ROCHESTER RAIL LINK FEASIBILITY STUDY

Highway 52 Multimodal Corridor ←

Alternative 2 → ← **Alternative 1**

Prepared for

Minnesota Department of Transportation

Presented by

TEMS

Transportation Economics & Management Systems, Inc.

in association with

HNTB

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1. Introduction

The Twin Cities region faces many challenges in the 21st Century, one of the most important being the upgrading of transportation connections at a local, regional, and national level. To meet this challenge, the metropolitan area will need to

- ⊕ Expand the existing airport system to support the rapidly growing population and industrial base of the region and their associated passenger and cargo markets

- ⊕ Provide intercity rail service to support interurban mobility and connections between its own towns and cities and at the regional level of the Midwest.

To address these needs, the City of Rochester – together with the Minnesota Department of Transportation – has set out to assess the potential of Highway 52 corridor as a multimodal corridor and a key connector for the 21st Century. Achieving this would facilitate both the development of Rochester International Airport as a potential reliever airport for the Twin Cities region and provide (as outlined in the Tri-State Study) the first leg of the proposed Twin Cities-Rochester/LaCrosse connection as was recommended in the second phase of the MWRRI development program.[1] This connection will make Rochester integral to the 3,000-mile MWRRI system and provide access to Rochester, not just from Twin Cities, but also from all the cities and towns of the nine-state MWRRI region.

The purpose of this study, therefore, is to evaluate the potential for developing the Highway 52 corridor as a high-speed rail connection between Minneapolis-St. Paul International Airport and Rochester International Airport. The scope of the study is to assess the potential for rail service by evaluating, for different scenarios, the following:

- ⊕ Technology/Equipment Assessment

- ⊕ Corridor Assessment/Operations

- ⊕ Impacts Assessment

The study examines the introduction of a modern rail service that would use the latest technology and provide a high quality high-speed rail service that travelers and freight movers expect in the 21st Century. The rail service evaluated will include both inter-airport passenger and freight traffic.

Transportation Economics & Management Systems, Inc.'s (TEMS) approach to assessing the potential for high-speed rail in the Twin Cities-to-Rochester airports corridor involved the use of a range of software tools and databases (the *RightTrack*© Business Planning System) that has been successfully applied in planning numerous rail, highway, air and transit passenger systems throughout North America and Europe.

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[1] The Midwest Regional Rail Initiative (MWRRI) is an ongoing effort to develop an improved and expanded passenger rail system in Minnesota, Illinois, Indiana, Michigan, Missouri, Nebraska, Ohio and Wisconsin. This system would use existing rail right-of-way shared with freight and commuter rail trains. Minnesota Department of Transportation participates as a planning study partner to determine ridership forecasts, service options, revenue, and capital and operating costs. The *MWRRI Executive Report* was made available in March 2000.

As shown in Exhibit 1.1, the *RightTrack*© system consists of five interactive models that provide a balanced assessment of how ridership, track infrastructure, and vehicle technology interact for any given development scenario.

Exhibit 1.1: *RightTrack*© Business Planning System
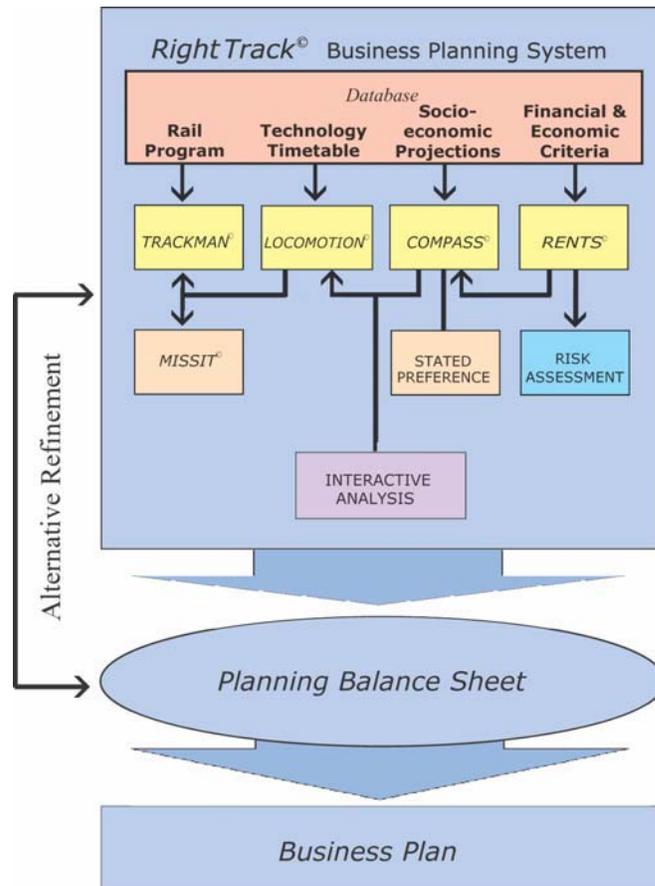
Determining appropriate rail service depends on obtaining the best trade-offs between costs and revenues for any given route and associated technology. Higher levels of ridership generate higher revenues, which permit a greater level of infrastructure investment and thus higher speeds. Lower levels of ridership and lower revenues require that infrastructure investment be minimized and/or the use of more sophisticated vehicles (e.g., tilt technology to compensate for inadequate track geometry). As a result, an *interactive analysis* is the most efficient means of developing and identifying operational and infrastructure needs. The interactive analysis uses the software tools listed above, which permits an evaluation and re-evaluation of route, technology, and/or ridership factors.

This study focuses on the concept of Highway 52 as a multimodal corridor connection between the Twin Cities and Rochester. The study is largely concerned with evaluating the concept or vision of Highway 52 and its potential as a multimodal corridor rather than a detailed feasibility assessment. As such, it did not undertake either detailed demand or engineering studies. For rail

passenger ridership and cargo traffic, benchmark assessments were undertaken to provide preliminary estimates. Engineering unit costs were derived from recent studies across the US, including the Midwest, Mid-Atlantic, and Florida. These unit costs were then applied to route profiles for various Highway 52 corridor alignments. The output of the interactive analysis will be an operating and cost/benefit ratio for each route/technology option that optimizes the financial and economic benefits of the potential infrastructure, technology and traffic levels, as shown in Exhibit 1.2.

Exhibit 1.2: Interactive Analysis
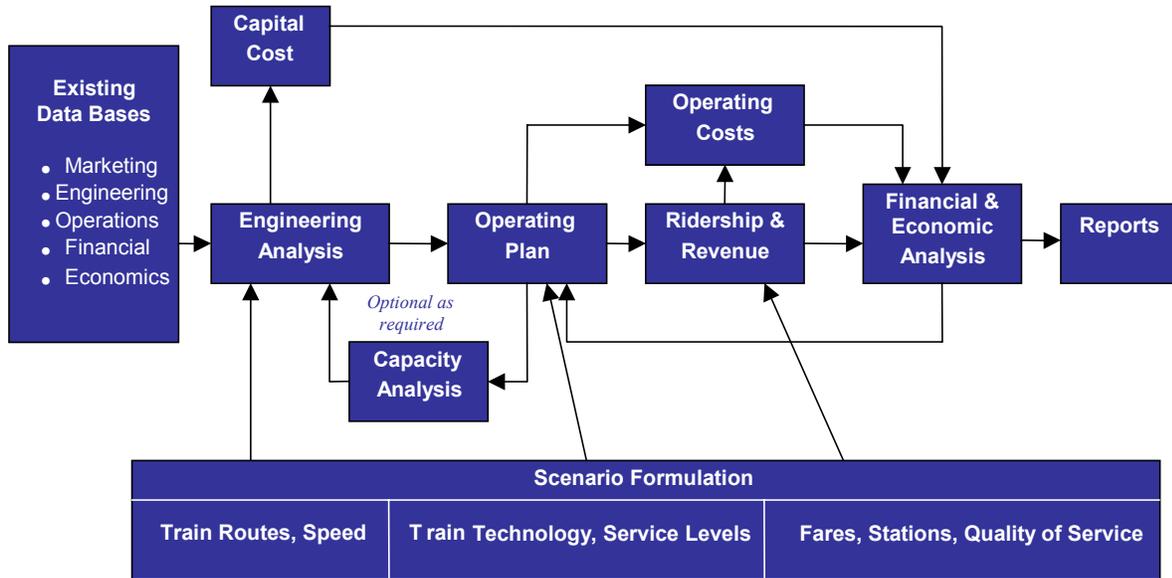
TEMS' *LOCOMOTION*[©] and *TRACKMAN*[©] models were applied to develop the operating plan for the proposed corridor. *LOCOMOTION*[©] optimizes train timetables in relation to given civil engineering or signaling work programs. The system estimates new train schedules for different rail technologies using train performance, engineering track geometry, and train control input data. *LOCOMOTION*[©] also provides milepost-by-milepost graphic output of train performance based on the characteristics of the track. The system evaluates train interaction, provides stringline output for new and existing services, and identifies any capacity constraints. In conjunction with *TRACKMAN*[©]**,** *LOCOMOTION*[©] can estimate the capital costs of improving train speeds and eliminate any capacity constraints.

The *TRACKMAN*[©] program is designed to build an infrastructure database and provide graphic review capabilities for a given railroad route. Using condensed profiles, engineering information, and even track car data, *TRACKMAN*[©] develops a milepost-by-milepost database of the physical infrastructure of the route, including gradients, curves, bridges, tunnels, yards and signaling systems. These data are displayed along with maximum permissible train speeds to provide input to the *LOCOMOTION*[©] program that calculates the performance of trains and potential train interaction for the track.

Feedback from *LOCOMOTION*© to *TRACKMAN*© provides the track engineer with an understanding of which track sections are limiting train performance and allows the engineer to develop a "shopping list" of track improvements that will raise maximum permissible speeds. Using either specific engineering cost data or default unit costs, the proposed shopping list can be costed and a "cost-per-minute saved" priority ranking generated for each of the shopping list track improvements. In this way, *TRACKMAN*© and *LOCOMOTION*© provide a powerful analysis of engineering improvement needs and ensure that the most effective engineering improvements are made to maximize the value of capital investments and improve the operating plan for passenger and freight service.

TEMS has used the *TRACKMAN*© program extensively in its rail planning projects, including the Midwest Regional Rail System Study, Tri-State High Speed Rail Studies, Rockford Rail Link Study, Virginia Passenger Rail Study, Minnesota Intrastate Rail Study, and Illinois Rail Plan and Service Improvement Study.

2. Technology Assessment

To undertake the technology assessment, two critical factors need to be evaluated: maximum commercial speed requirements of a train and the corresponding Federal Railroad Administration (FRA) track class for any given rail system. This dictates critical elements of infrastructure need, including track, signal and communications systems, and the equipment options available. This report uses maximum commercial speeds to delineate the equipment and infrastructure choices available in this corridor. The three speed ranges chosen for evaluation are as follows:

 ⊕ Maximum commercial speed of 150+ mph (FRA class 8 track)

 ⊕ Maximum commercial speed of 180+ mph (FRA class 9 track)

 ⊕ Maximum commercial speed of 250+ mph (Maglev).

Exhibit 2.1 portrays each of these technologies.

Exhibit 2.1: Generic Examples of Train Technologies

150+ mph (Bombardier's Acela/American Flyer)

180+ mph (TGV)

250+ mph (Transrapid-Maglev)
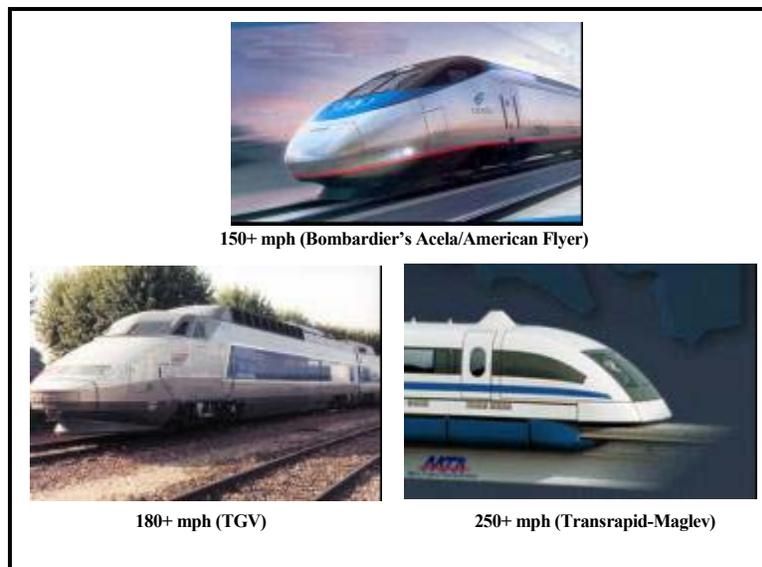
Maximum commercial speed differs from the more theoretical equipment "design speed" in that it reflects real world operating conditions, taking into consideration speed restrictions such as curves, grades, bridges and interlockings. Maximum commercial speed is also subject to FRA track speed regulations for each given class of track, as noted above. Typically, the 150+ mph technology uses upgraded but existing infrastructure, allowing for an incremental approach to investment, while the two higher commercial speeds (180+ mph and 250+ mph) require new dedicated systems built from the ground up.

2.1   High-Speed Equipment Technology Options

North American passenger train operators have benefited from the extensive global technology development as railways around the world have upgraded their passenger systems to high-speed rail operations. Over the past year, true domestic high-speed rail has become a reality with the introduction of Amtrak's Acela technology in the Northeast. The electric-powered Acela, specifically designed to meet US DOT equipment standards, is being further developed into the *American Flyer* fossil-fueled option. The technology is undergoing further advancement through the development of the Advanced Turbine Locomotive, a gas turbine capable of speeds of 150+ mph.

Given these developments, a wide array of equipment choices is available for this corridor. However, two basic characteristics of each equipment type need to be considered: propulsion system technology and tilting design.

Each of the technologies is described in the paragraphs below.

Gas-turbine technology, popular in a variety of applications including marine propulsion, has seen limited use in rail systems due in part to potentially higher fuel consumption rates in comparison to diesel-electrics. This is changing with the current development of this technology, which has advanced dramatically in recent years with its use in both helicopters and fast ferries. As a result, the American Flyer/Advanced Turbine Locomotive offers higher commercial speeds (150+ mph) and acceleration rates than diesel-electrics, making it more suitable for high-speed passenger service. In the future, this technology may also feature flywheels and other energy storage systems that will make the unit more energy efficient.

Electric propulsion uses either AC or DC electric power fed directly to the train through either an overhead wire catenary system or a surface-mounted third rail. Typically, high-speed systems use high voltage AC overhead catenary systems. The advantage of electric power is that it can provide very high peak power inputs, allowing for rapid acceleration rates and high maximum speeds. All systems in operation with commercial speeds in excess of 150 mph use electric power for this reason. The disadvantage is that the power transmission system is a large added capital and maintenance expense. Examples include Amtrak's Acela train, the French TGV system, the German ICE system and the forerunner of them all, the Japanese Shinkansen, or Bullet, train system.

Magnetic levitation, or Maglev, was first conceived and developed in the United States by technology innovators Drs. James Powell and Gordon Danby. Maglev, the sole option for ground transportation systems with commercial speeds in excess of 250 mph, is the most exotic technology discussed here in that it uses a much different propulsion and "track" design. Instead of relying on steel wheels and rails, as the other technologies discussed, Maglev vehicles are magnetically levitated and propelled along their guideways. Two basic types of Maglev systems have been developed: electromagnetic and superconducting. The types of magnets used on the vehicles differentiate these systems. Magnets located on the electromagnetic Maglev vehicle's undercarriage are attracted to reaction rails attached to the

guideway above, creating magnetic fields that cause the vehicle to levitate. An active, electronically controlled suspension system ensures that the vehicle levitates at a constant distance away from the guideway.

The magnets in the superconducting system interact with guideway conductors, creating a magnetic force that levitates the vehicle. The nature of the magnetic field makes this system vertically stable at all times. At present, neither system is in commercial operation, though both are undergoing extensive testing in Germany and Japan, respectively, and development is currently underway for the possible construction of a commercial electromagnetic Maglev system in Shanghai, China. Furthermore, the German Transrapid is currently applying for US operating licenses.

Passenger car technology can be divided into **"tilt"** and **"not-tilt"** designs. Tilt equipment differs from conventional, or "non-tilt," car designs in that onboard hydraulic systems (active tilt) or car suspension designs (passive tilt) smooth out curves to lower the centrifugal forces felt inside cars. This in turn allows for the trains to operate at higher curve speeds, reducing overall transit times. Applications include the Acela/American Flyer design, with an active tilting system and commercial speeds of 150+ mph. The Acela system is currently in domestic use, while the American Flyer is being tested.

2.2   Characteristics of the Technologies Selected for Study Analysis

Equipment choices were narrowed to one representative or generic type for each commercial speed. For each train technology, operators, equipment suppliers and published sources on vehicle dimensions provided detailed data on performance capabilities, types of propulsion, costs, and the characteristics of related track and infrastructure requirements.

All of the equipment chosen for this report had to meet a number of important criteria. Most importantly, the equipment has to be commercially available for domestic service in the near term. This requires that the systems comply or will comply with all relevant FRA and American Association of Railroads (AAR) requirements. This compliance can be a major hurdle since the FRA has recently issued upgraded passenger equipment safety standards that are in some ways more stringent than European Union Internationale Des Chemins De Fer (UIC) standards. The key difference between US and European regulations is the design loads mandated, including the buff or static compressive strength requirements. US standards require that all passenger cars have the strength to withstand a buff load of 400 tons, while UIC requirements typically call for buff loads of 200 metric tons. In addition, the FRA has different standards for lower speed (up to 125 mph) equipment, called Tier I standards, versus the higher speed Tier II standards that apply to equipment operated up to 150 mph.

Currently, no US standards exist for technologies operated at speeds in excess of 150 mph or for Maglev technology. Given that both of these technologies have excellent safety records in Europe, suppliers will likely develop suitable standards and regulations by using existing design criteria prior to domestic market introduction.

The following three generic systems were chosen for this study:

- ◇ 150+ mph   Gas-turbine trainsets

- ◇ 180+ mph   Electric trainsets

- ◇ 250+ mph   Magnetic Levitation trainsets

For the generic technology options, the design specifications are compared in Exhibit 2.2.

Exhibit 2.2: Train Technology Specifications

	150+ mph	180+ mph	250+ mph
Consist [1]	1+3+1 [2]	1+3+1	2-car unit
Motive Power	Gas-Turbine	25 KV 50Hz electric	Electromagnetic magnetic levitation
Power Car/Locomotive Weight (tons)	115	75 each	---
Total Horsepower	4,000-5,000	12,000	---
Maximum Axle Load (tons)	27	19	---
Buff Strength (tons)	400	200	---
Maximum Tilt/Unbalance (inches)	9	4.5	12
Maximum Design Speed (mph)	150	185	310
Maximum Commercial Speed (mph)	150	185	300
Seating Capacity (per coach) [3]	65	60	96
Seating Capacity (per train)	195	180	192

[1] For the two steel-wheel-on-steel-rail technologies, the first number indicates the lead locomotives in the consist; the second, the number of passenger cars; and the third number, if present, is the trailing locomotive and/or cab car (see note 2).
[2] The 150+ mph technology includes 1 locomotive and 1 cab car.
[3] All passenger cars in this study are configured as having only one class, with a minimum seat pitch of 39 inches.

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150+ MPH Technology Option
The American Flyer/Advanced Turbine Locomotive is the option chosen for the 150+ mph option. This system allows for high speeds and acceleration rates without the need for expensive overhead catenary systems. The passenger cars feature an active tilting system with relatively conventional coupling systems, allowing for the addition or subtraction of cars from a trainset. The electric version of this system, the Acela train, is already in operation and has a proven record of accomplishment.

Gas-turbine power units typically provide faster acceleration rates and higher top speeds than diesel-electrics, but consume more fuel and require more maintenance than other types of motive power, potentially resulting in greater life cycle costs. Both British Rail and SNCF

used the gas-turbine technology to test early versions of the 150-mph technology in the 1980s, and it is currently used by Amtrak in the New York-Albany corridor.

180+ MPH Technology Option

At speeds of 180+ mph, electric traction provides the only real alternative. The French-designed TGV-Atlantique is one of the most successful examples. The advantage of this type of equipment is that train size is relatively flexible, with the ability to add or remove cars. The disadvantage is the increased capital and maintenance cost requirements for the overhead catenary system. It has also not yet been introduced into domestic operation in the US, which may result in modifications to European design train systems and components. It is also a technology that has not been fully approved for domestic service by the US DOT/FRA.

250+ MPH Technology Option

Maglev is the only high-speed rail technology option available for speeds in excess of 250 mph. The Transrapid-electromagnetic Maglev system constitutes the generic design chosen for this analysis, as it is the only system available for commercial service in the near term. The electromagnetic Maglev technology is also the system used by the candidates chosen by the FRA for its Maglev Deployment Program. This program will serve to demonstrate Maglev technology in commercial US operations. The two systems currently under evaluation are:

⬧ A connection between Baltimore, MD, and Washington, DC

⬧ A link in Pittsburgh, PA, and surrounding areas.

The disadvantage of the electromagnetic Maglev systems is that it requires a greater precision in comparison with steel-wheel technologies in building and maintaining equipment and track tolerance for optimum operation, potentially increasing relative capital and life cycle costs.

2.3 Freight Technology Options

The development of freight or cargo carrying capability for high-speed rail systems is an emerging technology. However, while very little of this technology is in use, most manufacturers see little difficulty in converting the technology for the lighter air cargo type traffic.

150+ MPH Technology Option

To move high-speed freight, a new freight car will need to be designed. Like the TGV, the envisioned technology (American Flyer) would have two locomotives, one at each end with freight cars in between. The locomotives would be gas turbine powered, with the freight car being a passenger car stripped back to make a flat car. Each flatbed car can be independently coupled and decoupled to each other and the locomotives.

180+ MPH Technology Option

For this option, a modified TGV is proposed. The TGV technology consists of ten freight cars and two electric locomotives at each end of the train powered by an overhead catenary.

Each freight car would be a cut down passenger car, specially adapted to carry air cargo loads. The freight cars are coupled to each other and the locomotives and can be decoupled independently.

250+ MPH Technology Option
Maglev technology, the 250+ mph option, has been designed to accommodate passenger and freight uses. The guideway for the train is designed for dual capacity and is a replication of that used for passenger operations, which consists of two end sections and eight middle sections. Each section is powered independently by an electromagnetic current and is articulated with another as one fixed trainset. A Maglev car can transport freight containers and truck trailers. As shown in Exhibit 2.3, the seats can be removed from a typical car to accommodate freight with a width of four meters and height of six meters.

Exhibit 2.3: Maglev Freight and Passenger Compartment Comparison
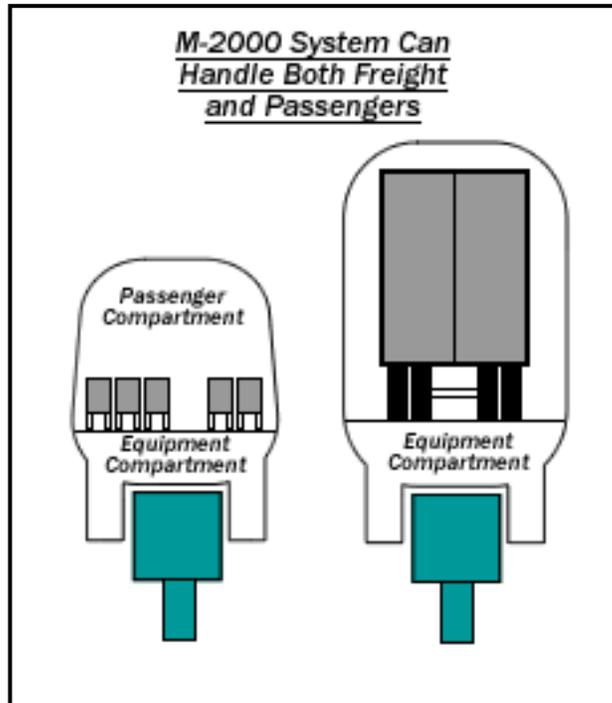
Source: Maglev 2000, Inc.

2.4 Rolling Stock Costs

The costs of both passenger and freight rolling stock were assessed following discussions with potential manufacturers. For passenger operators the number of trainsets required to provide a convenient service for passengers are used to determine rolling stock costs (See Section 3.23). The configuration of the consist for each technology used to derive equipment costs assumes a seating capacity between 180 – 200. As a result, the consist for the 150 + technologies and 180 + mph technologies requires three passenger cars, while the 250+ Maglev technology requires only a 2-car unit. As shown in Exhibit 2.4, the cost difference

between trainsets is relatively small, in a range $20-$22 million. The difference in total costs is due to the number of trainsets required to provide assumed schedule frequencies.

Exhibit 2.4: Rolling Stock Costs Summary

	150+ mph	180+mph	250+ mph
Consist [(1)]	1+3+1	1+3+1	2-car unit
Cost per Trainset (millions)	$20	$22	$22
Required Initial Number of Trainsets [(3)]	7	8	9
Rolling Stock Cost (millions)	$142	$175	$200
[(1)] For the two steel-wheel-on-steel-rail technologies, the first number indicates the lead locomotives in the consist; the second, the number of passenger cars; and the third number, if present, is the trailing locomotive and/or cab car (see note 2 in Exhibit 2.2). [(2)] For each of the technologies, the trainset requirement includes a spare trainset.			

The number of trainsets required to carry freight in the corridor, provided in Exhibit 2.5, was determined from the amount of cargo that is projected to be handled at the airport (see 4.2: Freight Estimates). Four round trips per night are required to meet the estimated demand for service and to provide the level of service needed to support airfreight operations. The analysis showed that two freight trains are required for the 150+ and 180+ technologies and one for the 250+ technology. The cost of the freight car is estimated at $100,000 for both the 150+ and 180+ technologies. The cost per freight car is substantially higher at $3 million for the Maglev technology. However, the 150+ and 180+ technologies require locomotives that significantly raise the overall cost of equipment for these options. Furthermore, while this analysis of Maglev uses the currently FRA-approved technology, lower cost options are in development that might significantly reduce the Maglev options costs.[2]

Exhibit 2.5: Freight Rolling Stock Costs Summary (2002$)

	150+ mph	180+ mph	250+ mph
Cost per Car	$100,000	$100,000	$3,000,000
Cost Per Trainset (million)	$11	$11	$30
Total Trainsets Required	2	2	1
Rolling Stock Cost (millions)	$22.3	$22.3	$30

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[2] Bechtel Corporation. "Super-Speed Ground Transportation Project: Executive Summary." Playa Del Rey, CA and Las Vegas, NV: California-Nevada Super-Speed Ground Transportation Commission, 1990.

3. Preliminary Corridor Assessment

3.1 The Routes

Several potential route Highway 52 corridor options were evaluated in the initial pre-screening stage of the analysis. This included an examination of the different existing rail lines in and close to the corridor and the route alignments proposed or considered in previous rail corridor studies (see Exhibit 3.1).

Exhibit 3.1: Map of Initial Potential Routes
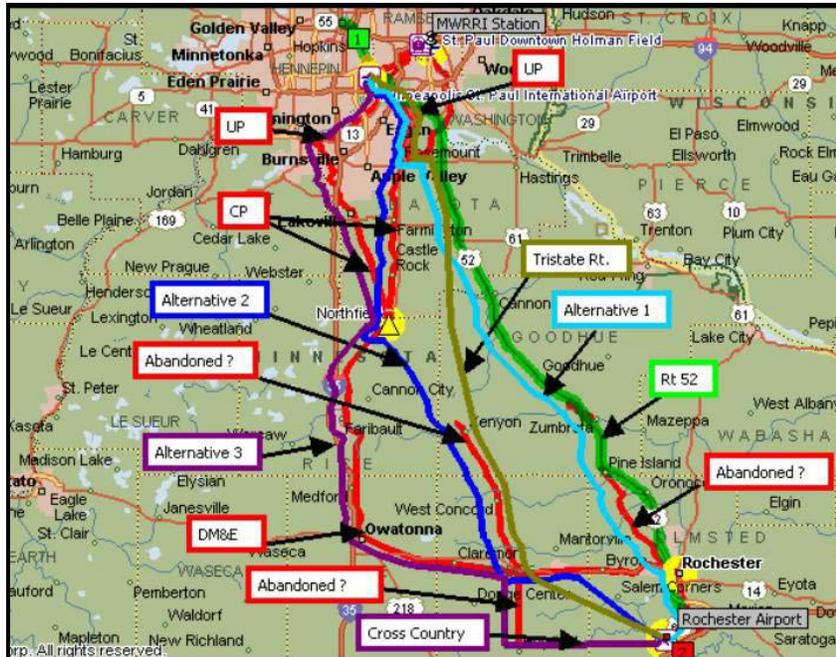
After the initial pre-selection process, two routes were chosen for further analysis as potential options within the Highway 52 multimodal corridor –

1) Tri-State High-Speed Rail route

2) Highway 52 route (see Exhibits 3.2 and 3.3 for route descriptions).

A comprehensive review of the two routes is shown in Appendix A of this report.

Exhibit 3.2: Description of the Tri-State and Highway 52 Routes

Tri-State Route		
Segment	**Mileage**	**Description**
MSP Airport – Rosemount	0-13	Shared R.O.W. with CP
Rosemount – Rochester Airport	13-85	New R.O.W.
Highway 52 Route		
Segment	**Mileage**	**Description**
MSP Airport – Rosemount	0-13	Shared R.O.W. with CP
Rosemount – Rochester (West End)	13-71	New R.O.W.
Rochester (West Approach) – Rochester (West End)	71-75	Abandoned R.O.W.
Rochester (West End) – Rochester (Central)	75-76	Shared R.O.W. with DM&E
Rochester (Central) – Rochester (South End)	76-78	Abandoned R.O.W.
Rochester (South End) – Rochester Airport	78-85	New R.O.W.
Please See Appendix A for further description of routes.		

Exhibit 3.3: Potential Highway 52 Multimodal Corridor Routes
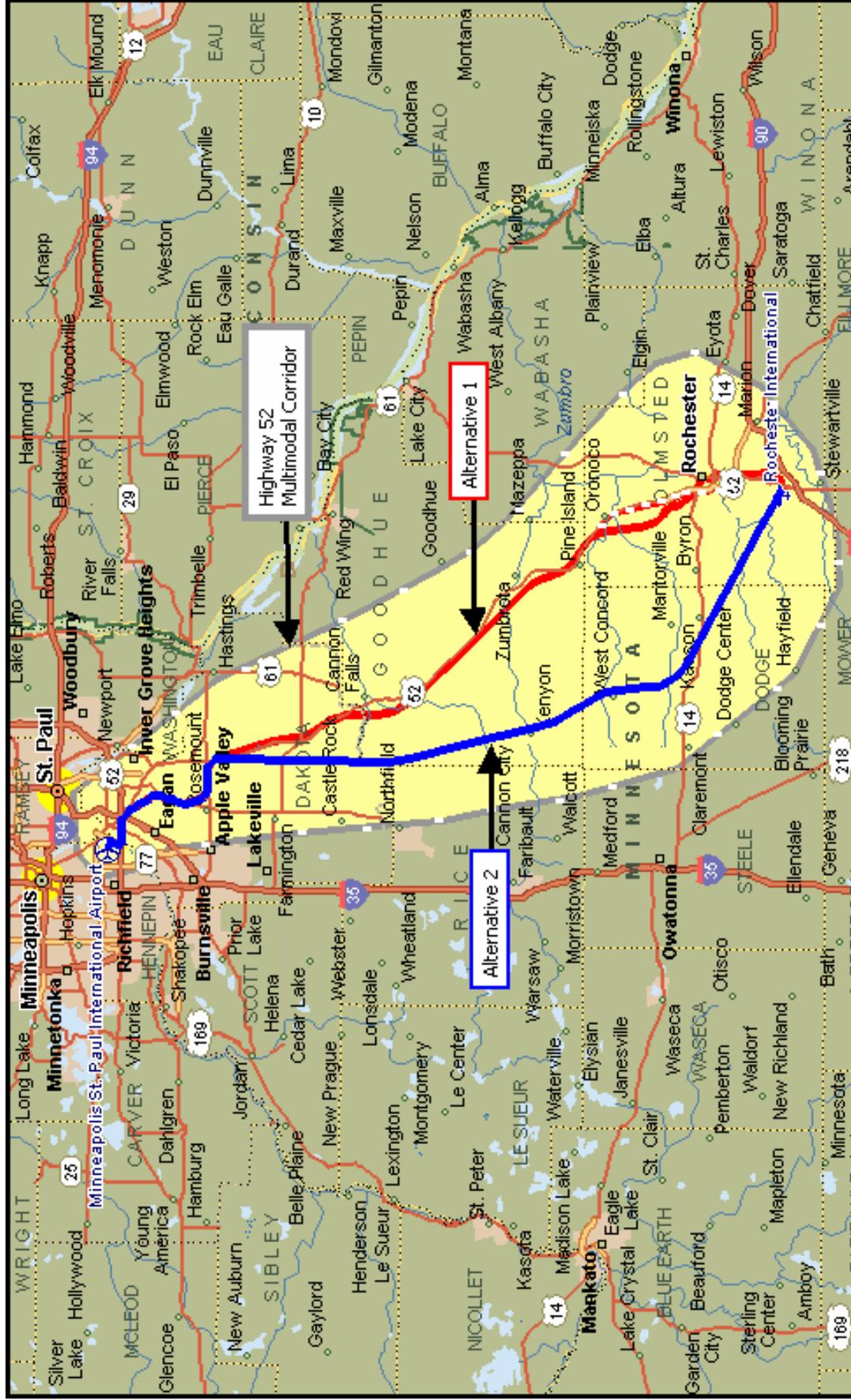
These two route alternatives can be characterized as being more direct as well as providing the most effective route at minimizing interference with both urban areas and other rail traffic. See Exhibits 3.4, 3.5, 3.6, and 3.7.

3.2   Tri-State Route

As noted in the Tri-State report, this route is essentially a "cross-country" or new right-of-way route from Rochester to Twin Cities. Furthermore, since both ends of the route have been moved from downtown Rochester and St. Paul (Union Station) to Rochester and Twin Cities' airports, the route uses less rail right-of-way than proposed in that study. The only stretches of rail line that are used for the airport-to-airport route are short stretches of Canadian Pacific (CP) and Canadian National (CN) right-of-way between Rosemount and the Twin Cities airport.

From Rochester's airport, the route proceeds north and west to Kasson, where it crosses Highway 14 and leads north to Randolph on a route parallel and between Highways 56 and 52. It passes east of Wasjoja, West Concord, Kenyon, and Stanton. Along this route, the terrain is flatter and less rolling to the west than to the east, so a more western alignment for the Highway 52 multi-corridor route is likely to provide a more cost effective engineering solution. However, the final selection of the route alignment will depend not only on engineering issues, but also on environmental considerations and impacts.

North of Randolph, the route parallels Highway 52 as far as Rosemount. From Rosemount north, the route uses open country and the CP right-of-way to access the airport. Access to the Twin Cities' airport requires a crossing of the Mississippi River. It is assumed that this will be achieved using the Expressway 494 Bridge. The route can then use a CN track to the airport and can gain entry to the terminal by running parallel to the access road (Glimack Drive) right-of-way. A station would be developed close to existing terminal parking and rental car facilities. A detailed engineering study, needed to finalize the airport access route, will need to consider air space as well as traffic, engineering and environmental issues.

Exhibit 3.4: Twin Cities High-Speed Rail Access Routes
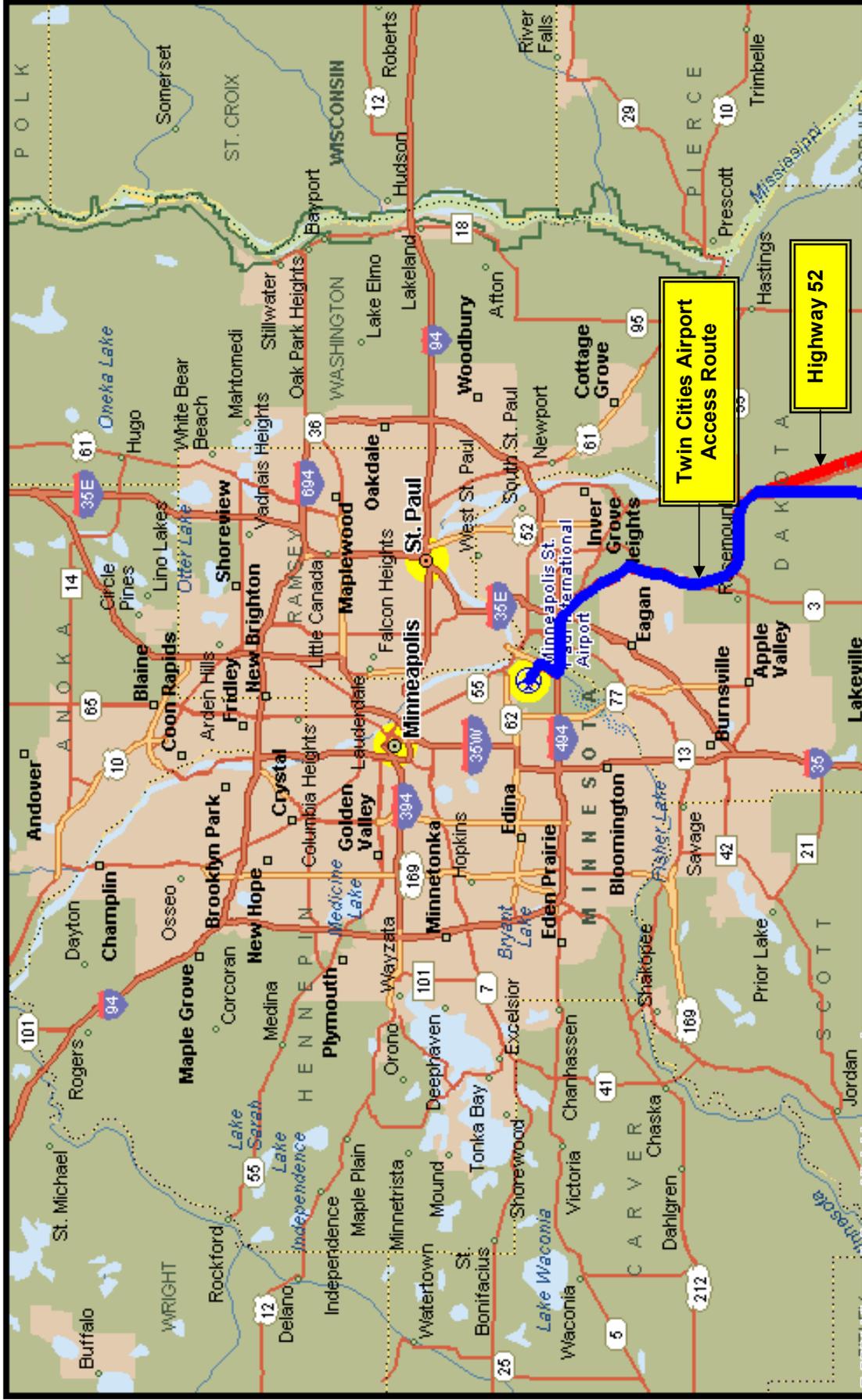
Exhibit 3.5: Twin Cities Airport High-Speed Rail Access Routes
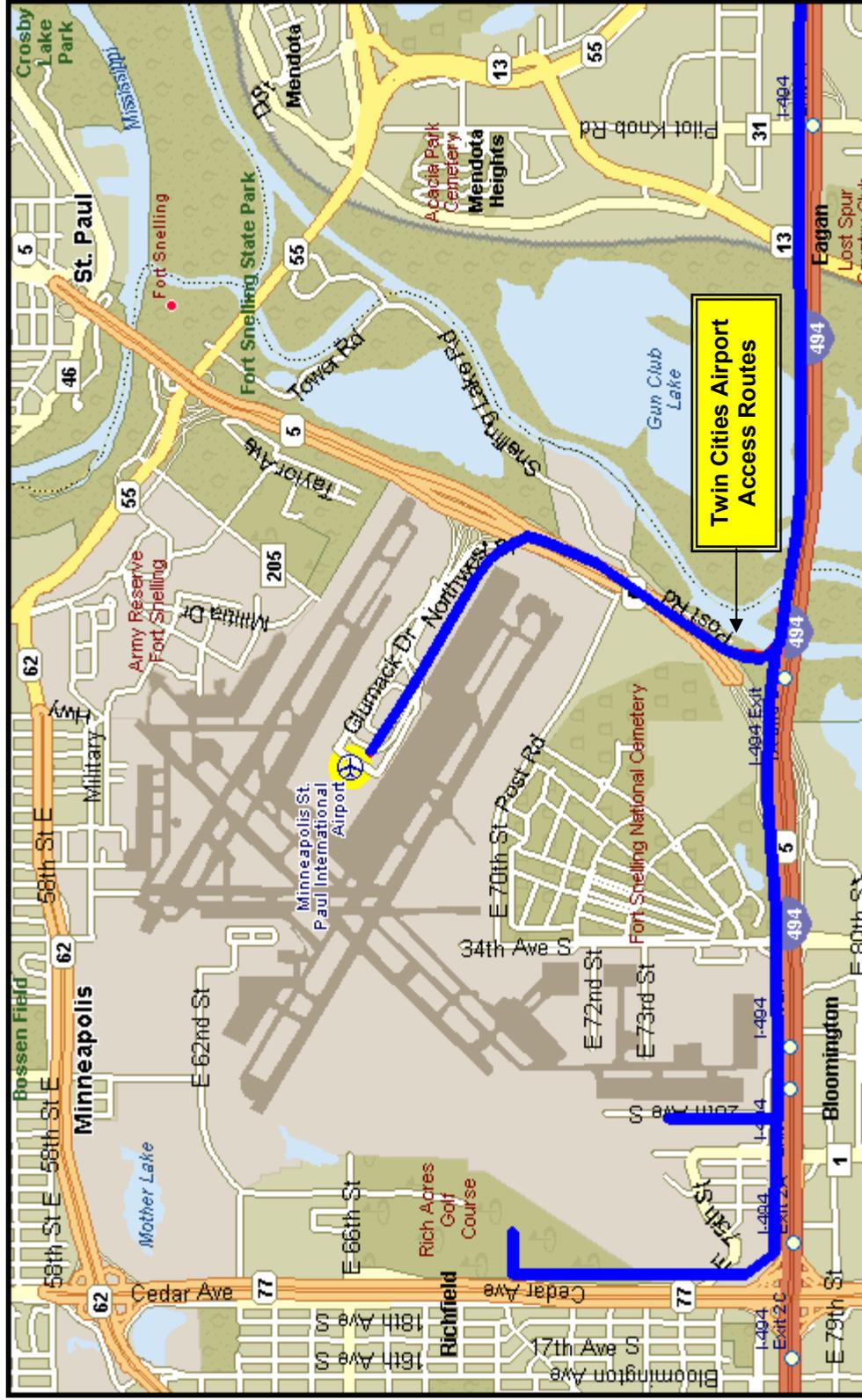
3.3   Highway 52 Right-of-Way

The second route alignment would run north from the airport using either Highway 52 right-of-way that skirts the eastern side of Rochester or the abandoned rail right-of-way that leads to the city center. The abandoned rail right-of-way would allow a downtown station, while the Highway 52 right-of-way would provide a parkway station.

For the downtown route, after using part of the Duluth –Minnesota –Eastern (DME) route an abandoned rail right-of-way can be used to head west out of the city across Highway 52 and then northwest to Pine Island, where it again connects with Highway 52. The Highway 52 route takes a more northerly direction from Rochester but then cuts back northwesterly from Oronoco to Pine Island. From Pine Island north, the route heads northwesterly via Cannon Falls, Hampton, and Coates, and finally enters the Twin Cities area just east of Eagan along Route 28 using a CP rail right-of-way. As with the Tri-State route, it would use the CP right-of-way to gain access to the river, close to the airport. The 494 Bridge would be used to cross the Minnesota River, and the CN line gives access to the airport. As in the case of the Tri-State route, the airport terminal is accessed by using the airport access road. A station would be located close to the existing parking and rental car facilities.

Details of airport access and the crossing of the Minnesota River require careful evaluation and detailed study before deciding the most effective way of accessing the airport and the level of infrastructure cost. Final route alignments will not be selected until the completion of a full Environmental Impact Study that will assess both the overall route selection and the specific characteristics of airport access.

Exhibit 3.6: Rochester High-Speed Rail Access Routes
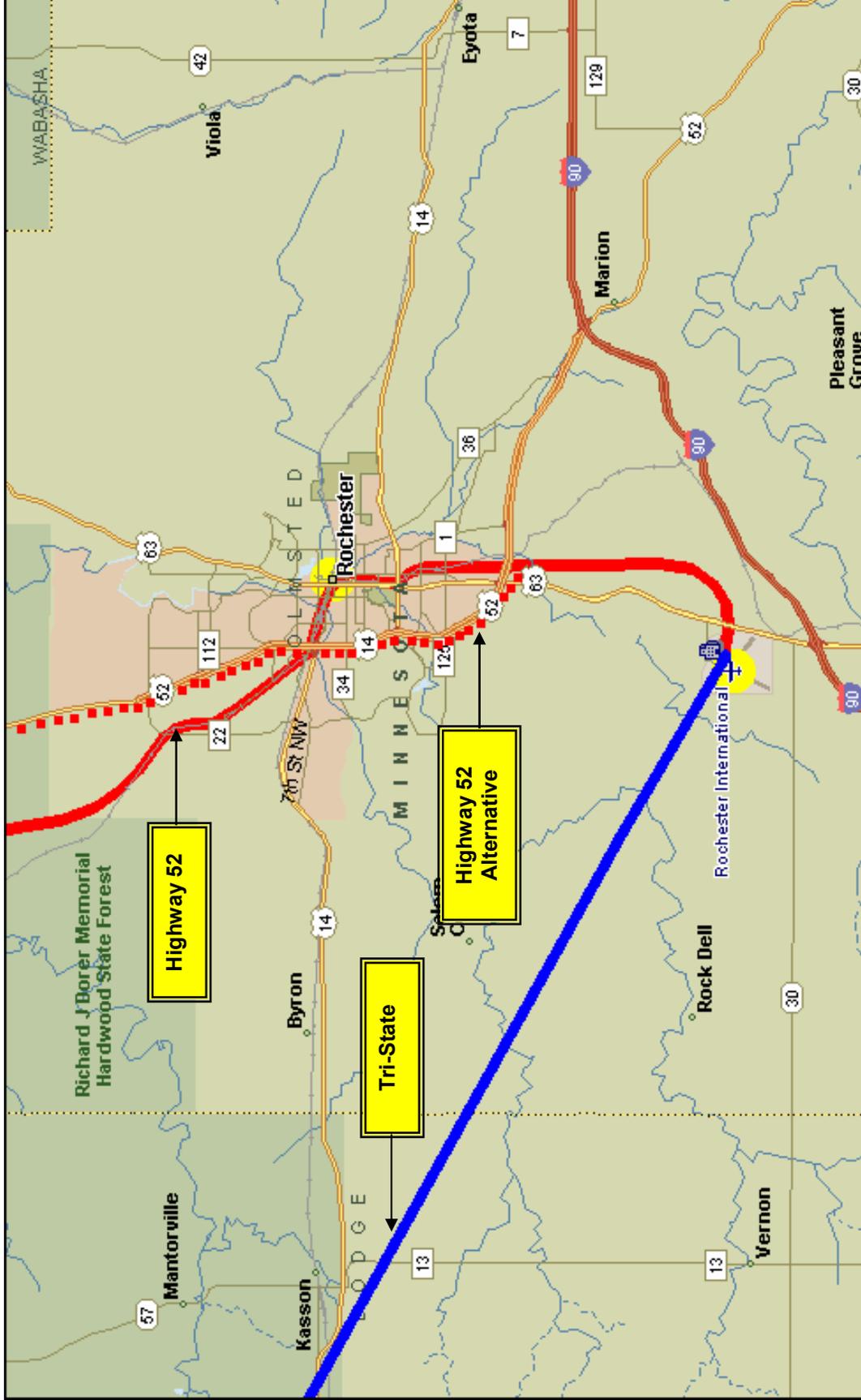
Exhibit 3.7: Rochester Airport High-Speed Rail Access Routes
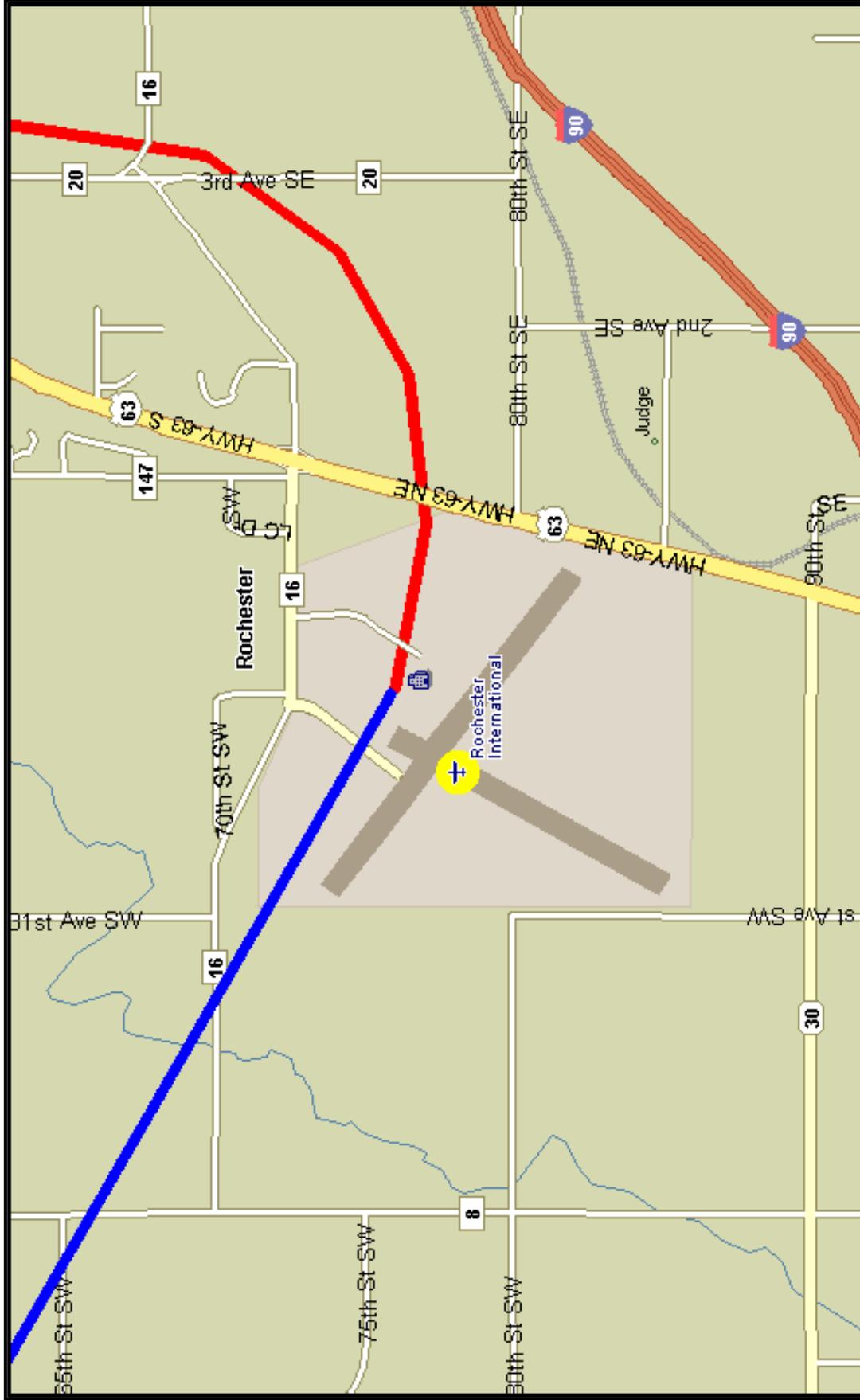
4. Ridership and Traffic Estimates

For the purpose of this study, ridership and traffic forecasts are based on "benchmark" assessments. For passenger service, the volume of train operations was used to derive likely ridership estimates, while the freight market assessment was based on the assumption that if Rochester becomes the Twin Cities' potential reliever airport, Rochester would develop as a major freight hub.

4.1 Passenger Ridership Estimates

The ridership required to meet the volume of passenger train operations was estimated, in the absence of extensive demand studies, by assuming a 65 percent load factor for rail service. This level of passenger load is typical for effective high-speed rail services. Additionally, the estimated passenger volumes for the system in 2010 and 2039 are given by year and technology in Exhibit 4.1.

Exhibit 4.1: Estimated Passenger Volumes Required for the Proposed High-Speed Rail Service

(Ridership in millions)

YEAR	150 MPH	185 MPH	250 MPH
2010	1.4	1.6	2.4
2039	2.4	2.8	4.3

The growth rate in passenger traffic between 2010 and 2039 was based on the growth of air passenger traffic in the region and socioeconomic expansion derived from the Tri-State High-Speed Rail Study. Annual growth rate was determined to be 2 percent. The estimates assume that 90 percent of the rail traffic is diverted from the auto mode and 10 percent from air mode.

The fare levels for the service were set by reference to existing services and fare levels found optimal in a range of US studies, including the Tri-State and Midwest studies. Exhibit 4.2 shows the adopted fare levels.

Exhibit 4.2 Fare Levels by Technology

(Dollars per mile)

	150 MPH	185 MPH	250 MPH
Average fare per passenger mile	$0.35	$0.37	$0.40

4.2 Freight Estimates

An evaluation of the freight traffic potential that would be generated by a second Twin Cities airport located in Rochester suggests that the airport would quickly become a freight hub. Specific air cargo operations frequently move to reliever airports before even air passenger service is established. As such, Rochester could soon become a specialist cargo hub, supporting up to 500,000 tons of traffic each year. This would put it on a level with the airport in Toledo,

which services Detroit and Cleveland airports, and well below such airports as Louisville (UPS hub) or Memphis (FedEx hub). See Exhibit 4.3.

Given the rate of growth of airfreight traffic in the Twin Cities region (4.3 percent each year), a base tonnage of nearly 500,000 tons in 1999 could have been expected. This could almost double to just over 900,000 tons by 2010. By 2010, Rochester airport freight could be expected to approach 1 million tons. See Exhibit 4.4

In terms of the tariff that can be charged for moving the freight from Rochester to Twin Cities, a competitive truck movement rate would be between 0.5 and 0.7 cents per pound or between $10 and $14 per ton. For this study, a competitive rate of 0.5 cents per pound or $10 per ton was adopted.

Exhibit 4.3: Sample Air Cargo Airport Tonnage

Airport	Tonnage
Minneapolis/St. Paul (MSP)	366,356
Toledo (Bax)	490,352
Louisville (UPS)	1,486,205
Memphis (FedEx)	2,412,905

Exhibit 4.4: Freight Traffic Twin Cities to Rochester

Year	Tonnage
1999	486,720
2010	904,784
Assuming the Rochester airport becomes a typical cargo hub airport	

5. Operating Plan

Preliminary operating plans were developed for both passenger and freight train operations.

5.1   Passenger Operations

The analysis of train operations and the development of an operational plan were predicated on the following attributes:

- Characteristics of the route and technology
- Establishing train running times and schedules.

5.1.1   Characteristics of the Route

The first step in evaluating the two routes selected as rail corridors (as outlined in Section 3 of this report) was the development of track characteristics. The data on the track infrastructure included the number and location of tracks, curves, speed restrictions, stations, bridges, and subdivision names and lengths. This database was incorporated in the *Trackman*© program. The track files from the original Tri-State study were reviewed and adjusted to reflect the new endpoints for the route. In the case of the Highway 52 option, a new track chart was developed showing the curves and passenger and freight speeds along the route.

A slightly different track chart was developed for each technology to reflect the characteristics of that technology in terms of route and speed. The charts do not include any crossings data as all high-speed train operations must be grade separated. Details on gradient local bridges and culverts were not included, as the final alignment within each route has not been selected.

An allowance was made for each type of infrastructure element in the cost estimates. The specifics of how the routes access the Rochester and Twin Cities urban areas were not assessed, as this would require detailed engineering and environmental analysis. Once the track information was developed for each route, travel times were then computed.

5.1.2   Train Travel Times

LOCOMOTION© Train Performance Calculator estimated train travel times. This software system estimates the speed of a train given the various types of track geometry, speed restrictions, curves, and station stopping patterns. It then calculates the train's travel time for each route segment and sums the times to produce a timetable. The software assumes that a train will accelerate to the maximum possible speed and will only slow down for stations or for speed restrictions where it can safely travel through curves, crossings, tunnels or other civil engineering works.

The travel times produced through the software represent "ideal" travel times. These times assume that the train is not delayed for any reason, including congestion along the line, mechanical difficulties, weather factors, or other more general operating difficulties. In

anticipation of these minor delay problems, a five percent recovery time was added to the corridor-based travel times.

In addition to the recovery time, a turn-around time of one hour was added to the return departure time to allow for station maintenance checks, sewage removal, refueling, catering, watering, general cleaning and staff repositioning (time for the engineer to walk to the other end of the train).

Preliminary timetables were developed for three technologies – 150+ mph, 180+ mph and 250+ mph for each route option. The resulting travel times are summarized in Exhibit 5.1.

Exhibit 5.1:Travel Times by Route and Technology*

Route	Technology		
	150 + mph	**185+ mph**	**250+ mph**
Highway 52	0:48	0:43	0:39
Tri-State	0:45	0:39	0:31
Note: The estimates include recovery time of 5%.			

Depending on the technology, Highway 52 route is between four to nine minutes longer in time than the Tri-State route. The Maglev technology is fastest of the three and allows for corridor travel times between 31 and 39 minutes. The 185+ mph train is estimated to need around 39 to 43 minutes to complete a full run, while the 150+ mph technology would take around 45 to 48 minutes from one end of the corridor to the other.

5.1.3   Preliminary Train Schedules

Development of frequencies is a key input into train schedules. Frequencies were determined on the basis of providing convenience to passengers and sufficient capacity to accommodate the assumed minimum levels of ridership, as well as the increased investment and costs of technology options. Depending on the technology type, the proposed frequencies vary between sixteen and thirty daily round trips. The frequencies for the three technologies are shown in Exhibit 5.4.

Exhibit 5.4: Proposed Passenger Frequencies in the Corridor (by technology)

Technology	Frequency (Daily Round Trips)
150+ mph	16
180+ mph	20
250+ mph	30

Based on the travel time estimates and proposed frequencies, preliminary schedules were developed for the three technologies/levels of service and were based on the Highway 52 route (see Exhibit 5.5).

Exhibit 5.5: Preliminary System Schedules (by technology)

a) 150+ mph technology

Southbound 150+ mph Technology

		Train Number / Daily Frequency															
Station	Mileage	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
MSP Int'l Airport	0	5:30	6:15	7:00	7:45	8:30	10:00	12:00	13:00	15:00	16:30	17:15	18:00	18:45	19:30	21:00	23:00
Rochester Int'l Airport	84.45	6:23	7:08	7:53	8:38	9:23	10:53	12:53	13:53	15:53	17:23	18:08	18:53	19:38	20:23	21:53	23:53

Northbound 150+ mph Technology

		Train Number / Daily Frequency															
Station	Mileage	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31
Rochester Int'l Airport	0	5:30	6:15	7:00	7:45	8:30	10:00	12:00	13:00	15:00	16:30	17:15	18:00	18:45	19:30	21:00	23:00
MSP Int'l Airport	84.45	6:21	7:06	7:51	8:36	9:21	10:51	12:51	13:51	15:51	17:21	18:06	18:51	19:36	20:21	21:51	23:51

b) 185+ mph technology

Southbound 185+ mph Technology

		Train Number / Daily Frequency																		
Station	Mileage	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
MSP Int'l Airport	0	5:30	6:00	6:30	7:00	7:30	8:00	9:00	10:00	12:00	13:00	15:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	23:00
Rochester Int'l Airport	84.45	6:18	6:48	7:18	7:48	8:18	8:48	9:48	10:48	12:48	13:48	15:48	17:18	17:48	18:18	18:48	19:18	19:48	20:48	21:48	23:48

Northbound 185+ mph Technology

		Train Number / Daily Frequency																		
Station	Mileage	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39
Rochester Int'l Airport	0	5:30	6:00	6:30	7:00	7:30	8:00	9:00	10:00	12:00	13:00	15:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	23:00
MSP Int'l Airport	84.45	6:15	6:45	7:15	7:45	8:15	8:45	9:45	10:45	12:45	13:45	15:45	17:15	17:45	18:15	18:45	19:15	19:45	20:45	21:45	23:45

c) 250+ mph technology

Southbound 250+ mph Technology

		Train Number / Daily Frequency																		
Station	Mileage	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
MSP Int'l Airport	0	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	11:00	12:00	12:30	13:00	14:00	15:00	15:30	16:00	16:30
Rochester Int'l Airport	84.45	5:39	6:09	6:39	7:09	7:39	8:09	8:39	9:09	9:39	10:09	10:39	11:39	12:39	13:09	13:39	14:39	15:39	16:09	16:39	17:09

Southbound 250+ mph Technology

		Train Number / Daily Frequency									
Station	Mileage	42	44	46	48	50	52	54	56	58	60
MSP Int'l Airport	0	17:00	17:30	18:00	18:30	19:00	19:30	20:00	21:00	22:00	23:00
Rochester Int'l Airport	84.45	17:39	18:09	18:39	19:09	19:39	20:09	20:39	21:39	22:39	23:39

Northbound 250+ mph Technology

		Train Number / Daily Frequency																		
Station	Mileage	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39
Rochester Int'l Airport	0	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	11:00	12:00	12:30	13:00	14:00	15:00	15:30	16:00	16:30
MSP Int'l Airport	84.45	5:39	6:09	6:39	7:09	7:39	8:09	8:39	9:09	9:39	10:09	10:39	11:39	12:39	13:09	13:39	14:39	15:39	16:09	16:39	17:09

Northbound 250+ mph Technology

		Train Number / Daily Frequency									
Station	Mileage	41	43	45	47	49	51	53	55	57	59
Rochester Int'l Airport	0	17:00	17:30	18:00	18:30	19:00	19:30	20:00	21:00	22:00	23:00
MSP Int'l Airport	84.45	17:39	18:09	18:39	19:09	19:39	20:09	20:39	21:39	22:39	23:39

5.2   Freight Operations

To determine rail freight operations required to support the development of Rochester International Airport as a air cargo hub for the Minneapolis metropolitan area, an assessment was made of both the volume and timing of air traffic likely to be generated.

Since air freight cargo hub operations are largely at night, it was assumed that the flow of traffic would reflect that of Toledo airport operations. Toledo Airport (Ohio) was selected because it is about the same size as Rochester's in terms of operations and potential freight capacity. Based on this evaluation, Rochester could reasonably expect to generate approximately 5 million pounds of cargo a day by 2010 by mimicking Toledo's freight infrastructure and operations.

In terms of the airfreight service, the analysis assumed that 747 jets would be used for cargo flight operations with a mix of large and smaller loads. In order to accommodate the projected volume of cargo, approximately 32 flights (16 arrivals and departures), are required. The rail operation was assumed to reflect the air operation, with the first trains arriving at Rochester from Twin Cities at least one hour before inbound aircrafts arrive. Since air movements are typically between 7 p.m. and 10 p.m. inbound and 2 a.m. and 5 a.m. outbound, trains would arrive between 6 p.m. and 10 p.m. and depart between 1 a.m. and 5 a.m.

The number of daily rail trips required is shown in Exhibit 5.6. The Maglev technology requires more trips because the Maglev car can only handle much smaller loads (248,000 lbs. vs. 1,400,000) than the flat cars; however, its higher speed provides the ability to handle more trips in a specific period.

Exhibit 5.6: Freight Frequencies

Freight Technology		Frequency (daily trips)
150 mpg	American Flyer	4
180 mph	TGV	4
300 mph	Maglev	20

6. Capital Cost

Capital costs have been developed for the three MSP Approach Options and the two RST to MSP Alignment Alternatives. The Alignment Alternatives include the cost for MSP Approach Option 2. Capital Costs are depicted in the following table. Detailed cost estimates are provided in the appendices. Maglev costs are computed at $70 million per mile. All costs are in year 2002 dollars and include project management, construction management, engineering, contingency and insurance.

Exhibit 6.1: Summary of Infrastructure Cost Estimates

Rochester Airport to Minneapolis/St. Paul Airport

Route Option	Total Cost (in Thousand$)
US 52 Route	
Electrified	$933,119
Non-electrified	$768,719
Maglev	$5,565,000
Tri-State Route	
Electrified	$869,302
Non-electrified	$697,327
Maglev	$5,929,000

7. Preliminary Cost/Benefits Assessment

The proposed Twin Cities-Rochester HSR passenger rail service is expected to provide a wide range of benefits, contribute to regional economic growth, and improve mobility between two of Minnesota's major population and business centers. This section provides an overview of the preliminary estimates of financial and economic impacts to be derived from the proposed rail service. The economic benefits consist of two types – users' benefits and benefits to the public at large – resulting from the proposed high-speed rail system.

7.1   Economic Impacts Evaluation Methodology

The economic forecasting and assessment techniques used here are those approved and used by the U.S. Department of Transportation/Federal Railroad Administration (FRA). This process has been accepted by other federal, state and local governmental authorities and has been used throughout the transportation planning industry as a mechanism for justifying federal investments in transportation projects.

The FRA's *High-Speed Ground Transportation for America (Commercial Feasibility Study - CFS)* investigated investment needs, operating performance, and benefits of high-speed ground (including Maglev) transportation corridors to transportation users.[3] *CFS* assesses methodology for the economic benefits of implementing different high-speed rail technology options.

In order to measure the impact of high-speed rail, the analysis compared the benefits of a "no-build" strategy with a "build" strategy-generated benefits comparison measure. The methodology was adopted to assess the users' and public benefits of the high-speed rail proposed for Minnesota. A summary of the benefits and costs based on the CFS is provided in Exhibit 7.1.

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[3] US Department of Transportation, Federal Railroad Administration. 1997. *High-Speed Ground Transportation for America.*

Exhibit 7.1: Commercial Feasibility Study - Subcategories of Benefits

Types of Benefits and Costs	Related Analytical Components
Benefits to HSR Users	
Benefits that HSR users pay directly Benefits that HSR users do not pay directly	♥ System revenues ♥ Users' consumer surplus
Benefits to the Public at Large	
Airport congestion delay savings Highway congestion delay savings Emission savings	♥ Airline and air passenger savings from reduced air traffic ♥ Highway users' time savings from reduced auto traffic ♥ Difference in emissions resulting from diversion to HSR

7.2   Revenue Estimates

7.2.1   Passenger Ridership and Revenue Estimates

An estimate of trips was needed for estimating the economic impacts. Since modeling of ridership and revenue was not envisioned for this stage of the study, a non-parametric analysis of trips were derived. This was achieved by applying a number of assumptions. The revenue estimates were derived by applying typical fare estimates. These range from $0.35 per mile for a 150-mph high-speed rail to $0.40 per mile for 250-mph technologies. Exhibit 7.2 shows the estimated ridership and revenue summary.

Exhibit 7.2: Summary of Preliminary Passenger Non-Parametric

Ridership and Revenue Estimates (by technology)

a) 150+ mph technology

	2010	**2020**	**2039**
Ridership (millions)	1.4	1.7	2.4
Farebox Revenue (millions)	$41	$50	$72

b) 185+ mph technology

	2010	2020	2039
Ridership (millions)	1.6	1.9	2.8
Farebox Revenue (millions)	$50	$61	$88

c) 250+ mph technology

	2010	**2020**	**2039**
Ridership (millions)	2.4	2.9	4.3
Farebox Revenue (millions)	$82	$101	$146

7.2.2   Freight Revenue Estimates

Freight revenue is calculated based on an average tariff charge of $0.005 per pound. By transporting daily almost 5 million pounds of air cargo, revenues of $24.8 thousand will be generated daily. This translates into $7.734 million a year in revenue in 2010. By 2039, the airport is projected to move 2.6 million tons of freight, with revenues exceeding $26.2 million.

Exhibit 7.3: Minneapolis/Saint Paul-Rochester Annual Freight Volume and Revenue

Year	250+ mph		180+ mph		150+ mph	
	Tons of Freight	Revenue ('000s of 2002$)	Tons of Freight	Revenue ('000s of 2002$)	Tons of Freight	Revenue ('000s of 2002$)
2010	773,404	7,734	773,404	7,734	773,404	7,734
2020	1,178,283	11,783	1,178,283	11,783	1,178,283	11,783
2039	2,622,114	26,221	2,622,114	26,221	2,622,114	26,221

7.3   Users' Benefits – Preliminary Estimates of HSR

In line with the FRA methodology, the benefits to users of the HSR are the sum of consumer surplus and system revenues.

7.3.1   Consumer Surplus

Consumer surplus is the additional benefits consumers receive from the purchase of a service above the price actually paid for that service. This measurement is used to assess the broad economic impacts of a transportation investment. It exists because consumers are willing to pay a higher price than that actually charged for the service. A transportation improvement is seen as providing benefits in terms of time and costs savings, as well as convenience, comfort, and reliability to users of the mode. In this context, the consumer surplus is the difference between the amounts an individual would be willing to pay for high-speed rail service and the fare required to use the system. For the purposes of this study, consumer surplus was derived by applying a percentage to the system revenue estimate (94 percent based on the proportion found in the *Midwest Regional Rail Initiative Project Notebook*).

7.3.2   System Revenues

Revenues reflect additional consumer surplus benefits to users of the system, benefits for which they pay directly. The decision to include revenues in a benefits analysis (as approved by the U.S. Department of Transportation) is based on the notion that revenues are a proxy for the increase in consumer surplus that is generated by a travel option but accrues to system providers in the form of increased revenue. Total system revenues also include ancillary revenues, found to add an additional eight percent to the farebox revenues. Users' Benefits –

7.4   Preliminary Estimates of Other Modes

In addition to HSR users' benefits, travelers using other modes will also benefit from the HSR service, as the system will contribute to highway congestion relief and reduced travel times for users of these other modes. For purposes of this analysis, these benefits were measured by identifying the estimated number of air and auto passenger trips diverted to HSR and multiplying each by the benefit levels used in the FRA study.

7.4.1   Highway Congestion Savings

Auto travelers diverting to high-speed rail service will reduce congestion and delays on highways relative to the levels that would take place without the implementation of high-speed rail. The benefits stemming from the travel time saved when traffic volumes are reduced on highways in the corridor were monetized.

7.4.2   Airport Congestion Delay Savings

There will be somewhat reduced delays and air carrier operating cost at the two airports resulting from trip diversions to HSR. These benefits were also monetized.

7.4.3 Emissions Savings

The diversion of travelers to rail from the auto mode generates emissions (air pollutants) savings for the public at large. The emissions savings were calculated based on changes in energy use with and without the proposed HSR service.

7.5 Operating Costs

In order to calculate cost/benefit ratios, operating costs were derived for each of the technologies. Maintenance and operating costs for each technology are measured on a train mile basis. For passenger rail operations, per unit O & M costs are fairly close for each technology (Exhibit 7.4). If a reasonable range of variation is considered (± 20 percent), unit costs can be considered about the same. The difference in total cost is primarily attributed to the number of train miles projected for each technology by 2010. As the travel time improves for each technology, ridership projections are increased and higher frequencies are required. Therefore, the train miles will tend to rise as the technology provides the ability to operate at higher speeds.

The unit cost to operate and maintain the freight equipment is $26 for both the 150+ and 180+ technologies (Exhibit 7.5) because they haul the same consist and have similar operating environments. Maglev technology uses a modified version of its passenger car. The resulting cost per train mile is 20 percent higher than the more conventional high-speed rail freight trains. The number of train miles is the same for all technologies, which are calculated based on moving 773,000 tons of air cargo freight in 2010 and 2.6 million tons in 2039.

Exhibit 7.4: Passenger Operating and Maintenance Cost Estimates

Passenger HSR in Year 2010	American Flyer*	TGV Atlantique*	Maglev**
	150 mph	180 mph	300 mph
O & M Unit Cost/Train mile	$37.59	$37.01	$39.99
Train Miles	995,904	1,244,880	1,867,320
Total Operating Cost	$37,436,031	$46,073,009	$74,674,127
* Unit costs are based on Midwest Rail Initiative and Tri-State studies. ** Maglev O&M costs are based on Baltimore-Washington and Florida Maglev.			

Exhibit 7.5: Freight Operating and Maintenance Cost Estimates

Freight HSR in Year 2010	American Flyer*	TGV Atlantique*	Maglev**
	150 mph	180 mph	300 mph
O & M Unit Cost/Train mile	$26.00	$26.00	$31.00
Train Miles	106,704	106,704	106,704
Total Operating Cost	$2,774,304	$2,774,334	$3,307,824
* Unit costs are based on Midwest Rail Initiative and Tri-State studies. ** Maglev O&M costs are based on Baltimore-Washington and Florida Maglev.			

7.6   Economic Costs/Benefits – Estimates Summary

The values of the benefits presented in this section are based on an analysis of discounted cash flow (DCF). The DCF is an extended stream of cash flows, as in Equation 1.

Equation 1. $PV = \Sigma C_t / (1 + r)^t$

Where

PV	=	Present Value
C_t	=	Cash flow
r	=	Opportunity cost of capital
t	=	Time period

Discounted cash flows were calculated over the project life of 30 years. For the purposes of the analysis, the implementation schedule assumes operations starting in 2010. The discount rate is the financial return foregone by investing in a project (such as the proposed system), rather than in securities. All the benefits were discounted at the real rate of four percent (consistent with the current discount rate used by the Office of Management and Budget for large-scale infrastructure projects) to the year 2001. The benefits were assessed in year 2000 dollars.

The 30-year discounted present value of passenger system revenues was estimated between $0.7 billion and $1.4 billion. Freight revenues contribute an additional $.24 billion, while the present value of consumer surplus was projected in the range of $0.66 billion to $1.4 billion. Within the public benefits category, the present value of highway congestion savings is expected in the range of $0.31 to $0.55 billion, and airport congestion savings are forecast to be between $15 million and $22 million. Air congestion estimates are based solely on rail ridership estimates and, in the context of a reliever airport, are likely to prove highly conservative, as they do not account for capacity limitations at the Twin Cities airport. The estimated emission savings range between $35.3 million and $129 million, while air carrier operating savings are estimated to be between $9 million and $14 million. This estimated air operator savings is also highly conservative in light of possible capacity limitations at the Twin Cities airport. The total present value benefits range from $2.1 billion for the 150+ mph American Flyer technology to almost $4 billion for the Maglev train. Exhibit 7.6 summarizes the present value of the benefits.

The present value of total costs for the system are $1.57 billion for the 150+ mph technology, $1.82 billion for the 180+ mph TGV and $6.93 billion for the Maglev technology. The largest components of the total costs are infrastructure costs. Infrastructure costs are a larger percentage of total costs, as the train technology has the potential for higher speeds. Infrastructure costs are 49 percent of the American Flyer's total costs and increase to 80 percent for Maglev. The operating costs range from close to $600 million to over $1 billion depending on train technology. Passenger rolling stock costs range from $142 million to $200 million. Freight rolling stock is estimated to be $22.3 million for the two conventional rail-based technologies and $30 million for the Maglev train.

Exhibit 7.6: Twin Cities- Rochester HSR Cost/Benefit Summary

(30-year Present Value in millions of 2002$)

Benefits	Am Flyer 150 mph	TGV Atl 180 mph	Maglev 300 mph
Passenger System Revenues	$698.5	$852.0	$1,412.3
Freight System Revenues	$236.2	$236.2	$236.2
Pass. Users' Consumer Surplus	$656.6	$800.9	$1,327.6
Freight Users' Consumer Surplus	$162.7	$162.7	$162.7
Pass. Highway Congestion Savings	$283.6	$321.0	$520.9
Freight Highway Congestion Savings	$27.7	$27.7	$27.7
Passenger Emission Savings	$33.0	$90.2	$127.1
Freight Emission Savings	$2.4	$2.4	$2.4
Pass. Air Carrier Operating Savings	$9.4	$9.2	$14.1
Pass. Airport Congestion Savings	$15.1	$17.0	$22.5
Total Benefits	**$2,125.1**	**$2,519.3**	**$3,853.6**
Costs			
Infrastructure Cost	$768.7	$933.1	$5,565.0
Passenger Rolling Stocks	$142.0	$175.0	$200.0
Freight Rolling Stocks	$22.3	$22.3	$60.0
Passenger Operating Costs	$587.2	$644.3	$1,044.3
Freight Operating Costs	$48.6	$48.6	$57.9
Total Costs	**$1,568.8**	**$1,823.3**	**$6,927.2**
Operating Ratio	**1.47**	**1.57**	**1.50**
Benefit/Cost Ratio	**1.35**	**1.38**	**0.56**

The results of the economic impact analysis suggest that the Twin Cities-to-Rochester high-speed rail service will create a high level of both users' and public benefits. Both the 150+ and 180+ mph have positive cost/benefit ratios of above one, indicating that from an economic standpoint this service will provide a net positive service to the community. The benefit/cost rations for the 150+ and 180+ Technologies are found to be between 1.35. and 1.38. Meanwhile the benefit/cost ration for the 250+ Technology is less than 1

Another measure of the vitality of the system is provided by the operating ratio, which is strictly a financial barometer of the ratio of operating revenue to operating costs. *Operating revenue* is the sum of passenger revenues, on-board service (food) revenues and air cargo revenues. The operating costs are all costs incurred to run the service including wages, overhead, and fringe benefits. The FRA uses both ratios to gauge the feasibility of a project. A ratio greater than 1.0 means that the operating revenue is in excess of costs. The higher the ratio is, the higher the operating surpluses are. The calculation of the operating ratios is shown in Exhibit 7.7.

Exhibit 7.7: Operating Ratios

(30-year Present Value in $millions)

	Am Flyer 150 mph	TGV Atl 180 mph	Maglev 300 mph
Revenues			
Passenger System Revenues	698.5	852.0	1,412.3
Freight System Revenues	236.2	236.2	236.2
Total Revenues	**934.7**	**1,088.3**	**1,648.6**
Operating Costs			
Passenger Operating Costs	587.2	644.3	1,044.3
Freight Operating Costs	48.6	48.6	48.6
Total Costs	**635.8**	**692.9**	**1,102.2**
Operating Ratio	**1.5**	**1.6**	**1.5**

All three technologies have about the same operating ratio of 1.5 or higher and meet the FRA criteria for financially viable projects.

8. Implementation Plan – The Path Forward

8.1 Introduction

Passenger and freight rail mobility is key to sustaining the pace of economic growth in Minnesota in the 21st Century. With this in mind, Minnesota's commercial and economic growth will depend in the future, as it has in the past, on efficient transportation not only between its own cities, but also with those of the rest of North America. The Rochester-Twin Cities airport rail link meets this need as both an enhancement of the regional transportation system and an economic engine for the future growth of the region. The proposed airport-to-airport high-speed rail link will reduce the travel time between the Twin Cities and Rochester airports to 40 minutes. It will further allow Rochester to function as the reliever airport in the state as well as provide the first leg of the proposed Tri-State and MWRRI/Twin Cities-Rochester/LaCrosse connection. This connection will make Rochester integral to the 3,000-mile MWRRI system and provide access to Rochester, not just from Twin Cities, but also from all the cities and towns of the nine-state MWRRI region. Both of these options will greatly enhance local and regional mobility and maximize the opportunity for economic growth in the region.

The following sections outline the steps that the Minnesota DOT and the city of Rochester should follow to implement the potential of Highway 52 as a multimodal corridor and outlines the key short- and long-term actions that are necessary to advance the plan to implementation.

8.2 Project Steps

This report provides a conceptual, preliminary analysis of the potential for a Twin Cities-to-Rochester high-speed link that will allow Minnesota, and in particular the city of Rochester, to achieve two goals:

- Develop a potential reliever airport in Rochester

- Implement the first leg of the MWRRI-Rochester connection.

In order to develop the concept, the current analysis needs to be refined in the following ways:

- Develop investment-grade freight and ridership volumes and revenues

- Carry out an alternatives analysis on Route 52 and Tri-State alternatives

- Prepare an EIS report to selected route and technology options for the high-speed rail connection.

This work will take two to three years to complete. At this point, the project will be ready for final decisions to be made on the concept. If a decision is made to proceed with the final design and construction for the project, it will take another two to three years before

operations can begin. Exhibit 8.1 shows the likely milestones in the process and the funding requirements for each technology.

Exhibit 8.1: Time Scales and Costs (in $millions)

	2002	2003	2004	2005	2006	2007	2008	2009
Feasibility Study	$0.325							
EIS/PE		$6-10 per year						
Final Design					$2-6 per year			
Construction							$230-1980 per year	

8.3   Project Funding

The approach to funding a high-speed rail corridor between Twin Cities and Rochester requires developing a multifaceted financial action plan to obtain commitments at a local, state and federal level. This plan must secure short-, medium- and long-term capital.

8.4   Short-Term

In the next phase of the airport high-speed rail connection program, funding must be secured for Feasibility and Environmental Impact Studies. This will take approximately two to three years to complete and cost in the order of $6 -$10 million. Outstanding demand and route feasibility can be assessed using mostly local and state funds that can come from community resources, airport planning funds, and state multimodal corridor planning funds.

The money required to undertake an EIS and Preliminary Engineering Study can be obtained from federal sources via an "earmark" from FTA new start funds or FRA high-speed corridor funds. The FAA will not likely provide resources for airport access infrastructure outside of airport grounds. In each case, a state and local match of at least 20 percent will be needed. Typically, federal and state shares vary between 70-30 and 80-20, although 60-40 has occurred on some transit projects.

Given the nature of the Twin Cities-Rochester Airport link, private financing may be possible to help fund certain components of the project. In particular, freight operators such as UPS, the US Postal Service, or FedEx could be interested in taking an equity stake in the project since it would provide them with a commercial advantage. Typically, this type of involvement occurs after completion of the EIS and prior to construction. Such investors may have specific requirements that must be met to ensure their involvement in the project. Rockford Airport is a classic example of a private sector (UPS) investment ($240 million).

8.5 Medium-Term

In this phase of the project, money is needed for final design and project implementation planning. Typically, this funding can be derived from similar sources as the short-term EIS money. A full funding agreement will be prepared at this stage to ensure construction financing.

8.6 Long-Term

In this phase, construction planning and operation finance is needed for a two to three year construction program. Various financing procedures can be adopted, including the use of a Capitalized Interest Fund and the Transport Infrastructure Finance Investment Act (TIFIA) to develop finances that will meet construction capital needs, peaks and troughs. Federal and state funding is maintained at a fixed annual commitment for the life of the project.

9. Conclusion

There is clearly a *prima facie* case for the development of a multimodal Highway 52 corridor that would connect the Twin-Cities and the city of Rochester by high-speed rail. This vision of a high-speed rail link would achieve an important objective: to provide an effective transportation connection between Rochester and the Twin-Cities. At the same time, it will help link these cities to the rest of the Midwest.

Still, the viability of this vision needs to be carefully researched by additional studies of both the nature of the market and the engineering and environmental costs of building the system. It is essential to ensure there are no fatal flaws in the logic that has been used to create this vision, and the promise of the vision can effectively be turned into reality.

The development of the high-speed rail link will help the cities of Rochester and Twin-Cities meet the transportation challenges of the 21st century. This should ensure that both the prosperity and the long-term economic growth of the region are achieved.

Appendix A: Engineering Report

Engineering Assessment Process

The proposed high-speed rail system will operate between Rochester International Airport (RST) and Minneapolis-St. Paul Airport (MSP). Technologies under consideration include 150+ mph gas turbine, 180+ mph electric, and Maglev at 250+ mph. The track (or guideway) is planned to be a single track over the majority of the alignment, with a twenty-mile passing track located around the center point to provide passing of opposite-direction trains. Terminal stations at the Rochester and Minneapolis St. Paul Airports will require multiple tracks to berth trains. The base estimate allows for two tracks at each station. A maintenance facility with train storage tracks is required at either the Rochester or Minneapolis St. Paul end of the alignment to minimize non-revenue mileage. The entire alignment is fully grade separated to facilitate high-speed rail operations.

The engineering assessment was conducted at a *Feasibility Level* of accuracy and detail. It is important to note that this cursory a level is not sufficient to support a thorough alternatives analysis. If a decision were made to advance one of the high-speed rail alternatives analyzed in this study, the next step in the planning/engineering process would be to undertake a more detailed engineering assessment of the selected alternative or alternatives.

Exhibit A-1 highlights the typical development phases and levels of accuracy for engineering projects.

Exhibit A-1: Engineering Project Development Phases and Levels of Accuracy

Development Phases	Approx. Engineering Design Level*	Approx. Level of Accuracy**
Feasibility Study	0%	+/- 30% or worse
Project Definition/Advanced Planning	1-2%	+/- 25%
Conceptual Engineering	10%	+/- 20%
Preliminary Engineering	30%	+/- 15%
Pre-Final Engineering	65%	+/- 15%
Final Design/Construction Documents	100%	+/- 10% or better
*Percent of *Final Design*. **Percent of actual costs to construct.		

Two route alternatives have been designed and plotted at 1000 scale on electronic USGS contour maps. The routes and terrain have been examined to determine major civil and structural

elements necessary to construct a high-speed alignment. Selected sections of the route alternatives have been examined using available aerial photography. The alignments have been stationed in thousands of feet, allowing accurate determination of route length and the dimensions of cost elements that vary directly with length. Each route alternative has been divided into segments to depict costs and to correlate more easily cost elements and land features.

The alignment has been designed using tangents connected by simple curves. Curves at the northern end in the more developed Minneapolis-St. Paul area are more restrictive due to the presence of existing infrastructure. The same is true of the area near Rochester. In general, the middle segments in rural areas may be constructed with curvature of sufficient radius to meet the needs of the technology. Our design has used a nominal curvature value of approximately 1 degree for these segments of the alignment, allowing speeds approaching 150 mph.

Three options have been developed for the northern end of the high-speed rail system. Each was subject to a field inspection to verify feasibility and make decisions on major structures required. The options are described in the field report below. A single option was selected for use in developing the two route alternatives.

Capital cost estimates were prepared using unit costs developed for the MWRRI Phase 4B Study, supplemented and modified as indicated in the footnotes.

Alignment Descriptions

The two high-speed rail alignments that have been evaluated in this study are referred to as "Alternative 1: US Highway 52 Alignment" and "Alternative 2: Tri-State High-Speed Rail Alignment." Each includes a common segment on the north end, identified as "MSP Approach Option 2."

Alternative 1: US Highway 52 Route generally follows US Highway 52 between Rochester and Minneapolis-St. Paul. This alignment departs from US-52 in order to maintain tangent track with the necessary slight curvature to permit high-speed operations and to avoid populated areas.

The Tri-State II High-Speed Rail Feasibility Study, published in December 1999, defines our **Alternative 2: Tri-State High-Speed Rail Route**. This alignment proceeds northwesterly from Rochester International Airport to Dodge Center, avoiding the more densely populated areas around Rochester. Our analysis modifies the Tri-State Report alignment slightly to use the MSP Approach Option 2 from Roseport northwest to MSP Airport. This modification provides a more feasible approach to the Minneapolis/St. Paul Airport, considering the constraints imposed by the existing infrastructure and land uses in the area.

Three separate options for approaching the MSP Airport were identified and a field investigation was undertaken to evaluate the feasibility of each option. We have selected Option 2 as the best alternative to use in our two alignment descriptions and capital cost estimates. Option 2, while not the least-cost alternative, provides the shortest distance and least curvature, allowing faster travel times.

The alignment alternatives range from 79.5 to 84.7 miles in length from Rochester International Airport (RST) to Minneapolis-St. Paul Airport (MSP), with the US Highway 52 Route offering the shorter distance due to its more direct alignment between the two points. The curvature of each is relatively similar, offering unrestricted speeds for all technologies – except at the Rochester and Minneapolis ends of the route. Our analysis did not address grades and elevations specifically, but based on the nature of the terrain traversed, each alignment alternative should offer similar grades and vertical curvature. High-speed operations require constant grades connected by long vertical curves, thus the civil work through the rough terrain is expected to be extensive, as is indicated in the capital cost estimates.

More detailed descriptions of the alignment alternatives and MSP approach options are provided below. The alignment alternatives have been broken into segments to facilitate capital cost estimating and analysis.

Alternative 1: US Highway 52 Route

Segment 1: Rochester International Airport (RST) to Douglas. From a surface station facility at RST, the Route 52 alignment runs northwest for approximately 5 mi., crosses County Route 8 and just north of the 60th Ave/County Route 117 intersection, then turns north parallel to and west of 60th Ave SW. The alignment continues on a northerly-heading parallel to 60th for 7 miles, crossing Salem Creek, County Route 25, Cascade Creek, and County Route 4. Approximately 1 mile north of the County Route 4 crossing, the HSR alignment turns northwest. The crossing of County Route 3 south of Douglas is the terminus of the first segment, providing a segment length of 14.4 miles. The terrain traversed by this segment is particularly rugged and rural.

Segment 2: Douglas to SR 57. The high-speed rail alignment continues northwest towards Pine Island, crossing two branches of Plum Creek and paralleling the eastern side of SR 3. The HSR alignment then crosses SR13 at the southwest edge of the Pine Island. A twenty-mile passing siding begins north of Roscoe Center. The HSR alignment crosses CR 57 at a point 1 mile north of the town of Wanamingo, ending the segment with a length of 18.4 miles. Again, this segment includes particularly challenging terrain with large earthwork quantities and structures.

Segment 3: SR 57 to 260th St. The alignment continues northwesterly, crossing a number of county routes approximately one to three miles west of and parallel to US Highway 52. The route continues through some slight curves in the Cannon River valley, crossing the Cannon and Little Cannon rivers at several points west of Cannon Falls. The twenty-mile passing siding ends near Cannon Falls. Several miles north of Cannon Falls, the alignment crosses over US Highway 52 as the highway bends northwest at 260th St. This crossing ends the segment with a length of 19.7 miles. The terrain traversed by this segment is rugged.

Segment 4: 260th St to Rich Valley. The high-speed rail alignment continues on a similar northwesterly-heading parallel to and on the east side of US Highway 52, crossing the Vermillion River and a number of roadways. South of 145th St., the alignment crosses over US Highway 52 to the west side, following the highway to Rich Valley. This segment terminates at 140th St., a distance of 12.7 miles. The terrain is rural, but less rugged than that to the south.

Segment 5: MSP Airport Approach Option 2. The final segment of the Tri-State HSR alignment consists of the 14.4 mile CP Railway/SR55/US52 alignment described in detail below.

Alternative 2: Tri-State High-Speed Rail Alignment

Segment 1: Rochester International Airport (RST) to Dodge Center. From a surface station facility at RST, the Tri-State alignment runs northwest to the northeast corner of the town of Dodge Center, a distance of 19.3 miles. The alignment runs through primarily rural country and crosses a number of existing roads and natural waterways. Significant crossing structures are required at Salem Creek, I-14 and the DM&E Railroad.

Segment 2: Dodge Center to State Route 60. The alignment turns towards a slightly west-of-north course, which passes between the towns of Concord and West Concord on County Road 24. North of the County 11 Blvd. crossing, a twenty-mile passing siding begins. The alignment runs through primarily rural country, crossing a number of minor roads and waterways. This segment is 17.0 miles in length.

Segment 3: State Route 60 to Randolph. North of State Route 60, the alignment turns northwesterly. The route continues on its northwesterly path through rugged rural terrain, crossing a number of waterways requiring significant bridge structures, including the Zumbro River north fork, Little Canyon tributary, Little Canyon River, and Canyon River. The twenty-mile passing siding ends south of 320th St. The alignment skirts to the northeast of the Carleton Airport east of Stanton and crosses over the Chicago and Northwestern Railroad (now Union Pacific), reaching the western edge of the town of Randolph. This segment is 18.8 miles in length.

Segment 4: Randolph to Rich Valley US Highway 52. From Randolph the alignment continues on a north to northwesterly heading and crosses a number of roadways, including Northfield Blvd. The alignment turns due north on the east side of Blaine Ave and proceeds north to approximately 160th St. Between 160th and 140th Streets, the alignment turns northeast to approach the west side of US Highway 52 at 140th St. in Rich Valley. The alignment crosses over the UP Railroad west of Rich Valley. The terrain on the southern end of the segment is rural but becomes more populated and industrialized approaching the Minneapolis-St. Paul suburbs. This segment is 15.2 miles in length.

Segment 5: MSP Airport Approach Option 2. The final segment of the Tri-State HSR alignment consists of the 14.4-mile CP Railway/SR55/US52 alignment described in detail below.

Minneapolis-St. Paul Airport Approach

Option 1: CP Railway/SR149/SR3. From 160th St. and US Highway 52, the alignment extends to the west-northwest following an abandoned railroad corridor presently occupied by a pipeline. The alignment crosses a number of roadways generally requiring new roadway bridges over the high-speed rail facility. On reaching the CP Railway corridor north of 135th St. (SR 38), the alignment follows the railroad northward through a series of curves east of SR 3. A number of

high-speed rail bridges must be constructed on this alignment to achieve grade separation with the numerous crossing streets in this developed area. The existing CP Railway alignment crosses SR 3 at the junction of SR 149 and proceeds to the north/northwest on the east side of SR 149, crossing most intersecting transportation facilities, including I-35E and I-494. While the CP Railway active tracks end at the Coca Cola spur at MP 160, the high-speed rail alignment continues to follow the abandoned railroad corridor northwesterly, passing under Pilot Knob Rd and SR 13. From the bluff on the east side of the Minnesota River, the alignment descends to cross the river on a new fixed bridge structure consisting of deck plate girder sections across the flood plain and a through girder section across the main channel. On the west side of the river, the alignment tunnels under the airport between the main runways to the airport terminal, for a distance of approximately 3000 feet to a new underground station facility. The total distance of this option is approximately 16.1 miles.

Option 2: CP Railway/SR55/US52. From 140th St. and US Highway 52, the alignment extends north on the west side of the highway. Multiple grade separations are required, with the high-speed rail alignment generally going over the existing crossings to north of 105th Street. The high-speed rail alignment remains west of SR 55 as it turns to the northwest between Concord Blvd. and SR 149 Dodd Rd. The alignment joins the CP Railway corridor northwest of the intersection of SR 149 and US 52. From this point, it follows the CP Railway tracks and abandoned railroad right-of-way, crossing over the Minnesota River and tunneling under the airport as described in Option 1. The total distance of this option is approximately 14.4 miles.

Option 3: CP Railway/SR55/US52/UP Railroad. From south of 145th St. and US Highway 52, the alignment extends northwest to join the UP Railroad corridor located west of US 52. The alignment follows this railroad corridor to the north/northwest to approximately 135th St, where it diverges (to avoid the refinery switching yard) and continues northwest to join the Blaine Ave./Rich Valley Blvd. corridor, running on the east side of the roadway. The high-speed rail alignment joins another UP Railroad corridor running north/northeast and joins the US Highway 52/SR 55 corridor on the west side in the vicinity of 105th St. From this point, the alignment is identical to that of Option 2. The total distance of this option is approximately 15.3 miles.

These options are depicted in Exhibits A2-A4.

Exhibit A-2: MSP Approach Option 1
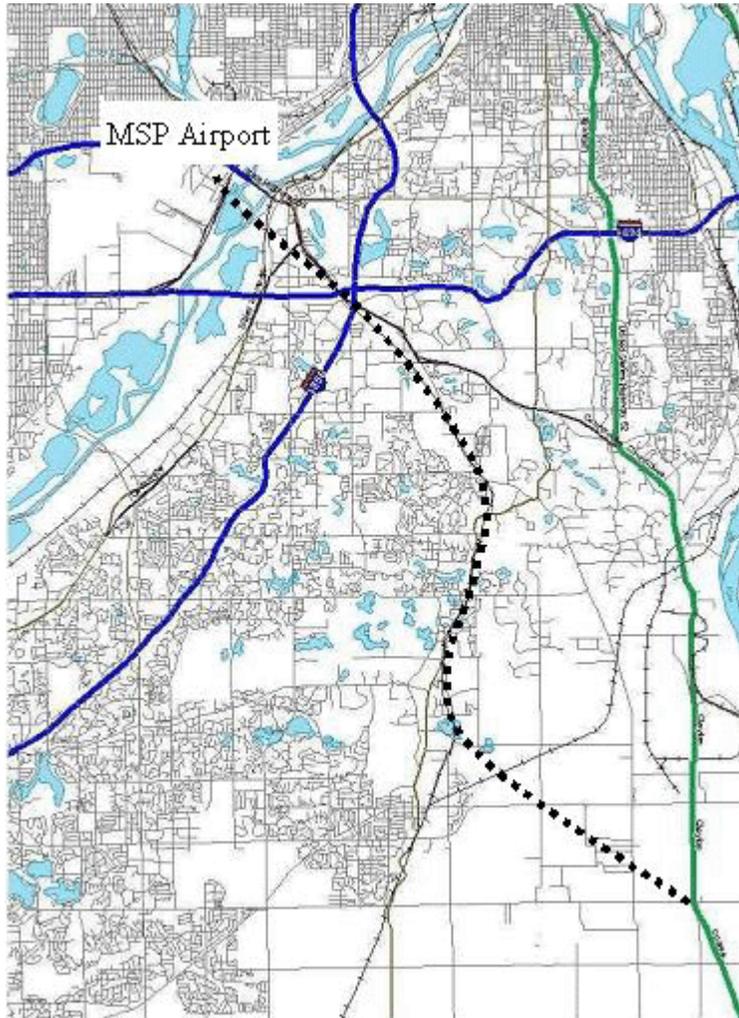
Exhibit A-3: MSP Approach Option2
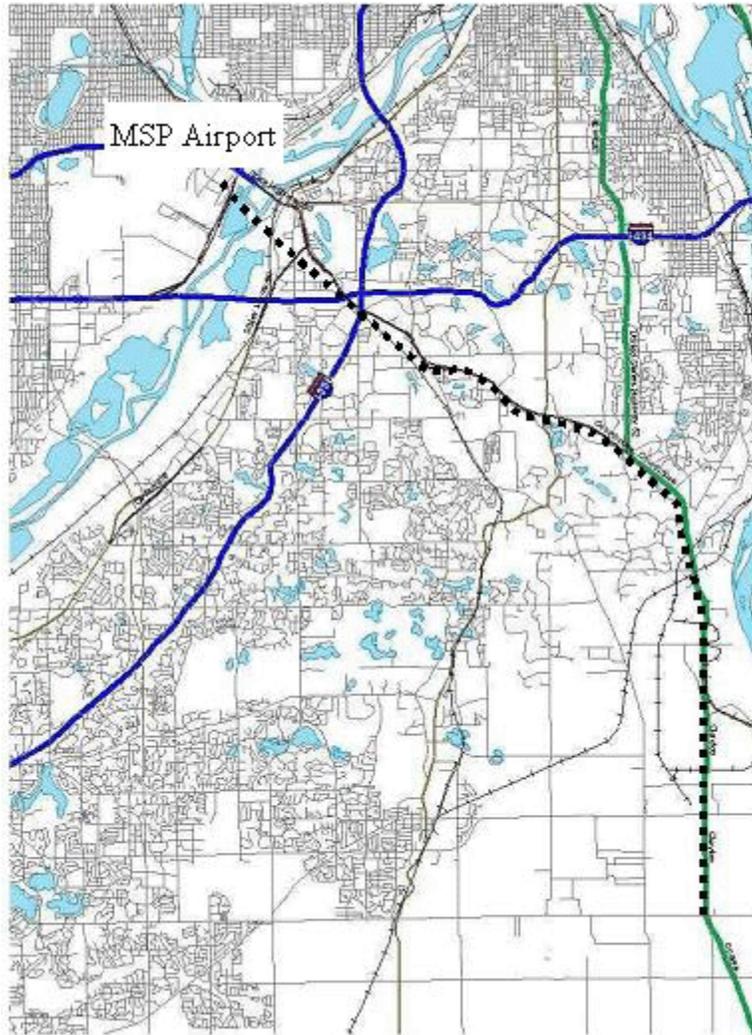
Exhibit A-4: MSP Approach Option 3
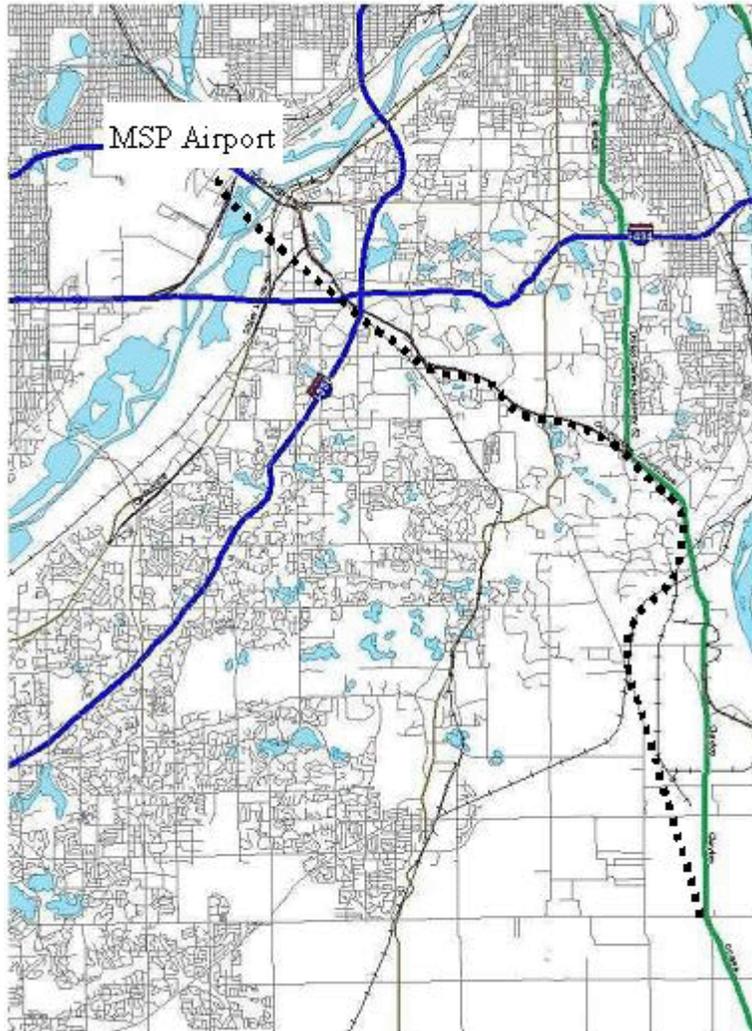
Field Investigation of MSP Approaches

A field investigation to select potential routes into the MSP Airport for the high-speed rail corridor was conducted on August 20 and 21, 2002. The focus of this investigation is an area from the airport to the southeast ending near the interchange of US 52 and CR 42 within the City of Rosemount.

Area Description

The area has high concentrations of residential development west of a line delineated by SR 149 and SR 3. Industrial and commercial development exists north of Wescott Road along SR 149. A Canadian Pacific Railroad branchline runs parallel to SR 55, SR 149 and SR 3 and connects to the Union Pacific Railroad at the south end of Rosemount. The north end of this branchline ends at the Coca-Cola bottling plant spur just south of I-494. The railroad/SR 149/SR 3 corridor was established as the western limits of the study area.

The SR 55 and US 52 corridor was established at the east and north limits of the study area. These highways have limited access and most major intersections have interchanges. Minor intersections and driveways intersect at grade. Residential development exists to the north and east of this corridor beginning at CR 73 and extends south to 105th Street. Industrial development, which includes an oil refinery, exists south of 105th Street. The industrial area ends at 140th Street, where agricultural land use begins.

The area between the CP Rail/SR 149/SR 3 corridor and the SR 55/US 52 corridor contains light density residential development north of 120th Street. This area consists of rolling and hilly terrain, where the home values typically range between $300,000 to $500,000 and upwards. South of 120th Street, the land use is agricultural with homes scattered throughout. A University of Minnesota Research Center is located south of CR 42.

The Pine Bend oil refinery is located along the west side of US 52 between 117th Street and 140th Street. The refinery's western limits run along Rich Valley Boulevard and the Union Pacific Railroad line that runs to Rosemount. Landfills are in operation on either side of 117th Street between the two Union Pacific rail lines and US 52.

Airport Access

Access alternatives to the Minneapolis-St. Paul Airport are limited. The Fort Snelling National Cemetery is located in the southeast quadrant of the airport and Fort Snelling is located in the northeast quadrant. The light rail line currently under construction enters the airport from the south along 34th Avenue, goes around the cemetery, and then into a tunnel to access the airport terminal. The light rail line exits west of Fort Snelling and heads towards Minneapolis. These obstacles and the presence of dense residential development to the south and east of the airport limit accessing the airport by way of crossing the Minnesota River and entering between the two parallel runways from the southeast. Because ground surfaces are unavailable for additional development, a tunnel connected to a bridge across the river would be required to access the airport.

MSP Approach Options

Three approach options were identified in the field and investigated for this study. The first option (CP Rail/SR 149/SR 3 Corridor) parallels the Canadian Pacific Railroad/SR 149/SR 3 corridor from the east bluff of the Minnesota River, along the rail line to CR 38 (135th Street), where the corridor diverges from the railroad alignment and runs southeast towards the CR 42/US 52 interchange.

The second option (SR 55/US 52 Corridor) shares the same alignment with the first corridor from the Minnesota River to the SR 55/SR 149 intersection by use of the railroad corridor. At the SR 55/SR 149 intersection, this second corridor parallels SR 55 on the south side and then parallels US 52 on the west side up to the CR 42/US 52 interchange.

The third option is identical to the second between MSP and approximately 105th St., where the alignment departs to the southwest to parallel the Union Pacific Railroad and Rich Valley Boulevard to the west of the oil refinery.

A potential corridor was examined in the field that parallels Rich Valley Boulevard and connects to the CP Rail/SR 149/SR 3 corridor. The Rich Valley Boulevard corridor is suitable up to Cliff Road. At Cliff Road, high-cost, low-density residential development begins. This residential development spreads from the US 52 corridor west to the CP Rail/SR 3 corridor. This is also the beginning of rolling and hilly terrain. A park is located northeast of 105th Street and Rich Valley Boulevard. Due to these conflicts, it was decided to reject this corridor for further study and focus on the options described above.

Option 1: CP Rail/SR 149/SR 3 Corridor Description

This corridor option uses the Canadian Pacific Railroad Corridor that parallels a portion of SR 55, SR 149 and SR 3. The railroad is abandoned north of I-494. Most all of the rail spurs that diverge from this line come off from the west side of this alignment. The parallel highways are 100 to 200 feet east of the railroad alignment until the railroad crosses over SR 3 and then the highway is several hundred feet west of the railroad. Railroad bridges exist at I-494, I-35E and SR 3. The railroad grade is intact north of the I-494 Bridge but is blocked by the relocated SR 13 embankment. A bikeway is built on the old rail bed west of SR 13. A Koch oil pipeline parallels the rail alignment on the west side.

The railroad right-of-way appears to be at least 50 feet wide in most locations. With this right-of-way and some of the highway right-of-way, the existing tracks could be shifted to the west to allow room for the construction of the high-speed line. The line would either need to be depressed or elevated north of the SR 3 bridge and would need to be elevated south of Cliff Road because of surface water in the area. Highway intersections located close to the rail line would not allow for the construction of highway overpasses with the high-speed and freight lines located at the existing grade. The freight line could remain at grade, but the high-speed line would have to go over or under the intersecting roadways. Photographs and a narrative of the corridor follow in the next section.

Option 1: CP Rail/SR 149/SR 3 Corridor Photographs and Narrative

Photographs are ordered starting from the north end of the corridor (airport) and work toward the south end of the corridor (CR 42/US 52 interchange).

Photo 1: View from Big Rivers Regional Trail parking area, looking across the Minnesota River to the airport. The newest parking garage is to the left of center. This area is within the Fort Snelling State Park. The alignment would pass north of this parking area on the way to the airport. The Union Pacific Railroad is at the base of this bluff.

Photo 2: View of the I-494 bridge over the Minnesota River looking southwest from the parking area. Rail bridge might have a similar layout. The river valley is approximately 4500 ft. wide and contains wetlands throughout.

Photo 3: View looking west from the SR 13 embankment. Bikepath is on the old Canadian Pacific Railroad right-of-way. The corridor would be located just south of the bike path. Koch Pipeline Co. runs along the old railroad alignment.

Photo 4: Railroad alignment looking east from SR 13 embankment. The fill is approximately 30 ft. above the old railroad grade.

Photo 5: Railroad alignment looking east from Pilot Knob Road.

Photo 6: Railroad alignment looking east of Enterprise Drive. Warehouse once had rail service.

Photo 7: Railroad alignment looking northwest of Mendota Heights Road. SR 55 is to the right.

Photo 8: Railroad alignment looking northwest from Mendota Heights Road. SR 55 is to the right.

Photo 9: Railroad alignment looking southeast from Mendota Heights Road. Koch Pipeline Co. is in the right-of-way.

Photo 10: From railroad bridge over I-494 looking northwest. Northland Drive is in the background.

Photo 11: Single-track railroad bridge over I-494 looking southeast, ballast deck, concrete pan.

Photo 12: Railroad bridge over I-494 looking southeast. Relatively new structure, weathering steel girders.

Photo 13: Railroad at Coca-Cola Bottling spur, end of line MP 160, looking northwest.

Photo 14: Railroad at Coca-Cola Bottling spur, near Egandale Blvd. and service road, looking southeast over I-35E bridge.

Photo 15: Railroad bridge over I-35E. Two track ballast deck, concrete pan.

Photo 16: Railroad bridge over I-35E, relatively new, weathering steel girders.

Photo 17: Railroad alignment at Lexington Avenue looking northwest with I-35E bridge in background.

Photo 18: Railroad alignment at Lexington Avenue looking southeast.

Photo 19: Railroad alignment at Lone Oak Road looking northwest.

Photo 20: Railroad alignment at Lone Oak Road looking southeast.

Photo 21: Railroad alignment at Yankee Doodle Drive looking northwest.

Photo 22: Railroad alignment at Yankee Doodle Drive looking southeast. SR 149 is on the left. Thomson West office building to the right is located at Opperman Drive.

Photo 23: Railroad alignment at Wescott Road looking northwest. Thomson West office building in the background.

Photo 24: Railroad alignment at Wescott Road looking southeast.

Photo 25: Railroad alignment at Rich Valley Boulevard, CR 71 looking northwest. SR 149 is on the right.

Photo 26: Railroad alignment at Rich Valley Boulevard, CR 71 looking southeast, beginning of residential area to the south.

Photo 27: Railroad grade separation at SR 3 looking east.

Photo 28: Railroad alignment at Cliff Road looking north. SR 3 is to the left.

Photo 29: Railroad alignment at Cliff Road looking south. SR 3 is to the right.

Photo 30: Railroad alignment at Biscayne Ave. looking north.

Photo 31: Railroad alignment at Biscayne Ave. looking south. Surface water is present along the railroad from this point south to CR 38, 135th Street.

Photo 32: Railroad alignment at 130th Street looking north.

Photo 33: Railroad alignment at 130th Street looking south. Corridor alignment diverges to the left and heads southeast from this point.

Photo 34: Railroad alignment at Bonnaire Path, CR 38, looking north.

Photo 35: Railroad alignment at Bonnaire Path, CR 38, looking south. Corridor alignment is to the left of the roadway heading southeast.

Photo 36: Looking southeast from the intersection of Bonnaire Path and Birchwood Ave. Corridor crosses through this property.

Photo 37: Pipeline crossing along Akron Avenue, CR 73, looking west. Corridor crosses at this point. Several homes are located to the right.

Photo 38: Pipeline crossing along Akron Avenue, CR 73, looking southeast. Corridor crosses at this point.

Photo 39: CR 42 at Audrey Ave. looking northwest. Corridor crosses at this point. Dakota County Technical College is located on the left. CR 42 is a four-lane roadway with a center left turn lane.

Photo 40: CR 42 at Audrey Ave. looking southeast, corridor crosses at this point.

Photo 41: Blaine Avenue at abandoned rail line looking northwest. Corridor parallels this abandoned line.

Photo 42: Blaine Avenue at abandoned rail line looking southeast.

Option 2: CP Rail/SR 55/US 52 (and Option 3: CP Rail/SR 55/US52/UP RR) Corridor Description

This corridor alternative uses the same corridor alignment as the CP Rail/SR 149/SR 3 corridor alternative from the east bluff of the Minnesota River up to the SR 55/SR 149 intersection. From this intersection, the alignment would run along the south side of SR 55. Development is sparse along this side of SR 55 and the interchange with US 52 is on the north side of the road. Residential and commercial development is more intense on the north and east sides starting at CR 73 and continuing to 105th Street. The south interchange with US 52 and SR 55 veers off to the east and thus will not interfere with the corridor alignment on the west side of US 52. The topography along this corridor is rolling, with frontage roads at many locations parallel to SR 55 and US 52. SR 55 and US 52 are 4-lane divided roadways with a median at least 60 feet wide. Housing is sparse along the west side of US 52 so there would be sufficient room to relocate frontage roads and allow room for the corridor alignment. High-tension power lines run parallel to US 52 from 117th Street to 140th Street. These may need to be relocated, depending on the final alignment of the corridor. Photographs and a narrative of the corridor follow.

Photographs are ordered starting from the north end of the corridor where it diverges from the rail corridor (SR 55/SR 149 intersection) and works toward the south end of the corridor (CR 42/US 52 interchange).

Photo 43: From Apollo Road and Canadian Pacific Railroad alignment, looking southeast towards SR 55/SR 149 intersection.

Photo 44: SR 55/SR 149 intersection looking northwest.

Photo 45: SR 55/SR 149 intersection looking southeast. Frontage road is located on the right; corridor alignment would be to the right of SR 55.

Photo 46: SR 55 corridor at Black Oak Drive looking northwest.

Photo 47: SR 55 corridor at Black Oak Drive looking southeast.

Photo 48: SR 55 at Argenta Trail looking northwest.

Photo 49: SR 55 at Argenta Trail looking southeast.

Photo 50: SR 55 on south frontage road, west of SR3 interchange and looking northwest. Slide area has been barricaded to the left.

Photo 51: SR 55 on south frontage road west of SR 3 interchange looking southeast.

Photo 52: Large fill on the south side of SR 55, east of SR 3 and looking east.

Photo 53: On 80th Street east of SR 3 and north of SR 55 looking northwest.

Photo 54: On 80th Street, east of SR 3 and north of SR 55 looking southeast.

Photo 55: End of Babcock Road, north of SR 55 looking northwest.

Photo 56: Barnes Ave. interchange with SR 55, looking southeast from the end of Babcock Rd.

Photo 57: Courthouse Boulevard adjacent to US 52, east of Barnes Ave. looking northwest. Interchange with SR 55 is to the right.

Photo 58: Courthouse Boulevard adjacent to US 52, east of Barnes Ave. looking southeast.

Photo 59: US 52 interchange with Buckley Court looking northeast.

Photo 60: US 52 interchange with Buckley Court, ramps looking southeast.

Photo 61: Shopping center north quadrant of US 52 and Concord Boulevard.

Photo 62: Courthouse Boulevard west of US 52 at 96th Street turnoff, looking south, what may be a lift station is located at the bottom of the hill.

Photo 63: US 52 from lift station looking south.

Photo 64: US 52 bridge over Union Pacific Railroad, northern line, looking south. Option 3 corridor alignment would follow the railroad corridor to the right.

Photo 65: US 52 at 105th Street looking north.

Photo 66: US 52 at 105th Street looking south. The southern Union Pacific Railroad alignment crosses under US 52 at the bridge.

Photo 67: US 52 just south of 117th Street looking north. High-tension power line runs from 117th Street to 140th Street on the west side of US 52.

Photo 68: US 52 just south of 117th Street, looking south. Pine Bend oil refinery is located on the right.

Photo 69: US 52 at end of frontage road along oil refinery, looking north.

Photo 70: US 52 at end of frontage road along oil refinery, looking south.

Photo 71: US 52 at 140th Street, looking north.

Photo 72: US 52 at 140th Street, looking south toward CR 42 interchange.

Photo 73: US 52/CR 42 interchange looking north.

Photo 74: US 52/CR 42 interchange, looking south. Subalternative corridor follows the Union Pacific Railroad and Rich Valley Boulevard, starting at 105th Street and heading south.

Photo 75: Union Pacific Railroad at 105th Street, looking north.

Photo 76: Union Pacific Railroad at 105th Street, looking south.

Photo 77: Union Pacific Railroad at 117th Street, looking north. Landfill is located on the right.

Photo 78: Union Pacific Railroad at 117th Street, looking south. Landfill is located on the left.

Photo 79: Landfill looking northeast from Union Pacific Railroad and Rich Valley Boulevard.

Photo 80: Rich Valley Boulevard at Union Pacific Railroad crossing, looking northeast.

Photo 81: Rich Valley Boulevard at the Union Pacific Railroad grade crossing looking south. Oil refinery is located to the east. Pipeline facilities are located along the east side of Rich Valley Boulevard.

Photo 82: On Rich Valley Boulevard south of the railroad grade crossing, looking north.

Photo 83: On Rich Valley Boulevard south of the railroad grade crossing, looking south.

Photo 84: On 140th Street west of the Union Pacific industrial spur (southern alignment), looking north.

Photo 85: On 140th Street west of the industrial spur, looking south.

Photo 86: On 140th Street at Union Pacific industrial spur crossing, looking north.

Photo 87: On 140th Street at Union Pacific industrial spur crossing, looking south.