Spines
I-35W North	3	2	0	0	0	0	0	0	5
I-35W South	8	8	0	0	0	0	0	0	16
I-394	5	4	0	0	0	0	0	0	9
I-94 Northwest	6	4	0	0	0	0	0	0	10
I-94 East	0	0	0	0	0	0	4	5	9
Sub-total	22	18	0	0	0	0	4	5	49
Local Service	36	36	25	25	19	19	20	21	201
Total	58	54	25	25	19	19	24	26	250

Source: Metro Transit

*Note: I-394 includes Rts 755, 756; North-South Spine totals include Nicollet and Main North-South Spine; Service on Nicollet includes 20 vehicles per peak hour to account for shuttle (see North-South Alternatives Analysis section later in this report); East-West Spine includes 6th/7th and Main East-West Spine.

Assumption on Through-Routing of the Primary Transit Network

On local lines, Metro Transit makes an effort to minimize downtown layover and route overlap by connecting a local line on one side of downtown with a local line in the other, so that both ends of the combined line are outside of downtown. This practice is called *through-routing*. An example of a through-route is Line 5, which serves the Fremont Avenue corridor in the northwest, flows across downtown in the east-west direction, and continues to serve the Chicago Avenue corridor in the southeast. However, this practice results in some very long lines and line length is a predominant factor in determining reliability. (Layover is needed to get back on schedule after arriving late, so the longer a bus has been running since its last layover, the more likely it is to be off schedule.)

The midday bus volume count, and the assessment of ultimate layover needs below, both assume that the longer Primary Transit Network lines would no longer be through-routed by 2030. Severing through-routes is a very effective strategy for improving reliability, and while it is expensive[12] it is likely to be necessary by that time.

[12] For example, severing Line 5 would create two lines: A Fremont Avenue line would flow across downtown and end in the southeast downtown, perhaps near 8th & Chicago, while a Chicago Avenue line would flow across downtown and end at 5th Street Garage. These two routes, formerly one, would overlap on 8th Street between 1st Avenue North and Chicago. The cost of severing the line is the bus hours required to operate just the overlap segment, at the frequency of either of the lines.

Severing through-routes contributes approximately 32 bus trips per hour to the volumes shown above. It also increases edge of downtown layover requirements, as noted below. However, the result is an improvement in intra-downtown circulation, since these additional trips contribute to midday frequency along the downtown spines.

2030 Lane Needs

What do the above volumes mean for downtown transit lanes? As discussed above in the 'Downtown Transit Lane Toolbox', one-lane transit facilities have a maximum capacity of 70 buses/hour, but bus-bus interference begins to compound beyond 50 buses/hour. Assigning over 60 buses/hour to these streets replicates the current problems in the Marquette and 2nd Avenue lanes, where bus-bus interference produces very low peak speeds. However, two transit lanes in the same direction accommodate 180 buses -- triple the capacity of a single lane – while largely eliminating bus-bus interference. The two-transit-lane operations in downtown Portland moved over 175 buses/peak hour, when bus volumes were at their highest in 1994. Double-width transit lanes are the most efficient means of running such a large volume of service through the downtown – efficient not only operationally, but also in the amount of service provided relative to the amount of right-of-way required.

If we compare **Figures 9 and 11** to the capacity of single and double-width transit lanes, we can reach these conclusions about long-term downtown lane needs in 2030:

- The Hennepin and 4th Street spine can continue to function with single transit lanes, with-flow or contraflow, though if the with-flow operation slows down further, a with-flow transit lane may become necessary.
- The East-West spine justifies at least a single transit lane in each direction. Peak requirements will exceed this capacity by 2030, which will call for either some mixed flow operation on parallel streets, or perhaps portions of double-width lane.
- The North-South spine volumes clearly exceed what can be carried in a single lane, even midday. Here, double-width lanes are recommended.
- In the North-South spine, the double-width lane would need to be supplemented by operations on other streets, for peak-only use. By 2030, the peak requirement could reach the point of supporting an entire double-width lane. Alternatively, this demand could be spread across several streets using peak-only, with-flow lanes (created, for example, by eliminating on-street parking only during peak hours.) By 2030, also, downtown is likely to have grown further east, making it possible to imagine using streets as far east as 4th or 5th Avenues for some of these services.

These 2030 conclusions must be put in some perspective, because of the many factors that could arise that would moderately reduce the bus demand. These factors, discussed earlier in the report, include Peak Spreading and modest constraints on how peak commuter service is provided, including a partial use Peak Interception (at the edges of downtown) for certain peak services, and/or replacement of some peak commuter services by connections to LRT. While these capacities must be planned for in the long term, there is time for alternative strategies to be developed for some of these needs.

Existing and short-term needs, however, need to be addressed at once with specific projects. The next section looks at which of the long-term needs are already upon us.

Short Term Lane Needs

Current downtown bus volumes are shown in **Figure 13**. **Figure 12** below shows the total volumes now operated in the general direction of each spine, that would logically be combined into the spine street. (For the North-South spine, this is the sum of all streets between Nicollet and 3rd Avenue S, inclusive. The East-West spine refers to 6th St through 9th St inclusive.)

Figure 12 Total Downtown Bus Volumes, 2005

Travel Corridor (Lines beyond Minneapolis and St. Paul only)	North-South Spine *Nbd*	North-South Spine *Sbd*	Hennepin *Nbd*	Hennepin *Sbd*	East-West Spine *Ebd*	East-West Spine *Wbd*	4th St Spine *Ebd*	4th St Spine *Wbd*
AM Peak	193	121	33	32	25	36	34	42
Midday	35	34	14	14	19	19	24	26
PM Peak	131	170	34	29	36	27	39	35

If we were planning only for today, but aiming to accommodate the capacity needs of the peak at reasonable speeds, the North-South Spine would need to be up to four single-width transit lanes in each direction (each carrying 50 buses/hour) *or just one double-width lane in each direction* (carrying about 180 buses/hour). Given the trajectory of future growth, the double-width facility is clearly in order. By accommodating about 180 buses/hour in each direction, it will provide some flexibility and a crucial speed benefit, although in the AM peak northbound, it will be at capacity at once. Some peak buses will still overflow onto other parallel streets. In the short term, these can be accommodated in mixed flow, though eventually (beyond 10 years) other facilities will be needed for them if these volumes grow as projected.

Midday, the current volumes are well below what requires two lanes, but the midday volume will grow to a point that exceeds the capacity of one lane, as the 2030 estimate shows, and as noted, it may increase further and faster due to Peak Spreading and the growth of midday demand that tends to occur with densification.

Hennepin and the East-West Spine currently have enough peak demand for a one-lane facility. For Hennepin, this is adequate indefinitely, but on the East-West Spine, there will be an eventual need for two lanes, or for buses to spill over onto multiple parallel streets, as they do now.

The following sections develop preliminary recommendations for primary transit streets through the downtown, addressing both local service (especially the PTN) and also regional express service. **Figure 14** shows the basic pattern of all-day transit streets discussed below.

Figure 13 Metro Transit Downtown Bus Volumes

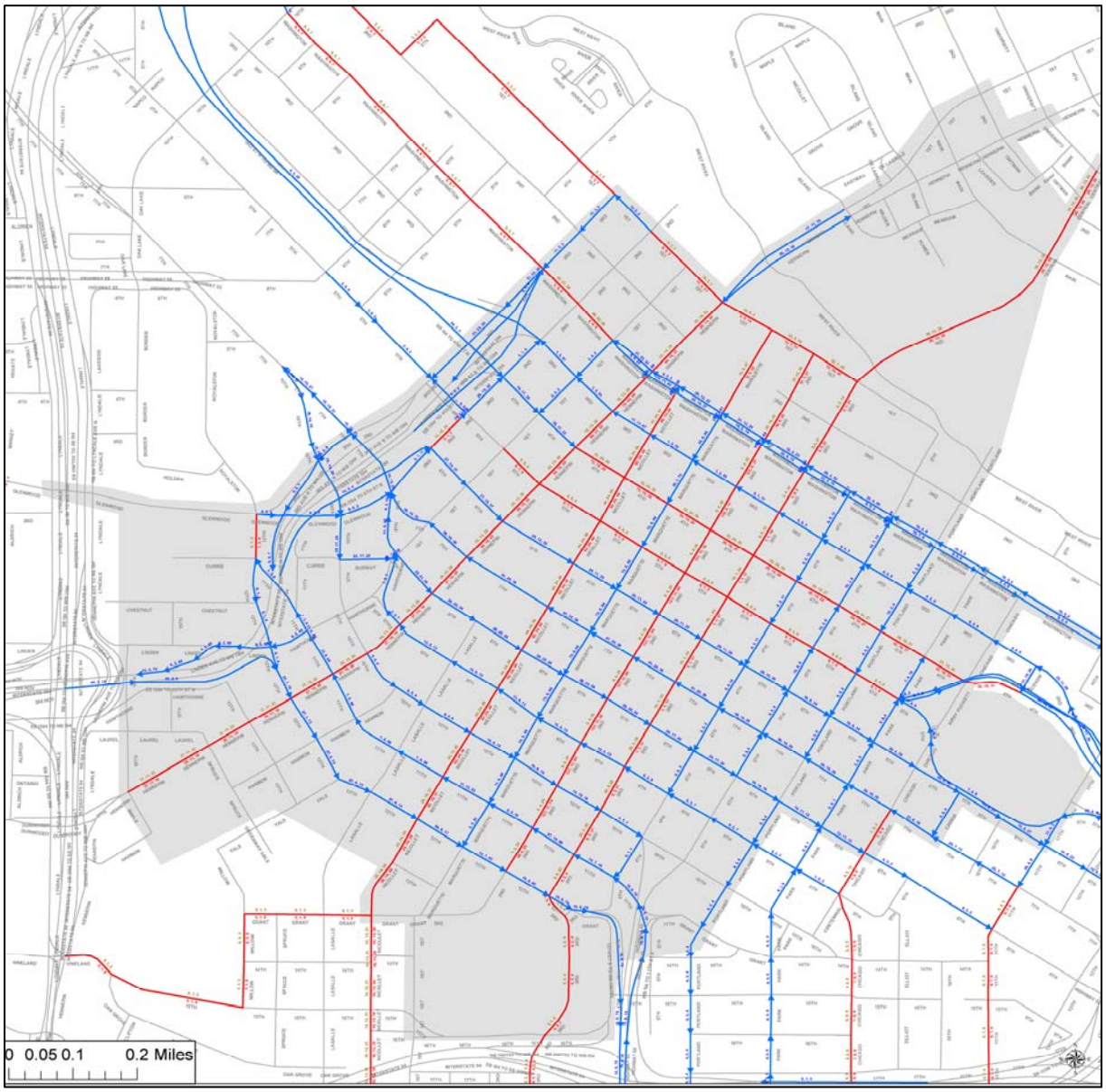
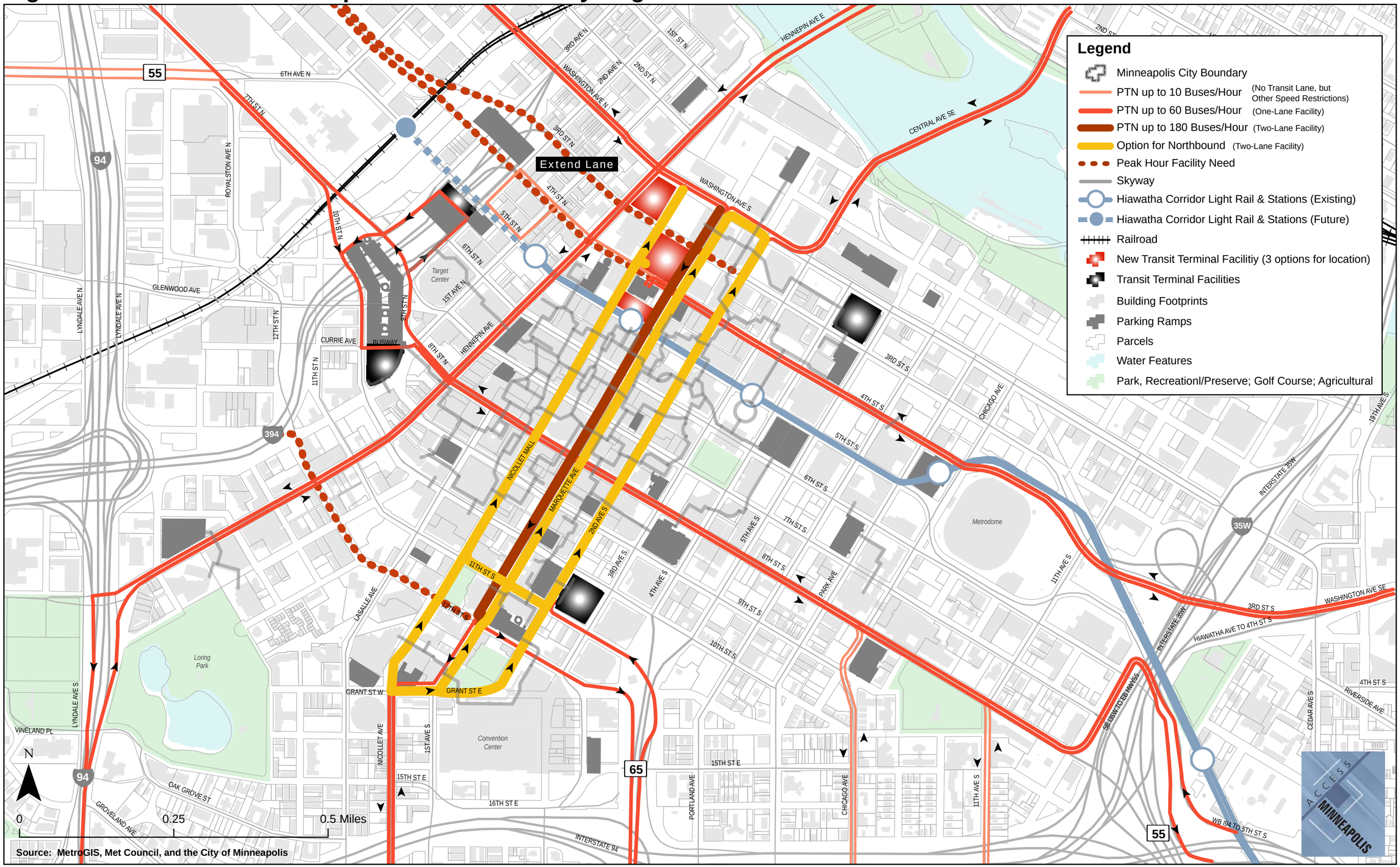


Figure 14: Downtown Minneapolis - Pattern for City/Regional Service

Nelson|Nygaard consulting associates



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

North-South Spine: Nicollet, Marquette, 2nd Avenue S, 3rd Avenue S

What is the most logical way to accommodate two transit lanes in each direction? While a more detailed analysis may be needed to resolve the more difficult tradeoffs, this section offers a qualitative comparison that defines the most obvious options.

In considering Nicollet Mall as a spine option, we assume that if Nicollet Mall were used in this way, it would be reconstructed so that it meets the basic requirements of a high-volume transit street. This would include three significant changes to the mall:

(a) Turning the street one-way, with both transit lanes flowing the same direction and stops only on one side,
(b) Raising the speed limit to the standard speed limit for other downtown streets.
(c) Reconstructing the street to eliminate the curvature. Operations in a double-width street require buses to routinely pass one another, so long clear sightlines are an important feature.[13]

In choosing where to locate a double-width lane, among the available streets, the key considerations are these:

1. **Centrality to the core.** The office/retail core is one of the densest, most transit-oriented destination in the region, and depends most heavily on transit access. An effective system should bring people within an easy walk of all the destinations in the core. Nicollet, Marquette, and 2nd Avenue S all do this. 3rd Avenue S is much less attractive because it is beyond an easy walk to much of the core. (The tables below rank streets Good if they are within ¼ mile of the centroid of the core, which is near Nicollet, and rank lower as the distance from the centroid increases.)
2. **LRT connections.** LRT is a crucial regional connection for these bus routes. Nicollet, Marquette, and 3rd all serve stations directly. 2nd Avenue S passes directly between two stations, over a block from each. Walking distance at transfers is more sensitive than walking distance to the passenger's origin or destination, so this remains a concern for 2nd Ave S Avenue. (The tables below rank a street Good if it places a stop right at an LRT station, Fair if it places a stop across the street from an LRT station, and Poor if it passes a block or more from the nearest LRT station.)
3. **Impact on Existing Curb Uses.** Many of the land uses on the North-South Spine streets have an interest in a particular configuration of their curb space. While changes in the use of curb space will be needed in many places, it may be appropriate to give some weight to options that minimize this disruption. The easiest way to achieve double-width bus lanes, in terms of the impact to existing street uses, is to widen the existing lanes on Marquette and 2nd Avenue S, where single transit lanes already exist, since this does not require introducing new transit-only operations on any existing streetface. (Rankings in this category are Good if curb uses on the street do not change as a result of the project.)

[13] Passing is not as difficult if the right-side stops occur where the street is curving to the left, but this creates a significant limitation on stop locations. It also means that stops are always at the point where the pedestrian space is narrowest, maximizing conflicts between the needs of waiting passengers and other pedestrians.

Speed and reliability are also crucial, but assuming that Nicollet would be reconstructed if selected, the options are the same on this score.

How do the streets stack up based on these criteria?

Figure 15 Tradeoffs Among Options for North-South Spine

	Nicollet	Marquette	2nd Avenue S	3rd Avenue S
Southbound				
Centrality to Core	Good	Good	Fair	Poor
LRT connection	Fair	Good	Poor	Fair
Speed and Reliability	Good	Good	Good	Good
Impact on Existing Curb	Good[14]	Good	Poor	Poor
Northbound				
Centrality to Core	Good	Good	Fair	Poor
LRT connection	Good	Fair	Poor	Good
Speed and Reliability	Good	Good	Good	Good
Impact on Existing Curb	Good	Poor	Good	Poor

*In the southbound direction, Marquette is clearly the best option on all these criteri*a. This street (1) is central to the core, (2) provides the optimal location for a southbound bus-LRT connection, (3) does not require immediate reconstruction, unlike Nicollet, and (4) already has a transit lane in this direction, so that no changes to curb access would result from widening this to two lanes.

In the northbound direction, there is a more difficult tradeoff. While more detailed analysis may be in order to choose among finalists, the following qualitative comparison captures the essence of the tradeoff.

From a transit service quality standpoint, the ideal solution is to use Nicollet Mall. Nicollet is in many ways ideal for northbound spine transit service. It is perfectly central to the core and when used northbound, it puts a stop on the correct side of the street for easy access to the light rail station.

However, the required changes to Nicollet Mall would need to be weighted against the many other visions for that street. A later section in the report, "Nicollet Mall Outcomes", discusses these impacts in detail.

If a decision is made not to favor Nicollet as a North-South spine street, the second-best option from a transit standpoint is Marquette northbound, because of its centrality to the core and access

[14] There is a change to existing curb uses in this case. Reconstructing Nicollet would move all bus stops to one side of the street. However, it is not clear that this in itself would be a negative impact for business and institutions now facing onto the Mall.

to light rail. Of course, this option has a major impact on current street users, since it would eliminate all through auto traffic on Marquette in both directions. (A detailed review of this option would generate some need for local access auto lanes, especially to access garage entrances, but there are numerous strategies for accommodating these, and the need for them should not be considered a fatal flaw.)

Third Avenue S is the weakest option, because it ranks poor on two counts. Centrality to the core is a fundamental issue in transit design, and the city's adopted goals from the Minneapolis Plan clearly call for transit to be a preferred mode. Third is sufficiently far from the core, and also from the bus connections on the Hennepin spine, that it would not be consistent with this vision.[15] It will probably be useful as an "overflow" street for peak buses that do not fit through the spine, which is how it's used today.

Second Avenue S is the easiest to implement in terms of impacts on existing uses, but it does have the disadvantage of a maximum walking distance to LRT. Not everyone considers 2nd Avenue S to be sufficiently central to the core.

Based on the analysis above, staff requested a more detailed analysis of options for both the North-South Spine and the related issue of Peak Interception. This analysis appears in the section, "North-South Spine Alternatives Analysis" below. The remainder of this section completes the discussion of the rest of the downtown issues, including the other spines and the major routes of access to them.

Hennepin Spine

Several important local lines enter downtown from the southwest along Hennepin, and Hennepin is the only viable downtown alignment for them. Some future arrangements could use 1st Avenue N, perhaps contraflow in the northbound direction, but this requires a very explicit deviation which makes bus transfer distances longer, and it is not clear what benefit is achieved. Subsequent analysis of traffic, especially with concepts that turn Nicollet two-way, will be needed to reach a recommended arrangement for Hennepin. However, any solution must protect the speed and reliability of the crucial PTN corridors that use this street. (A Southwest LRT alignment via Uptown could reduce this market somewhat, but it would still be a PTN corridor.)

The Hennepin spine would have constant bus volumes south of 4th Street, extending at least past Loring Park. Northward, some routes could turn off around 3rd or 4th Streets to terminate at a new layover facility (see below), but many would continue north across the river into lines on the northeast side.

[15] While more capacity may be needed in 2030, and this may involve using streets further east, the assumption is that the core will have grown further eastward during that time.

East-West Spine (6th through 9th Streets)

The East-West spine consists of the band of numbered streets including 6th, 7th, 8th, and 9th Streets. [16] Currently, Metro Transit lines are spread over all four of these streets. These lines include local lines serving southeast and northwest Minneapolis, as well as express buses in the I-94 East corridor. Although express buses to downtown St. Paul will be replaced by Central LRT, Metro Transit assumes that there will still be a market for peak-only express service from Minneapolis to suburbs east of St. Paul.

In considering tradeoffs among these streets, the following key differences may be critical.

- **Centrality to Core**. The centroid of the office/employment core is around 7th and 8th Streets S, so these streets are most central to it.
- **Continuity of Transit Corridors**. Buses proceeding west out of the East-West Spine are headed mostly for 7th Avenue N (continuing to Olson Highway or other northwest corridors.) Sixth and 9th Streets both have poor connections to this street, while connections to 7th and 8th Streets are relatively direct.
- **Speed and Reliability**. Contraflow lanes are much more reliable than with-flow operations in severe congestion. A westbound contraflow lane obviously needs to be on an eastbound street, which means an even-numbered street in this area.
- **Usefulness for Local Circulation**. There is definitely a purely local need for east-west circulation across the core, all the way from Target Center to Elliott Park. This circulation is more useful if it is not too close to light rail, which performs this function along 5th Street.
- **Impact on existing curb uses**. Hotel front doors on 7th Street, especially between Hennepin and Nicollet, create a long stretch where stopping would be difficult, and weaving with local-accessing vehicles would be extreme.

Figure 16 below provides a rough sense of the tradeoffs among these streets.

[16] There is also east-west service on 4th Street, but the long term assumption – after Central LRT – is that this would turn south into the North-South Spine. Needs for 4th Street are discussed further in the next section.

Figure 16 Tradeoffs Among Options for East-West Spine (assuming single contraflow or with-flow transit lane)

	6th Street	7th Street	8th Street	9th Street
Westbound				
Centrality to Core	Fair	Good	Good	Fair
Continuity to transit corridors	Poor	Good	Good	Poor
Speed and Reliability	Good	Poor	Good	Poor
Usefulness for Local Circulation	Poor	Fair	Good	Good
Impact on Existing Curb	Fair	Poor	Fair	Fair
Eastbound				
Centrality to Core	Fair	Good	Good	Fair
Continuity to transit corridors	Poor	Good	Good	Poor
Speed and Reliability	Good	Good	Good	Good
Usefulness for Local Circulation	Poor	Fair	Good	Good
Impact on Existing Curb	Fair	Poor	Fair	Fair

The westbound tradeoff clearly argues for a contraflow lane on 8th Street. Eastbound could be contraflow on 7th Street, but the hotel frontage on the south side of 7th Street makes it very problematic to remove auto access on this side of the street. For this reason, the best arrangement for eastbound service appears to be with-flow on 8th Street. This has the added advantage of putting both directions of service on the same street. 8th Street is not ideal, but no street is ideal in this group. Clearly, 8th Street is the least impactful choice that can lead to a widely useful transit spine.

The need for the contraflow lane lies primarily through the core, west of about 3rd Avenue S. However, for continuity, it would be prudent to continue it as far east as possible, to minimize turning movements. The draft maps shows the lane extending all the way to 13thAvenue S, but there may be other alternatives for navigating the hospital and Elliott Park areas, especially after Chicago when volumes begin to dissipate. Alternatively, 8th Street could be made two-way to all traffic through the Elliot Park and hospital areas, though this may be problematic for transit through the core.

Buses on 8th Street would be at their highest volume all the way from 2nd Avenue N to roughly Portland Avenue. No buses would turn into or out of the street on this segment.

4th Street Spine (Pending Central LRT)

In addition to the major spines listed above, some transit service would continue to operate across downtown along 4th Street to end at the 5th Street garage. (As noted below, other lines would continue to run along 4th Street east of Marquette, but these routes would turn south into

the North-South Spine.) Currently, buses making this movement must follow an unacceptably circuitous route westbound. A westbound bus on 4th Street, upon reaching the end of its contraflow lane at Hennepin, must turn right and go two blocks out of direction, to Washington, in order to continue west and then south to the 5th Street terminal. This deviation is tolerable to the public only because there are not many riders on the bus at that point, but it is a significant cost to Metro Transit's operations.

For this reason, we recommend a one-lane extension of the 4th Street contraflow lane from Hennepin to 1st Avenue N, with a signal for a left turn at that point. This would permit buses from 4th Street N to turn left on 1st Avenue N, right on 5th Street N to reach the garage and thus connect to the Intermodal Center. While buses can turn left on Hennepin, they cannot turn right from Hennepin onto 5th Street S because of the LRT station there.

Major Routes of Access to Spines

To connect the spines to the points of transit access around the edges of downtown, the following are proposed, as described clockwise from I-35W North:

I-35W North and University Avenue East buses

These lines mostly now use 3rd/4th Streets, though some use Washington. Westbound with-flow operations on 3rd Street are often problematic because of backups from I-394.

These buses alone have sufficient volume to justify a contraflow lane westbound on 4th Street, which is the recommended option. (Midday demand is relatively high, due to the University Avenue lines.) A with-flow lane on 3rd Street is also possible. In either case, the outbound movement from downtown would be via 4th Street.

These lines would turn south into the North-South spine from the north end, with the exception of direct buses from 4th Street to the Intermodal Center, noted above.

I-94 East buses

These lines come into downtown aligned with 5th and 6th Streets, but 5th Street is not usable as a bus street because of LRT. Currently, they use 6th Street outbound, but inbound they use 4th Street.

Conceptually, we show these buses using 8th Street two-way, for a consistent two-way routing that uses the 8th Street contraflow. Other options would include leaving these routes on 6th/7th Streets, though the concerns identified above about 7th Street would continue to be an issue.

One capital project would follow from this. To permit buses to transition from the exit ramps to 8th Street S, 13th Avenue S would need to be connected across 7th Street S.

I-35W, including BRT

I-35W BRT will introduce frequent all-day service in this corridor, which will flow through the North-South spine. Currently, these services exit into downtown via HOV ramps at 11th and 12th Streets. This works well from the downtown perspective, since it provides for direct access

to the southern part of the core, and the turning movements are far enough out of the core that they have a manageable traffic and delay impact. Most important, it cleanly separates transit from most auto traffic, which ends up on 9th/10th Streets.

If the I-35W project develops a center HOV lane, however, this arrangement is likely to be revisited, since a center HOV lane would more easily orient to 9th/10th Streets.

At this time, we recommend looking for ways to keep the HOV connection at 11th/12th Streets because it provides the best coverage downtown access, the least impactful turns, and the best separation of buses and auto traffic. The high bus volumes on these streets, west as far as the North-South spine, will continue to need at least peak-period bus/HOV lanes. Much more significant preferences would be needed if buses faced greater interaction with auto traffic as a result of that project.

Southern Local Lines

- Chicago & 11th Avenue S: These would feed into the 8th Street spine from the east end, similar to the movement most of them make now.
- Nicollet through Portland: These would all feed into the south end of the North-South spine.
- Hennepin: No change to these lines, which would continue to flow into downtown on the Hennepin spine.

I-394 Corridor

This express corridor is almost entirely peak-only in its market, especially if the Southwest LRT line is built. This service would flow through the North-South Spine in the peak direction only. A contraflow lane on 12th Street may be needed for access to I-394 from the North-South spine, though this is only an afternoon market.

Northwest Locals

Northwest locals approaching from 7th Street N (or Olson Highway) would feed into the 8th Street spine at the west end. Locals approaching via Washington would use Washington to Hennepin before turning east into the 4th Street spine.

I-94 Northwest Express

These express lines are expected to continue using the 3rd/4th Street viaduct. Downtown, these lines would use 3rd/4th Street all the way to the North-South spine, then turn south into the spine to access the core. Eastbound movements are currently impacted by routine morning backups west of 2nd Avenue N. Restoration of a right-hand transit lane may be required in order to achieve a reasonable travel time.

Layover and Terminal Facilities

Since downtown is the origin and destination of many Metro Transit riders, most lines logically end downtown. The end of a line requires a place for the bus to dwell for a few minutes. This dwell, called layover, has two purposes: It provides a regular break time for the driver, and it provides time to catch up to the schedule if the bus is running late.

Some one-way lines require a small break at the beginning of their afternoon outbound trip, especially if the bus has come from a garage that is some distance away. In this case, the arrival time from the garage is variable, so it is necessary to schedule some extra time to ensure an on-time departure from downtown. When this time is not needed, a small break is the result.

With the scheme identified here, the layover needs appear to be as follows:

Leamington Garage (and Convention Center Area)

From the standpoint of regional and citywide needs, Leamington would be southern terminus for most routes entering the North-South spine from the north end, except those that are through-routed to southern routes. However, extension of some of these lines further south, to the Convention Center area, should also be considered to meet intra-downtown circulation needs, since Leamington is too far north to serve the Convention Center well.

If this is judged to be an important consideration (see the section on Circulation Needs below), then a small layover area (up to 6 buses) should be sought in the vicinity of 15th Street E & 1st Avenue S. If the determination is made that north-south circulation will be provided primarily by a local shuttle service, then all service from the north (that is not flowing through to southern lines) would terminate at Leamington.

Services terminating at Leamington (or near the Convention Center) would include:

- All two-way express routes from the I-35W North corridor, and one-way routes to the extent that they need recovery time at the beginning of the afternoon run.
- Some local routes from the University Avenue corridor.
- Local Route 10 from the Central Avenue corridor. (This route would be logical to extend to the Convention Center area, if complete intra-downtown circulation via North-South spine buses is required.)
- Routes from the I-94 West corridor.

There appears to be adequate capacity to meet these needs within the current Leamington facility plus some new layover space near the Convention Center. The "North-South Alternatives Analysis" below discusses the impacts of Peak Interception on Leamington.

7th Street and 5th Street Garages

The 8th Street spine leads logically to the 7th Street Garage terminal facility. However, the new

Intermodal Terminal will be adjacent to the 5th Street Garage facility. Connections from the 8th Street spine to the Intermodal Terminal are important for several reasons:

- Passengers arriving on commuter rail services will need the option of using a shuttle connection to reach the southern downtown core. The most efficient way of providing this connection is via the combined frequency of the 8th Street buses from the east that terminate downtown. These would include all St Paul (Line 94 and 300-series) commuter routes, as well as some local routes from southeast Minneapolis. Together, they will likely provide a combined headway of at worst every 10 minutes, and probably closer to 5 minutes, at peak hours.
- During peak hours when Northstar Commuter Rail is operating, but before the completion of Central LRT, 8th Street will be the location of I-94 express services to St. Paul, which is an obvious secondary destination from Northwest corridor commuters.
- While the proposed Twins Stadium may be more convenient to the 7th Street garage, the flexibility is needed to provide access from 5th Street, depending on the final design.
- In addition, if Southwest LRT is built on the Kenilworth alignment, entering downtown from the west along 5th Street, then the Intermodal Terminal will be the logical place to connect for trips from the Southwest LRT destined for St. Paul.

It is worth noting, though, that of these identified needs, only the last exists all day. If Southwest LRT ends up on a Nicollet alignment, and other developments lead the intermodal facility to be primarily a peak-hour facility, then extending 8th Street buses to 5th Street may be less efficient. Since these things are unknown, we recommend creating the capability for all 8th Street buses to reach the 5th Street garage so that future planners have the flexibility to extend service to the garage, or terminate at 7th Street garage, depending on future demand.

The logical extension to the 7th Street garage for 5th Street buses is shown on the main routings map. The westbound contraflow lane on 8th Street would end at 1st Avenue North, whereupon 8th Street becomes one-way westbound. From here, buses from 8th Street heading to the terminal would continue west on 8th Street, turn north on 2nd Avenue North, and then turn left into the 5th Street Transit Center. This would require reversing the direction of at least one lane of the facility, which appears to be viable.

Departing the terminal to go back east, buses would need a new access and signal to turn left into 3rd Avenue North. From here, they would proceed south into 10th Street, turn left into the 7th Street garage, and emerge from the garage into 8th Street to begin their eastbound run.

North Edge of Core

A facility on the north edge of the core, if properly sited, could serve as the north-end layover for both the North-South spine and the Hennepin spine. These routes would include:

- I-35W BRT service. This would be the northern terminus.
- All Hennepin lines, except those through-routed to the north.
- Other south Minneapolis lines, if not through-routed.
- One-way routes to the extent that they need recovery time at the beginning of the afternoon run.

Gateway is the existing terminal used for routes from this direction, but it is too small for the volumes of buses envisioned from the south, and further east than optimal for minimizing operating cost. Rather than remodel it to be a major bus hub, the priority should be to develop a new facility closer to the north end of the corridors served. This process is already underway, and three blocks are under some consideration:

- Nicollet Hotel Block: Washington to 3rd, Hennepin to Nicollet.
- Ritz Block: 3rd to 4th, Nicollet to Marquette.
- Powers Block: South half of the block: 4th to 5th, Nicollet to Marquette.

Considerations in siting this facility include the following:

- To be useful to both the North-South spine and the Hennepin corridors while minimizing excess mileage, the facility should be close to Marquette, but accessible from Hennepin. Marquette (one of the North-South spine streets) is a priority because the North-South spine represents far more buses than the Hennepin spine, so the need to minimize running time is greater for the North-South spine. *The Nicollet Hotel block is slightly weaker on this score, though the tradeoffs are different depending on which streets is used for the North-South spine northbound.*
- For easy access for deadheading buses, it should be convenient to eastbound and westbound arterials. *The Powers Block is problematic on this score.*
- It should have easy access to/from the west, and from nearby freeways, to enable easy movement of out-of-service between the terminal and their garages. *The Ritz block is ideal, positioned between 3rd and 4th with easy access to both I-394 and I-94 east via 3rd or 4th. Nicollet Hotel is also adequate on this score, since I-394 can be accessed from Washington. Powers Block is problematic.*

The North Terminal is discussed further in the "North-South Alternatives Analysis" below.

Southeast Edge of Core at 8th St

In the long run, if Primary Transit Network routes cease to be through-routed, there may be a need for buses entering the East-West Spine (8th St) to layover at the east edge of downtown. This is a very small requirement, since it affects no more than three PTN lines, with a combined requirement of no more than six bays and possibly less. It could probably be accommodated on-street somewhere between 3rd Avenue S and Chicago Avenue. There are many other possibilities that could mitigate the need for some of this space, and the identified need is only long-term as through-routes are severed. For these reasons, we do not recommend defining a necessary project here.

Downtown Circulation Needs

The discussion up to this point has focused on the needs of transit service connecting downtown to the rest of the city and the region, rather than needs for short-distance trips within downtown or to the edges of downtown. Downtown transit planning logically begins with the city-regional need simply because it is quantitatively the largest. As noted, up to 800 buses per peak hour may need to converge on downtown to meet all the city and regional needs, while the most comprehensive intra-downtown shuttle system imaginable would amount to fewer than 100. By

focusing first on the quantitatively largest problem, we have been able to identify needed projects, some of which may also serve intra-downtown needs. We have also noted cases where an intra-downtown need may tip the balance in making a tradeoff among different options for meeting the city and regional need. (For example, noting that putting the East-West Spine buses on 8th Street makes them more useful to Elliot Park, or that some North-South spine buses may need to run further south to connect to the Convention Center.)

This section turns to the circulation needs within the greater downtown. These can be divided into two general categories:

- Circulation within the dense core of the downtown. The most obvious issue here is north-south circulation between light rail, the office and retail core, major hotels, and the Convention Center area.
- Circulation to edge-of-downtown residential areas, such as Loring Park, Elliot Park, and new areas along the river.

In setting the stage for these discussions, it is important to note the special challenges of serving extremely short-distance transit trips, mostly under a mile in length. Within the core, the typical travel distance is beyond a comfortable walk, but often just barely. An able-bodied person on a nice day always faces the choice: "should I use the shuttle or just walk, or drive?" Even if they can't drive, walking may offer a travel time that is competitive with the shuttle, given the shuttle's average waiting time. As a result, a successful short-distance shuttle must run extremely frequently, yielding a very short wait time, to be the clear choice for its target market.

Circulation within the Dense Core

This study envisions a future in which it is easy to get to downtown by transit – and in many cases, easier than coming by car. For transit to be the preferred option, however, it is also important that people be able to circulate easily within the downtown core. Circulation within the downtown also important for people who come downtown by car, since the downtown circulation system benefits from making it easy to park once and then reach all of your destinations without moving the car again.
This section looks at circulation within the very dense core area of offices, retail, and hotels, where the demand for intra-downtown circulation will be most intense. This core extends 2-4 blocks on each side of Nicollet Mall, and extends from 3rd Street in the north to the Convention Center in the south.

Although these are all potential markets, the need for circulation is arguably greatest furthest south. The hotel and convention center area south of 11th Street is the southernmost part of the core, the furthest from light rail, and the furthest from the centroid of the core – which is roughly 7th Street S & Nicollet. Here, trip distances to major destinations such as light rail may exceed five blocks. At this distance, many people will find a shuttle to be worth waiting for. Over very short distances – up to five blocks – walking will be the predominant mode, even if the walk is slightly longer than customers would like, because waiting even briefly for transit will take longer than the walk.

During inclement weather, the tolerance for walking goes down, and the interest in transit service may therefore go up. However, for many intra-downtown trips, the Skyway will offer a more fully weather-protected experience all the way, whereas a transit service will usually require at least brief exposure to the elements.

Existing Walking Options for Circulation: Street vs. Skyway

There are two common ways to circulate within the core:

- Walking or cycling onstreet.
- Walking through the Skyway system.
- Taking existing local transit services for short distances.

Walking is an unusually convenient mode in the Minneapolis downtown core, compared to many other cities, because of the comprehensiveness of the Skyway. Traveling within downtown, pedestrians have the choice of the street, where the grid is easy to navigate but weather may be a deterrent, or the Skyway, a fully weather-protected system that is well integrated into most of the buildings that it serves. The street usually offers the most direct travel path, and is far easier to navigate. The Skyway is faster to many destinations on its level, often easier to walk along, and certainly the most weather-protected. The two systems create a degree of redundancy and choice, yielding a resilient pedestrian network that is very effective over distance up to roughly five blocks.

However, the Skyway is limited in the far south of downtown. There is only one complete Skyway path from the core to the Convention Center, and it is not especially direct for much of the demand. Other outer edges of the core, such as the 5th Street Garage, have access to the Skyway but with lengthy and indirect walks.

Existing Transit Options for Circulation

Existing transit does not compete for a large share of the intra-downtown market today, mainly because:

- It charges a full fare for short rides within downtown. This is acceptable for customers who are transferring from other transit, since they receive a free transfer, but discourages other riders.
- The existing downtown network is not designed, presented and marketed as a high-frequency downtown circulation system. On a few downtown streets, including Nicollet Mall and Hennepin, several routes overlap to create a very high local frequency, but the usefulness of this service for trips within downtown is not obvious unless you are extremely familiar with the network. Other key downtown streets, such as Marquette and 2nd, have extremely frequent service during the peak hours but none midday.

Again, the southern end of downtown has especially limited transit circulation, because many Nicollet Mall buses turn off at 10th/11th to terminate at Leamington, thereby missing the southernmost reach of the Mall.

Circulation Options Via Recommended Spines

The proposed system of transit spines will make it much easier to use local transit for intra-downtown circulation, because buses are consolidated onto fewer streets. This has two payoffs for intra-downtown circulation:

- On the spines, many bus lines will combine to form a very high intra-downtown frequency. Applying 2005 bus volumes to the North-South spine, from **Figure 12** above, even midday volumes will be 36 buses per hour in each direction, an average of more than one every two minutes. The next bus will almost never be more than a few blocks away. The East-West and Hennepin spines will average better than every 5 minutes all day. These frequencies improve further as the system grows toward 2030.
- The downtown route structure will be simpler, and therefore easier to market for casual and spontaneous use. Both Portland and Seattle make especially effective use of mapping to convey how regular local buses can be used for short trips downtown.[17]

However, there are also some limitations to using concentrations of city/regional buses as the intra-downtown circulation system.

- The three spines cover the core area well, but with one major exception: Most of the North-South Spine buses will turn off the spine at 10th/11th Streets, either to enter I-35W or terminate at Leamington, which is envisioned as the major layover terminal for the south end of the spine. Again, the Convention Center area will have less service than the rest. Relatively few buses would continue south past the convention center into Nicollet.

  For this reason, the Layover section above discusses the possibility of creating another layover area just south of the Convention Center, so that bus lines approaching from the north could extend further south, this bringing a greater frequency of service all the way past the convention center. A conceptual site area would be in the vicinity of 15th Street and 1st Avenue South.

- There is no free-fare zone in downtown Minneapolis. Some cities, including Portland and Seattle, have created free-fare zones to encourage intra-downtown use of downtown bus spines. However, many larger and denser cities do not provide any fare incentive for short-distance bus trips downtown, reasoning that this use of transit competes with walking, rather than the automobile, and is therefore not as directly related to regional auto trip reduction goals.

Shuttle Concepts

Intra-downtown shuttles are a logical alternative to free-fare zones, especially where there is an intra-downtown travel demand that the main spines of bus service do not serve, or where regular

[17] Portland's Mall is self-marketing as a downtown circulation system, because its signage helps clarify the downtown destinations shared by all the buses serving each stop. Seattle publishes a downtown map showing the pattern of its high-frequency services within the downtown, for use in intra-downtown navigation.

buses are too routinely crowded to be useful for local trips. Los Angeles and Denver have especially rich downtown shuttle systems, and may be especially useful as models. Los Angeles provides a network of several frequent shuttle routes, called DASH, connecting activity centers in the core, while Denver provides a single extremely frequent shuttle route, with a bus on every signal cycle during peak hours, along a downtown mall on 16th Street.

There has long been a strong interest in creating a dedicated north-south shuttle service -- separate from the city/regional bus service and with a low or free fare – to connect downtown's major destinations to each other. Much of this work has focused on Nicollet Mall, because the pedestrian-oriented design of this street, featuring the front doors of many hotels and retail centers, fits well with a frequent shuttle service. The Downtown Circulator Task Force, which has been working on this issue for some time, recommends a free shuttle running along Nicollet Mall between the Convention Center and the new north terminal, proposed for one of several blocks in the vicinity of 3rd Street & Nicollet. This very logical routing would connect a range of government, institutional, office, retail, hotel, and activity centers, and would directly connect with Light Rail at 5th Street. It would have obvious markets throughout the day.

The primary challenge of a downtown circulator is the frequency requirement for the very short trips. If a shuttle vehicle is not in sight, it is often easier to start walking toward your destination. The most successful and comprehensive downtown shuttle systems run every 5 minutes or less, offering an ease of spontaneous use that makes them clearly preferable to walking even for a trip as short as five blocks.

Recommendation

In order to support the necessary volumes of buses to serve city/regional access, the North-South spine needs to be created on some mixture of Nicollet, Marquette, and 2nd Ave S, with its southern terminus at Leamington. This spine will have a combined headway of less than 2 minutes, and even closer on the peak. This headway will mean that spine buses are departing on virtually every signal phase – in other words, they will be operating at the highest frequency that is physically possible downtown.

If the goal is purely transit efficiency – making transit services useful to as many people as possible, so as to reduce the need for overlapping service – then the solution is to make the spine buses attractive as the circulation system, rather than introduce a parallel shuttle service. This strategy would include:

- Extending a consistent high-frequency service past Leamington to the vicinity of 15th Street & 1st Avenue S.
- Preferring Nicollet or Marquette as the northbound spine alignment, rather than 2nd Avenue S, due to better connectivity to Light Rail.
- Providing free or subsidized fares for customers originating in the hotels and Convention Center, where reliance on the spine for circulation will be greatest.
- Working to make the standard buses more attractive to a broader public. This is work that must be done anyway on the Primary Transit Network.

A shuttle along Nicollet Mall may be valuable as an amenity in any case. Its transit value, however, would depend mostly on other possible outcomes for the North-South Spine:

- *If the North-South Spine is two-way on Marquette*, then this spine may serve much of the circulation need, so long as enough buses are routed beyond Leamington to the proposed small layover near 15th Street E & 1st Avenue S, thus maintaining a high frequency to the Convention Center. Again, a free-fare or subsidized-fare arrangement would be ideal. Marquette does not provide as much of the attractive front-door access that will appeal to visitors and recreational users, and is further from the retail core.
- *If the North-South Spine is either two-way Marquette or Marquette and 2nd*, then Nicollet may be a logical location for an intra-downtown shuttle service, along the lines suggested by the Circulator Task Force. Such a shuttle would have two large markets: (a) access to LRT from the central and southern core, and (b) access from the Convention Center area to the entire office/retail core.
- In an intensive Peak Interception arrangement, a Nicollet Mall shuttle would take on a third purpose: providing southward distribution for commuter arriving at a new North Terminal. However, it is less likely that the shuttle would effectively serve Peak Interception terminals at both ends. Leamington is the logical terminal for the south end of downtown, sited for its access to I-35W South, but shuttle departures from Leamington would logically use 11th westbound to Nicollet – too far north to pick up passengers at the Convention Center on the same bus. It is more likely that Leamington passengers would rely on Marquette or Marquette-2nd spine buses, since these would be terminating at Leamington in significant numbers anyway, providing an easy connection.

In light of these considerations, the "North-South Alternatives Analysis" provides more detailed study of a shuttle on Nicollet Mall, assuming that the North-South Spine buses are on either Marquette or a combination of Marquette and 2nd Avenue South.

Edge-of-Downtown Residential Areas

On all four corners of downtown, dense residential areas are adding to the vibrancy of the core, providing a base of customers for the diversity of services and activities that makes for a great downtown. These dense areas also have the potential to be attractive sites for people who choose not to own cars, or to use their cars rarely.

The four corners of development, roughly, are:

- Loring Park in the southwest, by far the oldest and most built-out of the four.
- The North Loop area, whose residential component runs generally from Washington Street to the river, and extends out to around 9th Avenue North.
- The Downtown East area, which includes the area between Washington and the river from Hennepin to I-35W.
- Elliot Park in the southeast, already well established but still growing, generally south of 8th Street and east of Park Avenue.

This section looks at circulation options for these neighborhoods. A drawing of the concepts appears in **Figure 17**.

Effective transit to edge-of-core residential areas is an important part of making these areas attractive. Good transit is an important amenity of high-density living, because as these areas fill in, the automobile ceases to be efficient for many of the short trips of daily life. In the longer term, these areas can be places where people choose not to own cars, or more commonly, to share a car between a couple. Lower auto-ownership is an important payoff for the city and developers, because it means that the need for expensive structured parking in highrise residential buildings may decline somewhat over time.[18]

[18] Of course, parking ratio requirements (spaces per unit) should always be monitored against changes in actual auto-ownership patterns, so that they can be lowered for new buildings as the actual ratio of usage declines.

Figure 17: Downtown Minneapolis - Neighborhood Circulator Concepts

Nelson|Nygaard consulting associates

Direct Egress for 8th St. Buses

Extend Lane

Into Core

Closure Issues

Legend

- Minneapolis City Boundary
- Neighborhood Circulator Concept
- PTN or Peak Period Service Routes
- Skyway
- Hiawatha Corridor Light Rail & Stations (Existing)
- Hiawatha Corridor Light Rail & Stations (Future)
- Freeway Bus Stops
- Railroad
- Layover Terminals
- Existing Bus Terminal De-Emphasized
- Building Footprints
- Parking Ramps
- Parcels
- Water Features
- Park, Recreationl/Preserve; Golf Course; Agricultural

N

0 0.25 0.5 Miles

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

Several important principles bear on designing transit services for the edge of the core.

- As discussed above, short trip distances require very high frequency, in order to make the service worth waiting for. The same challenge exists with a shuttle within the core, such as Nicollet Mall, but these edge-of-downtown markets are much smaller than markets within the core, so it is far harder to justify the frequency they need to be effective. Of course, a less-frequent shuttle could put a line on the map and carry some passengers, but it would not be the core transit infrastructure that these dense neighborhoods need as an alternative to the automobile.
- A new neighborhood does not necessarily require a new transit line. Very specialized services, focused just on one neighborhood, for example, can work during the peak hour, but for the all-day market, transit performs best, and therefore justifies the highest frequency, when it serves many diverse markets with the same route. The long, direct lines of the Primary Transit Network are designed on this principle. A bus running the length of Chicago Avenue, for example, serves many neighborhoods, connects them to many others, and also provides connections to reach others throughout the region. As a result, it will always perform better, and therefore justify better service, than a line custom-designed to a single neighborhood, even one as dense as Loring Park.
- Existing lines, especially Primary Transit Network (PTN) lines, should never have deviations that take a majority of riders out of their way. For example, the very busy West Broadway primary line, which enters downtown on Washington, should not be deviated through 2nd and 1st Streets just to get closer to Warehouse district residents. On the contrary, PTN must remain as straight and direct as possible, and this need becomes more critical as you approach the peak load point – the point where bus typically has the most people on board. While the neighborhood needing service is important, each PTN line entering downtown has served a much larger market of many neighborhoods extending across the city, so at the peak load point, where they enter downtown, the ridership's sensitivity deviation will be at its maximum.

In some cases, Primary lines – without deviation – provide good service for radial trips from edge-of-downtown neighborhoods. This is the case with much of Loring Park, which has the Hennepin and Nicollet Primary corridors, and also Elliot Park, which would have the 8th Avenue spine service, the Chicago Primary corridor, and a candidate Primary corridor on 11th Avenue S. In the new neighborhoods along the river, however, the tradeoff is more difficult:

Radial Service: North Loop

The area northwest of Hennepin (North Loop) is densely developed mostly between Washington and the river. 1st and 2nd Streets are the most central to this development, and provide the best "front door" service to residents. However, Washington is the direct path for the Primary line passing through the area, and deviating this service through 1st and 2nd adds potentially several minutes to the trip for everyone from the West Broadway corridor. Currently, Metro Transit serves 1st and 2nd Streets only with secondary bus routes, whose low frequencies are not especially useful to the short trips that edge-of-core residents make. Here, there are three options:

- Create a separate dedicated shuttle solely to run along 1st and 2nd Streets N and connect them to the core, while leaving Primary service on Washington. This solves the problem, but very expensively and with a route that is likely to perform poorly and therefore be difficult to sustain in lean budget

cycles. Washington is still where the high ridership will be, because it is a logical direct path for a line that serves other neighborhoods.

- Focus the next stages of development on creating pedestrian links to Washington, and taming Washington for the pedestrian. Washington is a wide street with a median and few signals. This encourages fast auto traffic and creates a poor pedestrian environment. This in turn discourages the neighborhood from accessing the street where it will always have the best transit service. One payoff of developing a Washington / West Broadway streetcar is that it would catalyze development interest in more pedestrian-scale "boulevard" treatment of this street. However, a sustained focus on this issue by neighborhood planners and Public Works could achieve this effect even without a streetcar.
- Develop the West Broadway / Washington corridor as a streetcar, but route this streetcar via 1st and 2nd Streets N through the neighborhood. This strategy would use the appeal of the streetcar as the tradeoff, for the West Broadway neighborhoods, in return for a slightly slower ride. This may be a politically viable strategy in the short term. In the long term, though, as transit becomes more foundational to the city's identity, this deviation is likely to become a long-term irritant, much like the notorious deviation of Nicollet Avenue.

Radial Service: Downtown East

The situation along the river east of Hennepin (Downtown East) is similar, except here, Washington does not appear to be an attractive street for the PTN. Fourth Street, with its contraflow is much better in serving the high-volume demand into the core from the east (especially prior to Central LRT where this is the main route to both University of Minnesota campuses). There are two options for this area:

- Create a dedicated shuttle route from the core to the neighborhood. To serve a reasonable share of markets, this route should extend east out of the neighborhood to either the University of Minnesota or a Hiawatha LRT connection. It would be ideal to serve both, but the grade separation of the Cedar & Washington intersection makes it hard to serve both the west end of the pedestrian bridge to the campus and the Cedar-Riverside station. This is an issue to be worked out in more detailed planning. On balance, given the choice, the University is the more logical anchor.

  This route is more justifiable than a shuttle route to the North Loop area, because the Primary service will be further away, while Washington is still a formidable pedestrian obstacle.

- Possibly, deviate the Primary line from the Como corridor to serve this area. This is possible because the peak load point of the Como line is not at the edge of downtown, as it is on most other radial lines. Instead, the Como line peaks east of the campus, in Dinkytown. Many riders coming from further east on Como are destined for the campus, and many other destinations, including the Hennepin corridor to Uptown, will be best reached by a Primary connection there. As a result, it may not be unreasonable to deviate the Como line in this case. The result would be a frequent service direct to the center of the neighborhood, without the high cost of a dedicated shuttle.

Circumferential Circulation

The edge-of-core residential neighborhoods have also expressed interest in shuttle service around the edge of downtown. An approximate route of such a conceptual shuttle is shown in **Figure 17**.

The idea has appeal. Such a shuttle would, for example, be a direct route from Elliot Park and the northeast waterfront to their nearest LRT station, at Metrodome. It would be useful as a connection between Elliot Park, Loring Park, and the Convention Center area between them. Some people would find it useful as a link between the predominantly residential areas, but this is a much smaller market. The Metrodome, and the event-related closures of 5th Avenue S, form something of a barrier to this transit movement, but it might not be insurmountable.

Overall, the highest-ridership piece of this market is an east-west line running south from Metrodome station, then west across Elliot Park, the Convention Center area, and Loring Park to a connection with the Hennepin corridor. This is an area of continuous density, with many further opportunities for infill. Its ridership would tend to be uniform across most hours of the day, which makes a smaller shuttle vehicle attractive.

Still, the ridership on such a circumferential line will be low compared to lines (and shuttles) extending into the core, and like other short shuttles, it would have to run extremely frequently in order to be useful to most potential riders. While the shuttle concept certainly follows travel paths that people take, it does not represent a concentrated market, such as the market from Elliot Park to the downtown core.

For this reason, we acknowledge the desire for circumferential shuttle service, but recommend that the first priority be to provide radial service from the core to all of the edge-of-core neighborhoods, at the highest possible frequency. From this standpoint, the consolidated two-way service on 8th Street will be a major improvement for Elliot Park, since it brings the very frequent westbound service (now on 7th Street) closer to the residential area. Loring Park will benefit from continued growth in the frequency and overall quality of Hennepin and Nicollet corridor services, which are both Primary corridors.

To sum up, while a separate shuttle may be needed to serve the Downtown East area, the first priority for the other edge-of-downtown neighborhoods should be improved frequency and amenities on their Primary corridors into downtown, with frequent connections to other edge-of-downtown destinations.

Nicollet Mall Outcomes

Few people are entirely happy with Nicollet Mall as it is. There seems to be widespread dissatisfaction with the poor fit between heavy urban bus service and the pedestrian character for which the mall was designed. The decision to lower the speed limit to 10 mph dramatically reduced the street's usefulness to transit, though transit still operates there.

Some aspects of Nicollet Mall's future can be effectively debated at the level of the downtown community, or even of the Mall's landowners and tenants. However, the nature of transit service on the mall cannot be decided in isolation. For example, in the current configuration, transit cannot simply be removed from the mall, because the other available north-south streets are all at capacity, at least during peak hours. Instead, Nicollet Mall's transit service needs to be an outcome of this study process, which looks at the entire downtown transportation issue, with emphasis on transit, and looks for the best place to accommodate different modes.

Those who want a particular outcome on the mall therefore have an interest in the decisions made about the adjacent parallel streets. It is only by thinking about these interrelated decisions as a package that reasonable win-win solutions can be found – solutions that do more than push a problem from one place to another.

Different lines of thought presented in this study suggest several different outcomes for the mall's transit service. These are not alternatives for the mall to consider alone, but rather outcomes of different approaches to the whole downtown transit issue.

Peak-only Transit on the Mall

As noted, the projected need for peak bus trips may exceed even the capacity of the North-South spine, requiring some buses to use other streets. While 3rd Avenue S is a possibility, another possibility is for buses to run along Nicollet only during peak hours, leaving it to other uses the rest of the day and all weekend. Peak commute buses, running in both directions, would provide the desired commuter connection between the core and the light rail station, though an equally frequent service will be available on other streets of the spine, whether Marquette or 2nd Avenue S. The 10 mph speed limit might still be workable for this limited set of services.

Streetcars, and Pre-Streetcar Bus Lines, on the Mall

The idea here would be to leave certain Primary lines on the Mall that are leading candidates for upgrades to streetcar service, with the intention of gradually evolving toward a street where streetcars are the only transit mode. This would reduce the overall volume of buses on the mall to between half and two-thirds of its present level, and to no more than half the current level during peak hours.

Light Rail on the Mall

- If the Southwest LRT line is developed with an Uptown alignment, one option is clearly to bring this line down Nicollet Mall to intersect the existing line at Nicollet Mall station. However, this option must be analyzed in terms of its impact on bus volumes. If LRT eliminates the potential for buses to operate on the mall, then it must also replace that same number of buses through the service it provides. All of the bus volume estimates in this report presume that Southwest LRT is built on the Kenilworth alignment, thereby replacing some southwestern regional services. To take over Nicollet Mall, then, LRT would have to replace additional city-oriented service.

Shuttles on the Mall

Finally, of course, a Peak Interception concept would include low-emission shuttle buses along the mall.

Further Analysis

The options studied below in the North-South Alternatives Analysis include three possible outcomes for Nicollet Mall:

- Shuttles, as part of a Peak Interception concept. (Alternative A)
- All-day Primary Transit Network bus service. (Alternative B)

- Peak-only bus service. (Alternative C).

Bicycle Lane Outcomes

None of the alternatives for the North-South Spine requires eliminating a designated north-south bicycle route through the core.

Nicollet Mall was originally intended to be this route through the core, but in the wake of a bus-bicycle collision on Nicollet Mall some years ago, one-way bicycle lanes were created on Marquette and 2nd Avenue S instead. These two-way lanes lie between the traffic lane and the transit contraflow lane, but are intended to be used in the contraflow direction.

If the Marquette facility were widened to two lanes, but the corresponding northbound transit facility were on a different street, then the effect on Marquette would be to require a choice:

- Eliminate the bicycle lane. Restore bicycle access to Nicollet; or
- Retain the bicycle lane and remove a general purpose lane.

In a scenario where both directions of the North-South spine are on Marquette, there would be no room for a bicycle lane there. Again, Nicollet Mall would remain an option, but so would 2nd Avenue S, which would no longer have bus service.

North-South Alternatives Analysis

Previous sections of this report recommends organizing downtown transit services into three general categories, called spines, according to their logical orientation within downtown. The recommended spines are:

- North-South: This term refers to the group of services that logically follow Nicollet, Marquette, 2nd Avenue S, or 3rd Avenue S. The north-south orientation of these services is dictated by their route of approach to downtown, but there is considerable flexibility in which services are assigned to which streets.
- East-West. This term refers to services that logically follow 6th, 7th, 8th, or 9th Streets across downtown.
- Hennepin.

Since then, an additional spine along 3rd/4th Streets has been identified.

This report makes recommendations for how services should be configured on each of these spines, but in the case of the North-South spine, there are numerous options. Further analysis and framing of these options was required.

This section undertakes that further analysis. It looks at three possible configurations of north-south service, and assesses the differences between them in terms of operating cost, capital cost, and overall service quality. The three alternatives are:

- **Alternative A: Peak Interception with Nicollet Mall Shuttle.** This alternative intercepts some peak-only express services at two terminals on the periphery of the downtown core: the existing Leamington Terminal and planned North Terminal. This alternative includes a high-frequency shuttle traveling via Nicollet providing local distribution for intercepted transit users as well as circulation throughout the day for other downtown users. Local services in this alternative use the double-width lanes on Marquette, along with select peak express service (See **Figure 18**)[19].
- **Alternative B: Local Services on Nicollet; No Peak Interception.** In this alternative, local services operate on Nicollet to provide intra-downtown circulation. Because of sensitivities regarding noise and exhaust on Nicollet, a commitment to phasing in hybrid electric vehicles is assumed. All express services traverse downtown, either via the double-width transit lanes on Marquette or other streets in the East-West direction (See **Figure 19**).
- **Alternative C: Local Services on Marquette; No Peak Interception.** Select peak Express buses run on Nicollet Mall during the AM and PM peak hours only, leaving the Mall available for non-transit uses at all other hours. Local lines and peak expresses would use the double-width lanes on Marquette all day and be marketed as the way to circulate through downtown with connections to LRT. This alternative would not require hybrid electric vehicles for the local lines (See **Figure 20**).

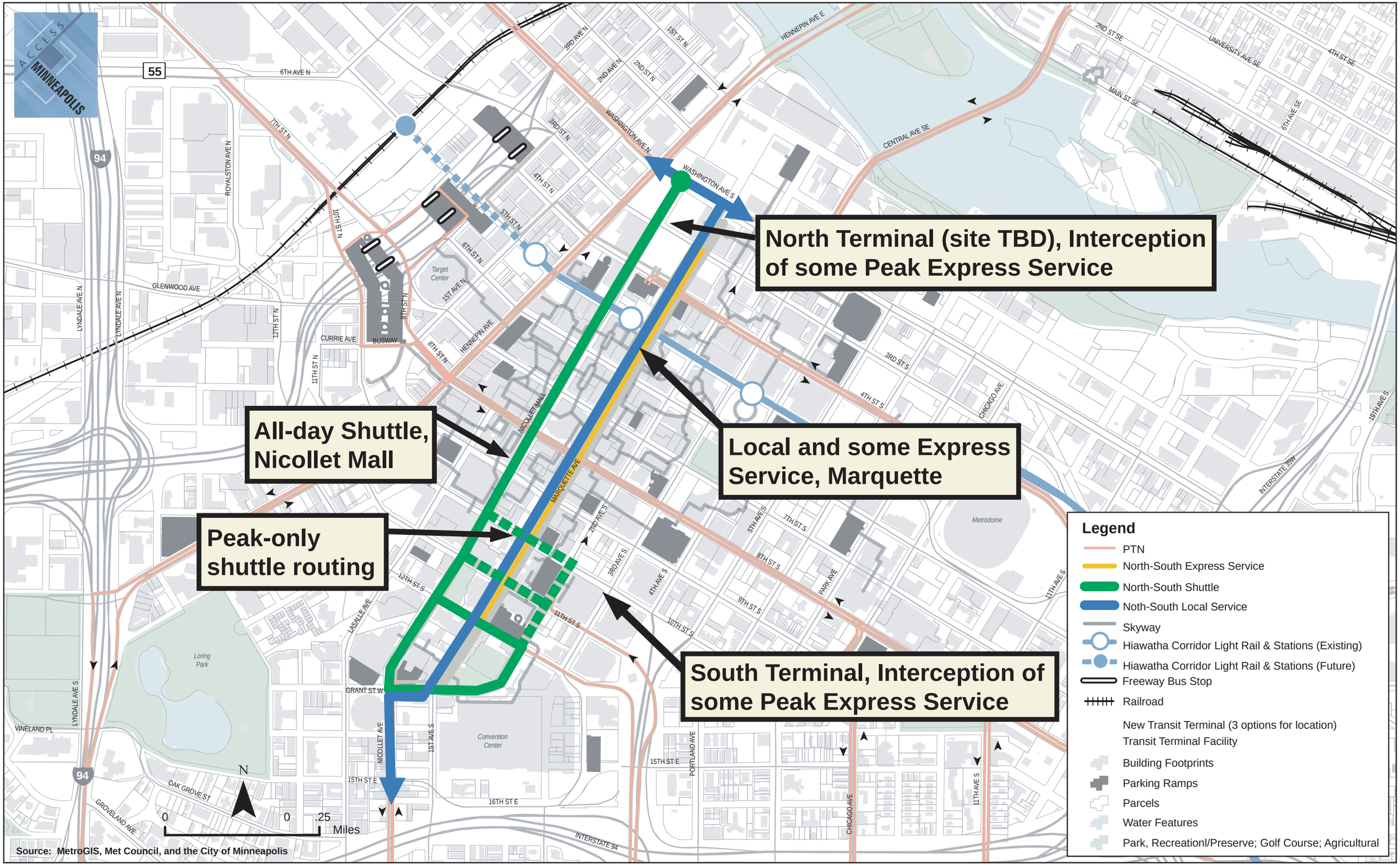
Ridership estimation is not included, nor is it recommended. The available tools of ridership estimation do not work well at the intra-downtown scale. In the case of a proposed downtown

[19] Metro Transit has historically tried to separate expresses from locals due to their difference in fare payment and resulting difference in operating speed.

shuttle included in one alternative, the peer experience with this type of design is so limited that there is little data on which to calibrate a ridership estimate.

Figure 18 Alternative A: Peak Interception with Nicollet Mall Shuttle

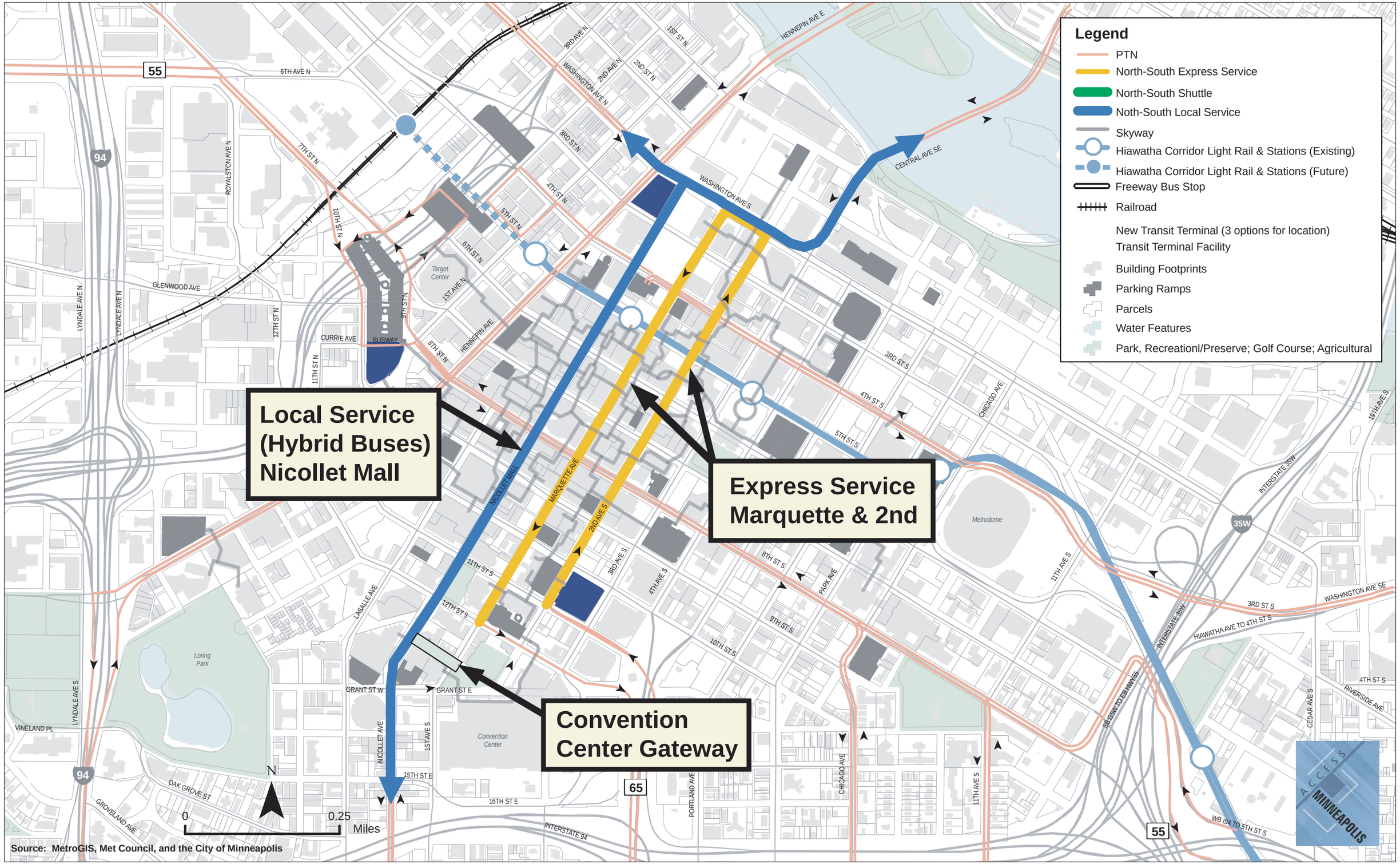
Nelson|Nygaard consulting associates



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

Figure 19 Alternative B: Local Services on Nicollet; No Peak Interception

Nelson|Nygaard consulting associates



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

Figure 20 Alternative C: Local Services on Marquette; No Peak Interception

Nelson|Nygaard consulting associates

Some Peak Express Service, No Midday/Evening/Weekend Service

Express and Local Service Marquette (two-way)

Legend

- PTN
- North-South Express Service
- North-South Shuttle
- Noth-South Local Service
- Skyway
- Hiawatha Corridor Light Rail & Stations (Existing)
- Hiawatha Corridor Light Rail & Stations (Future)
- Freeway Bus Stop
- Railroad
- New Transit Terminal (3 options for location)
- Transit Terminal Facility
- Building Footprints
- Parking Ramps
- Parcels
- Water Features
- Park, Recreationl/Preserve; Golf Course; Agricultural

0 0 .25 Miles

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

Assumptions and Previously Established Conclusions

Several major conclusions – from the previous sections of this report and subsequent work – are considered constant among the three alternatives:

- Double-width transit lanes are needed along the North-South Spine in both the short and long term. These provide triple the capacity of a single transit lane, (180 vs. 60 buses/peak hour) but only requires double the space. These lanes could be two-way on Marquette, or southbound on Marquette and northbound on 2nd. *Two-way Marquette is assumed as the configuration for this analysis.*
- Current average operating speeds[20] for transit in the downtown, some below 5 mph, are unacceptable. A target of 7-8 mph is recommended.
- A new "North Terminal" transit facility is required that is nearly identical in size and functionality to the Leamington Terminal. This facility would be needed to handle layover and staging needs that will arise by 2030, regardless of the alternative. For the purposes of this analysis, it is assumed that the North Terminal would encompass an entire city block (330' x 330'), include an underground boarding/layover/staging facility and several at-grade transit-only lanes through the facility. As at Leamington, about half of the ground-floor blockface would be available for non-tranist uses, as would any levels built above the ground level.
- Any short-term solution must provide attractive options for north-south circulation within the downtown. To achieve a travel time that is faster than walking, this service must also achieve a reasonable operating speed, and must operate at very high frequency.
- The ability to handle higher volumes of peak express services through the North-South spine is greater in the AM peak period than the PM peak period. This is because the peak express services are dropping off in the AM peak whereas they are loading in the PM peak period, which generally takes longer. When estimating the capacity of the double-width lanes, the PM peak hour volumes were used.
- The double-width lanes would be close to capacity in 2007 (170 buses during the PM peak hour), if all service now on Nicollet, Marquette, and 2nd-3rd Aves S are consolidated into them. Accommodating growth in bus volumes from 2007 to 2030 requires additional capacity. In Alternative A, the surplus buses are intercepted, while in the other two alternatives, some service operates on Nicollet Mall in addition to the double-width lanes on Marquette.
- Long-term (2030) bus volumes in the North-South direction (excluding Hennepin) are nearly 250 buses/peak hour in each direction in the PM peak. In all alternatives, the capacity of the double-width lanes should be just adequate to handle the bus volumes in 2030, given that some buses are assigned to Nicollet Mall (Alternatives B and C) or Peak Interception (Alternative A).

Review of Previous Study Efforts

A significant amount of study and discussion regarding downtown transit circulation has taken place prior to and during the Access Minneapolis project. Much of this discussion has focused on Nicollet Mall and intra-downtown circulation for commuters, visitors and downtown

[20] The aggregate speed including all causes of delay, i.e. the distance traveled by transit divided by the time it takes.

shoppers. The work of the Access Minneapolis project, by contrast, is to meet these needs in the context of a comprehensive solution that considers all transportation demands on downtown.

The first such study, the Nicollet Mall Shuttle Report, was conducted in 1988 (and updated in 1991) by SRF Consulting, Inc. on behalf of the City of Minneapolis. The key recommendations of that study were as follows:

- A high frequency, free shuttle operating on Nicollet Mall between a northern terminal and southern terminal that would intercept peak express buses from I-94 W and I-35W.
- The north terminal was proposed for the old Nicollet Hotel block (Nicollet, Hennepin, Washington, 3rd St.) and the south station at the old Leamington Hotel block (2nd Ave., 3rd Ave, 10th St. and 11th St.).
- Operation of a free shuttle was recommended due to faster operation, shorter dwell times and less bunching. Denver-style vehicles were recommended.
- Local routes using Nicollet would instead use Marquette and 2nd.

In October 2003, the Downtown Circulator Task Force issued another report focused on downtown transit circulation, titled the Draft Downtown Minneapolis Circulator Report. With the primary goal of providing circulation for LRT commuters, and the ancillary goal of enhancing economic development, the key recommendations that came out of that report (*quoted directly from report*) were:

- **Daytime Route.** Two-way on Nicollet Mall, with the southerly terminus at the Convention Center and the northerly terminus at the North Terminal located on the former Nicollet Hotel Block bounded by Washington Avenue, Nicollet Mall, 3rd Street, and Hennepin Avenue. Circulator connects with LRT at the Nicollet Mall LRT station.
- **Evening Route.** Northbound on Nicollet Mall, Southbound on Hennepin Avenue, being more convenient to the Entertainment District and evening/weekend activity patterns. The southerly terminus is at the Convention Center and the northerly terminus is 3rd Street.
- **Hours and Frequency.** Hours and frequency to match LRT hours and frequency. Circulator schedule to be synchronized with LRT schedule at the Nicollet Mall LRT Station, so as to minimize waiting for passengers making LRT-Circulator connections.
- **Vehicles.** Vehicles to be designed for easy entry and exit, featuring low noise and low emissions. All Circulator buses will be low floor with perimeter seating and a wide (54") rear door for easy entrance and exit. Three buses will be hybrid diesel-electric and the other five will use ultra low sulfur fuel. All buses will appear identical from the outside.
- **Future Goals:**
    - Obtain a long-term funding source for Circulator operations.
    - Increase frequency of circulator service, especially during PM peak hours and lunchtime.
    - Extend the northerly end of the Circulator route to 1st Street North.

As with the 1991 Nicollet Mall Shuttle Report, the Downtown Circulator Report focused primarily on a separate circulator route and did not evaluate other potential options. This report

also did not determine whether or not the shuttle was the best solution for intra-downtown circulation needs.

The recommendations that were presented in these two reports, along with discussions with the Downtown Business Association, have been continually reviewed and referenced in developing the downtown transit circulation plan. The concept of a circulating shuttle primarily along Nicollet is one of the major factors driving this analysis of North-South circulation.

Review of Peer Downtown Circulation Systems

To provide a comparison of other North American cities in the country with downtown transit circulation systems similar to those proposed in Minneapolis (both the double-width transit lanes and a downtown circulating shuttle), a brief review of peer systems was conducted.

Only three cities in North America were identified that currently have double-width transit lanes similar to those proposed in Minneapolis: Portland (OR), Seattle and Manhattan. These are discussed below:

Double Width Transit Lanes

Portland, Oregon – 5th and 6th Avenue Transit Mall

A two-lane transitway on a downtown street is best exemplified by Portland's downtown transit mall, which was created in 1978.

The Portland Mall consists of two streets through the very center of downtown: 6th Avenue, where transit runs northbound, and 5th Avenue to the east of it, where transit runs southbound. This "inside couplet" configuration means that passengers can walk from a stop on one street to a stop on the other without crossing the street. The street is narrower than most downtown streets in Minneapolis, a mixture of two-lane and three-lane sections with wide sidewalks. Where the third lane is present, it is a local-access auto lane, but the streets do not serve through auto traffic.

Buses on the mall are assigned to four groups, which stop at different stops. There are two stops per block, so over the course of two blocks there are stops for all four groups, for a net two-block spacing for any group. The four groups provide common stops for buses going the same general direction. The right lane is always for stopping, the left lane for proceeding. As a result, two buses going down the mall at the same time, serving different stops, will leapfrog, each passing the other when it is stopped. As a result, buses rarely obstruct each other.

Buses flowing through the mall can also be used for local trips within downtown. Although some buses turn off the mall partway, most run the full length of it. More important, buses running the full length of the mall all leave from the same stops, so a passenger can catch any bus at that stop and be assured of service all the way along the mall to the far end of downtown.

The operating speed of the 5th Avenue transit mall is approximately 8 mph.[21]

Seattle, Washington – 3rd Avenue

The best example of a street with two-lane transitways in both directions is Seattle's 3rd Avenue, where this arrangement was created in September 2005. The left lane of the transitway is continuous but the right lane, where stopping occurs, is reserved for transit only every other block. There are two stops in each of those blocks, and four groups of routes, so the result is a four block spacing for each group. As with Portland's Transit Mall, the four groups provide common stops for buses going the same general direction. In the blocks where there are no stops, there are auto lanes, permitting right-in access from the preceding cross street and requiring right-out egress at the next street. These fit logically into the one-way street grid, beginning at a street going to the left from the point of view of the bus, and ending at a street going to the right.

Based on recent data from King County Metro, the average operating speed on 3rd Avenue is approximately 7 mph. This figure derives from average travel times for all buses along the entire length of the 3rd Avenue bus lanes (just under 1 mile in length).

Manhattan – Madison and 5th Avenues

Between 42nd and 57th Streets, Madison Avenue has double-width northbound transit lanes, coupled with a single-width transit lane in the opposite direction on 5th Avenue. The double-width lanes on Madison are restricted to buses only during peak hours and right turns are restricted between 2:00 PM – 7:00 PM. Although local, limited and peak express buses operate on Madison Avenue, the primary purpose is to improve speed for the inter-borough express buses, by making it easier for them to pass locals. There are two bus berths per block face, and each block face is 220 feet long. Locals and limited-stop buses typically stop at the same berth and peak express buses typically stop at a different bus berth.

Downtown Shuttles

Downtown shuttles are much more common than double-width transit lanes, but only a handful of them have been designed with the same purpose as that proposed in Minneapolis. By far the most relevant peer is Denver's 16th Street Mall Shuttle. Other cities with large and possibly-relevant operations include Los Angeles (LA DASH), and Washington DC (DC Circulator). A brief summary of each of these systems is provided below.

Denver – 16th Street Mall Shuttle

The 16th Street Mall opened in 1982 and is served by a very frequent shuttle (the MallRide) that connects two terminals, Market Street and Civic Center, through the core of downtown Denver. Regional express service operates only to one of the two terminals rather than through the center of downtown.

[21] Source: Tri-Met. Measured from NW Hoyt St. to SW Hall St., including the entire transit mall segment. This data is approximately 2 years old but operating conditions have not changed significantly during this time.

The shuttle is an attractive, high-amenity vehicle that operates on a street exclusively redesigned for this purpose. The 16th Street Mall has become one of downtown Denver's most attractive pedestrian areas and the epicenter of commercial and retail activity.

Service on the 16th Street Mall Shuttle is extremely frequent, especially during peak periods. Service hours are from 5:00 am until 1:30 am on weekdays, 5:30 am until 1:30 am on Saturday and 7:00 am until 1:30 am on Sunday. Maximum headways during the peak hours during the week are every 75 seconds, so the next bus is almost always in sight.

Denver has a fleet of 36 low-floor, hybrid electric buses that are used exclusively for the 16th Street Mall Shuttle. The shuttle has a peak vehicle requirement of 23, including 13 spares. The relatively high spare ratio is due to the newer hybrid electric technology. The vehicles have three wide doors for fast boarding and a convenient wheelchair ramp. The vehicles have a capacity of approximately 116, with 18 perimeter seats and 98 standees.

The 36 shuttle vehicles, purchased between late 2000 and early 2002, cost approximately $450,000 each.

Based on 2004 data, the 16th Street Mall shuttle had an annual operating cost of $8.3 million and had 65,700 annual operating hours. Over 18 million passengers rode the 16th Street Mall shuttle in 2004. Based on these figures, the annual operating cost per hour is around $126 and subsidy per passenger of $0.46.

Los Angeles – Downtown Area Shuttle (DASH)

The City of Los Angeles operates an extensive, high-frequency, low-fare shuttle system, called DASH, connecting major destinations within downtown. This shuttle system operates largely in mixed traffic with no dedicated right-of-way, but still attracts riders due to the high cost of downtown parking and the time required to drive from one parking structure to another.
As in Minneapolis, most transit service in the City of Los Angeles is operated by the regional transit agency, the Los Angeles County Metropolitan Transportation Authority. Many bus routes flow through downtown, including frequent locals, regional all-day service, and regional peak express commuter service. However, there are no fare subsidies or free zones to encourage the use of regular bus service for intra-downtown travel, and in many cases, the capacity to meet this demand is not available. Instead, DASH evolved to meet this niche.

A key point about DASH is that it responded to a localized need that was crucial to the city, but did not rank as a high priority from the perspective of the regional transit agency, given the regional mission of the latter. For that reason, the City of Los Angeles developed the service on its own, using a portion of a Countywide sales tax that was reserved for city-level initiatives. Over time, the City has developed a range of other services at its own expense, often choosing to operate services that the regional agency proposed to delete. While the resulting mixture of logos and policies can be confusing, the underlying idea is sound: Regional agencies must divide up regionwide resources to meet regionwide needs, and the result of that division is often an inadequate level of service in the densest cores. Recognizing this, Los Angeles chose to

initiate its own transit program to cover the gap between what the region could fund and what the city felt its own needs were.

The City owns a total of 63 vehicles that are used exclusively for DASH services, 53 of which are required to operate service during peak periods (a 16% spare ratio).

Annual operating costs for DASH are approximately $8.0 million with around 8.5 million annual passengers. Productivity on DASH (annual passengers divided by annual revenue hours) is around 50. The City competitively contracts out their service, and thus their cost per revenue hour of service is significantly lower than LA Metro (the regional transit provider) - $60/hour compared to $100/hour.

Washington DC (DC Circulator)

The DC Circulator system is designed to provide frequent circulation within the core area of DC, connecting with rapid transit. Service is every 5-10 minutes from 7:00 AM until 9:00 PM, seven days a week. Fares on the circulator are $1.00, lower than the standard WMATA bus/subway fares and an attractive feature for downtown circulation needs. The DC Circulator is targeted to many different user groups, including residents, downtown workers and visitors.

The DC Circulator has a fleet of 29 low-floor vehicles that are branded separately from other Washington Metropolitan Area Transit Authority (WMATA) buses. The 42 foot vehicles, manufactured by the VanHool corporation, are low floor and have three double-width doors for faster boarding. The vehicles have a seated and standing capacity of 77 passengers.

Although the DC Circulator was initiated in July 2005, it is estimated that annual operating costs will be approximately $5.5 million, annual service hours will be 103,000 and carry 1.8 million passengers annually. The estimated subsidy per passenger is around $2.80 and annual cost per hour is $53.40.

2005 and 2030 Bus Volumes

The alternatives presented in this report were shaped by the need to meet year 2030 demands for bus service through the downtown, based on projected citywide and regional transit needs. These estimates assume implementation of Bus Rapid Transit (BRT) in the 1-35W, Cedar and Bottineau Boulevard corridors, enhanced service on the existing Hiawatha LRT line, as well as construction of the Southwest light rail, Central light rail, and Northstar commuter rail projects. Without the rail projects, the volumes would be somewhat higher.

Figures 21-23 show Metro Transit's projection for 2030 bus volumes, with and without Peak Interception during the AM and PM peak hour. The tables summarize bus volumes only in the North-South direction. Bus volumes were estimated by using Metro Transit's 2030 projected transit ridership.

In Alternative A, the 20 buses/hour on Nicollet Mall represent a shuttle operating every 3 minutes. In the other two scenarios, Nicollet Mall's capacity is capped at about 50, to ensure an operating speed of at least 7 mph.

The double-width lanes on Marquette would have a capacity of about 180 in the critical PM peak. Where estimates exceed this amount, there is some indication that demand may exceed capacity. However, these overages occur only in outer years, and only during very short peaks. We recommend considering these overages as potential issues, but not as fatal flaws, since there are numerous possibilities for how these volumes could be handled by 2030.[22]

Figure 21 2030 North South Bus Volumes (Alternative A: With Peak Interception)

Corridor	Hennepin NB	Hennepin SB	Nicollet NB	Nicollet SB	Marquette NB	Marquette SB	Peak Int. NB	Peak Int. SB
AM Peak Hour								
I-35W N	0	0	0	0	6	51	0	0
I-35W S	0	0	0	0	52	12	59	0
I-394	0	0	0	0	87	13	0	14
I-94 NW	0	0	0	0	6	43	0	69
I-94 E	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	151	119	59	83
Local Svc.	58	56	20	20	48	43	0	0
Total	**58**	**56**	**20**	**20**	**199**	**162**	**59**	**83**
PM Peak Hour								
I-35W N	0	0	0	0	43	8	0	0
I-35W S	0	0	0	0	15	43	0	52
I-394	0	0	0	0	22	70	11	1
I-94 NW	0	0	0	0	46	6	65	2
I-94 E	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	126	127	76	55
Local Svc.	60	51	20	20	48	51	0	0
Total	**60**	**51**	**20**	**20**	**174**	**178**	**76**	**55**

Source: Metro Transit

[22] These possibilities, discussed in detail in the *Downtown Transit Circulation Concept*, include (a) spreading of the peak hour, which is likely but not accounted for in these estimates, (b) shifting of additional peak express demand to parallel light rail lines, and (c) the possibility that by 2030, downtown would have grown far enough east that avenues further east, such as 4th or 5th, would become appropriate alignments for certain services.

Figure 22 2030 North South Bus Volumes (Alternative B: Locals on Nicollet)

Corridor	Hennepin NB	Hennepin SB	Nicollet NB	Nicollet SB	Marquette NB	Marquette SB	Peak Int. NB	Peak Int. SB
AM Peak Hour								
I-35W N	0	0	0	0	6	51	0	0
I-35W S	0	0	0	0	111	11	0	0
I-394	0	0	0	0	99	13	0	0
I-94 NW	0	0	0	0	8	114	0	0
I-94 E	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	224	189	0	0
Local Svc.	58	56	48	42	0	0	0	0
Total	**58**	**56**	**48**	**42**	**224**	**189**	**0**	**0**
PM Peak Hour								
I-35W N	0	0	0	0	43	8	0	0
I-35W S	0	0	0	0	17	95	0	0
I-394	0	0	0	0	21	82	0	0
I-94 NW	0	0	0	0	112	8	0	0
I-94 E	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	193	193	0	0
Local Svc.	60	51	49	51	0	0	0	0
Total	**60**	**51**	**49**	**51**	**193**	**193**	**0**	**0**

Source: Metro Transit

Figure 23 2030 North South Bus Volumes (Alternative C: Locals on Marquette, some peak buses on Nicollet)

Corridor	Hennepin NB	Hennepin SB	Nicollet NB	Nicollet SB	Marquette NB	Marquette SB	Peak Int. NB	Peak Int. SB
AM Peak Hour								
I-35W N	0	0	0	0	6	51	0	0
I-35W S	0	0	0	0	111	11	0	0
I-394	0	0	50	13	49	0	0	0
I-94 NW	0	0	0	37	8	77	0	0
I-94 E	0	0	0	0	0	0	0	0
Local	58	56	0	0	48	42	0	0
Total	**58**	**56**	**50**	**50**	**222**	**181**	**0**	**0**
PM Peak Hour								
I-35W N	0	0	0	0	43	8	0	0
I-35W S	0	0	0	0	17	95	0	0
I-394	0	0	21	50	0	32	0	0
I-94 NW	0	0	29	0	83	8	0	0
I-94 E	0	0	0	0	0	0	0	0
Local	60	51	0	0	49	51	0	0
Total	**60**	**51**	**50**	**50**	**192**	**194**	**0**	**0**

Source: Metro Transit

Operating Cost Differentials

There are five elements that will result in different operating costs between the three alternatives:

- Nicollet Mall Shuttle
- Operating local routes on Marquette versus Nicollet
- Running all peak express services through downtown
- Deadhead for peak express buses
- Staging needs for peak express buses

Throughout the analysis, Alternative C (No Peak Interception; Locals on Marquette) is treated as the base scenario, and the cost incurred or saved by the other two alternatives is described relative to this baseline. The differences in operating cost are discussed below for each of the five elements.

Nicollet Mall Shuttle

Configuration:

The shuttle would operate only in Alternative A and have three different operating scenarios depending on the time of day and day of week. The purpose of this design is so that:

- Direct service between North Terminal, Nicollet Mall, and Leamington is provided during peak hours when peak commute buses are intercepted at the terminals.
- Service is provided at all hours along the length of Nicollet Mall between 3rd St and Grant, and to the Convention Center, connecting all these points to LRT and to each other.

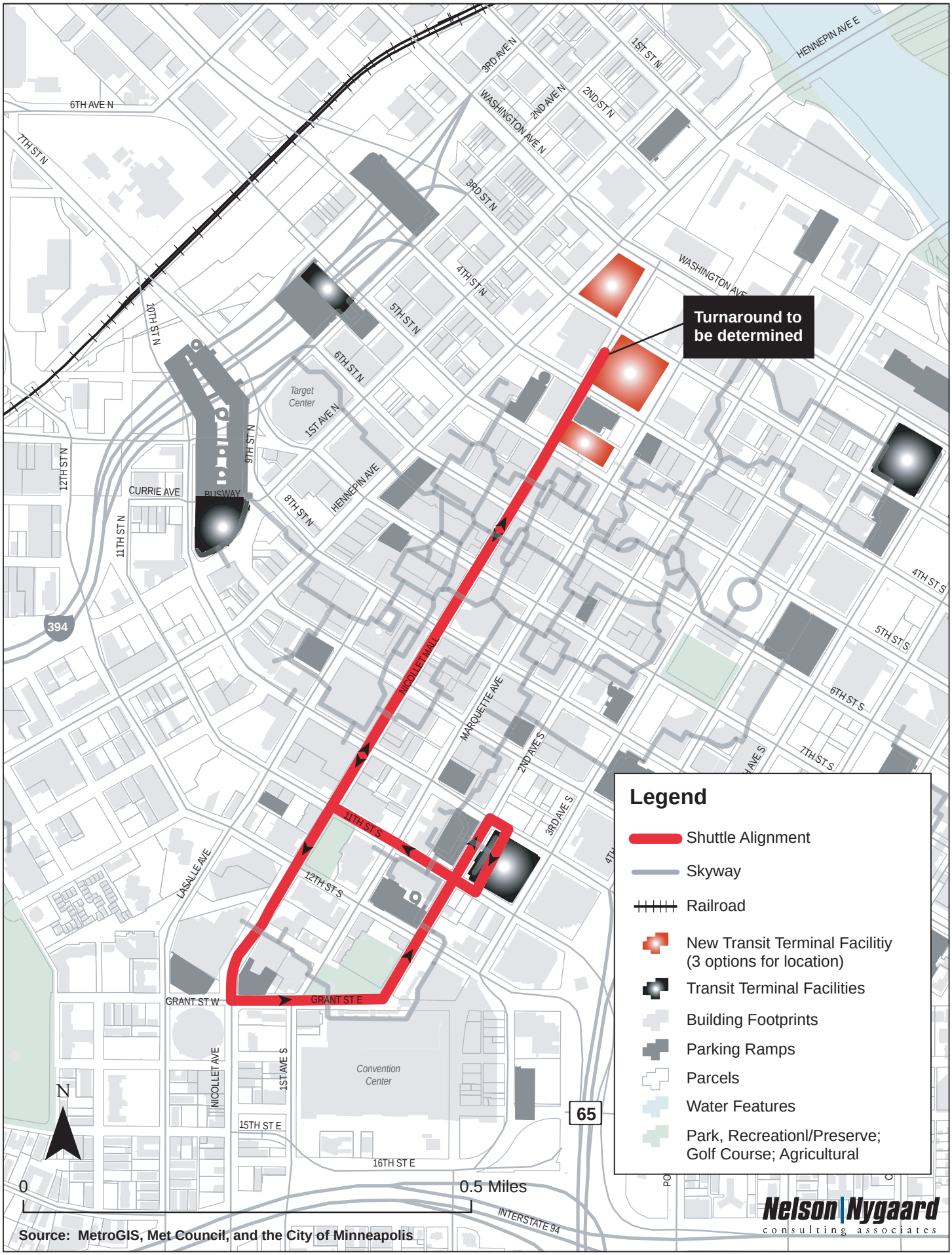
The routings are:

- **Monday-Friday, AM peak:** From North Terminal southbound on Nicollet, eastbound on Grant continue to northbound 2nd Ave S, eastbound on 10th Street to Leamington Terminal. From Leamington Terminal westbound on 11th Street, northbound on Nicollet to North Terminal.
- **Monday-Friday, PM peak:** From North Terminal southbound on Nicollet, eastbound on 10th Street to Leamington Terminal. From Leamington Terminal, westbound 11th Ave, southbound on 2nd Ave S[23] continue to Grant, northbound on Nicollet to North Terminal.
- **Monday-Friday, midday and evening and Saturday/Sunday:** From North Terminal southbound via Nicollet, eastbound on Grant, northbound on 2nd Ave S to 12th Street S, northbound on Nicollet to North Terminal. No service would be provided to Leamington during off-peak periods.

These routings are shown in Figures 24, 25 and 26 on the following pages.

[23] The left turn from 11th Street westbound to 2nd Avenue S southbound would be difficult under current circumstances. To achieve this turn may require a special signal

Figure 24: Nicollet Mall Shuttle Configuration, AM Peak Period, Mon-Fri



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

Nelson|Nygaard consulting associates

Figure 25: Nicollet Mall Shuttle Configuration, PM Peak Period, Mon-Fri

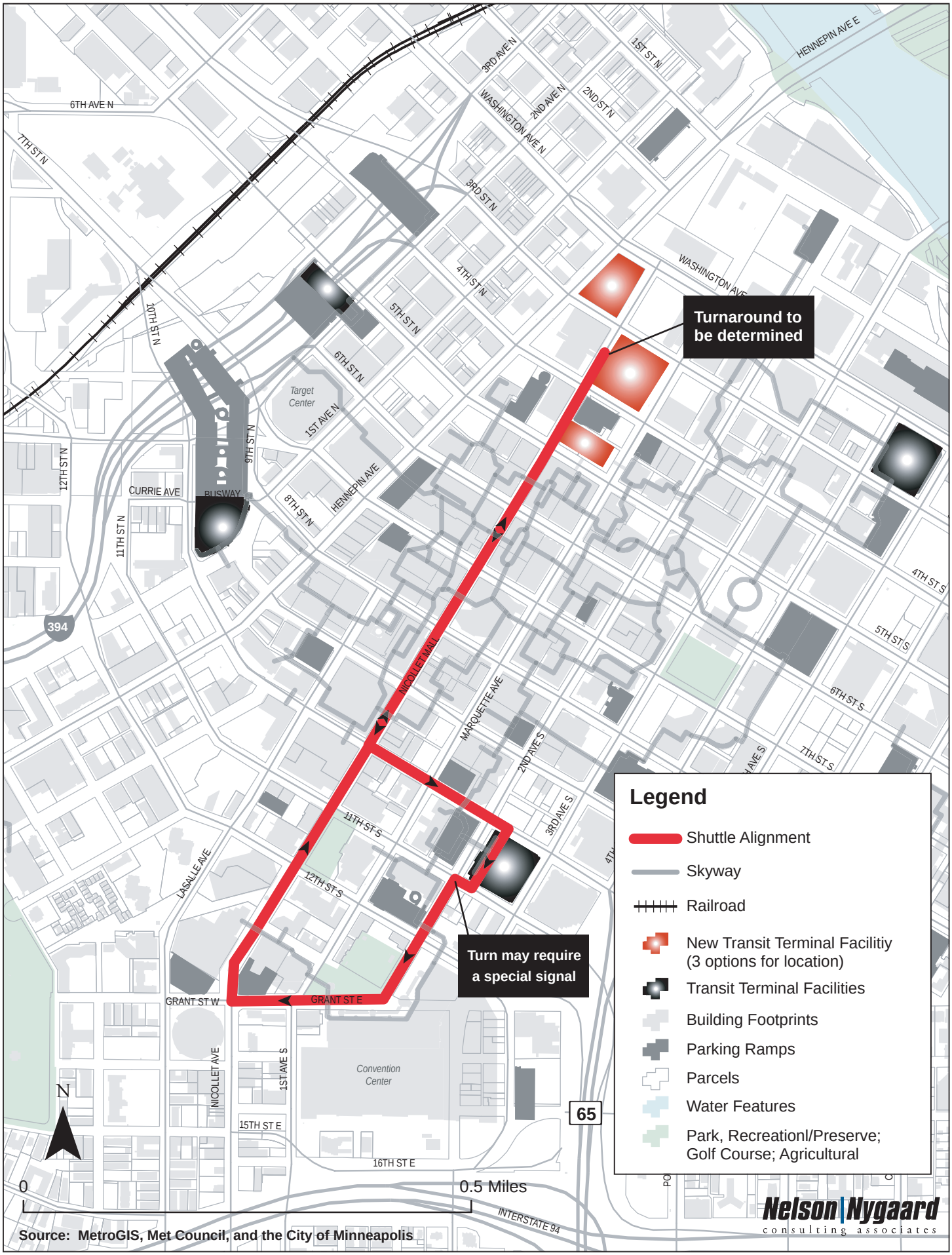
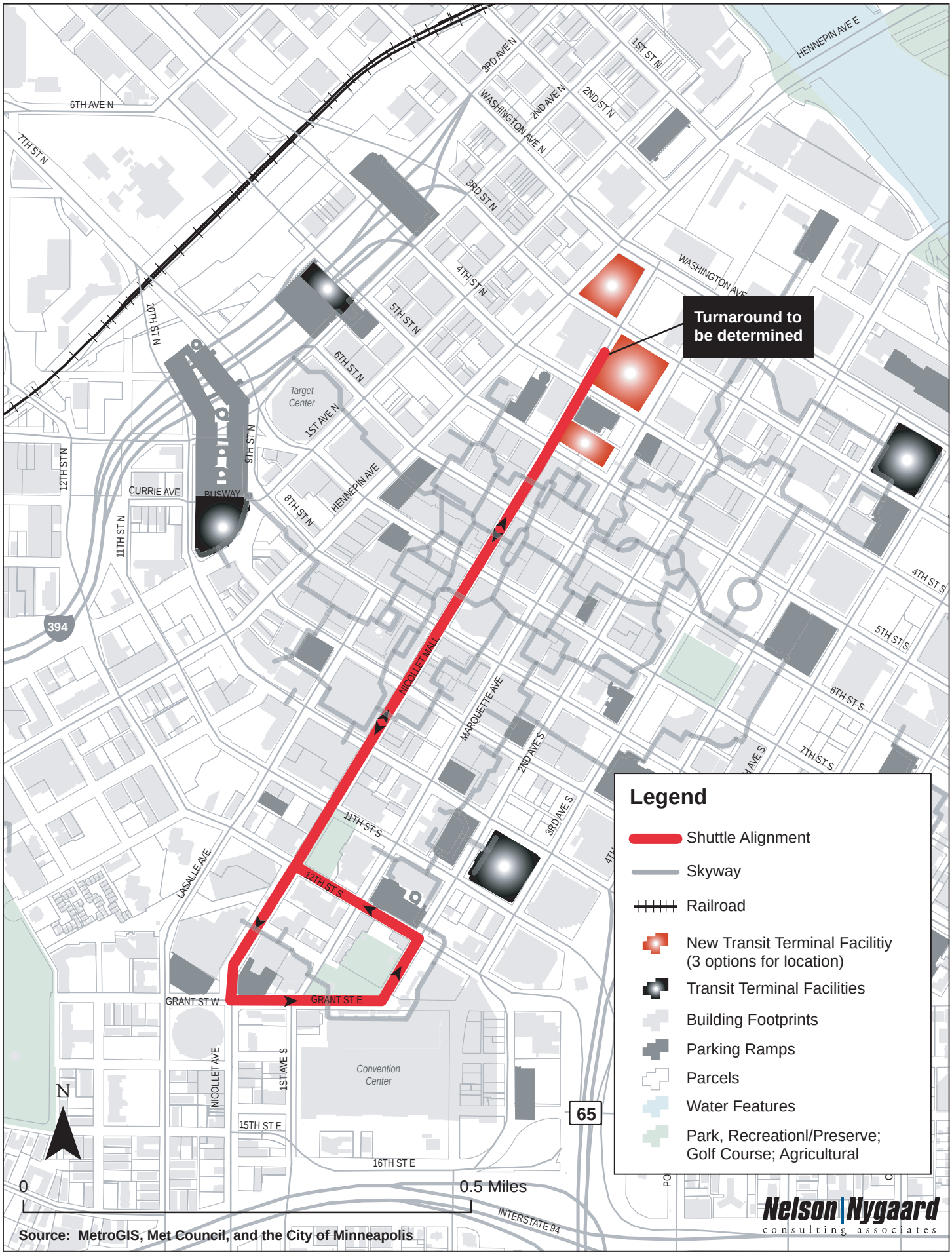


Figure 26: Nicollet Mall Shuttle Configuration, Midday, Evening and Weekend



Shuttle Frequency

To determine the appropriate frequency of the shuttle, several issues needed to be considered:

- The likelihood that peak express riders would use a Nicollet Mall shuttle in the downtown area.
- The estimated number of peak express commuters intercepted at the two terminals.
- Circulation needs from other users along Nicollet Mall, including users of the Convention Center and hotels near the south end Nicollet.

From the point of view of peak express commuters, the shuttle must be so frequent that it makes the transfer as seamless as possible. In other words, the shuttle must be so frequent that during peak periods, the next shuttle is almost always in sight. For comparison purposes, frequencies of the 16th Street Mall shuttle in Denver are based its signal cycles of every 75 seconds during peak periods.

As noted in earlier sections of this report, a couple of main differences exist between downtown Denver and Minneapolis:

- Employment concentrations in downtown Minneapolis are not as linear as in Denver. The 16th Street Mall in Denver cuts directly through the heart of the downtown, and the concentration of employment in Denver generally follows this street. While Nicollet certainly bisects the core of downtown Minneapolis, a significant amount of employment is also concentrated between Marquette and 4th Ave S, especially along 6th and 7th Streets.
- The extensive skyway network in Minneapolis is another very important distinction between the two cities. Especially during winter months, Minneapolis' skyway network provides a comfortable, climate-controlled walk to many of the major employment centers in downtown. Denver has no such skyway network. It is assumed for the purposes of this analysis that the North Terminal will have a direct skyway connection similar to the Leamington Terminal.

To determine the appropriate shuttle frequency, a detailed analysis was conducted to determine the likelihood of walking versus using the shuttle from each of the terminals. This analysis is summarized below:

1. A number was assigned to every block in downtown Minneapolis (bounded by I-94, I-35 W North, the Mississippi River and Plymouth Avenue). Only blocks in this area that had significant employment were included. Although this is a larger market area than is likely for peak express commuters, about 85% of the employment in downtown Minneapolis is located within ¼ mile radius of either the shuttle alignment or both terminals.
2. It was then estimated how likely it was for peak express users intercepted at each terminal to use a shuttle versus walking. The estimated percent of shuttle users was assigned to each block (e.g., 80% shuttle, 20% walk). This was done by adhering to several criteria:
    - If the block was within 1/8 of a mile from either terminal, regardless if it was directly adjacent to the shuttle route, it was assumed that all peak express users would walk.
    - If the block was clearly out of direction of the shuttle, it was assumed that all users would walk.

- If the block was beyond 1/8 of a mile from either terminal, and the shuttle would be a possible choice, the distance between the block and the shuttle alignment was then compared with the distance between the block and the terminal. The *time* was then calculated between taking the shuttle[24] versus walking[25]. If the time differential was approximately the same, a value of 50% shuttle, 50% walk was assigned to that block. If there was a skyway connection from the terminal to the block, and the time differential was the same, it was assumed that walking would be more attractive for most users (e.g., 40% shuttle, 60% walk).

3. The square footage of retail and office space per block was used to estimate employment by block. For retail, the ratio was one employee to every 750 sq. ft. of net leasable space. For office, the ratio was one employee to every 250 sq. ft. of net leasable area.

4. The percentage of potential shuttle users per block (from step 2 above) was then multiplied by the total number of employees in that block (step 3). The total number of employees that were likely to use the shuttle was then added up and divided by the total number of employees in the downtown area. From the Leamington Terminal, the estimated percent of peak express users who would choose the shuttle was estimated at 45%. This figure was slightly lower for the North Terminal, and therefore 45% was the chosen factor.

The next step was to estimate the number of commuters who would be intercepted at each terminal in 2030. This was done by simply multiplying the maximum number of buses intercepted during the AM peak hour by an estimated average load of 45. At the Leamington Terminal, 59 buses were intercepted in the peak hour and at the North Terminal, 83 buses were intercepted in the peak hour. This resulted in approximately 2,700 commuters intercepted at Leamington and 3,700 commuters intercepted at the North Terminal. These figures were then multiplied by 45% to get an estimate of the number of peak express users who would use the shuttle. For the Leamington Terminal and the North Terminal, these figures are approximately 1,200 and 1,700 respectively.

Assuming the Nicollet Mall shuttle uses the same type of vehicles as those used in Denver, the shuttle capacity would be approximately 115 passengers (seated and standing). If we assume 1.5 minute frequencies on the shuttle, this equates to 40 buses per hour from each terminal, or a total hourly capacity of 4,600. Even using the terminal with a higher number of intercepted passengers per peak hour (North Terminal), this frequency far exceeds the needed capacity to handle the peak intercepted passengers. Therefore, if we assume three minute frequencies, still an attractive headway (amounting to a bus every second signal cycle), the total capacity is much more in line with the needs of peak interception.

[24] Assuming 1 ½ minute frequencies and an operating speed of 8 mph. This frequency was chosen because it is the maximum frequency that would be likely in Minneapolis. This is also the approximate frequency of the 16th Street Mall shuttle in Denver. This approach, then, produced a high estimate of shuttle use along the Nicollet Mall.
[25] Assuming a walking speed of approximately 3 mph.

Frequency, Vehicles and Hours of Operation:

Based on the analysis above, it is proposed that from 6:00 am until 6:30 pm, the frequency of the shuttle be every three minutes. **Figure 27** below shows the proposed days and hours of operation for the shuttle with corresponding service frequencies. It should be noted that the service span and service frequency are comparable to that of the 16th Street Mall Shuttle in Denver, except that peak frequencies are about half of those in Denver. It is also assumed that operating speed on the Nicollet Mall is similar to Denver's 16th Street Mall – around seven miles per hour.

Figure 27 Summary of Nicollet Mall Shuttle Service Characteristics

Days and Hours of Operation	Avg. Service Frequency (min.)	Number of Buses	Annual Service Hours*
M-F: 5:00 am – 5:30 am	10	3	383
M-F: 5:30 am – 6:00 am	5	5	638
M-F: 6:00 am – 9:00 am	3	9	6,885
M-F: 9:00 am – 3:30 pm	3	9	14,918
M-F: 3:30 pm – 6:30 pm	3	9	6,885
M-F: 6:30 pm – 7:00 pm	4	7	893
M-F: 7:00 pm – 9:00 pm	5	5	2,550
M-F: 9:00 pm – 11:00 pm	8	4	2,040
M-F: 11:00 pm – 12:30 am	10	3	1,148
M-F: 12:30 am – 1:30 am	20	2	510
Deadhead time:			3,856
M-F Service Hours:			*40,706*
Sat/Sun: 6:00 am – 8:00 am	15	2	440
Sat/Sun: 8:00 am – 6:00 pm	5	5	5,500
Sat/Sun: 6:00 pm – 10:00 pm	8	4	1,760
Sat/Sun: 10:00 pm – 12:00 am	15	2	440
Deadhead time:			1,016
Sat/Sun Service Hours:			*9,156*
Annual Service Hours:			***49,862***

* Estimated using 255 weekdays (M-F) and 110 weekend days (Sat & Sun).

Estimated Operating Costs:

The cost of operating and maintaining a shuttle vehicle would likely be higher than Metro Transit's fully allocated cost per platform hour of $93.70. The cost of operating the 16th Street Mall Shuttle in Denver (Regional Transit District – RTD) is approximately $126 per platform hour. This compares to $120 per platform hour for that agency's local, regional and express bus

operations[26]. In other words, the operating and maintenance cost of the Denver shuttle is approximately 5% higher than for regular bus operations in the same system.

Metro Transit's loaded operating cost per platform hour is $93.70, so a good estimate is that shuttle operations will be 5% higher, or $98.39. Annual operating costs would therefore be 49,862 hours/year x $98.39/hour, or about $4,906,000 per year.

Running Local Buses via Marquette Versus Nicollet.

Some operating costs will be saved in Alternatives A and C by running local lines via the double-width transit lanes on Marquette rather than on Nicollet. For the purposes of this analysis, operating speeds on both streets are assumed to be the same by 2030 (8 mph). **Figure 28** below estimates the number of minutes saved per bus line, and how that translates to service hours as well as the estimated difference in operating costs in 2030. Overall, operating local lines on Marquette versus Nicollet could save approximately $38,800 annually. Therefore, the operating cost differential between the alternatives is that Alternative A and C are the same (no difference) and Alternative B would cost $38,800 / year more than Alternative C.

Figure 28 Estimated Annual Cost of Running Local Buses on Nicollet versus Marquette (Alternative B only, compared to Alternative C)

Route	Time Difference (minutes/round trip)	Annual Service Hours*	Annual Cost**
10	+ 2.6	+ 2,691	+ $192,100
11	0	0	$0
17	+ 0.7	+ 625	+ $44,700
18	-1.7	-2,773	-$198,000
Total		**+ 543**	**+ $38,800**

* Estimated using 255 weekdays (M-F) and 110 weekend days (Sat & Sun).
** Using Metro Transit's marginal cost per platform hour of $71.40[27].

Peak Express Buses Running In-Service through Downtown

Operating costs are saved only in Alternative A when some peak express buses are intercepted at the two terminals, because it makes these express lines slightly shorter. For the purposes of this analysis, routes that are intercepted in Alternative A are assumed to have otherwise run through downtown to end at the opposite terminal. For example, we assume that I-35W South buses would be intercepted at Leamington with Peak Interception (Alternative A), while without Peak Interception (Alternatives B and C) they would run through downtown and end at North Terminal. The time saved, then, is the travel time between the two terminals, times the number of daily bus trips affected.

[26] Based on 2004 operating data available from RTD.
[27] A marginal cost per platform hour was used to estimate costs because there would not be significant savings in overhead, administrative and maintenance costs as a result of these changes.

Figure 29 shows the total number of buses that terminate at each of the two terminals during the AM and PM peak period and the cost savings associated with not traveling across downtown.

Figure 29 Estimated Annual Costs of Not Running Some In-Service Peak Express Buses Through Downtown (Alternative A only, compared to Alternative C)

Terminal	Intercepted Buses – AM and PM peak periods (2030)*	In-service distance between terminals (each direction)	In-service minutes between terminals (each direction)**	Estimated Annual Service Hours***
Leamington	274	0.75 miles	5.6 min	- 6,552
North Terminal	404	0.75 miles	5.6 min	- 9,647
Total				**- 16,198**

* All day intercepted bus volumes have been estimated by using the ratio of all buses entering downtown during the peak hour to all buses entering downtown for AM and PM periods.
** Estimating optimal operating speed in 2030 of 8 mph.
*** Estimated using 255 weekdays (M-F). No buses are intercepted on the weekends.

Assuming Metro Transit's marginal cost per platform hour of $71.40, this results in an annual cost savings of approximately **$1,156,600**.

Deadhead for Peak Express Buses

As with in-service peak express buses traveling across downtown, operating costs are saved in Alternative A (Peak Interception) as a result of not needing to deadhead across downtown. The cost savings lie in the time it would take peak express buses to deadhead to and from the opposite end of downtown at the beginning and end of their trips. Because this depends on garage location and the exact routing of each corridor, we have estimated this time savings to be approximately ½ of the in-service time (since these vehicles are operating non-stop) via the most direct streets.

Based on the figures above, the estimated cost savings are approximately 8,056 annual service hours, or an annual operating cost savings of approximately $578,300.

Staging Needs for Peak Express Buses

In the PM peak period only, outbound peak express buses need a scheduled break of five minutes at the beginning of their outbound run. This "staging" period gives time to recover from delays incurred deadheading to that point from the garage (or from a previous piece of work).

For the purposes of this analysis, we have assumed that buses go into service at Leamington or North Terminal regardless of the alternative, and that they would stage as close to these facilities as possible. Although operating costs will increase as a result of additional staging facilities away from these two terminals, this would not have a differential cost impact when comparing the three alternatives. Additional staging space does have a capital impact, but again, these

impacts are assumed to be held constant between the alternatives (see Capital Cost Differentials discussion below).

Summary of Operating Cost Differences

As shown **Figure 30** below, when Alternative C (No Peak Interception; locals on Marquette) is the base scenario, a comparison shows that operating costs for the Alternative A (Peak Interception) would be an additional $3.2 million per year compared to the Alternative C while Alternative B would cost about $38,000 more than Alternative C. The huge operating cost difference between Alternatives A and C is largely a result of the operating costs associated with the Nicollet Mall shuttle, about 35% of which is offset by cost savings on other bus operations resulting from the Peak Interception alternative.

Figure 30 Summary of Operating Cost Differences

Element	**Cost of Alternative A (compared to Alternative C)**	**Cost of Alternative B (compared to Alternative C)**
Nicollet Mall Shuttle	$4,906,000	$0
Local Routes on Marquette versus Nicollet	$ 0	+ $38,800
Peak Express Buses Running Through Downtown	- $1,156,600	$0
Deadhead of Peak Express Buses Through Downtown	- $578,300	$0
Staging Needs	$0	$0
Total	**+ $3,171,100**	**+ $38,800**

Capital Cost Differentials

Several capital elements were evaluated to determine the differential costs between the three alternatives:

- North Terminal facility
- Modifications to Leamington Terminal
- Vehicle costs
- Nicollet Mall passenger amenities, stops, etc.
- Shuttle maintenance and storage facilities
- Off-street staging needs
- Marketing costs

As with the evaluation of operating cost differentials, Alternative C (No Peak Interception; Locals on Marquette) is treated as the base scenario. The differences in capital costs between the three alternatives are discussed below.

North Terminal Facility

For the purposes of this evaluation, it is assumed that a North Terminal transit facility is required regardless of the alternative near the north end of the Nicollet Mall (with the preferred location between Nicollet and Marquette). This assumption has been made for the following reasons:

- To ensure an on-time departure, staging facilities are assumed for all peak express vehicles. This would occur for all three alternatives where expected bus volumes in the double-width lanes will be at or near their maximum capacity by 2030[28]. For these reasons, a staging facility on the north end of downtown that is as close as possible to the entry point of the double-width lanes is critical. Regardless of the alternative, Leamington Terminal would serve this function on the opposite end of downtown and thus, a similar arrangement is assumed at the north end.
- 2030 bus volumes in downtown will require additional staging and layover facilities (beyond what is currently available at existing facilities). Assuming a five minute staging time per bus, and the need for approximately 300 PM peak hour buses in both directions just in the North-South direction (see Figures 4-6), this requires approximately 25 separate staging berths for vehicles traveling just in the North-South direction. If we look at volumes during the peak 15 minute period, staging needs are likely as high as 31 berths.

[28] In Alternative A, PM peak hour volumes in the double-width transit lanes are 174 in the southbound direction and 178 in the northbound direction. In Alternative B, PM peak hour volumes in the double-width transit lanes are 193 in the southbound direction and 193 in the northbound direction. In Alternative C, PM Peak hour volumes in the double-width transit lanes are 194 in the southbound direction and 192 in the southbound direction. See Figures 4-6.

- If Peak Interception does occur (Alternative A), during the peak 15 minute period during the PM peak hour[29], eight bus berths are required. In addition, an at-grade facility would be required where a shuttle could board and alight passengers and layover.

Although the North Terminal facility is assumed for all three alternatives, only Alternative A (Peak Interception) would require enhanced passenger amenities and boarding and alighting berths below grade, similar to the Leamington Terminal facility. The major cost differential between the alternatives, therefore, is the cost required to modify North Terminal to include passenger waiting facilities[30] and boarding/alighting berths.

It was also assumed that the North Terminal facility would be constructed to accommodate other uses above it that would be on the same site, and thus the cost of land and costs associated with uses above the facility did contribute a differential cost.

The cost differential for North Terminal between Alternative A and the other two alternatives is discussed below:

Capital Cost Estimate for North Terminal

In 2003, the City of Minneapolis acquired a cost estimate to construct a transit facility on the Old Nicollet Hotel block (bound by 3rd, Washington, Nicollet and Hennepin). This proposed facility, with a footprint of approximately 90,000 square feet, included an underground transit layover facility with four optional layouts (including as many as 24 standard bus berths and 2 articulated bus berths). Spanning the facility between 3rd Street and Washington were 2-3 at-grade, one-way lanes (with layover space similar to the Leamington Terminal) with an entry ramp to the sub-grade close to Washington and an exit ramp from the sub-grade close to 3rd Street. The facility also included an at-grade passenger waiting area, driver break rooms, stairs and elevators.

In 2003 dollars, the estimated capital cost to construct this facility was approximately $8.15 million. Assuming an annual inflation rate of 4%, the estimated 2006 cost to construct the facility is approximately $9.13 million. Because the North Terminal is assumed between Nicollet and Marquette, the facility would be somewhat larger than the Old Nicollet Hotel block. A standard city block in downtown Minneapolis is 330 ft. x 330 ft., or a footprint of approximately 109,000 square feet. Based on the estimate of a transit facility on the Old Nicollet Hotel block of $9.13 million, and a footprint of 90,000 square feet, this is a cost per square foot of approximately $101.45. However, recent trends in the cost of oil, steel, concrete and labor would likely make construction costs higher than this. For the purposes of this analysis, the estimated construction cost is increased to $175 per square foot. Applying this estimated cost ($175/square foot) to a standard city block (109,000 square feet), we get an estimated cost for a North Terminal facility between Nicollet and Marquette of $19.1 million.

[29] The peak 15-minute period during the PM peak hour is the maximum number of buses that will be intercepted at a north terminal facility. During the peak PM hour, 76 vehicles are intercepted. Metro Transit assumes that the peak 15 minute period accounts for 1/3 of those vehicles (or about 25 vehicles). Assuming a five minute layover/boarding time per bus berth, each bus berth can handle 3 buses during a 15 minute period. So with 18 vehicles during the peak 15-minute period, this results in the need for 8 bus berths.

[30] These facilities include a climate controlled waiting area at grade and below-grade, stairs, elevator and escalators to the below grade boarding/alighting area, a driver break room, bathrooms, signage, ventilation, etc.

As discussed above, the cost difference between the three alternatives is that Alternative A would require an enhanced at-grade and below-grade passenger waiting facility along with below-grade boarding/alighting berths (similar to the Leamington facility). Since the cost estimate developed in 2003 for the North Terminal did not include these enhanced amenities, the estimated construction cost is increased to $200 per square foot. Applying this estimate to a full city block (109,000 square feet), we get a cost of approximately $21.8 million.

The cost differential, therefore, for a North Terminal facility with enhanced passenger facilities is approximately $2.7 million ($21.8 million minus $19.1 million). This additional cost would only be required for Alternative A.

Modifications to Leamington Terminal

There are several modifications that would need to be made to Leamington Terminal to accommodate higher volumes of vehicles. These capital costs would be required only for Alternative A (Peak Interception) and include:

- Signal priority needs to enter/exit facility onto 3rd Ave S
- Improved signal or communication system within lower level to manage significant increase in bus volumes through the facility.

It is estimated that a mid-block signal into and out of the facility would cost $150,000. The estimated cost for improved signal or communication system would be $200,000.

Vehicle Costs

In Alternative A (Peak Interception), it is assumed that Denver-style hybrid CNG/electric shuttles would be used. Based on the discussion above regarding operating costs, it is assumed that a maximum of nine in-service vehicles are required for the shuttle. Assuming a 25% spare ratio, this brings the total number of required shuttle vehicles to 13. Based on Denver's purchase in 2002, at a cost of $450,000 per vehicle, it is estimated that in 2006 dollars, each vehicle would cost approximately $500,000. This results in a total cost of $6.5 million.

Alternative B (No Peak Interception; Locals on Nicollet) assumes that the local routes 10, 17 and 18 would provide service on the Nicollet Mall, creating a high-frequency (every 2-3 minutes during peak hours) connection between Grant and Washington. A marketing and information campaign would make it clear that any bus coming along Nicollet Mall can be used for circulation along the Mall's entire length.

Although not a requirement of Alternative B, one of the *recommended* elements of operating local routes on Nicollet is that their propulsion system be environmentally friendly and as quiet as possible. Based on Metro Transit's past experience, it is assumed that these vehicles would be hybrid diesel/electric.

Hybrid vehicles are not shown as a *necessary* part of Alternative B, because in this scenario a shift to hybrids on Nicollet Mall requires converting a significant amount of fleet to hybrids, so

as to affect all of the routes serving the mall. Such a conversation would clearly be done for reasons extending beyond the Nicollet Mall environment, and would involve much larger costs and benefits than what this study can capture.

Should hybrid/electric vehicles be desired, it is estimated that in 2030 a total of 90 vehicles will be required to operate Routes 10, 17 and 18. Assuming a spare factor of 25%, the total number of new hybrid diesel/electric vehicles that would be required is 113. 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. Therefore, the estimated differential capital cost to purchase hybrid diesel/electric vehicles for the local routes 10, 17 and 18 is $20.3 million (113 x $180K).

Alternative C would not have any capital costs associated with vehicle purchases.

With Alternative C as the base scenario, the capital cost differential between Alternatives A and C is +$6.5 million. There is no vehicle cost differential between Alternatives B and C.

Passenger Amenities on Nicollet (and 2nd/Grant in Alternative A)

In Alternatives A and B, there will be the need for enhanced passenger amenities along the Nicollet Mall – including shelters, bus stop signs and marketing information (maps and general information). These elements are discussed separately below:

Shelters and Passenger Amenities

For all alternatives, it is assumed that the existing shelters along the Nicollet Mall will be used. Currently, there are 10 shelters on the Mall (five in each direction). These shelters are located roughly every two blocks at 5th, 7th, 9th, 11th and 13th. In all three alternatives, the North Terminal is considered to be a good northern terminal and would include shelter from the elements. Likewise, the Leamington Terminal already includes several at-grade bus berths that provide overhead shelter. In Alternative A, however, the shuttle would travel in front of the Convention Center on Grant in both directions, requiring some sort of shelter. Although a Nicollet Mall style shelter could be constructed, it is recommended that a shelter be considered that is somewhere between a standard Metro Transit shelter and the Nicollet Mall style shelter. Based on an estimated cost of a Nicollet Mall style shelter at $200,000, and a standard Metro Transit shelter around $5,000, an estimated cost of $25,000 per shelter was chosen. This would result in an additional $50,000 for Alternative A over the base Alternative C.

For all three alternatives, it is assumed that 10 additional shelters would need to be provided along Marquette (five in each direction), similar in size and cost to those proposed in front of the convention center. Because this is assumed for all alternatives, there is no differential associated with this cost.

Bus Stop Signs

Although there would need to be three additional bus stops (two in front of the Convention Center and one at the Leamington Terminal) in the Alternative A, it is assumed for this analysis

that the cost differential would be negligible. Likewise, there would be negligible costs associated with additional stop signs on Marquette versus Nicollet for Alternative C.

Maintenance and Storage Facilities

In Alternative B and C, the number of vehicles that Metro Transit must store and maintain remains the same, regardless if the local lines are operated on the Nicollet Mall or not. Based on conversations with Metro Transit staff, the cost differential between maintaining and storing hybrid diesel/electric vehicles versus standard diesel vehicles is negligible.

In Alternative A (Peak Interception), a total of 13 hybrid CNG/electric vehicles (similar to those used in Denver) would also need to be stored and maintained. Although there are likely differences in how these vehicles are stored and maintained (compared to standard diesel vehicles), the operating cost estimates used above account for this difference. Based on discussions with Metro Transit, no additional facilities will be required for an additional 13 vehicles, and therefore a negligible difference in capital costs.

Off-Street Staging Facilities

In all three alternatives, the 2030 growth in peak express vehicles would require additional staging facilities to ensure an on-time departure. Ensuring an on-time departure is a critical component to managing volumes both in the terminals (Alternative A) and/or double-width transit lanes (all three alternatives). Because we are assuming that adequate staging facilities would be required in either case, and staging needs are the same, there is not a capital cost differential between the three alternatives.

Marketing Materials

In all three alternatives, it will be imperative to convey the message that any bus operating on the Nicollet Mall (or Marquette for Alternatives A and C) can be used for circulation between Grant and Washington. Therefore, for this analysis, it is assumed that the costs to produce marketing materials and passenger information about downtown circulation will be negligible between the alternatives.

Convention Center Gateway Pedestrian Connection

A critical element of all three alternatives is that they provide north-south circulation within downtown. Since the Convention Center is one of the main attractions in downtown Minneapolis, a priority of all alternatives was to connect the core of downtown, and the LRT station, with the Convention Center. The shuttle in Alternative A accomplishes this (see Figures 7-9) as does Alternative C, which provides service on Marquette (which is a short walk through the plaza in front of the Convention Center). Only Alternative B, which provides local service along Nicollet, does not *directly* serve the front door of the Convention Center.

Therefore, in Alternative B only, the pedestrian connection between the local routes on Nicollet and the Convention Center was seen as a necessary capital project. The most logical street to make this connection is 13th Street South. Pedestrians on Nicollet have two choices of reaching the Convention Center: 1) walk along the street or 2) use the skyways (which connect to the

Convention Center). The street is the most direct route but lacks the character desired for a "gateway" to the Convention Center. In addition, access to the skyway from 13th Street/Nicollet is only through adjacent buildings (such as the Hyatt Regency Hotel), which is not a convenient or intuitive connection. Therefore, a connection from the street to the skyway was seen as an important element.

Order of magnitude costs for these additional facilities were estimated based on similar projects that have been recently been completed in downtown. The project includes the following elements:

- Two-way escalator; elevator; stairs: $820,000
- Removal of old street, curb, gutter, sidewalk, etc: $85,000
- New construction of street, curb, gutter, sidewalk, etc: $278,000
- Landscaping: $130,000
- Public Art: $60,000

All of these elements combined results in an order-of-magnitude estimate of $1.4 million. Again, this cost would only be applied to Alternative B.

Summary of Capital Cost Differences

Figure 31 below shows the cost differences between the alternatives, assuming Alternative C is the base scenario. The major capital cost difference derives from the cost of shuttle vehicles in Alternative A. Because of the cost differential of purchasing shuttle vehicles, Alternative A is clearly the most expensive option. Alternative B is less expensive than Alternative A but significantly more than Alternative C because of the cost of the Convention Center gateway project.

Figure 31 Summary of Capital Cost Differences

Element	**Cost of Alternative A (compared to Alternative C)**	**Cost of Alternative B (compared to Alternative C)**
North Terminal	+ $2.7 million	$0
Modifications to Leamington Terminal	+ $350,000	$0
Vehicle Costs	+ $6.5 million	$0
Passenger Amenities: Shelters Bus Stop Signage	 + $50,000 $0	 $0 $0
Maintenance and Storage Facilities	$0	$0 $0
Off Street Staging Facilities	$0	$0
Marketing Materials	$0	$0
Convention Center Gateway	$0	+ $ 1.4 million
Total	**+ $9.6 million**	**+$ 1.4 million**

Comparison of Service Quality

From the standpoint of service quality, the alternatives are more similar than different, with the major exception of the impacts of peak interception on commuters.

- All transit service in the north-south direction is concentrated on Nicollet and Marquette, providing direct access to the core and to the Nicollet Mall LRT station.
- High-frequency north-south circulation within the downtown core, via either Nicollet Mall (Alternatives A and B) or Marquette (Alternative C).
- Clean-fueled vehicle operation along Nicollet Mall (except for peak-period service in Alternative C).
- All service should be able to average at least 7 mph.

The primary service quality differences are as follows:

- Impact on Peak Commuters.
- Centrality of Local Services to the Core

Impact on Peak Commuters

Peak Interception Delay

For peak express commuters who now have direct service to the core, Peak Interception (Alternative A) will be perceived as a significant inconvenience.

- The transfer itself is an inconvenience, regardless of the travel time. Passengers continuing to destinations outside of downtown are likely to experience this as a second transfer. For example, an inbound commuter destined for the University of Minnesota would have a one-transfer trip converted to a two-transfer trip.
- Total travel time will increase by an average of 5 minutes each direction. This estimate is based on the configuration of Leamington terminal, but practical configurations of a new North Terminal are likely to have a similar impact. The estimated 5-minute delay is composed of the following, described from the point of view of an inbound trip in the morning:
    - 0.5 minute for the inbound commute bus's out-of-direction movement into the underground terminal
    - 2.5 minutes for the time to alight the bus and walk to the shuttle boarding area.
    - 1.5 average waiting time for the shuttle
    - 0.5 minute for the shuttle to depart the terminal and proceed in the commuter's intended direction.

The only compensation for this impact is that the Leamington and North Terminals will provide weather protection for commuting passengers on peak express services. This convenience is will take two forms:

- The Skyway system will provide a weather-protected pedestrian access between the terminal and the core.
- While passengers outbound in the afternoon will have to wait outdoors (or in semi-outdoor shelter) on Nicollet Mall, they will have a brief wait because they can board the next shuttle bus rather than waiting outdoors for their specific commute bus. Once at the terminal, they will have a weather-protected environment to wait for their bus.

A peak interception proposal is likely to be greeted positively by a segment of the existing commuting public, but very negatively by others. Those who currently use the service have accepted the necessity of waiting outdoors for it, and many will not see the weather protection as adequate compensation for a required transfer and 5-minute increase in travel time. Of course, these constituents mostly live outside Minneapolis, so their objection is likely to be registered at the Metropolitan Council level, rather than that of the City Council. Metropolitan Council acceptance is necessary for any service alignment, so this is an important consideration.

Nicollet vs Marquette Alignment

In the two scenarios where peak express service continues into downtown, the alignment differs. Alternative C assigns some peak express service to Nicollet, while Alternative B assigns all of it to Marquette.

Nicollet and Marquette are equally central to the office core, so both alignments are equally advantageous to peak commuters generally, though individuals will express strong preferences one way or the other.

Impact on Local Service, Primary Transit Network

Local service, including the crucial Primary Transit Network which forms the backbone of the city's transit system, is assigned to Nicollet in Alternative B, and Marquette in Alternatives A and C.

This service category is about all-day mobility, not just the peak period. While Nicollet and Marquette are equally central to the office core which drives the peak-period market, the centroid of all-day activity – particularly major retail – is mostly to the west of Nicollet. From this standpoint, Nicollet is preferable as a means of bringing the Primary Transit Network to the very center of the 18-hour city.

Centrality to the core of all-day activity (Nicollet and Hennepin) will also have an impact on perceived safety and security of using the local routes. In other words, the more "eyes on the street," the better the sense of security from the passenger's point of view. In this case, Alternative B is judged preferable because local services and local circulation are both on Nicollet. Alternative A is also judged good because local circulation is on Nicollet and the local

services are on Marquette. Alternative C is viewed as a less desirable alternative in terms of security and safety because local services and local circulation are both on Marquette.

North-South Intra-Downtown Circulation

The alternatives differ only slightly in the frequency of the all-day circulation provided. Alternative A's shuttle provides a consistent 3-minute headway all day. Where combined local routes are used for this circulation (Alternatives B and C), the net headway will generally be 2-3 minutes during peak periods and no worse than 5 minutes during the midday.

The alignment of the north-south circulation function is obviously different: Nicollet in Alternatives A and B, Marquette in Alternative C. Again, since this is an all-day market, Nicollet must be judged preferable in this regard, especially since it serves front doors of more key destinations. However, the practical needs of north-south circulation could be met on Marquette in the manner of Alternative C.

Conclusion

Figure 32 presents an overall comparison of each of the three alternatives, including major operational differences and capital and operating cost estimates. As noted throughout this analysis, Alternative C is considered the base scenario, and costs associated with Alternatives A and B are compared against Alternative C.

Overall, Alternative A (Peak Interception and Nicollet Shuttle) is the most expensive alternative in both operating and capital terms. Capital costs for Alternative B are clearly higher than Alternative C but operating costs are nearly identical between the alternatives. From a service quality standpoint, all of the alternatives produce benefits and disbenefits for certain groups, but none is vastly superior overall. All of the alternatives achieve the primary goals of accommodating both regional and intra-downtown travel, with emphasis on frequent north-south circulation between the Nicollet Mall LRT station and the Convention Center.

Figure 32 Comparison of Alternatives

Element	Alternative A: (Peak Interception with Nicollet Mall Shuttle)	Alternative B: (Local Services on Nicollet; No Peak Interception)	Alternative C: (Local Services on Marquette; No Peak Interception)
Service Characteristics			
Bus service on Nicollet	Shuttle only, all day (hybrid vehicles)	Local routes all day (hybrid vehicles)	Some peak express only (not hybrid vehicles)
Peak service frequency on Nicollet (for local circulation purposes)	3 min	2-3 min	None (local circulation would take place on Marquette – 5 min peak)
Bus service on Marquette	Peak express and local routes (not hybrid vehicles)	Peak express only	Peak express and local routes (not hybrid vehicles)
Operating Costs			
Nicollet Mall Shuttle	$4,906,000	$0	Base scenario
Local Routes on Marquette versus Nicollet	$ 0	+ $38,800	
Peak Express Buses Running Through Downtown	- $1,156,600	$0	
Deadhead of Peak Express Buses Through Downtown	- $578,300	$0	
Staging Needs	$0	$0	
Total Operating Costs	**+ $3,171,100**	**+ $38,800**	
Capital Cost Differential			
North Terminal	+ $2.7 million	$0	Base scenario
Modifications to Leamington Terminal	+ $350,000	$0	
Vehicle Costs	+ $6.5 million	$0	
Passenger Amenities: Shelters Bus Stop Signage	 + $50,000 $0	 $0 $0	
Maintenance and Storage Facilities	$0	$0 $0	
Off Street Staging Facilities	$0	$0	
Marketing Materials	$0	$0	
Convention Center Pedestrian Connection	$0	+ $1.4 million	
Total Capital Costs	**+ $9.6 million**	**+ $1.4 million**	

Figure 32 Comparison of Alternatives (continued)

Element	**Alternative A:** (Peak Interception with Nicollet Mall Shuttle)	**Alternative B:** (Local Services on Nicollet; No Peak Interception)	**Alternative C:** (Local Services on Marquette; No Peak Interception)
Service Quality			
Average Delay to Commute Trips to Core	5 min.	0	0
Centrality to All-Day Core for Primary Services	Good (Marquette)	Excellent (Nicollet)	Good (Marquette)
Intra-Downtown North-South All-Day Frequency	3 min.	5 min.	5 min.
Intra-Downtown North-South Peak Frequency	3 min.	3 min.	3 min.
Centrality of Intra-Downtown Circulation	Excellent (Nicollet)	Excellent (Nicollet)	Fair (Marquette)
Safety / Security	Good (local service on Marquette; downtown circulation on Nicollet)	Excellent (local service and downtown circulation on Nicollet)	Fair (Local service and downtown circulation on Marquette)

Summary of Transit Facilities

Figure 33 shows a summary of the major transit capital facilities identified for this report. For a graphic representation of facilities in the main scenario, see **Figure 34**. In some cases, a further review of the speed benefits is in order, as noted in the Priority column. Nothing identified is low priority, but the Priority column does distinguish between "crucial," without which the entire spine system definitely will not function, and "high" which generally affect just one of the access corridors to a spine.

Figure 33 Proposed Downtown Minneapolis Transit Facilities

Proposed Downtown Minneapolis Transit Facilities								
Street or Location	North-South Alternative	Timeframe (short = up to 10 yrs)	Priority	Direction of Travel	Advantage	Segment Affected	Hours	Comments
Washington	B,C (no Peak Interception)	short	medium	west	left turn bay and arrow	Marquette	all times	Creates shortcut from Gateway Ramp to Marquette, also useful for Central Avenue buses transitioning to sbd Marquette
3rd Street	all	short	Probably high. Speed analysis needed.	west	With -flow bus lane	3rd Ave S to Hennepin	3-6 PM	Speeds expresses bound for NB I-94
I-94 4th Street ramp	all	short	high	east	convert right lane to bus-only	5th Ave N to Marquette	6-9 am	Eliminates major delays to SB I-94 buses, requires MnDOT OK
8th Street	all	short	crucial	west	Contra flow bus lane	11th Ave S to 1st Ave N	all times	Create E-W Spine, remove most buses from 7th, 6th.
8th Street	all	short	high	east	With -flow bus lane	1st Ave N to Chicago	3-6 PM	Create E-W Spine, remove most buses from 7th, 6th.
11th Street	B,C (no Peak Interception)	short	high	west	With -flow bus lane	4th Ave S to N-S Spine	7-9 AM, 3-6 PM	Options are with-flow on 11th Street or contra-flow on 12th St
12th Street	B,C (no Peak Interception)	Probably short. Speed analysis needed.	Probably high. Speed analysis needed.	west	Contra flow bus lane	Marquette to Hawthorne	all times	Would speed I-394 expresses
Hennepin	all	Probably short. Speed analysis needed.	Probably high. Speed analysis needed.	north	With -flow bus lane	13th St to Washington	6-9AM, 3-6 PM	
Marquette	all	short	crucial	south	Double width contraflow lane	Washington to 11th Street	all times	N-S Spine. Would remove most northbound buses from parallel streets.
2nd Ave S OR Marquette	all	short	crucial	north	Double width transit lane	12th Street to Washington	all times	N-S Spine. Would remove most southbound buses from parallel streets.
2nd Ave S	if N-S spine on 2nd	short	high	north	Left turn arrow	3rd Street	all times	Eliminates major delay to NB I-94 buses
3rd and 4th Aves S	B,C (no Peak Interception)	long	high	both	Possible eventual double-width lanes. Could be peak period only if with-flow.	3rd to 10th Streets	all times	Eventually needed to accommodate the ultimate volumes of peak buses, if Peak Interception (or other strategies to reduce projected 2030 peak bus volumes) are not pursued.
4th Street	interim, pending Central LRT	short	high	west	Contra flow bus lane	Hennepin to 1st Ave N	all times	Done in conjunction with left turn arrow (see other 4th St note)
4th Street	interim, pending Central LRT	short	high	west	Left turn arrow	1st Ave N	all times	Done in conjunction with contra flow lane (see other 4th St note)
5th Street Garage	all	short	high	west	Reverse direction on one lane in the transit center, with new left turn egress onto 3rd Av N		all times	Permits E-W Spine buses on 8th Street to access 5th St Garage, and hence intermodal center.
15th & 1st Av S Layover	B,C (no Peak Interception)	short	medium	east				Provides a means for frequent service on N-S Spine to extend south of 10th. Less needed if there is a frequent Nicollet Mall shuttle.
Peak Interception Model (Alternative A): Proposed Downtown Minneapolis Transit Facilities								
All facilities above except those marked "no Peak Interception", plus:								
New North Terminal	All	short	crucial for full Peak Interception Model	n/a	North Terminal	One of three blocks studied along Nicollet north of 5th	all times	Layover needs increased by roughly 40 stalls above the requirements without Peak Interception model.
Modified Leamington Terminal	Peak interception (alternative A) only	short	crucial for full Peak Interception Model	n/a	Signal priority to enter/exit facility and enhanced communication system to handle higher volumes.	10th St and 3rd Av S	all times	
Previously Proposed Downtown Minneapolis Transit Advantages, No Longer Needed Under Plan								
6th Street				east	With -flow bus lane	1st Ave N to 11th Ave S	6-9AM, 3-6 PM	
7th Street				west	With -flow bus lane	Park to 2nd Ave S	6-9AM, 3-6 PM	
7th Street				west	Remove valet parking	Nearside 2nd Ave S		
11th Street				west	With -flow bus lane	2nd Ave S to Hawthorne Ave	3-6 PM	
2nd Ave S				south	With -flow bus lane	Washington to 11th Street	3-6 PM	Options are with-flow on 2nd Ave S or contra-flow on Marquette
5th Street				west	Longer right turn signal	right turn onto nb Park	all times	Consider carefully in that LRT should have preference

Figure 34: Downtown Minneapolis - Major Downtown Transit Facility Needs

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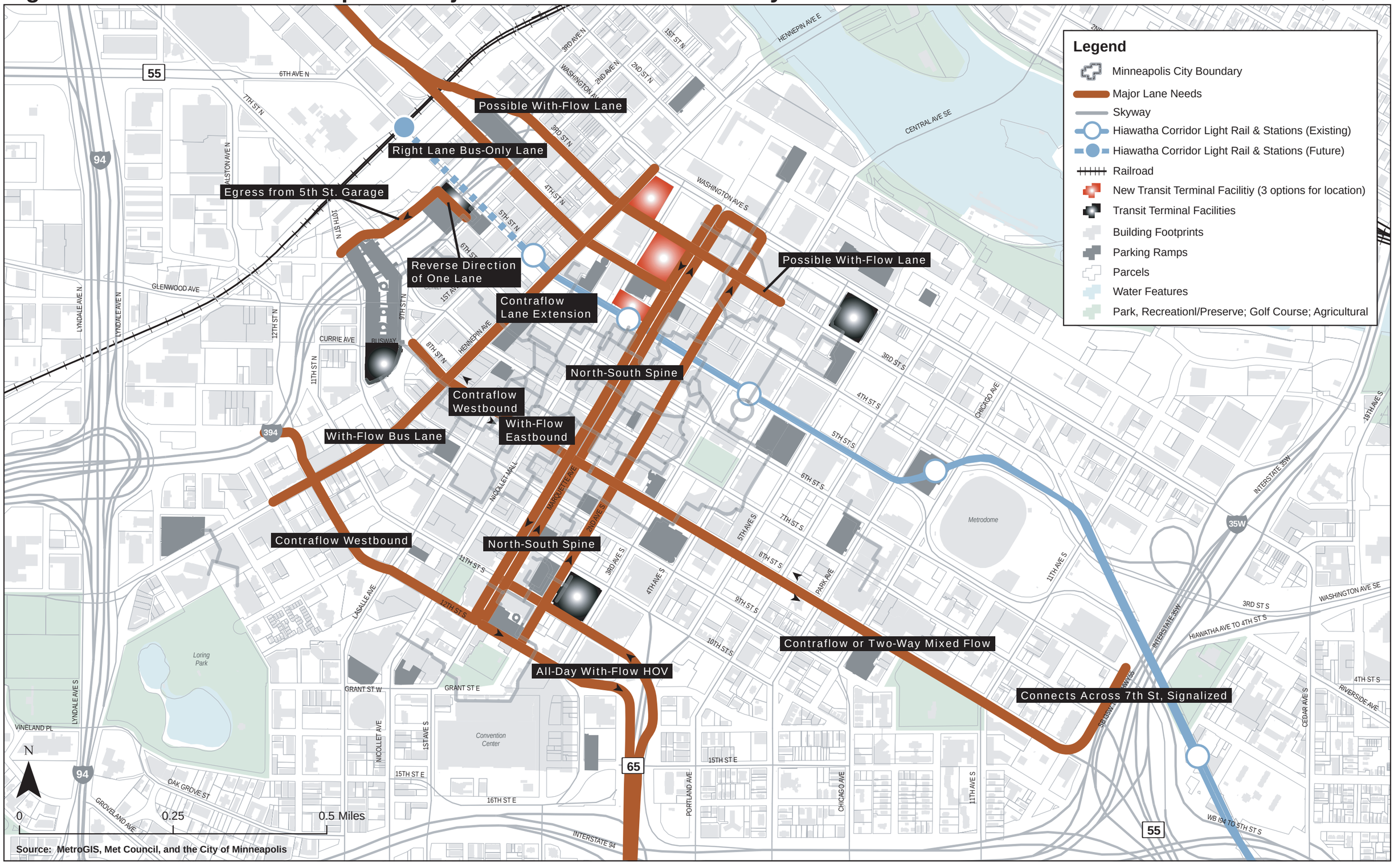

Source: MetroGIS, Met Council, and the City of Minneapolis