

Initial Operable Segments - Revised

The proposed long range streetcar plan for Minneapolis was described in the previous chapter. At a cost of over \$740 million (order of magnitude, \$2007), this entire system is obviously not going to be built at once. In fact, most streetcar implementations begin with relatively short segments that serve as building blocks to an ultimate line or system. Most modern streetcar implementations in North America have consisted of initial operating segments that are quite short (1-5 track miles in length).

This section identifies several “initial operable segments,” each of which could be implemented in a short timeframe (5-7 years). Operating costs, capital costs, ridership estimates, and development opportunities are identified for each segment. Initial operable segments include portions of the long-term network that are 2-3 miles in length and serve an important short-term circulation function.

While the initial operable segments are considered the best places to start building the long-term network, funding availability may limit how much can be built initially. Therefore, this chapter also identifies “minimum operable segments” (MOS) in each corridor that break the initial operable segments into shorter pieces that can be built in phases. *It is not recommended to start with a streetcar line shorter than a minimal operable segment.*

There are several possible phasing scenarios for developing the long-term network. One scenario would be to develop a single corridor in logical segments until an entire corridor is built before starting another corridor. Another option is to construct several minimal or initial operable segments out from the core, before completing any one long-term corridor.

A final recommendation is not made in this report as to which segment(s) should be implemented first, or which phasing approach is more appropriate. This decision must be made locally by determining the level of community support in each corridor, the level of private sector interest and the ability to generate sufficient capital and operating funding.

Criteria for Selecting Initial Operable Segments

Guidelines for selecting the initial operable segment on each corridor were developed in order to ensure that the first streetcar line would be viewed as a success. A well selected initial segment will not only generate further interest in streetcars, but will also build confidence that streetcars can successfully be integrated into the transportation network. An unsuccessful initial segment almost guarantees minimal investment in future extensions and a general lack of support for completing the long-term streetcar network. The following guidelines were followed in selecting the initial operable segments:

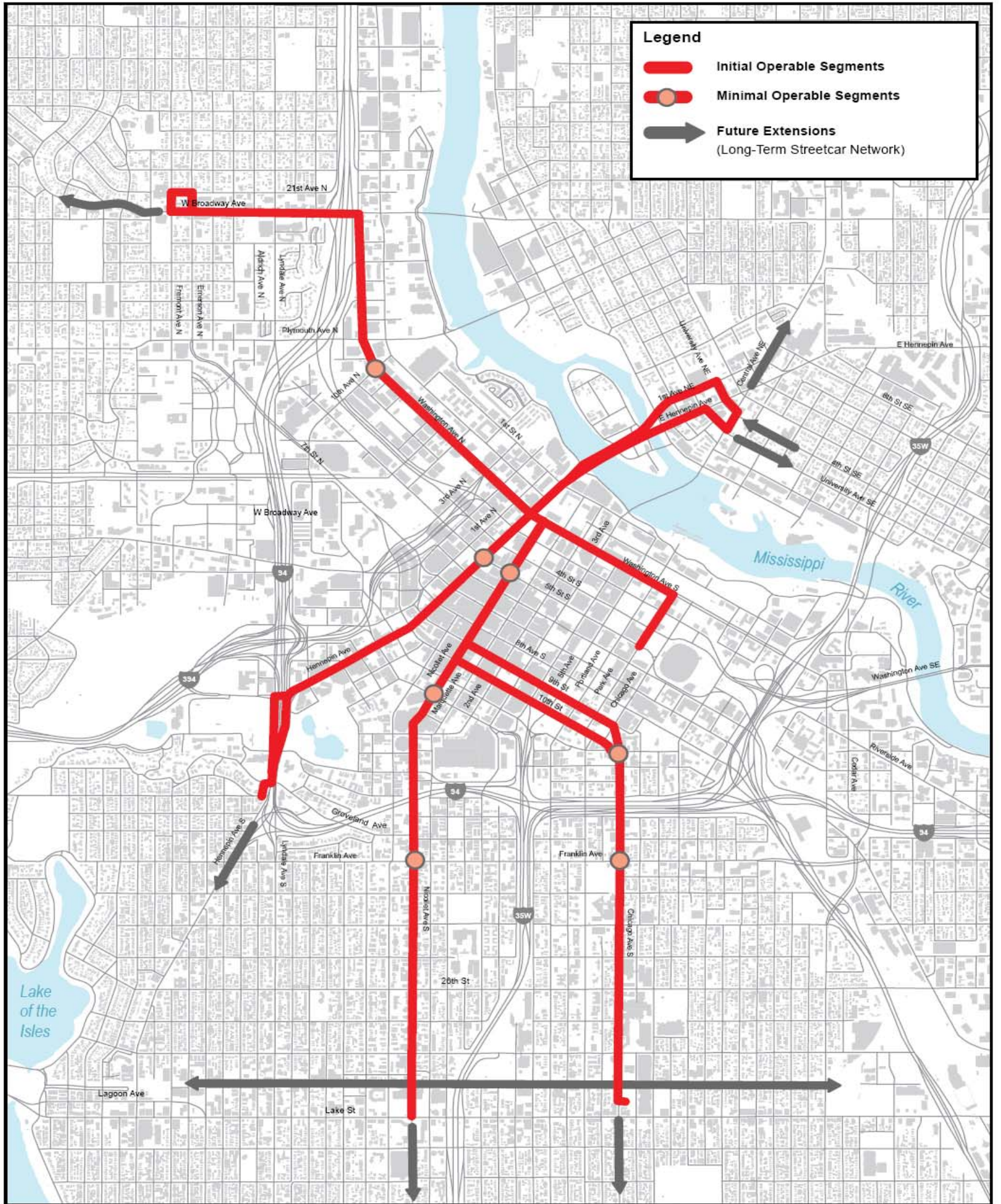
- Initial line must be successful from the beginning and should provide the foundation on which to “grow” the long-term system
- Initial line should lead to a longer line and provide meaningful service to nearby neighborhoods
- Initial line should avoid extraordinary capital costs
- Initial line should end at a safe and logical terminal location (turnaround)
- Initial line must have access to a maintenance/storage facility

Based on the guidelines presented above, the following initial operable segments were identified (also shown in Figure 1):

- **Hennepin Avenue** from Groveland to E. Hennepin and University/4th (long-term connection to University Avenue and Central Avenue corridors)
- **W. Broadway/Washington Avenue** from Fremont/W Broadway to Nicollet Ave/5th Street LRT station (long-term connection to W. Broadway corridor)
- **W. Broadway/Washington Avenue** from Fremont/W Broadway to Park Ave/5th Street LRT station (long-term connection to W. Broadway corridor)
- **Nicollet Avenue** from Lake Street or Franking Avenue to Washington Avenue (long-term connection to Nicollet corridor)
- **Chicago Avenue S** from Lake Street or Franklin Avenue to Nicollet Avenue/5th Street via 9th/10th Streets (long-term connection to Chicago corridor)

No initial operable segment was identified for the Midtown Greenway corridor because ridership forecasts indicate that a significant proportion of ridership in this corridor comes from its relationship to the Southwest LRT line, which has not yet been constructed. The success of the Midtown Greenway appears to be closely linked to its ability to connect the two LRT lines. While the Midtown Greenway is not a line from which other corridors can be grown, it remains an important part of the long term streetcar network. Because this corridor serves a different function than the other streetcar corridors, it can progress independent of the decision for an initial segment or starter line for the overall streetcar system.

Figure 1 Initial and Minimum Operable Segments



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Initial Operable Segments

All initial operable segments are proposed to operate on 15 minute headways, seven days a week. During weekdays and Saturday, the service would operate a total of 16 hours. Service hours would be reduced to 14 hours on Sundays. Because all initial operable segments have the same operating characteristics, and are approximately the same length, estimated annual revenue hours and operating costs are the same for all segments. Each initial operable segment is estimated to require 17,172 annual revenue hours with an annual operating cost of \$2,571,500 (based on an estimate of \$149.75 per revenue hour).

Because of their relatively short length, it is assumed that the initial operable segments will not have an impact on the existing bus network – that is, for a period of time, existing levels of bus service will operate in the same corridor as the streetcar. Streetcar trips would be primarily local in nature and would generally be very short trips. Longer trips, and trips into the corridor from outlying areas would continue to be made by bus. The service was not designed to “force” transfers between the “long line” bus service and the “short line” streetcars in the short-term, as this would require more streetcar service than would otherwise be justified, and would require large numbers of passengers to make transfers very close to their ultimate destinations. Metro Transit may ultimately decide to truncate some of the regional service at logical transfer points with the starter streetcar lines, particularly if the entire initial segment is built at once. To the extent that regional bus lines are truncated or service is reduced, streetcar ridership would increase. Operating costs may also increase.

Hennepin Avenue

The initial operable segment on Hennepin Avenue would travel from just south of the Walker Art Center to the East Hennepin area, mostly via Hennepin Avenue. The streetcar line would be double-track on Hennepin from I-94 to the Mississippi River. On the south end of the line, the terminal station could be integrated into the short segment of Douglas Avenue just south of Groveland Avenue (west of Hennepin). On the north end, the streetcar would use Hennepin Avenue northbound, turn eastbound on University Ave SE and then return via Central Ave NE, 4th Street SE and 1st Ave NE. All portions of this segment would operate in mixed traffic.

The initial line is 2.6 route miles (5.1 track miles). A maximum of three in-service vehicles would be required to maintain 15-minute headways.

Minimal Operable Segments

If building the full initial segment at once is not feasible, this line could be broken in half at approximately 5th Street and implemented in stages. An initial “minimal operable segment” could be built either from 5th Street south to Groveland, or at the other end of the line, from 5th Street north to the East Hennepin area. Either of these segments

would require two in-service vehicles, assuming service every 15 minutes. However, because of the requirement for an initial segment to have access to a maintenance facility, the southern minimal operable segment would need to be built first (see Maintenance Facility section below).

Development Opportunities and Special Generators

This line would serve the downtown entertainment district along Hennepin Avenue and would provide service to Loring Park, the Walker Art Center, Minneapolis Sculpture Garden, the Target Center, the new Twins Ballpark, the warehouse district, and the East Hennepin area. Therefore, this line would likely serve a significant tourist market.

Opportunities for moderate to high density residential and mixed use development exist in the East Hennepin area, as well as along Hennepin Avenue on the north edge and south edge of the downtown core. Although not directly on the streetcar line, the Hennepin Avenue line would be within easy access of the proposed development around the new Twins Ballpark.

Ridership

The initial operating segment on Hennepin Avenue between Groveland and Central Ave NE is expected to generate approximately 662,000-809,000 riders per year. The south minimum operating segment would generate slightly higher ridership than the north segment (see Figure 2).

Turnaround Considerations

Turnaround locations for the entire initial operable segment are feasible at the north and south ends of the line. If the line is implemented in phases, a turnaround at 5th Street and Hennepin would be slightly more challenging. The most promising option would be to use the existing LRT tracks exclusively for turning the vehicle around (no layover at this location would be possible). Another option would be to integrate a short section of track into the one westbound traffic lane on 5th Street (west of Hennepin). This would require a special signal phase at this intersection that restricts all turning movements until the streetcar vehicle has turned around.

Maintenance Facility

The most likely location for a maintenance facility for the Hennepin Avenue corridor is in the area near I-394 and Dunwoody Boulevard or near the intersection of N 16th St / Linden (see Maintenance Facility section later in this chapter for more details). Because there is no obvious location for a maintenance facility in the East Hennepin area, the south minimal operable segment would need to be built first if this line is built in stages.

Capital and Operating Costs

As noted earlier, the two minimal operable segments in this corridor could be implemented in either order because they would both work equally well on their own. The south section may need to be implemented first due to the options available for the location of a maintenance facility. Based on these two minimal operable segments, Figure 2 provides a summary of estimated impacts of developing this line in phases.

If either one of the minimal operable segments are implemented as an initial phase, two vehicles would be required to maintain 15-minute headways. If the entire initial operable segment is completed at one time, a total of three vehicles are required to maintain 15 minute headways. Capital costs for both MOS are roughly the same – around \$25M.

While capital costs are roughly twice as much to implement the full initial operable segment, this is preferable for several key reasons:

- The entire Hennepin Avenue corridor is intensely developed and that development does not end at 5th Street.
- Tourists and visitors are expected to account for a significant portion of ridership in this corridor and destinations are located both north and south of 5th Street.

Figure 2 Minimal Operable Segments – Hennepin Avenue

	From	To	Vehicles Required for 15-Minute Headways	Annual Revenue Hours	Estimated Annual Ridership	Operating Cost	Track Miles	Capital Cost Excluding Vehicles and Maintenance Facility *
Full IOS	Groveland Ave / Hennepin Ave S	Central Ave NE / 4 th St SE	3	17,172	662,000 – 809,000	\$2,571,507	4.8	\$50,100,000
Incremental costs for each minimal operable segment								
MOS A-1	Hennepin / 5 th St	Groveland Ave / Hennepin Ave S	2	11,448	463,000 – 566,000	\$1,714,338	2.6	\$26,100,000
MOS A-2	Hennepin / 5 th St	Central Ave NE / 4 th St SE	2	11,448	364,000 – 445,000	\$1,714,338	2.2	\$24,000,000

W. Broadway / Washington Avenue to Nicollet

The initial operable segment including W. Broadway and Washington Avenue would travel from Fremont Avenue N to the inner core of downtown to connect with the Hiawatha LRT station at 5th Street via Nicollet. This segment would be double track on W. Broadway, Washington and Nicollet and feed into a short single-track segment near the LRT station at 5th Street – ideally in an exclusive right-of-way that would not interfere with the buses operating on Nicollet. On the north end, the line would have a terminal station near Fremont Avenue N, likely turning on Emerson Avenue N, west on 21st Avenue N, south on Fremont Avenue N and then east on W Broadway Avenue.

This line is 2.4 route miles (4.8 track miles). A maximum of three in-service vehicles would be required to maintain 15-minute headways.

Minimal Operable Segments

If desired, this line could be broken into two short minimal operable segments that could be implemented sequentially. The first minimal operable segment would start at 5th/Nicollet and travel north on Washington Avenue to 10th Avenue North. The second segment would continue from 10th Avenue N/Washington Avenue to Fremont and W. Broadway. If the minimal operable segment to 10th Avenue N is implemented first, two in-service vehicles would be required to maintain 15 minute headways. The extension to Fremont Avenue N would require a third vehicle to maintain 15 minute headways.

Development Opportunities and Special Generators

This line will primarily serve the near-downtown neighborhood market, both the North Minneapolis neighborhoods focused along W Broadway, as well as the emerging North Loop area. It would also serve the new Central Library and the north end of the Nicollet Mall.

Economic development is an important goal of this corridor. The North Loop area, in particular, shows great promise for continued residential growth. And while the W Broadway corridor may be lagging behind other corridors in terms of economic development, the potential for redevelopment in this corridor is strong, as noted in the “West Broadway Alive!” revitalization plan.

Ridership

The initial operating segment between Fremont/Emerson and Nicollet/5th St. LRT Station via Washington Avenue is estimated to generate approximately 563,800 – 689,100 riders per year. The minimum operating segment between Washington/10th Ave N and Nicollet/5th St would generate approximately 338,300-413,500 riders per year (see Figure 3).

Turnaround Considerations

On the north end of the line, the preferable turnaround option is to loop around the block at Fremont, 21st, Emerson and W Broadway. On the south end, the line would terminate at the Nicollet Mall LRT station – either by utilizing the existing light rail tracks to turnaround, or by utilizing a short section of the parking lot just north of the LRT station for a single track.

If this line is implemented in phases, there would need to be a way to turn vehicles around in the vicinity of 10th Avenue N. Because 10th Avenue N has relatively low traffic volumes, and has two through lanes with a middle turn lane, the most likely option is to incorporate a short section of single track into the left lane of 10th Avenue N. Because of the low traffic volumes at this intersection, a separate signal phase would not be required. The single traffic lane on 10th Avenue N would need to allow vehicles to go straight and make both left and right turns.

Maintenance Facility

There is still a considerable amount of land in the North Loop area that is currently zoned industrial and there is an industrial park northwest of Washington Avenue/10th Avenue North. While care will need to be taken due to the changing character of the North Loop area, there appear to be appropriate sites for a maintenance facility (see later section in this chapter for details).

Capital and Operating Costs

Based on the two minimal operable segments, Figure 3 provides a summary of estimated impacts of developing this line in phases.

The entire initial operable segment to West Broadway requires a third vehicle in order to maintain 15 minute headways – resulting in an increase in operating costs of approximately \$860,000 over the first minimal operable segment (MOS A). Capital costs to Fremont/Emerson are approximately \$27M higher than the first minimal operable segment that ends at 10th Avenue North.

Although the costs of extending the line to Fremont Avenue N are clearly higher than the shorter segment, there are several primary advantages:

- It serves the most dense commercial corridor in North Minneapolis
- It connects to the high-frequency service on Fremont/Emerson (Route 5)

Figure 3 Minimal Operable Segments – Washington / W Broadway (to Nicollet Avenue)

	From	To	Vehicles Required for 15-Minute Headways	Annual Revenue Hours	Estimated Annual Ridership	Operating Cost	Track Miles	Capital Cost Excluding Vehicles and Maintenance Facility *
Full IOS	W Broadway / Fremont Ave N	Nicollet Ave / 5 th St	3	17,172	563,800 – 689,100	\$2,571,507	4.8	\$48,800,000
Incremental costs for each minimal operable segment								
MOS A	Nicollet / 5 th St	Washington Ave / 10 th Ave N	2	11,448	338,300 – 413,500	\$1,714,338	2.2	\$22,300,000
MOS B	Washington Ave / 10 th Ave N	W Broadway / Fremont Ave N	1	5,724	NA	\$857,169	2.6	\$26,500,000

W Broadway / Washington Avenue to Park

This line is a variation of the initial segment from West Broadway to Nicollet, continuing the line along Washington Avenue to Park and the LRT station located between 4th and 5th, rather than turning on Nicollet. Because Park Avenue is currently a one-way, northbound street, streetcar would require an exclusive, contraflow lane. The entire line would be double-track.

This line is 3.1 route miles (6.0 track miles). A maximum of four in-service vehicles would be required to maintain 15-minute headways.

Minimal Operable Segment

As with the W Broadway/Washington Avenue line via Nicollet, this initial operable segment could be implemented in two segments. The first segment would be from Park Avenue/5th Street to 10th Ave N/Washington Ave, followed by the segment from 10th Avenue N to Fremont Avenue N/W Broadway Avenue. The first minimal operable segment would require two in-service vehicles to maintain 15 minute headways.

Development Opportunities and Special Generators

As with the other W Broadway / Washington Avenue line, this streetcar line would primarily function as local circulation for near-downtown neighborhoods in the North Loop, riverfront Mills District and North Minneapolis. Special generators served by this route include the Central Library, the Guthrie Theatre, and the Metrodome.

As noted above, economic development potential exists along the entire corridor, especially in the North Loop area and (over the long term) along W Broadway. This corridor would also serve the East Downtown neighborhood, which has significant potential for economic development (especially between Washington Avenue and 5th Street).

As one of the major landmarks in downtown Minneapolis, plans call for demolition of the Metrodome and construction of a new Vikings stadium on the existing site. The Metrodome sits just east of Chicago Avenue (Kirby Puckett Place) between 4th and 6th Streets, encompassing much of the East Downtown area. The most recent plans include a new retractable stadium surrounded by new development east of the stadium that would include as many as 4,500 new housing units, 1.7 million sq. ft. of office and a new hotel.

Ridership

The initial operating segment between Fremont/Emerson and Park Ave (Metrodome LRT Station) via Washington Avenue is estimated to generate approximately 512,200 – 626,100 riders per year. The minimum operating segment between Washington/10th Ave N and Park Ave would generate approximately 307,300-375,600 riders per year (see Figure 4).

Turnaround Considerations

The north turnaround, as well as the possible turnaround at 10th Avenue N, is exactly the same for this initial operable segment as the other option W Broadway / Washington Avenue line terminating at Nicollet and 5th Street. On the south end of the line (at Park Avenue and 5th Street), an exclusive contra-flow streetcar lane would be required on Park Avenue from Washington Avenue to 5th Street. The turnaround for this line would occur on Park Avenue in a single lane in the exclusive contraflow lane (where the vehicle can layover and switch directions).

Maintenance Facility

As noted above, there are suitable sites for a maintenance facility in the North Loop area and in the industrial park northwest of Washington Avenue/10th Avenue North (see later section in this chapter for details).

Capital and Operating Costs

As with the other Washington Avenue / W Broadway line via Nicollet, two minimal operable segments were identified for this corridor. Figure 4 provides a summary of estimated impacts of developing this initial operable segment in phases.

The full initial operable segment to West Broadway / Fremont also requires three vehicles in order to maintain 15 minute headways, even though this segment is longer than the one via Nicollet. Capital costs to Fremont/Emerson are approximately \$27M higher than the minimal operable segment that ends at 10th Avenue North.

Figure 4 Minimal Operable Segments – Washington / W Broadway (to Park Avenue)

	From	To	Vehicles Required for 15-Minute Headways	Annual Revenue Hours	Estimated Annual Ridership	Operating Cost	Track Miles	Capital Cost Excluding Vehicles and Maintenance Facility *
Full IOS	W Broadway / Fremont Ave N	Park Ave / 5 th St	3	17,172	512,200 – 626,100	\$2,571,507	6.0	\$60,500,000
Incremental costs for each minimal operable segment								
MOS A	Park Ave / 5 th St	Washington Ave / 10 th Ave N	2	11,448	307,300 – 375,600	\$1,714,338	3.4	\$33,900,000
MOS B	Washington Ave / 10 th Ave N	W Broadway / Fremont Ave N	1	5,724	NA	\$857,169	2.6	\$26,600,000

Nicollet Avenue

The initial operating segment of the Nicollet Avenue corridor would travel from Lake Street or Franklin Avenue to Washington Avenue via Nicollet Mall. The line would be double-tracked the entire way from Lake Street to Washington Avenue. An exclusive lane of track at the north end of the line (likely near the Nicollet Mall LRT station) is recommended to allow streetcar vehicles to layover and reverse direction.

This line is 2.5 route miles (4.9 track miles). A maximum of three in-service vehicles would be required to maintain 15-minute headways.

One concern with incorporating streetcars on Nicollet is the width of the Nicollet Mall and the impact of operating streetcar and buses together. Nicollet Mall is only one lane in each direction, which can accommodate approximately 50 buses per hour¹ before operating speed starts to deteriorate significantly. Since buses and streetcars are expected to operate at similar speeds and the proposed streetcar, with 15-minute headways, would only add four additional vehicles an hour in each direction, no significant impacts are expected. However, if this line is selected, it should be with a plan to build out the line to an extent that the number of buses on the mall could be reduced dramatically before capacity conflicts occur.

Although all existing bus service in this corridor continues south of Lake Street, there may be some opportunities to reduce bus volumes on this corridor, even in the early phases of implementation, particularly if the recommended initial operable segment is implemented all the way to Lake Street at one time. However, for purposes of this analysis, it was assumed that all underlying buses would remain because, with the exception of a few evening trips, the existing Route 18 does not currently have short lines that start at Lake Street.

Minimal Operable Segment

If the full initial operable segment cannot be implemented at once, it could be implemented in three sequential phases. The first segment would be built from Washington Avenue to 13th Street (with service to the Convention Center). The next segment could then be to Franklin Avenue, followed by the third segment to Lake Street. The first minimal operable segment would require two in-service vehicles to maintain a 15-minute headway. The second segment to Franklin would not require any additional vehicles to maintain a basic 15-minute headway. Three in-service vehicles would be required for the full initial operable segment.

Development Opportunities and Special Generators

The initial operable segment of the Nicollet Avenue corridor would serve all of Nicollet Mall, the Minneapolis Convention Center and would be within walking distance of the Hennepin Avenue entertainment district. It would provide service to the Loring Park and Stevens Square neighborhoods, both high density residential areas. There are existing proposals for development of high density residential and mixed use along Nicollet Avenue between approximately 9th Street S and Franklin Ave. If constructed to Lake Street, this segment would also serve “Eat Street”, the Minneapolis Institute of Arts, and Children’s Theatre. While most of this corridor is fully built-out, some small-scale economic development potential exists along Nicollet Avenue S, and there is significant long-term development potential at the Lake Street node.

¹ This is the level at which bus-bus interference causes about a 20% loss in operating speed. See the Access Minneapolis Downtown Transit Circulation Report.

Ridership

The initial operating segment between Nicollet/5th St LRT Station and Lake Street is estimated to generate approximately 687,800-840,600 riders per year. If the minimum operating segment between Nicollet/5th St and 13th St S were constructed initially, it would generate approximately 402,000-491,400 riders per year (see Figure 5). If the minimum operating segment between Nicollet/5th St and Franklin Ave were constructed initially, it would generate approximately 446,900-546,200 riders per year.

Turnaround Considerations

If this line were implemented in phases, several interim turnaround locations would be required. The first MOS (from Washington to 13th Street) could utilize the middle lane of 13th Street for a short single-track spur to turn vehicles around. Although 13th Street is only two lanes, this street has relatively low traffic volumes and there appears to be adequate right-of-way for approximately 10 feet of exclusive right-of-way. On the north end, a short section of exclusive streetcar track could be added near the Nicollet Mall LRT station at 5th Street. Although this option would require further study, the surface parking lot just north of the LRT platform would likely allow adequate right-of-way to incorporate a single lane of exclusive streetcar track.

A turnaround location near Franklin Avenue would be most appropriate one block north of Franklin at Groveland. Because this is a two-lane, two-way street, a short single-track could either be incorporated into the middle of the street, or take over one of the lanes and restrict travel to only one direction.

The turnaround on the south end of the initial operable segment would be as close to Lake Street as possible. Because Nicollet does not currently provide a direct connection between 29th Street and Lake Street, streetcar would have to loop around the block (Blaisdell, Lake Street, 1st Avenue S, Cecil Newman Lane) in order to turn around. However, Nicollet Avenue is planned to connect directly to Lake Street in the future, at which time an appropriate streetcar turnaround location could be designed.

Maintenance Facility

The location of a maintenance facility is problematic for this corridor. There are some parking lots in the vicinity of I-94 that might be usable but these are currently proposed for redevelopment, they are relatively small for a maintenance/storage facility and offer limited expansion opportunities. Likewise, a maintenance facility might be incorporated near Lake Street but this area is currently proposed for redevelopment and expansion opportunities are likely to be limited.

Capital and Operating Costs

The first minimal operable segment in this corridor terminates at 13th Street on the south end (MOS A). South of downtown, the next two minimal operable segments continue to

Franklin Avenue (MOS B) and then to Lake Street (MOS C). Figure 5 below provides a summary of estimated impacts involved with completing this line in phases.

Figure 5 Minimal Operable Segments (MOS) – Nicollet Avenue S

	From	To	Vehicles Required for 15-Minute Headways	Annual Revenue Hours	Estimated Annual Ridership	Operating Cost	Track Miles	Capital Cost Excluding Vehicles and Maintenance Facility *
Full IOS	Nicollet / Washington Avenue	Nicollet / Lake St	3	17,172	687,800 – 840,600	\$2,571,507	4.6	\$48,500,000
Incremental costs for each minimal operable segment								
MOS A	Nicollet / Washington Ave	Nicollet / 13 th Street	2	11,448	402,000 – 491,400	\$1,714,338	1.8	\$20,000,000
MOS B	Nicollet / 13 th St	Nicollet / Franklin Ave	-	0	446,900 – 546,200	\$0	0.9	\$9,400,000
MOS C	Nicollet / Franklin Ave	Nicollet / Lake St	1	5,724	NA	\$857,169	1.9	\$19,100,000

Operating costs would be the same whether the service terminates at 13th Street or is extended as far as Franklin Avenue (MOS A and MOS B), since 15-minute headways can be maintained with two vehicles. Operating only to 13th Street would result in longer layover times and would be generally less efficient than an initial line built to Franklin. Building the initial segment to Franklin Avenue (MOS A and MOS B) would add about \$9.4M in additional capital costs over just MOS A. The extension to Franklin provides a connection to the crosstown Route 2 and begins to serve the very dense neighborhoods south of I-94.

Implementing the full initial operable segment to Lake Street would require an additional \$860,000 in operating costs over the combined costs of MOS A and MOS B because an extra vehicle is required to maintain 15 minute headways. In addition, capital costs are about \$19.1M higher because it is a longer line. It should be noted that an additional streetcar vehicle would also need to be purchased to implement the full IOS, adding another \$3.0M in costs. Despite the higher cost, the advantages of implementing the full initial operable segment to Lake Street include:

- A connection can be made to Routes 21 and 53 – one of Minneapolis’ most popular transit corridors;

- Development intensity is relatively high between Franklin and Lake Streets;
- The potential to connect this portion of Nicollet with the Nicollet Mall could attract significant tourists/visitors to the area; and
- Short line runs are more likely from Lake Street than they are from Franklin Avenue.

Chicago Avenue S and 9th/10th Streets to Nicollet

The optimal initial operable segment of the Chicago Avenue corridor would run from the Chicago/Lake Transit Center (just north of Lake Street and Chicago Avenue) on double track the entire length of Chicago Avenue S and then split to use the one-way couplet of 9th and 10th Streets before turning north on Nicollet Avenue to the LRT station at 5th Street. Like the other lines using Nicollet, it is recommended that the terminal station on the north end be in an exclusive right-of-way so as not to interfere with the volume of buses required to use Nicollet². If the issue of skyway clearance could be resolved, it would be preferable to make the east-west connection along 8th Street (or 8th and 9th Street) to avoid the freeway ramps on 10th.

The total length of this initial operable segment is 2.5 route miles (5.5 track miles). A maximum of three in-service vehicles would be required to maintain 15-minute headways.

While there may be some opportunities to reduce bus volumes on this corridor, particularly those short-line services that begin at 38th Street, it was assumed for this analysis that the underlying bus service would remain in this corridor.

Minimal Operable Segments

Similar to the Nicollet Avenue South corridor, this initial operable segment could be implemented in sequential phases. The first segment would be from 5th/Nicollet to 14th Street/Chicago Avenue, followed by a segment between 14th Street/Chicago Avenue to Franklin Avenue/Chicago Avenue. The third segment could extend to the Chicago/Lake Transit Center. The first segment would require two in-service vehicles to maintain a 15 minute headway. Extending the service to Franklin would not require additional vehicles to maintain a 15-minute headway. Three in-service vehicles would be required for the entire initial operable segment.

Development Opportunities and Special Generators

The initial operable segment and minimal operable segments would connect the Elliot Park neighborhood to the inner core of downtown and the LRT station at 5th Street and would serve the Hennepin County Medical Center complex. If the initial operable segment were built to Lake Street, the Abbott Northwestern and Children's Hospital

² If streetcar service has a regular impact on bus operating speeds on Nicollet, some buses may need to be re-routed to other north-south corridors, such as Hennepin or Marquette/2nd.

complex would be served along with the Midtown Exchange. The streetcar would also be within walking distance of the Metrodome. Economic development potential in this corridor is the strongest in the Elliot Park neighborhood, where very high intensity residential development is occurring, and in the areas surrounding the proposed new Vikings stadium. There is also some development opportunity at Lake Street around the Midtown Exchange building (at Lake Street) and Children's Hospital has just announced a significant expansion of its campus.

Ridership

The initial operating segment between Nicollet Avenue and Lake Street via 9th/10th Streets is estimated to generate approximately 572,900-700,200 riders per year. If the minimum operating segment between Nicollet Avenue and 14th Street were constructed initially, it would generate approximately 310,600-379,600 riders per year (see Figure 6. If the minimum operating segment between Nicollet Avenue and Franklin Avenue were constructed initially, it would generate approximately 329,800-403,100 riders per year.

Turnaround Considerations

The turnaround on the north end of this line would be the same as other segments that serve the Nicollet Mall LRT station. If this line is implemented in phases, the first possible turnaround location would be at 14th Street and Chicago Avenue. Because 9th and 10th Streets are a one-way couplet, the turnaround would simply utilize the existing traffic lanes.

The southern terminal of this initial operable segment would be the Chicago/Lake Transit Center. Because this is an exclusive transit facility, it is assumed that a single lane of track could be integrated into this facility to allow the vehicle to turnaround and layover.

Maintenance Facility

Most of the area east of the Metrodome is currently zoned industrial so there may be some opportunity for a maintenance storage facility in this area. However, there are redevelopment plans for this area which could make it challenging to provide an maintenance facility for the Chicago corridor. There are no known sites along Chicago outside downtown.

Capital and Operating Costs

The minimal operable segment that would eventually lead to the Chicago Avenue S corridor terminates at 14th Street and Chicago Avenue between 9th and 10th Streets. The next major street south of I-94 is Franklin Avenue, where connections to the crosstown Route 2 can be made. Beyond that, the next major street is Lake Street where connections can be made to Routes 21 and 53 at the Chicago/Lake Transit Center.

Based on these two logical terminal locations, Figure 6 provides a summary of estimated impacts of building the initial operable segment in phases.

Figure 6 Minimal Operable Segments – Chicago Avenue S

	From	To	Vehicles Required for 15-Minute Headways	Annual Revenue Hours	Estimated Annual Ridership	Operating Cost	Track Miles	Capital Cost Excluding Vehicles and Maintenance Facility *
Full IOS	Nicollet / 5 th St	Chicago Ave S / Lake St	3	17,172	572,900-700,200	\$2,571,507	5.0	\$50,700,000
Incremental costs for each minimal operable segment								
MOS A	Nicollet / 5 th St	14 th St / Chicago Ave S	2	11,448	310,600 – 379,600	\$1,714,338	2.2	\$21,900,000
MOS B	14 th St / Chicago Ave S	Chicago Ave S / Franklin Ave	-	0	329,800 – 403,100	\$0	0.9	\$9,600,000
MOS C	Chicago Ave S / Franklin Ave	Chicago Ave S / Lake St	1	5,724	NA	\$857,169	1.9	\$19,100,000

As with the Nicollet Avenue route, there is no difference in operating costs between a line terminating at 14th Street and Chicago Avenue S. and one that is extended to Franklin Avenue, since it is still possible to provide 15 minute service frequency with two vehicles. If the entire initial operable segment were developed first (to Lake Street), another vehicle would be required to maintain a 15-minute headway. This would increase operating costs by approximately \$860,000.

Capital costs for the extension to Franklin Avenue are about \$10 million higher than the first minimal operable segment, while the extension to Lake Street would increase capital costs by approximately \$19 million over the combined costs of the two minimal segments. Because the extension to Lake Street would require an additional vehicle to maintain 15-minute headways, an additional \$3.0 million would be required to purchase a vehicle, which is not reflected in the costs in Figure 7Figure 6.

Despite the higher cost, there are several advantages to implementing the full initial operable segment to Lake Street:

- Service would be provided to the hospitals (Abbot Northwestern and Children’s Hospital);
- With the Midtown Exchange building as a draw, there are stronger redevelopment opportunities near the Midtown Greenway and Lake Street;
- A connection can be made to Routes 21 and 53 at the Chicago-Lake Transit Center; and
- Short line runs are more likely from Lake Street than they are from Franklin Avenue.

Maintenance and Storage Facilities and Potential Sites

One of the most important factors influencing the decision on where to begin building a streetcar network is the ability to find a location to house and maintain the vehicles. In order for a streetcar network to function, there must be facilities to maintain and store the streetcar vehicles, which are located as near to the “revenue” line as possible. Since Minneapolis does not currently operate streetcars, an initial streetcar line would require a new facility designed to house and maintain the streetcar vehicles. As new streetcar lines are added, existing facilities would need to be expanded, or new facilities would need to be added if the vehicles could not access the existing facility.

Initial Maintenance and Storage Facility

The maintenance and storage facility for an initial streetcar line would maintain and store the streetcar vehicles on a daily basis. A typical modern streetcar vehicle is 66 feet long and 8 feet wide, runs on standard gauge tracks, is 11.5 feet high, and is classified as a low-floor vehicle. These vehicles have support equipment (HVAC, air compressor, resistor banks) mounted at roof level. The SKODA vehicle, which is being used in Portland and Tacoma, has two trucks with either a single or double center articulation. Each truck has two AC motors and drive units mounted on a wheel set that may or may not have resilient/bochum wheels. Although modern streetcar vehicles can be stored outside (as long as they are in a secure area), it is assumed that all vehicles in Minneapolis would need to be stored inside to minimize the impacts of extreme weather.

Key functions that will need to be provided for at a maintenance and storage facility include:

- Vehicle Storage
- Equipment and Parts Storage
- Administrative Functions
- Employee Parking
- Vehicle Cleaning (interior and exterior)

- Daily Inspections
- Preventative Maintenance
- Running Repairs

It is assumed that heavy repairs could be contracted out to other facilities, such as the existing LRT maintenance facilities owned by Metro Transit. Streetcar vehicles can be transported on a tractor-trailer to this facility when major repairs are required instead of requiring streetcar track. Portland Streetcar uses this method, using trailer trucks to transport streetcar vehicles to the TriMet light rail maintenance facility for major work, overhauls and component change-outs.

Site and Building Size Requirements

Site and building size requirements are dependent on the vehicle fleet size the facility will need to accommodate. A facility should be designed to accommodate peak vehicle requirements of an initial planned segment and any planned expansions.

Assuming a fleet size of 8 to 10 vehicles (which includes fleet expansion) a one- to two-acre site is needed. The site should be flat and generally rectangular in shape. The building footprint would be in the range of 8,000 square feet and would need to accommodate two tracks within the building of 100 feet in length each. One track could be used for inspections, running repair and exterior and roof-mounted work. The other should be over a pit to allow for work on the entire undercarriage of the vehicles.

Prefabricated steel buildings are a low cost alternative for a maintenance facility if area zoning and design standards allow for their use. The facility should be designed and situated on the lot to allow for easy expansion as the system grows and additional bay/storage capacity is required.

Cost

It is estimated that the development of a fully functional storage and maintenance facility would cost in the range of \$2-4 million. This cost does not account for property acquisition, so it is preferable if the site is owned by Metro Transit, the City of Minneapolis, Hennepin County or another public entity willing to contribute the land.

Potential Site Locations

Deciding which initial streetcar segment to begin with is dependent on the availability of a site for a maintenance and storage facility. Based on the initial operable segments identified earlier in this chapter, the location will need to be somewhere in the general vicinity of downtown. The maintenance and storage facility should be sited as close as possible to the initial streetcar alignment, as it will require additional track to get vehicles from the line to the facility (thus adding to the total cost of the project). In Portland, for example, the maintenance facility was located between the two directions of revenue

track under a freeway overpass that would never have demands for higher and better uses. While this may be an ideal situation, the location of this facility made the initial streetcar line more cost effective than if non-revenue track was required to access a maintenance facility.

Although specific sites are not identified in this study, the following section identifies some general areas that are appropriate for a maintenance and storage facility. A possible alignment for connecting these areas with an initial segment is also identified.

Dunwoody Boulevard and I-394

The area north of this intersection is primarily zoned Industrial 1 (I-1) or Industrial 2 (I-2), which would be appropriate for a maintenance and storage facility. It may be possible to use the area under I-394 in the vicinity of Dunwoody Boulevard or another parcel along this right-of-way (likely owned by MnDOT). A short section of single track, approximately 2,000 feet, could be used to access a facility in this location. Although additional study of the area is necessary, expansion opportunities are likely in this area.

This facility location would support an initial streetcar line on the Hennepin Avenue corridor.

North of the Basilica of St. Mary

The area north of I-394 near N 16th Street and Linden Avenue could be an appropriate location for a streetcar maintenance / storage facility. While some of this area is zoned OR3 (Institutional Office Residence District), adjacent parcels are zoned light industrial (I1) and the area in general is much more industrial in nature. A short section of single track, less than ¼ mile, could be constructed to access a facility in this location. Although additional study of the area is necessary, expansion opportunities are likely in this area.

This facility location would support an initial streetcar line on the Hennepin Avenue corridor.

North Loop Area

Much of the North Loop area is currently zoned I-2. Due to the changing character of this area, however, a maintenance facility will only be appropriate in certain locations. The area between 10th Avenue N, 4th Street N, 6th Avenue N and 7th Street N, as well as the industrial park northwest of Washington Avenue / 10th Avenue N, shows the most promise. Although the 3rd/4th access viaduct lanes to and from I-94 may not always define the character of this area, it is likely that the northern portion of this area will remain industrial – at least for the foreseeable future. One major advantage of this area is the proximity to the existing Heywood Bus Garage facility, owned by Metro Transit. It may be possible to integrate a streetcar maintenance facility into this facility, though this has not been confirmed with Metro Transit and other needs at that facility may prevent use for streetcar vehicles.

A section of single-track could be used to access a maintenance facility in this area. From Washington Avenue, a facility in this area could be accessed via 10th Avenue N with less than ½ mile of track. A maintenance facility in this area would be most appropriate for any of the initial streetcar segments on Washington Avenue. Based on existing land use, expansion opportunities appear to be strong in this area, especially closer to the 3rd/4th Street access lanes and I-94.

These facility locations would support an initial streetcar line on either Washington Avenue alignment.

Downtown East / Metrodome

Most of the area east of the Metrodome (to I-35W) is currently zoned I-1. While there are currently several opportunities for a maintenance/storage facility in this area, the Downtown East / North Loop Master Plan envisions a dramatic change in character for this neighborhood, including medium-density housing. The Downtown East / North Loop Master Plan also suggests the addition of a new LRT station east of the Metrodome, and a transit-oriented community node.

If the Metrodome remains in its current location, or is rebuilt in this general vicinity, a maintenance/storage facility may be more appropriate in this area – possibly integrated into future parking facilities.

This facility location would support an initial streetcar line on the Washington to Park alignment or on the Chicago Avenue corridor.

Nicollet Ave S / 31st Street

Metro Transit has an existing bus garage facility located at 31st Street and Nicollet Avenue S. Although further study would be required, it may be possible to retrofit this facility to store and maintain a small fleet of streetcars.

Midtown Greenway

The area with the greatest potential to accommodate a maintenance/storage facility along the Midtown Greenway is in the vicinity of Hiawatha Avenue and 28th Street E. Most of the land in this area is currently zoned industrial (I-1, I-2 or I-3), and it appears that several parcels are either vacant or underutilized. Access to this area would likely be via 28th Street E and require less than 1,300 feet of non-revenue track.

Although there are several other areas along the Greenway that may be conducive to a maintenance/storage facility, accessing those areas will likely be too expensive due to grade issues. There is, however, an at-grade crossing of the Greenway at 5th Avenue S which could provide access to this area (currently zoned I-1). It should be noted, however, that while industrial zoning currently exists along the Greenway, the long-term vision is for more residential and commercial uses, which is not entirely compatible with a maintenance/storage facility.

The existing LRT maintenance facility located near Hiawatha Avenue and Franklin Avenue is not expected to be available for routine streetcar maintenance and storage because the facility will be at capacity when vehicles are acquired for the Central LRT. However, major maintenance work on streetcar vehicles could be conducted at this facility by moving the streetcar vehicles to this location by truck. This is currently conducted in Portland where the main TriMet light rail maintenance facility is used for all major mechanical work on the streetcars.

Summary of Initial Operable Segments

Estimated operating costs, capital costs, ridership and development opportunities for the initial operable segments are summarized in Figure 7.

In addition, two key cost elements that were excluded from trackway capital cost estimates are included in Figure 7:

- **Vehicles.** Modern streetcar vehicles, such as those used in Portland and Tacoma, typically cost \$3.0 million each, depending on the vehicle configuration and market conditions when the vehicles are acquired. In addition, spare vehicles will be required for scheduled maintenance and unexpected breakdowns. For all of the shortest operable segments, a single spare vehicle is assumed. However, as the system grows, a standard spare ratio of 15-20% should apply.
- **Maintenance and storage facility.** A maintenance facility for a starter line can range from \$2.0 to 4.0 million, depending on the size of the facility. This figure assumes that the land will be owned by the City (or other government entity) and that land acquisition costs are minimal. Also, costs associated with a maintenance facility may be slightly higher in Minneapolis because streetcar vehicles are assumed to be stored inside. Another consideration is the location of the maintenance facility. The further the facility is located from the main line, the longer the track required to reach the facility will be and the higher the costs. For planning purposes, it is assumed that capital costs associated with a maintenance/storage facility would cost approximately \$4.0 million and that ½ mile of single track would be required to access the facility.

It is important to note that a maintenance/storage facility will be a one-time cost that would apply only to the first line. As the system evolves, however, it may be necessary to construct an additional maintenance/storage facility in order to accommodate a larger streetcar fleet.

Key Findings

This section presents key findings from this chapter, and conclusions that help make the decision on where to start in each corridor. One of the key factors in this decision is ensuring that the very first line has access to a location where a maintenance / storage

facility can be built. Once the first segment is built that connects to the maintenance / storage facility, other segments which do not have direct access to a maintenance / storage site could be connected to this facility via the first segment.

Hennepin Avenue

- The most promising location for a maintenance facility along this corridor is on the south end of the line. If the Hennepin line is built before other lines, the southern minimal operable segment would need to be built before the northern segment to have access to the maintenance / storage facility.
- The southern portion of the line serves the majority of special generators along this corridor (with the exception of the east Hennepin area).
- Economic development potential along this line is strongest in the East Hennepin area, on the north and south edges of the downtown core, and around the new Twins Ballpark.

W Broadway / Washington Avenue (via Nicollet or Park)

- The most promising location for a maintenance facility along this line is in the vicinity of 10th Avenue N
- The minimal operable segments between south of 10th Ave N offers much greater development opportunity than the segment north of 10th Avenue N.
- Estimated capital costs associated with the extension to Fremont/Emerson (\$26.5 M) are high compared to the potential gain in ridership.

Nicollet Avenue S

- The most promising location for a maintenance / storage facility along this corridor is just south of Lake Street (at the existing Metro Transit Garage Facility).
- If service in this corridor were implemented first, it would need to go as far south as Lake Street (or 31st) to access a maintenance / storage facility. This would be a strong line with service to a consistently dense neighborhood, connections to high-frequency bus service on Lake Street, and significant redevelopment potential at Lake Street. This line would also connect with the Midtown Greenway.
- If another corridor were implemented first that connects with this corridor, the shorter minimal operable segments to 13th Street or Franklin Avenue both provide good terminal locations.

Chicago Avenue S

- The most promising location for a maintenance / storage facility along this corridor is east of the current Metrodome – a significant distance from the revenue line in this corridor.

- If service in this corridor were implemented first, the shortest minimal operable segment to 14th Street would be able to reach a maintenance facility east of the Metrodome.
- The initial operable segment to Lake Street would provide the greatest benefit in this corridor by connecting three major hospitals, the Midtown Exchange area and high frequency bus service on Lake Street. This line would also serve the Midtown Greenway corridor.

Based on these findings, it becomes more clear that initial implementation of a streetcar network in Minneapolis must start with one of the centrally located segments that has access to a maintenance facility site and can easily be linked to other segments as the network grows (even if short sections of track are required).

Because all of the corridors “connect” near the intersection of Washington Avenue / Nicollet, the segments that best serve this function include the Washington Avenue / 10th Avenue N to Nicollet / 5th or to Park Avenue and the segment between Hennepin Avenue 5th Street and Hennepin/Groveland.

Figure 7 Summary of Initial Operating Segments Characteristics

	Hennepin Avenue	W Broadway/Washington Avenue to Nicollet Avenue	W Broadway/Washington Avenue to Park Avenue	Nicollet Avenue	Chicago / 9 th /10 th Streets to Nicollet Avenue
<i>From</i>	<i>Groveland</i>	<i>Fremont Avenue N / W Broadway</i>	<i>Fremont Avenue N / W Broadway</i>	<i>Nicollet Avenue S / Lake Street</i>	<i>Chicago Avenue S / Lake Street</i>
<i>To</i>	<i>Central Ave NE/4th Street SE</i>	<i>5th Street / Nicollet Avenue</i>	<i>5th Street / Park Avenue</i>	<i>Washington Avenue</i>	<i>Nicollet Avenue / 5th Street</i>
Minimal Operable Segments	A-1: Hennepin/Groveland to Hennepin/5 th A-2: Hennepin/5 th to Central Ave NE/University Ave SE	A: Nicollet/5 th to Washington/10 th Ave N B: Washington/10 th Ave N to W Broadway / Fremont Ave N	A: Park/5 th to Washington/10 th Ave N B: Washington/10 th Ave N to W Broadway / Fremont Ave N	A: Washington/Nicollet to Nicollet/13 th B: Nicollet/13 th to Nicollet/Franklin C: Nicollet/Franklin to Nicollet/Lake	A: Nicollet/5 th to Chicago/14 th B: Chicago/14 th to Chicago/Franklin C: Chicago/Franklin to Chicago/Lake
Operating Characteristics					
Peak Vehicle Requirement	3	3	3	3	3
Annual Service Hours	17,200	17,200	17,200	17,200	17,200
Estimated Annual Operating Costs (assuming \$149.75/hour)	\$2,571,507	\$2,571,507	\$2,571,507	\$2,571,507	\$2,571,507
Ridership Estimates					
Estimated Weekday Ridership	1,800 – 2,300	1,600 – 1,900	1,400 – 1,800	1,900 – 2,400	1,600 – 2,000
Estimated Annual Ridership	662,000 – 809,200	563,800 – 689,100	512,200 – 626,100	687,800 – 840,600	572,900 – 700,200
Economic Development					
Special Use	High	Moderate	Moderate	High	Moderate

Generators					
Development Opportunity	Moderate	Moderate	High	Moderate	High
Capital Cost Estimates (\$2007)					
Track Miles	4.8	4.8	6.0	4.6	5.0
Estimated Cost per Track Mile	\$9,948,067	\$9,948,067	\$9,948,067	\$9,948,067	\$9,948,067
<i>Subtotal</i>	<i>\$47,750,722</i>	<i>\$47,750,722</i>	<i>\$59,688,403</i>	<i>\$45,761,109</i>	<i>\$49,740,336</i>
Additional Capital Costs	1) Lowry Tunnel - \$244,000 2) Hennepin Bridge (Miss. River) - \$2.08 M 3) Center Stations (Wash – 10th) - \$450,000 4) LRT Crossing - \$50,000	1) 4 th Avenue N Bridge - \$70,000 2) LRT Crossing - \$50,000 3) Mall Modifications - \$300,000 4) I-94 Bridge - \$660,000	1) 4 th Avenue N Bridge - \$70,000 2) LRT Crossing - \$50,000 3) I-94 Bridge - \$660,000	1) LRT Crossing - \$50,000 2) Mall Modifications - \$2,100,000 3) I-94 Bridge - \$400,000 3) Greenway Bridge - \$200,000	1) I-94 Bridge - \$660,000 2) Greenway Bridge - \$180,000 3) LRT Crossing - \$50,000
<i>Subtotal</i>	<i>\$50,100,000</i>	<i>\$48,800,000</i>	<i>\$60,500,000</i>	<i>\$48,500,000</i>	<i>\$50,700,000</i>
Vehicle Costs ³	\$12,000,000	\$12,000,000	\$12,000,000	\$12,000,000	\$12,000,000
Non-revenue track ⁴	\$4,500,000	\$4,500,000	\$4,500,000	\$4,500,000	\$4,500,000
Maintenance Facility ⁵	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Total Capital Costs (\$2007)	\$70,600,000	\$69,300,000	\$81,000,000	\$69,000,000	\$71,100,000

³ Assumes \$3,000,000 per vehicle. Costs include one spare vehicle per shortest operable segment. If all segments were implemented together, the number of spare vehicles would likely be lower.

⁴ For planning purposes, it is assumed that ½ mile of single track would be required to access a maintenance facility.

⁵ Maintenance facility costs would only apply to the first shortest operable segment.

