



SOUTHWEST
transitway

green means go.

Southwest LRT

Technical Memorandum No. 8B

CONSTRUCTION COMPLEXITY

PRELIMINARY
FOR REVIEW ONLY

September 9, 2009



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1.0 INTRODUCTION

The purpose of this memo is to identify potential constructability issues for each of the alternatives being considered for the Southwest LRT project. Constructability is a measure by which the challenges, complexities, risks, and flexibilities for design and construction are considered. Each of these issues affects the scope, schedule, and cost estimate of each alternative.

1.1 Constructability

The constructability of each alternative is based on the following:

- ◆ Construction site accessibility.
- ◆ Capacity of work site to accommodate construction activities (size and configuration).
- ◆ Availability of materials storage and stockpile space in close proximity to project.

In the FTA Standard Cost Category (SCC) workbooks, an allocated contingency is applied to each cost item. The allocated contingency is entered by the project's sponsor as a measure of uncertainty of each item. The cost associated with the constructability of each LRT alternative is included in the allocated contingency of each SCC category. A higher allocated contingency for a specific item indicates that the item's constructability is subject to more risk than typically expected. The allocated contingencies for the major items are listed in Section 3 of Table 1.

2.0 OVERVIEW OF ALIGNMENTS

The LRT alignments were analyzed as individual segments for the purpose of this evaluation. Refer to Figure 1 for a map of the LRT Segments

2.1 LRT Segment 1

Segment one affects LRT 1A. There are three major challenges affecting the constructability of Segment 1. Refer to Figure 2 for a map of the construction challenges associated with LRT 1A.

2.1.1 Embankment

Segment 1 begins in Eden Prairie by following the HCRRA right-of-way corridor. This corridor is a former railroad alignment, generally above grade on an embankment. The width of the existing embankment is too narrow for an LRT guideway, requiring excavation of embankment until the width is sufficient for the LRT guideway, safety clearances, and adjacent trail. The work zone for the excavation, guideway, and station construction will be constrained by the steep side slopes, existing HCRRA right-of-way limits, and adjacent residential areas. Temporary construction easements may be required extensively along the alignment where space allows.

2.1.2 TC&W Railroad Crossing

Segment 1 requires a grade separated crossing at TH 62 and TC&W (Twin Cities and Western) RR tracks. The LRT guideway must pass under TH 62 at the existing bridge and continue under

the TC&W RR tracks. The TC&W RR tracks require a new bridge to be constructed over the LRT trackway, forcing a temporary track, or “shoofly” for TC&W RR to continue service during bridge construction. TC&W RR bridge construction requires design coordination with the railroad for structural, clearance, and shoofly alignment requirements to the railroad’s standards. The trail will also need to be accommodated in this area. The alignment’s underpasses force the trail to be cut off at the TC&W RR and re-routed along TH 62 to the west side of the railroad, then back along the existing trail to the HCRRA right-of-way.

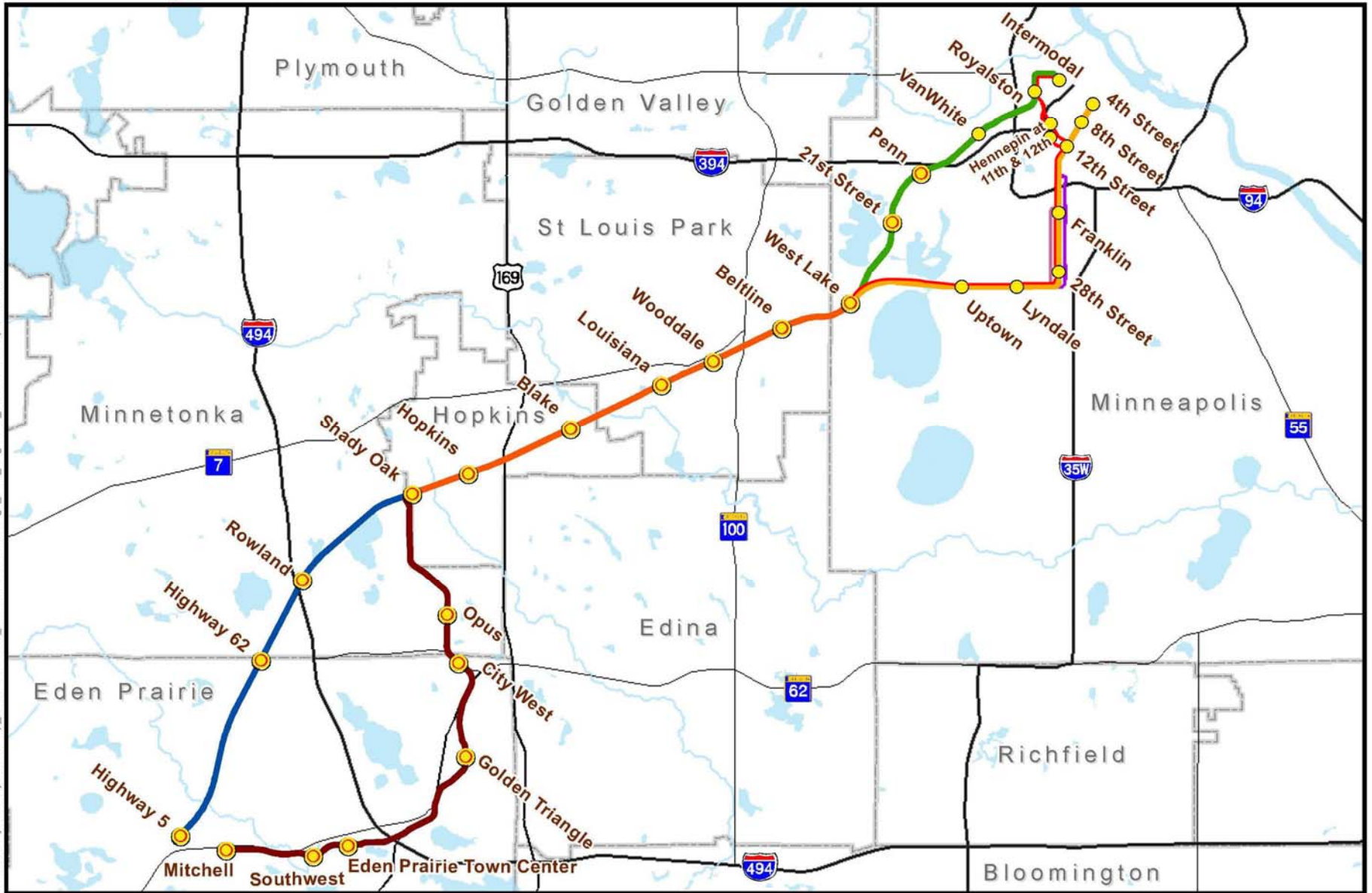
2.1.3 Shady Oak Lake

Within the City of Minnetonka, Segment 1 runs adjacent to Shady Oak Lake. For the guideway to remain within the HCRRA right-of-way, modification of the lake shoreline is required. The challenge of this area will be shoring and placement of retaining walls into the lake within a narrow right-of-way corridor, and the accommodation of the trail adjacent to the lake and the LRT trackway.

These and additional challenges are described in the table in Appendix A.

LRT Segments

Figure 1 - LRT Segment Map



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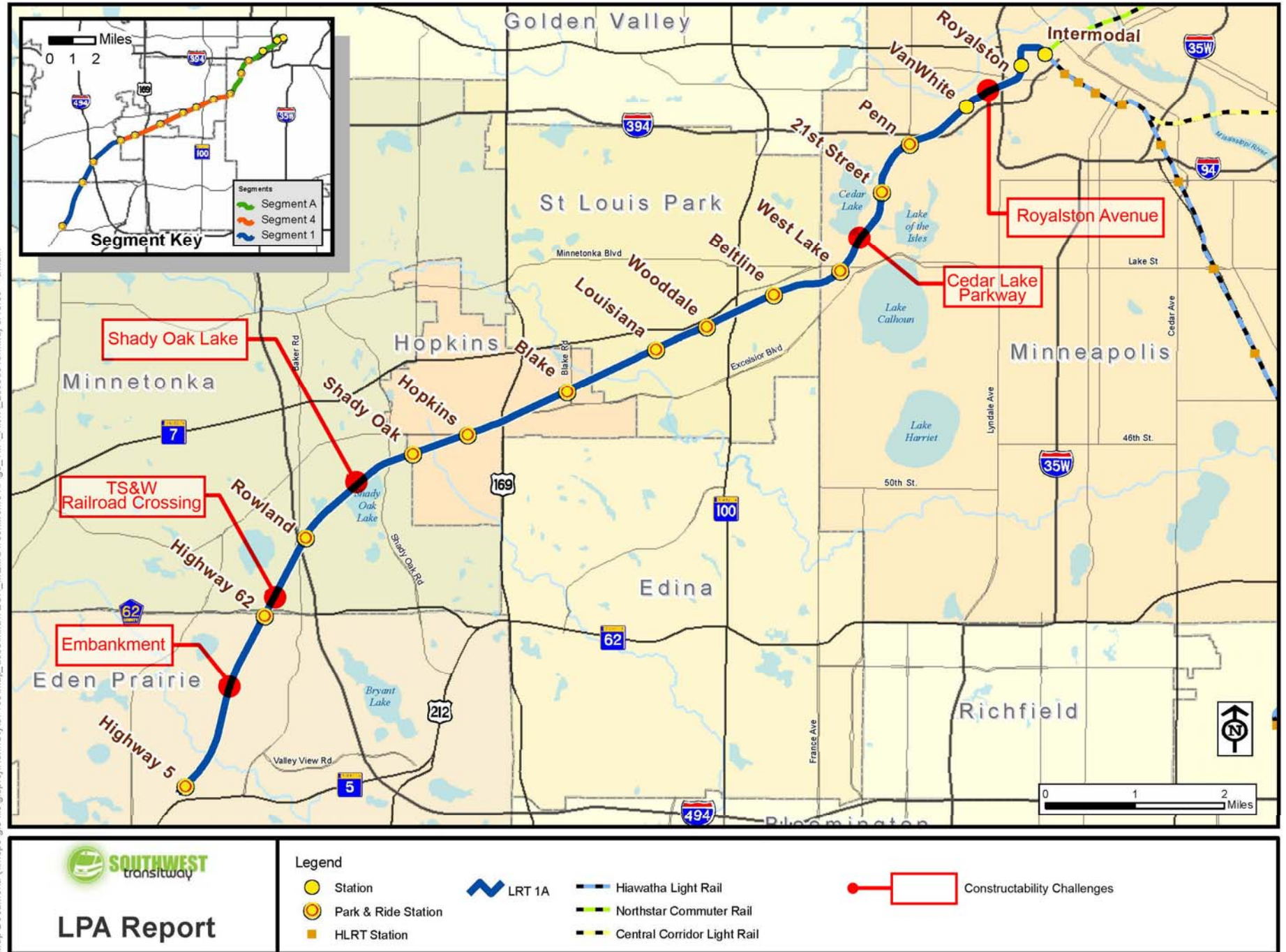
LPA Report

Legend

- Station
- Park & Ride Station
- Segment 1
- Segment 3
- Segment 4
- Segment A
- Segment C-1 (Nicollet Mall)
- Segment C-2 (11th/12th Street)
- Segment C-2A (Blaisdell Avenue)
- Segment C-2B (1st Avenue)

LRT 1A

Figure 2 - LRT 1A Map with Constructability Challenges



2.2 LRT Segment 3

Segment 3 affects LRT 3A, LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street). There are two major challenges affecting the constructability of Segment 3. Refer to Figure 3, Figure 4, and Figure 5 for a map of the construction challenges associated the alignments.

2.2.1 Bridge Construction over Freeways

Segment 3 requires bridges to be constructed over I-494, US 212 and TH 62. The bridges will be exclusively for LRT tracks and vary between 700 and 1,200 feet long. Bridge construction requires coordination with outside agencies (such as MnDOT) for temporary traffic control and specific windows of construction activities. The work zones for each bridge allow adequate room for equipment and workers.

2.2.2 Wetlands

Segment 3 traverses an area of wetlands within the City of Minnetonka. This area will require right-of-way acquisition and design mitigation to minimize impacts to ponds and wetlands. The mitigation measures may include (but are not limited to) retaining walls, structured trackway on small-footprint piers, or partial reclamation of ponds with pond construction elsewhere.

These and additional challenges are described in the table in Appendix A.

2.3 LRT Segment 4 (Affects All Alternatives)

This segment follows the HCRRA right-of-way adjacent to CPRR. Generally, the design and construction of this segment will not be complex, utilizing an at-grade guideway. Bridges are required over Excelsior Boulevard, Minnehaha Creek, and TH 100. Coordination will be required with CPRR, but should not negatively affect the cost or schedule of this segment since the alignment runs adjacent to the CPRR tracks.

Since this segment is common among all alternatives, the constructability of this segment should not factor into the LPA decision process.

2.4 LRT Segment A

Segment A affects LRT 1A and LRT 3A. There are two major challenges affecting the constructability of Segment A.

2.4.1 Cedar Lake Parkway

The HCRRA right-of-way width narrows to as little as 62 feet between the West Lake St. bridge and the Burnham Rd bridge. This will require modification to the standard LRT cross section and investigation of options to ensure safe LRT operations while remaining within the existing right-of-way width. Retaining wall or slope stabilization construction activities may need to be conducted within a narrow work zone.

2.4.2 Royalston Avenue

The alignment is planned to run within the existing Royalston Avenue right-of-way. To do so, the LRT trackway must cross over the existing BNSF RR tracks between existing underpasses at I-

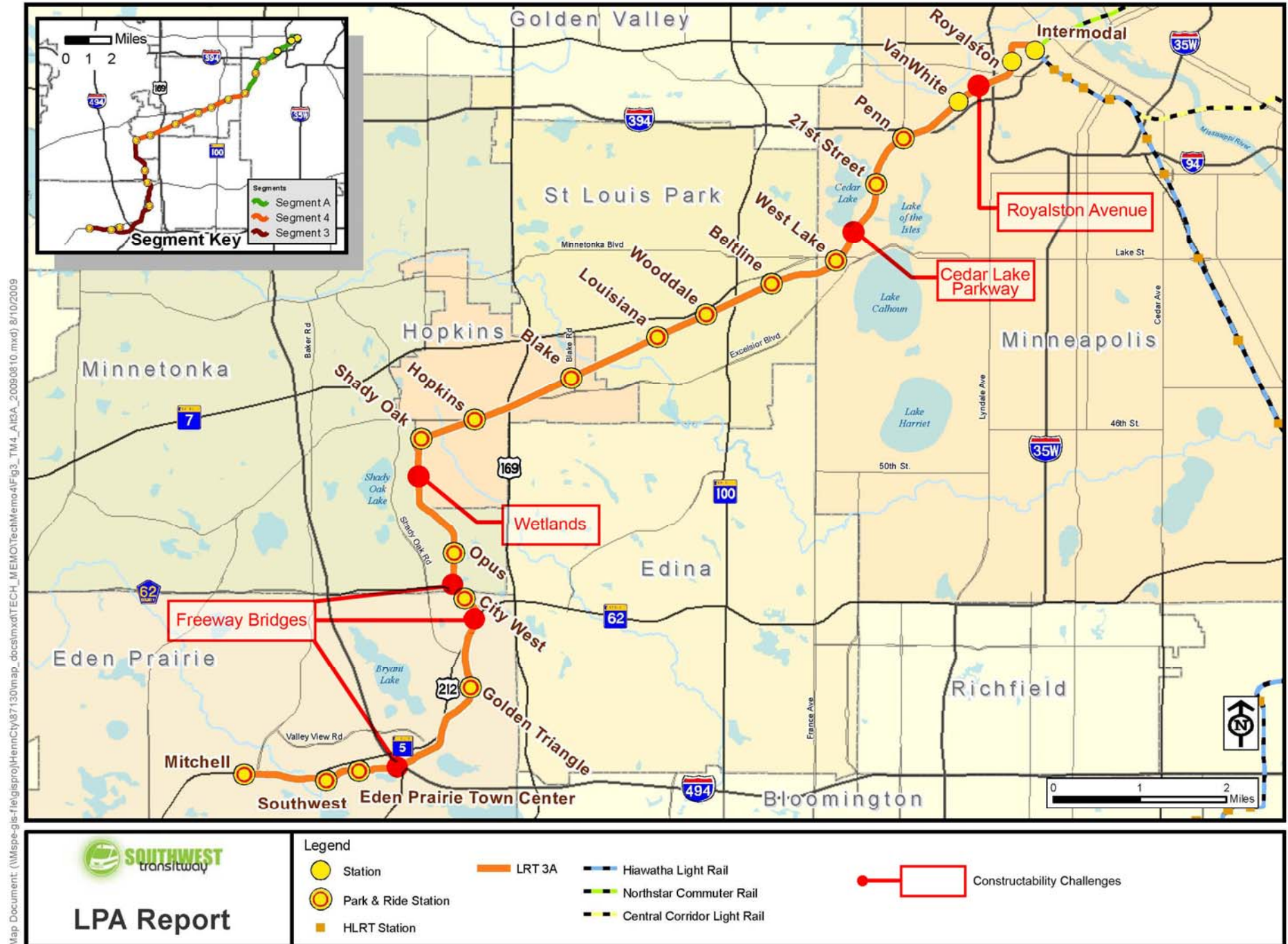
394 and I-94. The horizontal and vertical alignment design will require careful attention to the physical constraints of the railroad, existing roadways, and right-of-way while adhering to LRT design criteria for curves and grades. Bridge construction over the railroad tracks will require coordination with BNSF railroad for clearance and construction activity requirements.

These and additional challenges are described in the table in Appendix A.

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LRT 3A

Figure 3 - LRT 3A Map with Constructability Challenges



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LPA Report

- Legend**
- Station
 - Park & Ride Station
 - HLRT Station
 - LRT 3A
 - Hiawatha Light Rail
 - Northstar Commuter Rail
 - Central Corridor Light Rail
 - Constructability Challenges

2.5 LRT Segment C

Segment C affects LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street). There are seven major challenges affecting the constructability of Segment C. Refer to Figure 4 and Figure 5 for a map of the construction challenges associated with LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street) alignments.

2.5.1 Historic Bridges

For Segment C affecting both the LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street) alignments, the existing Midtown Corridor bridges located at Dean Parkway, Lake of the Isles, and Calhoun Parkway cannot support a double track light rail guideway. Structural reinforcement of the existing bridges, or a new LRT bridge, will be required at these locations. Concern regarding the historic nature of these bridges may require considerable coordination. This coordination may present additional risk to both the schedule and budget of the project.

2.5.2 Midtown Corridor

As mentioned already in Technical Memorandum 9 for Environmental Evaluation, Segment C for both the LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street) alignments would require widening the bottom of the existing Midtown Corridor trench, altering the bridge abutments on one or both sides of the corridor, and modifying the side slopes of the trench. Design activities must be coordinated with any historic treatment mitigation plans. Construction activities would be limited to a narrow work zone within the trench. Careful excavation and earthwork placement would be needed to avoid damaging the existing roadway bridge piers and decks over the trench. These activities present additional risk to both the project's schedule and budget.

2.5.3 Nicollet Avenue at 29th Street

The portion of the C segment for LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street), where alignment travels under Nicollet Avenue, transitions from the Midtown Corridor to Nicollet Avenue by entering a tunnel section from the trench grade. This design requires coordination of the light rail guideway and systems components through a 90-degree turn into a cut-and-cover tunnel. The tunnel portal would be located south of 29th Street near the north edge of the Midtown Corridor, requiring the purchase of property, temporary relocation of the bicycle path during construction, and closing Nicollet Avenue at Midtown Corridor during construction. A cut-and-cover construction method would be utilized, requiring the relocation of utilities and partial closure of Nicollet Avenue during construction. Similar issues would occur if the LRT 3C-2 (11th/12th Street) options to travel under Blaisdell Avenue or 1st Avenue instead of under Nicollet Avenue.

2.5.4 Tunnel Section

The portion of the C segment for LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street) between the Midtown Corridor and Franklin Avenue will be underground in a tunnel section, including two underground stations. This configuration will allow four lanes of traffic to be restored on Nicollet Avenue once construction is complete. A cut-and-cover construction method would be utilized, requiring one-half of the street to be closed for several weeks at a time. The design and construction of this segment will face numerous issues, including the following:

- ◆ Relocation of underground utilities within Nicollet Avenue right of way
- ◆ Modification/strengthening of area-way chambers present on Nicollet Avenue
- ◆ Shoring of excavated work zone
- ◆ Ventilation and emergency access to tunnel and stations
- ◆ Construction zone limited to approximately one-half of roadway width at a time
- ◆ Public outreach to adjacent businesses and property owners
- ◆ Restoration of Nicollet Avenue roadway, sidewalks, streetscape, and driveway access

These issues present significant uncertainties and risk to the design, construction, and testing of a light rail system. The uncertainties and risks will affect the design and construction schedule and budget within this segment. Similar issues would occur if the LRT 3C-2 (11th/12th Street) options to travel under Blaisdell Avenue or 1st Avenue instead of under Nicollet Avenue.

2.5.5 Nicollet Mall

The portion of the C segment for LRT 3C-1 (Nicollet Mall) will require reconstruction of the existing Nicollet Mall to accommodate a double track light rail guideway and side stations. The guideway will 'straighten out' Nicollet Mall's orientation by placing the tracks in or near the center and reconstructing the sidewalks to remain safely outside of the guideway clearance envelope. Construction activities will require partial closure of Nicollet Mall, and the work zone would be limited to one-half of Nicollet Mall at a time. Construction of OCS pole foundations would require an investigation of impacts to underground basements, parking garages, and other area-way chambers.

2.5.6 Connection to Hiawatha

The north end of Segment C for LRT 3C-1 (Nicollet Mall) intersects with the Hiawatha LRT line at 5th Street. A track connection between Segment C and Hiawatha would be difficult due to right-of-way constraints and adjacent property uses. An existing parking lot on the northeast corner could lend itself to a track connection; however, the connection would be a minimum-speed maneuver and require special trackwork connections. All connection options require additional design and construction activities, and present potential increases to both the project's cost and schedule.

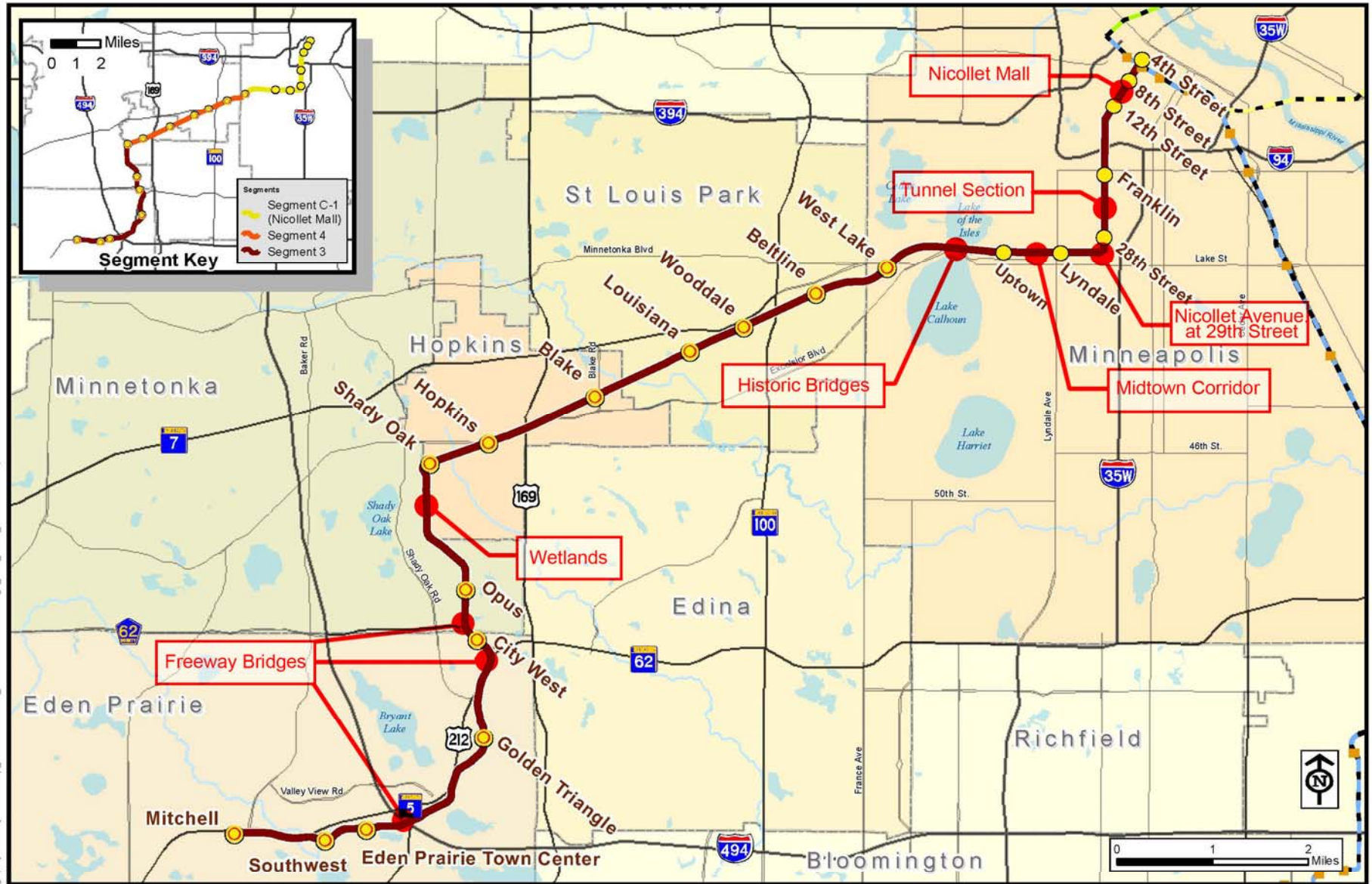
2.5.7 11th/12th Street at I-394

LRT 3C-2 (11th/12th Street) utilizes the 11th and 12th street one-way couplet to connect Nicollet Avenue to the existing terminal of the Hiawatha LRT line located west of downtown Minneapolis. This alternative requires the construction of two new light rail bridges over I-394 (one for each direction) and modification to the Hawthorne Avenue traffic signal east of I-394. Construction activities will require special coordination with traffic, transit operations, and maintenance of access to adjacent properties.

These and additional challenges are described in the table in Appendix A.

Figure 4 - LRT 3C-1 (Nicollet Mall) Map with Constructability Challenges

LRT 3C-1 (Nicollet Mall)

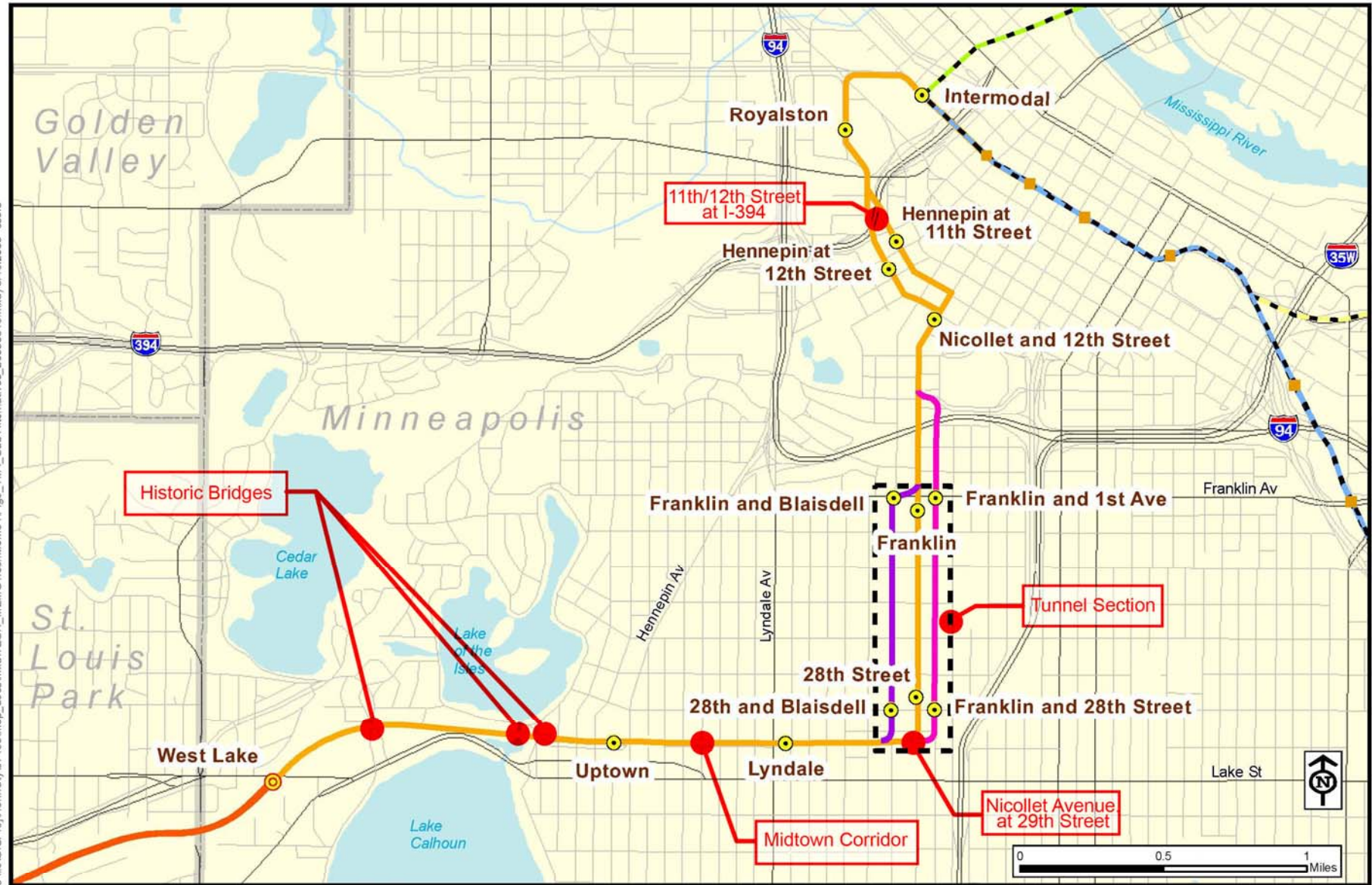


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<p>LPA Report</p>	<p>Legend</p> <ul style="list-style-type: none"> ● Station ● Park & Ride Station ■ HLRT Station 	<ul style="list-style-type: none"> — LRT 3C-1 (Nicollet Mall) — Hiawatha Light Rail — Northstar Commuter Rail — Central Corridor Light Rail 	<ul style="list-style-type: none"> Constructability Challenges
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Figure 5 - LRT 3C-2 (11th/12th Street) Map with Constructability Challenges

LRT 3C-2 (11th / 12th Street)



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<p>LPA Report</p>	<p>Legend</p> <p>Segment C-2 Stations</p> <ul style="list-style-type: none"> Station Park and Ride Station HLRT Station 	<ul style="list-style-type: none"> Segment C-2 (11th/12th Street) Segment C-2A (Blaisdell Avenue) Segment C-2B (1st Avenue) Segment 4 	<ul style="list-style-type: none"> Tunnel Area Hiawatha Light Rail Northstar Commuter Rail Central Corridor Light Rail 	<ul style="list-style-type: none"> Constructability Challenges
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3.0 MEASUREMENT OF CONSTRUCTABILITY

The cost associated with the constructability of each LRT alternative is factored into the allocated contingency of each SCC item. A higher allocated contingency for a specific item indicates that the item's constructability is subject to more risk than typically expected. For projects in the conceptual engineering phase, a base allocated contingency of 25-30% is applied to each SCC item. Based on the assessment made of the conceptual engineering plans at this stage of project development, an allocated contingency adjustment of 5% to 15% above standard contingencies will accommodate cost and schedule risks associated with design and construction challenges.

Table 1 - Allocated Contingencies

SCC Category	LRT 1A	LRT 3A	LRT 3C (Nicollet Mall)	LRT 3C (11 th /12 th Street)
10.02 Guideway at-grade	30%	30%	30%	30%
10.03 Guideway in mixed traffic	n/a	n/a	30%	30%
10.04 Guideway aerial structure	35%	35%	35%	35%
10.05 Guideway built-up fill	35%	35%	35%	35%
10.06 Guideway cut and cover	30%	40%	40%	40%
10.08 Guideway retained fill	30%	30%	30%	30%
10.09 Track – direct fixation	30%	30%	30%	30%
10.10 Track – embedded	30%	30%	30%	30%
10.11 Track – ballasted	30%	30%	30%	30%
10.12 Track – special	30%	30%	30%	30%
20.01 At-grade stations	30%	30%	30%	30%
20.06 Parking structure	n/a	35%	35%	35%
30.02 Light maintenance facility	30%	30%	30%	30%
40.01 Demolition	30%	30%	30%	30%
40.02 Site utilities	30%	30%	35%	35%
40.04 Environmental mitigation	30%	n/a	n/a	n/a
40.06 Pedestrian & bike facilities	30%	30%	30%	30%
40.07 Automobile facilities	30%	30%	30%	30%
40.08 Temporary facilities	30%	30%	30%	30%
50.01 Train control & signals	30%	30%	30%	30%
50.02 Traffic signals	30%	30%	30%	30%
50.03 Traction power supply	30%	30%	30%	30%
50.04 Traction power distribution	30%	30%	30%	30%
50.05 Communications	30%	30%	30%	30%
50.06 Fare collection	30%	30%	30%	30%
50.07 Central control	30%	30%	30%	30%
60.01 Purchase of real estate	40%	40%	40%	40%
60.02 Relocations	40%	40%	40%	40%
70.01 Light rail vehicles	20%	20%	20%	20%
70.06 Non-revenue vehicles	30%	30%	30%	30%
70.07 Spare parts	30%	30%	30%	30%