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About the Michigan Environmental Council & Michigan By Rail

Michigan Environmental Council (MEC), a 501(c)(3) charitable organization, is a coalition of more than 70 organizations created in 1980 to lead Michigan’s environmental movement to achieve positive change through the public policy process. These organizations place a high priority on transportation issues as key to Michigan’s economic success and environmental quality.

MEC is a co-founder and convener of Michigan by Rail—an informal coalition of advocates working together to improve and expand passenger rail in Michigan. Coalition members include the Michigan Association of Railroad Passengers (also a co-founder of the coalition), Groundwork Center for Resilient Communities, Friends of WALLY and the Midwest High-speed Rail Association.

Michigan By Rail was involved in hosting public meetings across the state in 2010 to collect feedback for the Michigan Department of Transportation’s State Rail Plan and hosted the first Michigan Rail Summit in 2011. The group is now working to advocate in support of multiple rail expansion and improvement projects across the state. Michigan By Rail led the public engagement portion of this study.

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- Macatawa Area Coordinating Council
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The steering committee played an active role throughout the development of this report. Steering committee members include:

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Project Overview

SUMMARY

Chapter 1 of this report sets out the background and purpose of the Coast-to-Coast Passenger Rail Line project, including outlining the study’s goal, the scope, and the methodologies used. In addition, a discussion of the Freight Railroad Principles impacting the project, particularly regarding the sharing of track with Passenger Rail, are included at the end of this chapter.

1.1 Introduction

This study provides a pre-feasibility level understanding about the basics of operating passenger rail service between Michigan’s major cities: Detroit, Lansing and Grand Rapids. Using basic operating assumptions about route and technology options this report outlines estimates for the travel market, capital and operating costs, potential financial and economic benefits and highlights early public feedback about possible service along the corridor.

Since the early 1980’s Michigan Department of Transportation (MDOT) and its associated Metropolitan Planning Organizations (MPO) have been interested in the development of passenger rail systems in Southern Michigan, as a mechanism to help support regional mobility and provide an alternative travel option for movement in the expanding urban areas between Holland on Lake Michigan on the western side of the Lower Peninsula and Detroit on the Detroit River and Lake St. Clair on the eastern side of the Lower Peninsula. The aim is to connect the major cities of Holland, Grand Rapids, Lansing and Detroit together with other communities such as Ann Arbor and Dearborn, Brighton, and Howell.

Over this period of time there have been many changes in the travel environment including:

- The changing demographic and socioeconomic factors that have occurred in the intervening period reflecting greater mobility and a more widely distributed population.
- Changing travel conditions for auto use due to more congestion on the interstate highway system and higher energy (gas) prices that make auto travel more time consuming and expensive.
- Changes due to Air Deregulation that has significantly reduced the amount of air service for trips under 300 miles, and reduced quality of service, due to the use of smaller aircraft in the corridor.
- The development of more cost effective rail technology due to improved locomotive performance and efficiency, as well as the introduction of modern communication systems.
As a result of these changes, rail travel has become increasingly competitive, and for example Amtrak has seen a significant use in its ridership since the year 2000 across the Midwest with Chicago-Detroit ridership increasing by 57% by 2011.

All these issues suggest the need to review the potential for rail service across Michigan / the Lower Peninsula connecting the major cities within Michigan.

### 1.2 Purpose and Objective

The goal of the study is to provide the Michigan Environmental Council and its associated organizations and stakeholders with a basic understanding of:

- The background history supporting the proposed development of the Coast-to-Coast Corridor.
- Potential route and technology options for the corridor.
- The market for intercity travel in the current travel environment.
- The capital and operating costs of train service.
- The financial and economic benefits that would be derived from implementing the system.
- The level of public and stakeholder support for the project by developing the pros and cons of the system for review by public and stakeholders.

Essentially, this study assesses the feasibility of each of the proposed corridor options with regards to: the need for passenger rail development in the corridor; capital costs; operation and maintenance costs; ridership and revenue; operating ratios and benefit-cost analysis; and funding and financing opportunities. In particular, the feasibility of each route and technology option will be determined by the potential benefits anticipated from the investment in transportation between the cities for each of the corridor options (ex. Grand Rapids, Lansing, Ann Arbor, Detroit, etc.). This study will not result in what is often called a “preferred alternative” in the environmental planning process nor will it exclude any route options from further analysis.

This assessment assumes an approximate +/-30% level of accuracy, with equal probability of the actual total cost moving up or down. Additional work will be needed to develop more precise estimates. This will be done if the project moves into the environmental planning process. Furthermore, based on the results of this analysis, this study will also provide recommendations for more detailed future studies of the various route options that will be needed for the next step in the Coast-to-Coast Corridor project.
1.3 Project Scope

The study approach uses TEMS RightTrack™ Business Planning System to provide a fully documented analysis of the corridor opportunity. The approach identifies existing and future markets, potential routes and capital costs, technology and operating costs, financial and economic returns and input to stakeholder and community benefits.

Specifically, key deliverables include:

- A comprehensive review of past passenger rail case studies in the Coast-to-Coast corridor that are relevant to the current proposed development for passenger rail in the corridor.
- A comprehensive intercity travel market analysis for the base and forecast years.
- An assessment of potential routes and stations based on existing and historic analysis of options.
- A review of potential train technology for 79 & 110-mph operations and its potential operating schedules and costs on different routes and for different stopping patterns.
- Both a financial and economic analysis of potential options and their ability to meet United States Department of Transportation (USDOT) Federal Railroad Administration (FRA) funding requirements.
- Output of community benefits to provide input to the stakeholder and community groups to identify the project pros and cons.
- Preparation of a conceptual level pre-feasibility report for use in assessing the project viability and its ability to achieve fundability.

1.4 Project Methodology

To ensure all of the FRA criteria and factors are fully evaluated, the study team has used a business plan approach. As specified by the FRA, the selection of an appropriate rail option is “market driven.” The difference in the selection of one rail option over another is heavily dependent on the potential ridership and revenue. A set of reasonable alternatives have been developed for evaluation based on the potential of each alignment option to improve market access, raise train speed, or to reduce cost. These alternatives provide a full range of trade-off options for configuring the rail system to best meet Michigan’s need.

To ensure that market potential is properly measured, the TEMS Business Plan Approach carries out a very detailed and comprehensive market analysis. The output of this market analysis is then used to determine the right rail technology and engineering infrastructure for the corridors.

In developing the Business Case, the TEMS team used the TEMS RightTrack™ Business Planning Process that was explicitly designed for passenger rail planning and uses the six step Business Planning Process as shown in Exhibit 1-1.
Key steps in the process are the definition of the proposed rail service in terms of its ability to serve the market; an interactive analysis to identify the best level of rail service to meet demand, and provide value for money in terms of infrastructure; ridership and revenue estimates for the specific rail service proposed; and the financial and economic assessment of each option.

**Exhibit 1-1: Six Step Business Planning Process**
1.4.1 Study Process

The Business Planning Process is designed to provide a rapid evaluation of routes, technologies, infrastructure improvements, different operating patterns and plans to show what impact this will have on ridership and revenues, and financial and economic results.

The current study entailed an interactive and quantitative evaluation, with regular feedback and adjustments between track/technology assessments and operating plan/demand assessments. It culminated in a financial and economic assessment of alternatives. Exhibit 1-2 illustrates the process that led up to the financial and economic analysis.

The study investigated the interaction between alignments and technologies to identify optimum trade-offs between capital investments in track, signals, other infrastructure improvements, and operating speed. The engineering assessment included GOOGLE® map and/or ground inspections of significant portions of track and potential alignments, station evaluations, and identification of potential locations and required maintenance facility equipment for each option. TRACKMAN™ was used to catalog the base track infrastructure and improvements. LOCOMOTION™ was used to simulate various train technologies on the track at different levels of investment, using operating characteristics (train acceleration, curving and tilt capabilities, etc.) that were developed during the technology assessment. The study identified the infrastructure costs (on an itemized segment basis) necessary to achieve high levels of performance for the train technology options evaluated.

A comprehensive travel demand model was developed using the latest socioeconomic data, traffic volumes (air, bus, auto, and rail) and updated network data (e.g., gas prices) to test likely ridership response to service improvements over time. The ridership and revenue demand estimates, developed using the COMPASS™ demand modeling system, are sensitive to trip purpose, service frequencies, travel times, fares, fuel prices, congestion and other trip attributes.
A detailed operating plan was developed and refined, applying train technologies and infrastructure improvements to evaluate travel times at different levels of infrastructure investment. Train frequencies were tested and refined to support and complement the ridership demand forecasts, match supply and demand, and to estimate operating costs.

Financial and economic results were analyzed for each option over a 30-year horizon using criteria recommended by USDOT FRA Cost Benefit guidelines, and the U.S. Office of Management and Budget (OMB) Social Discount Rates. The analysis provided a summary of capital costs, revenues, and operating costs for the life of the project, and developed the operating ratio and cost benefit ratio for each option.

### 1.5 Freight Railroad Principles

It is in the interest of passenger rail feasibility that any shared use of freight rail corridors or tracks along the Coast-to-Coast rail corridor respect the need for continued safe and economical rail freight operations. At a minimum, it is intended that the freight railroads need to be able to operate their trains as effectively as they could if passenger service did not exist. Beyond this, it is desirable to actually create benefits for freight rail service if possible while developing the infrastructure needed to support passenger services. Freight railroads must retain their ability not only to handle current traffic, but also to expand their own franchises for future traffic growth.

As such, both CSX and Norfolk Southern (like the other Class 1 railroads) have established “Letters of Principle” to provide guidance to passenger rail planners. The purpose of the principles is to protect the safety of railroad employees and communities, service to freight customers, and the right-of-way and land needed to fulfill the railroads’ freight transportation mission. However, Norfolk Southern acknowledges that each passenger proposal is unique, so Norfolk Southern’s application of the principles to particular proposals will often be unique as well.

With regard to High-Speed Rail (HSR) service and corridors, Norfolk Southern’s principles point out that the following special considerations are necessary:

- Norfolk Southern will work with planners to insulate higher-speed rail corridors from interference with and from NS freight corridors.

- On Norfolk Southern, passenger trains operating in excess of 79-mph require their own dedicated tracks. On Norfolk Southern, Trains operating in excess of 90-mph require their own private right-of-way.

- Where higher-speed trains share tracks with conventional freight trains, those high-speed trains will not be able to exceed 79-mph. Where shared track is concerned higher speed trains must meet the same safety standards as conventional freight trains.

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1 CSX Principles, email from Marco Turra, CSX to Elizabeth Treutel, Michigan Environmental Council, dated June 4, 2015; NS Principles, [https://wideni77.files.wordpress.com/2013/09/norfolk-southern-proposed-passenger-projects-061413.pdf](https://wideni77.files.wordpress.com/2013/09/norfolk-southern-proposed-passenger-projects-061413.pdf), retrieved on 08/06/15
CSX’s principles require that:

- Access to host railroad track and property must be negotiated between the parties on a voluntary basis.
- Designing for safety is paramount and separate tracks will be needed to segregate freight and conventional passenger rail from higher-speed rail at sustained speeds in excess of 90-mph.
- Service to rail freight customers must be reliable and protected and cannot be compromised; adequate capacity must be maintained and, in some cases, built to address future freight growth.
- New infrastructure design must fully protect the host railroad’s ability to serve its existing customers, both passenger and freight, and locate future new freight customers on its lines. Host railroads must be adequately compensated, especially in regard to the significantly higher maintenance cost associated with enhanced track infrastructure that will be required for high-speed rail.
- Host freight railroads need to be fully protected against any and all liability that would not have resulted but for the added presence of high-speed passenger rail service.

At present the passenger proposals laid out here are still un-negotiated, un-funded and at a pre-feasibility level. This report makes certain assumptions regarding the need for capacity enhancements along rail lines that would be utilized for providing passenger service. However, the required detailed capacity analysis for shared track segments has yet to be done. As a result, the work is not yet at a detailed enough level to satisfy the needs of the freight railroads. It is understood that in potential future detailed engineering and environmental studies, the required capacity work will be performed. These engineering and operation studies will address the details of integrating the proposed passenger operations with freight operations, and will be subject to close negotiations with the railroads. As a result, the final infrastructure need will not be known until these studies and railroad negotiations are completed. This report only suggests a starting point for the capacity analysis process and negotiations. These will need to be done if and when the Coast-to-Coast corridor moves forward into the environmental study phase.

In the meantime, this report contains preliminary data which is subject to review, verification and approval by both CSX and Norfolk Southern Railroads. As of the date of this report, this review process has not taken place. Findings are not to be construed as a commitment on the part of either CSX or Norfolk Southern to operate additional service.

### 1.6 Organization of the Report

1. **Chapter 1 – Project Overview:** Chapter 1 lays out the overall approach for implementing the proposed Coast-to-Coast Passenger Rail Line (Detroit - Holland) over the next 25 years. Chapter 1 of this report also sets out the background and purpose of the Coast-to-Coast Line, including outlining the goal for the project, the project scope, and the methodologies used. In addition, a discussion of the Freight Principles impacting the project, particularly regarding the sharing of track with Passenger Rail, are included at the end of this chapter.
2. **Chapter 2 – Development of the Coast-to-Coast Corridor:** The purpose of this section is to provide an extensive review of the background history and issues that have helped to focus the current analysis and that have led to the identification of a range of potential route and technology options that should be considered for the current Coast-to-Coast Study. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to evaluate an affordable set of options that provide good service at a reasonable price.

3. **Chapter 3 – Service and Operating Plan:** This chapter discusses the development of the Service and Operating Plan and includes a discussion of the track infrastructure and train technology options. This chapter also describes the operating plan, station stopping patterns, frequencies, train times and train schedules for each route and technology option. Operating costs were also calculated for each year the system is planned to be operational using operating cost drivers such as passenger volumes, train miles, and operating hours.

4. **Chapter 4 – Prioritized Capital Plan:** This chapter discusses the development of the Prioritized Capital Plan and includes a discussion of the capital cost methodology and the capital costs for the Coast-to-Coast Passenger Rail Line including breakdowns by unit costs. The unit capital costs for estimating infrastructure, equipment, and maintenance facility capital costs for each route and technology option are also described. This chapter also presents the Capital Spending plan for the project.

5. **Chapter 5 – Socio-Demographic Transportation Databases:** This chapter is divided into subsections of introduction of the chapter, zone system, socioeconomic data, transportation network data, origin-destination data, stated preference survey process, results and analysis. This chapter describes the steps of developing the market data which includes developing a zone system, socioeconomic database of the study area, how the transportation networks were developed, how the origin and destination databases were obtained and validated, the methodology used to conduct the stated preference surveys.

6. **Chapter 6 – Coast-to-Coast Travel Demand Forecast:** This chapter also presents the analysis of the Total Travel Demand for passenger rail in the Coast-to-Coast Corridor, including presenting ridership and revenue results. The ridership and revenue forecasts for this study were developed using the COMPASS™ Travel Demand Model. The COMPASS™ Multimodal Demand Forecasting Model is a flexible demand forecasting tool used to compare and evaluate alternative passenger rail network and service scenarios. It is particularly useful in assessing the introduction or expansion of public transportation modes such as passenger rail, air, or new bus service into markets.

7. **Chapter 7 – Assessment of Benefits – Preliminary Financial and Economic Analysis:** This chapter presents a detailed financial analysis for the Coast-to-Coast Passenger Rail Line, including key financial measures such as Operating Surplus and Operating Ratio. A detailed Economic Analysis was also carried out using criteria set out by the 1997 FRA Commercial Feasibility Study and including key economic measures such as NPV Surplus and Benefit/Cost Ratio which are also presented in this chapter. A sensitivity analysis was also performed on the Route 2 option using the State of Michigan’s lower more conservative demographic growth assumptions.
8. Chapter 8 – Public Engagement: This chapter outlines the Public Engagement aspect of the study and highlights the main findings of that process.

9. Chapter 9 – Conclusions and Next Steps: This chapter outlines the key findings of the study, and the next steps that should be taken to move the Coast-to-Coast Passenger Rail Line project forward.
Chapter 2
Development of the Coast-to-Coast Corridor

SUMMARY

The purpose of this chapter is to provide an extensive review of the background history and issues that have helped to focus the current analysis and that have led to the identification of a range of potential route and technology options that should be considered for the current Coast-to-Coast Study. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to evaluate an affordable set of options that would provide good service at a reasonable price. It is not expected that any true High-Speed Rail options will be reasonable as a first step in developing the Coast-to-Coast Corridor.

2.1 Background History

Since intercity passenger rail service in the Detroit – Lansing – Grand Rapids rail corridor ended in 1971, several feasibility studies have been conducted. While a variety of efforts to assess and pursue a potential re-establishment of intercity passenger rail service in the Detroit – Grand Rapids corridor have been taken up since the 1980s, Michigan today is experiencing unparalleled increases in rail ridership. As the first step in the study process, the findings of these earlier studies were reviewed and summarized. These results are presented in the next chapter. This provides an opportunity to learn from the results of the earlier studies and provides a starting point for the current assessment.

The genesis of the current study dates back to 2010 and 2011 when the Michigan By Rail (MBR) team, then made up of the Michigan Environmental Council (MEC) and Michigan Association of Railroad Passengers (MARP), held public forums to collect community input to submit as public comment for Michigan’s State Rail Plan. Feedback throughout these forums called for the re-establishment of service between Michigan’s east and west coasts. In Michigan Department of Transportation’s (MDOT) 2011 Michigan State Rail Plan, an Alternatives Analysis (AA) and Tier I Environmental Impact Statement (EIS) were recommended for the Detroit – Lansing – Grand Rapids corridor. These recommendations were broadly supported by local governments, Chambers of commerce, community groups and organizations throughout the proposed Study corridor. The process would not have advanced without their support.

Then in the spring of 2013, the MEC and MDOT Office of Rail began discussing the potential for intercity passenger rail service between Detroit and Holland. Tim Hoeffner, Director of the MDOT Office of Rail, recommended that a new ridership feasibility study be conducted in the corridor. With this recommendation MEC began researching the previous studies of the corridor. Additionally, MEC
reconvened the Michigan By Rail team under the umbrella of the Transportation for Michigan (Trans4M) coalition, a coalition for which MEC serves as the fiduciary.

Based on MEC’s research, Michigan By Rail chose to seek a base ridership assessment of the Detroit – Holland rail corridor as a low-cost catalyst to start the larger conversation towards a new intercity passenger service. The expectation is that this could later progress into the full EIS and AA efforts as described in the Michigan State Rail Plan. In August 2013, the Service Development and New Technology (SDNT) grant program, facilitated by the MDOT Office of Passenger Transportation, was identified as an appropriate grant program to apply to for funding of a base ridership study. The Ann Arbor Area Transportation Authority (AAATA) agreed to submit an application for study funding listing MEC as the project manager. This application was submitted to the MDOT Office of Passenger Transportation on April 30, 2014.

In February 2014, the Chair of the Michigan House Appropriations Subcommittee on Transportation, Representative Rob VerHeulen, expressed interest in including the ridership study in the transportation budget bill for Fiscal Year 2014-2015. Under Representative VerHeulen’s guidance and leadership, boilerplate language directing that this study be conducted was first included in HB 5308, and eventually became Section 712 of PA 252, Michigan’s omnibus budget act for Fiscal Year 2014-2015, signed into law by Governor Rick Snyder on June 30, 2014. As a result, this study has been undertaken by Transportation Economics & Management Systems, Inc. (TEMS) to provide an updated perspective on the prospects for implementing an effective passenger rail service in the Coast-to-Coast corridor.

### 2.2 Coast-to-Coast Rail Corridor: Historical Review

Historically, the Chesapeake & Ohio Railway provided rail passenger service in the “Coast-to-Coast” Detroit – Lansing – Grand Rapids – Holland rail corridor. However, on May 1, 1971, Amtrak assumed responsibility for the nation’s intercity rail passenger system. Communities like Flint, Lansing and Grand Rapids that were not on Amtrak’s system lost all passenger service that day. Thus, Lansing went from 10 passenger trains daily on April 30th (4 trains between Grand Rapids and Detroit and 6 trains between Chicago, Lansing and Detroit/Port Huron) to zero trains on May 1st. Only Chicago to Detroit service was retained with two daily round trips via Kalamazoo. After this:

- In 1974, Amtrak with the support of MDOT re-established one daily round trip from Chicago to Port Huron, via Lansing and Flint.

- Amtrak added a third round trip from Chicago to Detroit in 1975 with introduction of the Rohr Turboliners. This lasted only until 1981 by which time all Turboliners were replaced by conventional locomotive-hauled trains. The third round trip was retained; but 40 years later, rail service in the Chicago to Detroit corridor still remains at the same level – no additional train frequencies have been added since 1975. However, the corridor ridership received a major boost when the Detroit station was switched to the New Center location and the corridor was extended to Pontiac in 1994.
Service linking Grand Rapids with Chicago was not reestablished until 1984, again with only one daily round trip – a mere shadow of the corridor service that had formerly existed.

As a result, the northern “Coast-to-Coast” corridor cities Lansing and Grand Rapids only have minimal rail service of one round trip per day to Chicago, and have not been effectively connected to Detroit by rail since 1971. However since the early 1980’s, MDOT and its associated MPO’s have been interested in development of passenger rail systems in southern Michigan for connecting to Detroit. Such a rail service would help support regional mobility and provide an alternative to automobile travel. The aim is to connect Detroit to the major cities of Holland, Grand Rapids, Lansing and Ann Arbor as well as smaller communities such as Dearborn, Brighton, and Howell.

Since passenger rail service was discontinued in 1971, there have been many changes in the travel environment including:

- The changing demographic and socioeconomic factors that have occurred in the intervening period reflecting greater mobility, the greater propensity of the “millennial generation” to use public transportation ³, and a more widely distributed population.

- Changing travel conditions for auto use due to more congestion on the interstate highway system ⁴ and higher energy (gas) prices ⁵ that make auto travel more time consuming and expensive.

- Changes due to Air Deregulation that has significantly reduced the availability of air service for short trips and reduced quality of service ⁶, due to the use of smaller aircraft ⁷ and higher prices in small markets where the competition is less. This along with airport security delays has rendered flying less competitive with surface (rail or highway) modes for trips under 300 miles.

- The development of more cost effective rail technology due to improved locomotive designs ⁸ and higher speeds, as well as the introduction of modern communication systems like the Positive Train Control (PTC) system ⁹ that was prototyped in Michigan.

As a result of these changes, rail travel has become increasingly attractive, cost effective, and competitive with other modes. For example Amtrak has seen a significant rise in its ridership since the year 2000 across the Midwest with Chicago – Detroit ridership increasing by 57% by 2011.

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⁴ Impacts can be estimated by using the Bureau of Public Roads function, see http://www.sierrafoot.org/local/gp/engineering.html


⁶ Kahn, Alfred E. The Economics of Regulation, Principles and Institutions, p. 250 . . . competition should be permitted to do its job of bringing prices closer to cost, eradicating price discrimination, controlling tendencies to excessive service inflation . . . See: https://books.google.com/books?id=xO1ew7EmwOMC&pg=PA250&v=onepage&q&f=false


All these changes suggest the need to review again the potential for rail service across Michigan’s Lower Peninsula connecting the major communities of southern Michigan. Since rail service ended in 1971, a number of feasibility studies have been conducted for assessing the feasibility of re-establishing rail passenger corridor service linking Flint, Lansing, Grand Rapids to the rest of the country.

However, the major studies conducted by the Midwest Regional Rail System (MWRRS) from 1996 through 2004 focused only on development of a “Chicago Hub” rather than on linking Michigan communities to Detroit. Among all the Chicago based corridors, the Detroit/Pontiac rail corridor emerged as one of the three highest priorities for investment (along with St. Louis and Milwaukee/Madison.) For the past 10 years, these three corridors have received the most attention of all the Chicago Hub corridors in terms of improving track and adding train frequencies. Although Lansing and Grand Rapids (which are not on the direct Chicago to Detroit route) each received train station improvements, as “branch line” services, the corridors have not received as much attention as the “main line” since the main focus in Michigan, up until now, has been on developing the Chicago – Detroit/Pontiac route.

The first step in conducting the Coast-to-Coast study was to review prior studies and compile and update the operating, network, demographics and ridership databases that were needed to complete the study. Where necessary, relevant literature and comparison case studies were referenced, and data utilized from pre-existing studies of the corridor. Ten specific studies were referenced by MEC or the project managers/steering committee and requested to be included in this literature review. The studies are noted by reference number. All the key studies and reports referenced here are shown in the time line of Exhibit 2-1. This time line juxtaposes the timing of each study relative to events that were occurring in the real world. This understanding is needed, for example of what rail service networks were actually being operated at the time of each study, to provide context for the study recommendations. The time line is broken down into three major eras based on time frame of the pivotal MWRRS studies. These are:

- Pre-MWRRS: 1971 - 1985
- MWRRS: 1994 - 2004
- Post-MWRRS: 2005 - present

The Pre-MWRRS era was very busy starting in 1971 with the formation of Amtrak, continuing through 1976 with formation of ConRail and all the network rationalization activities that followed. There were many activities, but only a few passenger studies during this era since so much of the planning during this era was led by the federal government.

The MWRRS era started in 1994 when the service to the former Michigan Central Depot in downtown Detroit ended. At that time, Amtrak extended service to Pontiac via New Center Detroit, and Michigan’s passenger rail network assumed its current form with one Chicago round trip each to Grand Rapids and Port Huron, and three Chicago round trips to Detroit/Pontiac. There have been no changes to the train service pattern since then except for the 2004 truncation of the former International service at Port Huron.

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10 Nine Midwestern state DOTs have been working together since 1996 to develop a 3,000 mile accelerated rail system for the region based on a Chicago Hub. When this plan is fully implemented, passenger rail service will be dramatically increased and trip times significantly decreased. About 90 percent of the Midwest’s population will be within one hour car ride to a MWRRS station and/or 30 minutes of a feeder bus station. See: http://www.miprc.org/Advocacy/MidwestRegionalRailInitiative/tabid/88/Default.aspx retrieved on June 16, 2015.

11 After the initial wave of activity triggered by rail reorganizations ending in 1985, there was an almost 10 year period of planning inactivity until the beginning of the MWRRS era in 1994, although the rail services then in place were continued.
The post-MWRRS era started in 2004 with completion of the MWRRS study which launched a round of detailed NEPA environmental studies, State Rail planning and local transit planning activities, most of which are still ongoing today.
Exhibit 2-1: Michigan Passenger Rail Timeline
2.2.1 Pre-MWRSS Era, Studies and Reports 1971-1985

- 1981-Transmark, Michigan High-Speed Intercity Rail Passenger Study

This early study was performed by the British Rail Research and Consulting division (Transmark)\textsuperscript{12}. This early engagement was based on the success of the Intercity-125 diesel train\textsuperscript{13} that had been introduced in the UK. The analysis assessed potential demand for high-speed, multiple-frequency rail service in three travel corridors:

- Grand Rapids – Lansing – Detroit
- Bay City – Saginaw – Detroit
- Detroit – Chicago

This study was conducted using the British Rail SIGNALS model, a predecessor to the COMPASS\textsuperscript{TM} Model that is being used by TEMS for the current study, and based on a similar methodology. The 1985 forecasts are shown in Exhibit 2-2.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
\textbf{Transmark Study} & 79 & 110 & 150 \\
\hline
\textbf{Maximum Speed (MPH)} & 3 & 6 & 12 \\
\hline
\textbf{Daily Round Trip Frequency} & Grand Rapids to Detroit & 11.5 & 23 & 36.7 \\
\hline
& Bay City to Detroit & 9.5 & 18.1 & 28 \\
\hline
& Detroit to Chicago & 114.1 & 214.9 & 319.9 \\
\hline
\end{tabular}
\caption{1985 Intercity Rail Forecast Volumes, Transmark Study (Millions of Passenger Miles)}
\end{table}

British Rail clearly viewed the primary Michigan market as Chicago-based, since Detroit to Chicago forecasts are seen to be 9-10 times higher than those developed for the other two corridors. This study concluded that:

Forecast rail volumes on the Grand Rapids and Bay City corridors were found to approximately double with the inclusion of commuter traffic flows, an indication of the importance of appropriate scheduling for these services. In consequence, consideration was given to terminating the Grand Rapids corridor at Lansing in order to maximize the potential benefits from commuter traffic between Lansing and Detroit. This strategy appeared to be the most economical solution; potential rail traffic between Grand Rapids and Detroit would be routed via Kalamazoo in order to take advantage of connections between the Grand Rapids – Chicago and Detroit – Chicago services.

Transmark projected that less than 50 passengers would ride each Grand Rapids – Lansing – Detroit\textsuperscript{14} train with similar results for Bay City – Saginaw – Detroit\textsuperscript{15}. This is not enough ridership to support

\textsuperscript{12} Network Rail launches international arm, Railnews UK, July 9, 2012 http://www.railnews.co.uk/news/2012/07/09-network-rail-launches-international-arm.html.
\textsuperscript{14} Tables 5-8 and 5-9 on page 42 of the Transmark study
\textsuperscript{15} Tables 5-14 and 5-15 on page 50 of the Transmark study
Transmark’s model did not show that Detroit was a desirable travel destination at the time, saying that:

The potential for intercity rail services between the Lansing – Detroit city pair and indeed all intercity corridor flows to Detroit is constrained by the absence of a clearly defined travel destination. This results from the highly dispersed nature of the trip ends in Detroit. An earlier analysis by the MDOT Modal Planning Division concludes that since the business and commuting travel market between Grand Rapids/Lansing and Detroit is very small and highly dispersed by time of day, and since the importance of Detroit as an attractor of other purpose trips is limited, levels of potential rail ridership in this part of the corridor will inevitably be lower than comparable corridors possessing more active travel attractors and less dispersed trip end locations.

At the time of Transmark’s study, the old Michigan Central Station (MCS) was still in use. When the MCS was constructed in 1913, it was placed away from the downtown area in the hope that the station would become an anchor for development. Although Henry Ford bought land near the station in the 1920s and made construction plans, the Great Depression and other circumstances squelched this and many other development efforts. Fringe development instead occurred in the New Center area, where the Amtrak station is located today. This MCS problem clearly was also an important factor contributing to Transmark’s weak forecast of Detroit’s market potential.

As a result, it is clear that Transmark in 1985 considered Chicago, not Detroit trips as the primary intercity rail travel market in Michigan. Transmark recommended against development of Grand Rapids – Lansing – Detroit service. Instead, Transmark proposed to link Grand Rapids with Chicago via a branch line from Kalamazoo, and Lansing to Chicago using a branch line from Jackson, as shown in Exhibit 2-3. Thus, Grand Rapids and Lansing passengers could go either to Chicago or Detroit, although Transmark clearly expected that most of the riders would go to Chicago. 

16 Most passengers would arrive at and leave from Michigan Central Station by interurban service or streetcar due to the station’s distance from downtown Detroit. Further compounding MCS’s future problems was the fact that the original design included no large parking facility. So, when the interurban service was discontinued less than two decades after MCS opened, MCS was effectively isolated from a large majority of the population. Michigan Central Station: The story of its rise, fall and... BBC News, February 26, 2015 http://www.bbc.com/news/magazine-31596161.

17 The heart of New Center was developed in the 1920s as a business hub that would offer convenient access to both downtown resources and outlying factories. Some historians believe that New Center may be the original edge city—a sub-center remote from, but related to, a main urban core. The descriptor "New Center" derived its name from the New Center News, an automotive-focused free newspaper begun in 1933 that continues to operate under the name Detroit Auto Scene. From 1923 to 1996, General Motors maintained its world headquarters in New Center (in what is now Cadillac Place) before relocating downtown to the Renaissance Center; before becoming a division of GM, Fisher Body was headquartered in the Fisher Building. See: Randall Fogelman, Detroit’s New Center, Arcadia Publishing, 2004, ISBN 0-7385-3271-1 at https://books.google.com/books?id=MjFvAChs9wC.
Concurrently with Transmark’s ridership study, Michigan DOT in 1980 commissioned General Motors (GM) to develop a detailed operational and engineering assessment of the Detroit – Lansing – Grand Rapids corridor. The two studies were not in fact independent since GM reported that “the patronage data reviewed in this report is from a parallel study completed by another consultant to Michigan DOT” and in fact used Transmark’s ridership results. Both studies evaluated four different rail routing options east of Lansing as shown in Exhibit 2-4:

The GM study developed an extremely detailed (although now very dated) assessment of engineering, operations and equipment options for the rail corridor. However, given Transmark’s dim view of the prospects for rail service to Detroit in general, and weak ridership forecast for Grand Rapids – Lansing – Detroit in particular, it should come as no surprise that GM was forced to conclude that the train service would not cover its operating cost, and that its capital cost would be very high relative to the number of riders. GM’s report echoed Transmark’s recommendation that Grand Rapids and Lansing should be served as branches off the Chicago to Detroit main rail line. After this, there was a hiatus of over 10 years until the Midwest Regional Rail System (MWRRS) study launched in 1996.

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18 Figure 5-2 on page 48 of the Transmark Study
19 This is Exhibit 1-1 on page 1-2 of the GM Report.
2.2.2 MWRRS Era, Studies and Reports 1994-2004

Just prior to the start of the MWRRS planning effort in 1994, Amtrak extended the Detroit corridor to Pontiac so the structure of the passenger rail network in Michigan was the same as it is today. This was the starting point for the MWRRS study in 1996.

The MWRRS was a consortium of Midwest states who together decided to study the development of an integrated Midwest network based on a Chicago Hub. Since the MWRRS was focused only on Chicago and not on the need for connections to Detroit, Michigan DOT launched several independent studies during the MWRRS era that revisited the earlier Transmark and General Motors assessments. The Detroit metropolitan area was also undertaking major transit studies at the same time. This section describes those studies.

- **1997 – Southeastern Michigan Regional Rail Study (Report #4)**
  The Southeastern Michigan study was a commuter rail study rather than intercity rail. It proposed a three-route rail system serving Ann Arbor, Pontiac and Mount Clemens. Run-through rail services were proposed between Ann Arbor and Mount Clemens, and between Pontiac and Brush Street. Costs, revenues and economic benefits were only at a highly conceptual level, but this exercise did succeed in starting local and regional discussions regarding the need for developing a commuter rail system.

- **1998 – Lansing/Detroit Rail Service Survey (Report #5)**
  The Lansing/Detroit Rail Service Survey was undertaken to gauge the level of interest in intercity rail services by Lansing-area residents and commuters. A number of surveys were undertaken specifically to better understand the nature of travel demand in the Lansing/Detroit rail corridor. The survey results were considered quite positive, and confirmed the need for a full-fledged feasibility study.

  This report represented the work of the legislative task force established by Curtis Hertel, Speaker of the Michigan House of Representatives; chaired by Rep. Lingg Brewer, and undertaken in cooperation with the Lansing Regional Chamber of Commerce, the Tri-County Regional Planning Commission and interested agencies and citizens.

  The genesis for this work was the 1996 announcement that GM was transferring many Lansing based employees to the Detroit area. Informal meetings and discussions led to a decision to form a legislative task force to review the potential for passenger train service between Lansing and Detroit. The proposed service could accommodate both GM commuters and other travelers. The task force held a number of meetings, received information and testimony from many sources, and issued a final report in June 1998.

  The report includes 21 specific recommendations and other information. Key conclusions included:

  - An independent authority is needed to oversee the process and ensure its completion.
  - Public involvement and consensus building must occur.
  - Tax supported funding should be proportionate to public interest in using the system.
  - A minimum of three daily round trips are required.

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20 A description of this report is given on Page 5 of the 1999 Lansing-to-Detroit Rail Study: Part 1 (Reference #3.)
• The service should be designed to meet the needs of the prospective customer in terms of departure and arrival times, total trip time, station locations and station
• Adequate parking, reliability, end-point attractions and cost efficiency should be offered.
• Adequate marketing efforts and safety programs must be considered.

1999/2000 – Lansing to Detroit Study Phases 1 through 4 (Report #3)
This study developed a detailed feasibility study for introducing commuter rail service in the Lansing to Detroit corridor\(^{21}\). The origins of this study date back to the much earlier (1981) Transmark study, which recommended against development of the Grand Rapids to Lansing segment and suggested development of only a branch line service between Detroit and Lansing.

After having truncated the corridor at Lansing, this study assessed the project as a Federal Transit Administration (FTA) commuter rail project rather than as an intercity passenger rail corridor. The Interstate Commerce Commission defined the difference between commuter and intercity rail in the case of Penn Central Transp. Co. Discontinuance, 338 ICC 318 (1971)\(^{22}\). Therein the Commission stated that commuter and other short-haul service would “likely” include some or all of the following criteria:

• The passenger service is primarily being used by patrons traveling on a regular basis either within a metropolitan area or between a metropolitan area and its suburbs;
• The service is usually characterized by operations performed at morning and evening peak periods of travel;
• The service usually honors commutation or multiple-ride tickets at a fare reduced below the ordinary coach fare and carries the majority of its patrons on such a reduced fare basis;
• The service makes several stops at short intervals either within a zone or along the entire route;
• The equipment used may consist of little more than ordinary coaches; and
• The service should not extend more than 100 miles at the most, except in rare instances.

The truncated Detroit to Lansing corridor barely comes under the 100 mile limit; the four route options assessed in the 1999 study ranged from 87 up to 112 miles long. Since this corridor length is right at the threshold, it could qualify as either a very short intercity corridor, or as a very long commuter rail corridor. All previous studies found a reasonable ridership base from Detroit to Lansing for a service that would accommodate both the regular home to work commuter, as well as the intercity business, personal or recreational traveler.

Transmark found that:

*Differences in demand potential between routes will depend on the relative magnitudes of trip generators/attractors between Lansing and Detroit. However, where alternatives exist, due to the short distances between node pairs in this ring, the issue is clouded by the presence of very large commuter-type flows. Although commuter traffic may be an*

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important source of rail ridership in each of the corridors, it is contended that since the proposed service will be intercity in character, railroad operating issues such as consist size and service frequency should be decided on the basis of longer distance trips, with commuter traffic being able to use the rail service subject to the availability of space, suitable pricing strategies and appropriate scheduling.

It is thus seen that Transmark did not actually recommend that the Detroit – Lansing corridor be assessed as a commuter-only opportunity. In fact, since the extended “Coast-to-Coast” corridor substantially exceeds the 100-mile limit, it would more appropriate to treat the extended corridor as an intercity corridor for this study, using the economic criteria established by the Federal Railroad Administration (FRA)\(^23\) rather than as a commuter rail corridor under FTA criteria.

The same four alignment options assumed in the 1981 study were carried forward to the 1999 study, except the corridor was truncated at Lansing rather than extending all the way through to Grand Rapids. This truncation was reflective of the recognition of additional commuter demand at Lansing, as well as the recommendation of the earlier Transmark study. The four phases of the 1999 study were:

- **Phase 1** – A review of previous studies, benchmarking and definition of the route alignments to be assessed.
- **Phase 2** – The four initial route alignment options were screened based on twelve candidate measures. It is proposed to carry forward two of these route options in the current study, modify one option and drop one option. The derivation of the current study options and their relationship to previous options will be discussed in the following paragraphs.
- **Phase 3** – A detailed analysis of the proposed Lansing – Howell – Ann Arbor – Detroit route option was carried out. Station locations, schedules, fare structure, ridership, infrastructure and equipment needs, and environmental impacts were all addressed, as were organization and oversight issues. A detailed community involvement effort was undertaken and specific local recommendations on station locations, local funding sources and organizational structure preferences were obtained.
- **Phase 4** – The final phase of the process consisted of the development of a business plan that can serve as a guide for implementing the proposed service. This contained an implementation plan and schedule, a phased capital improvement program, funding strategies, marketing strategies, and strategies for working with freight railroads. The Phase 4 document also addressed issues relating to organizational and institutional arrangements for launching the corridor as a commuter rail service.

By 1999 the travel market had changed enough so Detroit was being viewed in a much more favorable light as compared to the 1981 Transmark study. For example, the Phase 1 study introduction stated:

*The reemergence of downtown Detroit as a destination center with increased business activity, new baseball and football stadiums, and new casinos offers many reasons for making the trip.*

As a result the ridership forecasts developed by the 1999 Detroit – Lansing study were far more robust than what Transmark earlier projected:

- The 1981 Transmark study forecasted ridership of 125,000 for Grand Rapids – Lansing – Jackson – Ann Arbor – Detroit routing (three round trips in 1985.)

\(^{23}\) See: [https://www.fra.dot.gov/eLib/details/L02519](https://www.fra.dot.gov/eLib/details/L02519)
• The 1999 Lansing – Detroit study forecasted ridership of 391,000 for Lansing – Jackson – Ann Arbor – Detroit routing (four round trips in 2002.)

The 1999 study projected more than three times (391,000 / 125,000 = 3.13 factor) the level of ridership as compared to Transmark, and for a shorter corridor that did not even include Grand Rapids. For developing an “apples to apples” comparison between the older and newer studies, Exhibit 2-5 (from page 45 of the Transmark Study) compares Grand Rapids and Lansing ridership. Applying this 36% increase to the 3.13 factor, if Grand Rapids had been included in the 1999 Lansing-Detroit study, the resulting ridership forecast would have been 4.5 times greater than Transmark’s.24

Exhibit 2-5: Grand Rapids vs. Lansing to Detroit Ridership, 1981 Transmark Study

<table>
<thead>
<tr>
<th>Lansing-Detroit (CBD):</th>
<th>13,794</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Rapids-Detroit (CBD):</td>
<td>7,782</td>
</tr>
<tr>
<td>Ratio: 7,782 / (13,794 + 7,782)</td>
<td>36% increase</td>
</tr>
</tbody>
</table>

From Lansing to Detroit, the Phase 2 report assessed the same four route alternatives that Transmark had earlier considered. The study reported the following results:

The forecast results reveal that the highest 2002 ridership occurs on the two southern routes – the NS Alternative (Lansing – Jackson – Ann Arbor – Dearborn – Detroit) and the TSBY Alternative (Lansing – Howell – Ann Arbor – Dearborn – Detroit). The higher ridership is predominantly attributed to the ability of these routes to serve cities such as Ann Arbor and Dearborn.

Conversely, the lowest ridership is forecasted for the two northern routes - the CN alternative (Lansing – Durand – Holly – Pontiac – Detroit) and the CSX Alternative (Lansing – Howell – Brighton – Plymouth – Detroit). Lower ridership is attributed to the lower population of the general service corridor and limited key travel generators.

Since Amtrak’s existing service now extends north of Detroit to Pontiac, if a new Lansing-to-Detroit service followed Amtrak’s route through Dearborn and Detroit, it would logically extend to Pontiac as well. As a result, there is really no need to consider an either/or choice in regards to serving Dearborn vs. Pontiac; since the southern route alternatives can easily be extended to serve both cities (Dearborn and Pontiac) or even extended farther north to Flint. In any case an option via Durand that bypasses Flint really does not make any sense from a passenger perspective.

As a result there is little reason to advance a northern alternative that bypasses all the major population centers along the route (Ann Arbor, Dearborn and Flint) when other alternatives could include all three of these cities. On top of this, the CN corridor is the busiest freight lines in Michigan; but CN single-tracked its route from Lansing to Durand in the early 2000’s, so this option is also problematical from a rail capacity point of view. As a result, and since this option did receive a detailed assessment in the 1999 study and was recommended to be screened, it is proposed that it should not receive any further consideration in this report. Similarly in the Phase 2 report, the CSX alternative via Plymouth had low

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24 But since the corridor had already been truncated at Lansing based on Transmark’s earlier findings, the implications of this higher forecast on the potential for Grand Rapids service were never evaluated. This study however, will provide an opportunity to make the needed reassessment in light of the renewed strength of Detroit as both a trip attractor and trip generator.
ridership, since as originally constituted it also bypassed both important cities of Ann Arbor and Dearborn. The Phase 2 report concluded that:

The CSX (Lansing – Howell – Plymouth – Detroit) scored fairly well. However, the CSX route has some track capacity/congestion issues between Plymouth and Detroit and it has a marginal ridership and financial viability rating. The CSX route (in its entirety) should also be dropped from further consideration.

Although the 1999 report suggested that both the CN and CSX alternatives be screened, for the purpose of this study, the CSX route may be improved by modifying the alternative to follow CSX south from Plymouth to Wayne, MI and then enter Detroit via Dearborn, using the same entryway as the Chicago corridor. This option at least includes the important Dearborn station as well as avoiding the expense associated with developing a parallel passenger entryway to Detroit over the CSX trackage. In terms of measuring the value added by including an Ann Arbor stop, it is valuable to retain at least one option that does not include Ann Arbor for comparison purposes. It is proposed to retain this modified CSX alternative in the current analysis.

In the Phase 2 report, the two southern alternatives (via Jackson and Howell) performed best. In both the Phase 2 Lansing/Detroit report as well as the earlier Transmark study, the Jackson alternative had a higher ridership forecast than did the Howell alternative. Nonetheless the Phase 2 report concluded that the Jackson alternative should be screened, saying that:

The NS route has good support from a ridership and financial viability standpoint. However, this is primarily derived due to its service of Jackson and Ann Arbor. Very little patronage will originate in Lansing because the NS route cannot provide a competitive overall trip time due to the Lansing to Jackson alignment constraint issues. The NS route (in its entirety) should be dropped from further consideration.

However, the NS Jackson alternative may be potentially “fixable” by upgrading tracks and using tilting trains to compensate for the curvature. This alternative also has the advantage of sharing the upgraded 110-mph tracks east of Jackson, which could offset some of the time loss due to curvature west of Jackson. Since this alternative had the highest ridership forecast in both previous assessments and serves both Ann Arbor and Detroit, it is worthwhile to reassess the alternative here. However, the context of the Jackson alternative makes a difference. In 1981 (as is still the case today) only one train per day operates on the direct CN route from Lansing to Chicago via Battle Creek. As shown in Exhibit 2-6, the Jackson to Lansing line could also serve Chicago trips:

- If the Port Huron route via Battle Creek remains at its current level or if the current Blue Water service were ended, it is likely that the Jackson route would attract a significant Lansing to Chicago ridership.
- If the Port Huron route via Battle Creek were improved to a level of four daily round trips, as called for by the MWRRS plan, Chicago riders would likely go direct via Battle Creek rather than via Jackson.
- If a western outlet from Grand Rapids to Chicago were developed, then Lansing to Chicago riders could go via Grand Rapids rather than via Battle Creek.
As a result, it can be seen that there is significant interplay between the corridor options in Michigan which may influence the results of a comparison between the Jackson and Howell alternatives. These comparisons are not driven by the Detroit ridership, which are the primary focus of this study; but rather by connecting Chicago ridership, which are also included by virtue of the connecting existing train services. Absent the development of an improved direct Grand Rapids to Chicago connection, the pent-up demand for train service from Grand Rapids and Lansing to Chicago will likely artificially inflate the ridership projection of the Jackson alternative.

- If the current service were used as the base-line, then the previous studies have shown that significant numbers of Grand Rapids and Lansing riders may choose to go to Chicago via a connection at Jackson. In fact it can be seen in Exhibit 2-3 that Transmark proposed to connect Lansing to Chicago using a branch line from Jackson. However, this traffic would disappear from the study corridor if a direct outlet were developed from Lansing and Grand Rapids to Chicago.

- On the other hand, if a through corridor from Lansing to Chicago via Grand Rapids were developed, then added ridership from Lansing through to Chicago would further boost the ridership of the Coast-to-Coast route. This boost would be further enhanced even by Port Huron and Flint riders which may choose to go to Chicago via Grand Rapids rather than via Battle Creek.

Further exploration of network options for connecting Lansing and Grand Rapids to Chicago can only be addressed by a statewide study, yet they may have a significant influence on the selection of the best route for the Coast-to-Coast corridor. However, it is clear that the northern cities of Grand Rapids, Lansing and Flint need either to be connected to the main line corridor to Chicago (as Transmark proposed) or else have their own independent connection to Chicago. This issue of network interplay will need to be addressed in a future study, because a full resolution of this issue is beyond the scope of the current study. FRA’s PRIIA guidance\footnote{See: https://www.fra.dot.gov/Page/P0511 retrieved on June 16, 2015.} suggests that State Rail Plans be updated every five years. Since Michigan’s State Rail Plan was last issued in 2011, the next update is due in 2016. It may be appropriate to address this issue in the next State Rail plan update.

Finally, in the Phase 2 report, it was found that:
The CSX/TSBY/AARR/NS (Lansing – Howell – Ann Arbor – Detroit) route is the clear choice for further study for providing a Lansing to Detroit passenger rail service based on the results of the route selection criteria. This route offers competitive trip times, a solid ridership base and a strong prospect for financial viability. The route effectively ties together the Lansing – Detroit corridor by connecting thru Ann Arbor and serving a growing population base in Livingston and Washtenaw counties. The route links together the major university centers at East Lansing (Michigan State University) and at Ann Arbor (University of Michigan) as well as serves major entertainment attractions such as Greenfield Village. The CSX/TSBY/ AARR/NS route utilizes a favorable geometric rail alignment that has the least freight traffic conflicts. This route also has a strong base of local support from Howell, Ann Arbor and Dearborn.

The CSX/TSBY/AARR/NS route was carried forward for further detailed study in Phase 3 of the 1999 Lansing to Detroit Passenger Rail Study. Since that time the corridor from Howell to Ann Arbor has also been the subject of separate commuter rail studies (North-South Commuter Rail line.) The main challenge associated with development of this option would appear to be the need for a new bridge and track connection in downtown Ann Arbor. However, the Phase 3 Study developed conceptual engineering for this connection and determined it to be feasible.

2002 – Lansing to Detroit Baseline Survey (Reference #7)

After the completion of the 1999 Lansing to Detroit study, the Baseline Survey developed an extensive database profiling the travel characteristics in the Lansing to Detroit corridor. Nearly 2,200 interviews were completed with an approximately equal number of interviews conducted in each major travel shed within each of the four counties as well as in the parts of the county not immediately served by a rail station. The data were then weighted so that the total numbers reflect the actual distribution of the population throughout the region. The survey also attempted to gauge the level of popular awareness and political support for the rail project. The Baseline survey found that:

- The proposed rail corridor would serve a variety of travel needs, notably:
  - Regular work commute travel to major work destinations – Lansing, Ann Arbor, Detroit
  - School commuting to/from major universities – Lansing, Ann Arbor, Dearborn, Detroit
  - Business travel to Lansing, Ann Arbor, Detroit
  - General travel throughout the corridor
- The totality of the corridor is important. This suggests that the corridor would perform better as an integrated whole (e.g. Lansing – Ann Arbor – Detroit) than as two disconnected segments.
- Awareness of proposal specifics is low; however, there is strong interest in the proposed rail corridor. More information is required before residents would support funding for the proposed service or think about using service for regular commute and/or business travel.

2004 – Midwest Regional Rail System (MWRRS) Final Report

MWRRS studies continued until 2004, finally recommending a Chicago Hub service with 7 daily round trips to Pontiac, 4 round trips via Battle Creek, Lansing and Flint to Port Huron and 4 round trips via Kalamazoo and Grand Rapids to Holland. However, it should be noted that these service plans and proposed train schedules were developed in the early 2000’s when gasoline prices were still less than $1.00 per gallon. Based on today’s demographics, higher oil prices and worsening traffic congestion, the market today could likely support higher train frequencies than were recommended by MWRRS-era planning.
2.2.3 Post MWRRS Era, Studies and Reports 2005-Present

In the post-MWRRS era, efforts have focused on implementing the MWRRS-recommended improvements as well as on developing numerous studies for rail commuter services and other transit services in Michigan. For intercity rail services, the State Rail planning process suggested several new corridors including Coast-to-Coast (Detroit to Holland) as well as improved rail connections linking Detroit with Traverse City, Toledo, Flint, Saginaw and Port Huron. This Coast-to-Coast study is the first major non-MWRRS corridor assessment in the post MWRRS era. Additional studies to more destinations are expected to follow shortly thereafter.

2006 – Detroit M-1 Streetcar Studies Begin

Development of the M-1 Streetcar offers an exciting enhancement to intercity passenger rail, since it will directly link the New Center train station to the Detroit Central Business District by developing a high quality rail transit service down Woodward Avenue. While the current Amtrak passenger service has effective pickup and distribution serving multiple station stops within the Detroit Metro area, the new streetcar line will provide an efficient connection to the traditional downtown. This is important to the Coast-to-Coast corridor since this downtown connection will help boost the ridership potential of the proposed new intercity rail corridor, as well as that of existing Amtrak services.

Planning for the return of rapid transit to Detroit began in 2006 when the Detroit Department of Transportation (DDOT) commissioned a study to determine expanded mass transit options along Woodward Avenue. In fact, prior to 2001 when the Detroit Speedlink Study recommended Bus Rapid Transit, this segment was intended to be the first leg of a light rail transit system for Detroit. The M-1 Streetcar system is now under construction, and is expected to become operational in 2016.

2007 – Ann Arbor to Detroit Transit FTA Alternatives Analysis

The 2007 Ann Arbor to Detroit study was a full Federal Transit Administration Alternatives Analysis that developed a number of commuter rail, light rail and bus options for the Ann Arbor to Detroit corridor. The study results were inconclusive since the detailed screening indicated that none of the alternatives presented to the public would be cost effective candidates for FTA New Starts funding. However, feedback from the Steering Committee, the general public and local policy makers indicated that there was still a strong desire to implement rail transit in the study area. In response to both the screening results and the strong support for rail, SEMCOG began to evaluate possible strategies to implement a rail line that could either be made competitive for New Starts funding or that could be implemented without New Starts funding.

In order to test the market for rail transit, the study recommended that a demonstration project be considered. The proposed demonstration service (called “CRT 1 Modified” in the EIS documents) could be

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26 Woodward Streetcar Project, see: http://www.michigan.gov/mdot/0,4616,7-151-9621_11058_62342---,00.html retrieved on June 16, 2015. In fact, prior to 2001 when the Detroit Speedlink Study recommended Bus Rapid Transit, this segment was intended to be the first leg of a light rail transit system for Detroit.

http://www.publictransit.us/ptlibrary/specialreports/speedlinkfinalreport.pdf


28 The Federal Transit Administration’s (FTA) discretionary New Starts program is the federal government’s primary financial resource for supporting locally-planned, implemented, and operated transit “guideway” capital investments. It provides up to 50% Federal matching funds for helping cover the cost of transit projects. See: http://www.fta.dot.gov/12304.html retrieved on June 16, 2015.
contracted out to Amtrak or another rail provider and utilize the existing rail infrastructure and stations along the Michigan Line. Such a service could provide significant travel time savings over automobile travel between Ann Arbor and Detroit. As demand for commuter rail services grows in the corridor, it would be possible to incrementally improve the Michigan Line, adding trains, track work, and signals as appropriate to meet service needs, and adding in-fill stations in jurisdictions interested in participating in the service. This was the genesis of the current project to develop a five-stop commuter rail service from Ann Arbor to Detroit. This commuter rail system is still under development pending completion of a capacity analysis by the freight railroads who own the tracks that would need to be used for providing commuter rail service in the corridor.

➤ 2008 – North-South Washtenaw Livingston Commuter Rail Line Studies

The proposed North-South Washtenaw Livingston Commuter rail line\(^\text{29}\) would comprise a second Michigan commuter rail service from Howell to Ann Arbor. This line, as currently proposed, would not connect to and would operate independently of the proposed Ann Arbor to Detroit commuter rail line and existing Amtrak services. This is due to the lack of the needed track connection in downtown Ann Arbor.

➤ 2011 – Michigan State Rail Plan (Reference #1) / Tech Memo #5 (Reference #8)

The Michigan State Rail plan provides a profile and statistical summary of current Amtrak operations in Michigan; since the Rail Plan has not been updated since 2011, this document predates the implementation of 110-mph service across Michigan. The State Rail plan also describes planning efforts for the Ann Arbor to Detroit and North-South Commuter Rail line commuter rail projects; and implementation status of the MWRRI plan which today is still focusing on the development of the Chicago to Detroit/Pontiac corridor. The public outreach process was also described:

- For the existing passenger rail corridors, comments most often mentioned the Chicago - Detroit/Pontiac corridor or Wolverine service. Comments typically discussed support for ongoing investments to improve service and achieve high-speed rail along the corridor. The proposed Coast-to-Coast route would share the Wolverine service's Detroit station access and may possibly share the rail corridor as far west as Jackson.
- The Pere Marquette was mentioned by several people who submitted comments, but only a few comments mentioned the Blue Water service. This comment is specifically relevant to this study, since the proposed Coast-to-Coast corridor would use a portion of the "Pere Marquette's" route (from Holland to Grand Rapids.)
- The most common proposed service connection was to Traverse City from either Grand Rapids or Detroit. Several comments also proposed new connections to Grand Rapids. This proposed Traverse City service may potentially share part of the Coast-to-Coast routing from Detroit via Ann Arbor as far north as Howell, since this service has been proposed and promoted by the Great Lakes Central Railroad\(^\text{30}\).
- Some comments suggested adding service to the Grand Rapids - Lansing - Detroit corridor and other comments proposed a corridor between Grand Rapids and Kalamazoo to improve access to the future high-speed rail line. These comments directly refer to the need for developing the proposed Coast-to-Coast rail corridor, as well as for improving access from Grand Rapids and Holland into Chicago.

\(^{29}\) See: [http://www.theride.org/AboutUs/Initiatives/NorthSouthCommuterRail](http://www.theride.org/AboutUs/Initiatives/NorthSouthCommuterRail) retrieved on June 16, 2015.

A few comments also mentioned adding passenger rail service to Toledo from Detroit to improve access from Michigan to east coast destinations.

The following passenger rail themes emerged over the course of sixteen Michigan by Rail public forums:

- Michigan's passenger rail system should include a Traverse City to southern Michigan connection. Each map at each forum included connecting Traverse City to the southern part of the state in some fashion. The southern connection points varied between Grand Rapids and the Ann Arbor area depending on where the forum was held. The maps, discussion, and comments, however, were consistent across forums regarding a Traverse City to southern Michigan passenger rail connection. Again, this Traverse City corridor would likely share at least a portion of the proposed Coast-to-Coast rail corridor from Detroit to Howell.

- Michigan's passenger rail system should connect east Michigan to west Michigan. Almost every map included connecting Michigan's east side to west side from Detroit to Lansing to Grand Rapids (and often Holland). Discussions around this passenger rail connection focused on linking together Michigan's three principal cities (without first traveling to Chicago); commuter possibilities; connecting two major universities, Michigan State University and Wayne State University; make doing business easier in the three cities; and tourist travel - sports venues in Detroit, Art Prize in Grand Rapids, the Capitol and other state government interests in Lansing. This theme identifies the importance of developing the Coast-to-Coast rail corridor in terms of connecting not only the universities and sports venues, but also the broader context for development of the rail corridor in terms of supporting the need for both social and business travel in Michigan.

- Michigan's passenger rail system should connect Michigan's universities. Participants mentioned a desire to connect Michigan's universities and colleges. Some Michigan college towns are currently served by Amtrak; increasing service frequency, re-scheduling to accommodate the academic calendar, and connecting the college and universities together were reoccurring points. The rationale that surfaced most typically in connecting the state's academic institutions was to allow for instructors and students to more easily work and study at more than one institution.

- Michigan's passenger rail system should include commuter rail connections. Participants at each forum discussed the need for some sort of commuter rail service connecting the principal cities to outlying areas, particularly Detroit, Ann Arbor, Flint and Grand Rapids. These discussions included a direct rail connection to Detroit Metropolitan Wayne County Airport (DTW). This theme mentions two of the commuter rail systems under development, both of which could share tracks with the proposed Coast-to-Coast rail system.

- Michigan's passenger rail system should connect to Toledo. Connecting Michigan's existing passenger rail system to Toledo was raised at each forum. Participants discussed that one must travel to Chicago - or by motor coach to Toledo, Ohio - to travel to points east such as New York. Connecting Toledo to the Wolverine at Ann Arbor or Detroit was typically suggested.

In addition, several comments specifically discussed the need for rail connections to Grand Rapids as this is the second largest metropolitan area in the state. Specifically, many comments supported initiating passenger rail service between Grand Rapids and Kalamazoo to connect Grand Rapids with the state's primary high-speed rail corridor. In addition, some comments suggested studying and initiating service between Grand Rapids, Lansing and Detroit. A few comments mentioned that it is very expensive to fly out of Grand Rapids and a convenient rail connection to the Detroit airport would help facilitate travel. Furthermore, several comments expressed disappointment that the recommended Good Investment Package in the Draft Michigan State Rail Plan did not include any recommendations to initiate rail improvements for the Grand Rapids area and encouraged the rail plan team to include investments that would benefit Grand Rapids in the Good scenario.
Several comments discussed fixed-guideway transit (commuter rail, light rail and streetcar) and intercity bus services. In regards to commuter rail, several comments mentioned the proposed Detroit – Ann Arbor commuter rail line and suggested expediting this service. Some comments also discussed expediting the proposed Ann Arbor – Howell commuter rail line (North-South Commuter Rail line). Other commuter rail corridors that were suggested by people who made comments on the Draft Plan included: Grand Rapids – Kalamazoo, Ann Arbor – Kalamazoo, Ann Arbor – Jackson, and Traverse City – Kalkaska. Also, a Metro Detroit commuter rail system that would make connections between downtown Detroit and Pontiac, Utica, Port Huron and Toledo was mentioned.

A few comments discussed the need for improvements at stations. Specifically, a comment was made that East Lansing needs a new station because the current facility is outdated and portrays a poor image of the state’s capital city. Also, some comments mentioned Jackson has been making improvements to their station to attract more riders, but additional improvements are needed. Furthermore, one comment mentioned that the Detroit Multimodal Transportation Center would need to accommodate Woodward Avenue light rail, Ann Arbor – Detroit commuter rail and existing and expanded Amtrak services in the future, which may require a new larger facility.

Some comments discussed the Chicago – Holland – Grand Rapids corridor, which serves the Pere Marquette passenger rail line. Typically, comments about this corridor expressed concern about the Midwest Regional Rail Initiative that proposes to reroute the corridor from its existing alignment to the Holland – Grand Rapids – Kalamazoo corridor. Communities that are currently served by the Pere Marquette would like to see service continued even if a connection between Grand Rapids and Kalamazoo is provided in the future.

Several comments also proposed new connections to Grand Rapids. Some comments suggested that the Rail Plan should consider taking steps to add service to the Grand Rapids – Lansing – Detroit corridor and inquired why this corridor is not part of the current rail investment packages proposed in the Draft State Rail Plan. Other comments suggested moving up the timeline for the implementation of the proposed corridor between Grand Rapids and Kalamazoo by placing it in the Good Investment Package instead of the Better Investment Package.

There is a strong interest in developing passenger rail service in new corridors throughout the state. The investment packages include recommendations for implementing new services to various regions of the state, including Northwest Michigan (i.e., Traverse City/Petoskey), Grand Rapids, and between Detroit and Toledo, Ohio. These recommendations are spread throughout the different investment packages in order to be consistent with the phasing required for a major corridor service development program. In accordance with the FRA corridor planning process, the first step is to conduct thorough alternatives analysis to determine feasibility, select a preferred alternative for service, determine cost and benefits and identify how the service would be funded. Depending on the outcome of the feasibility study, projects would be advanced by conducting preliminary engineering and environmental reviews. Once this phase is complete, the project moves to final engineering, construction and implementation.

The State Rail Plan incorporates this phased implementation approach by including the investment studies in the earlier investment packages. The feasibility studies for service to Grand Rapids and to Traverse City/Petoskey are included in the Good investment package, and the study of the feasibility of new service between Detroit and Toledo is included in the Better Scenario. Funding for the engineering, design and construction is only included in the investment packages for the Traverse City/Petoskey service. However, depending on the outcome of these feasibility studies, it is possible that some of these projects may be
accelerated, depending on ridership demand, cost, benefits provided, public support and the availability of funding.

The State Rail Plan identified two major issues that Michigan must address if the state wants to maintain and expand its current level of passenger rail service:

- State acquisition and rehabilitation of the Norfolk Southern (NS) rail line between Kalamazoo and Dearborn\(^\text{31}\), which was accomplished in 2012.
- Identifying a revenue source for subsidizing the operations of the Wolverine Service. The Wolverine service historically has been fully funded by Amtrak as part of its national system. However, Section 209 of the Passenger Rail Infrastructure and Investment Act of 2008 (PRIIA) requires Amtrak to develop and implement a single, nationwide standardized methodology for establishing and allocating the operating and capital costs among the states and Amtrak for all routes that are less than 750 miles long, beginning in October 2013. Agreements were reached with all parties, including Michigan, by the deadline, and the services continued to run without interruption.\(^\text{32}\)

Now that these two basic issues have been addressed, to be able to develop the MWRRS vision, new sources of public funding must be found. New federal rail programs, funded through ARRA and PRIIA, could provide new revenue sources, but they require a state match and are not available to support operating costs. MDOT has been successful in obtaining over $360 million in federal rail grant funds over the past two years, including partial funding for the purchase and upgrade of the Kalamazoo to Dearborn line from NS. A state match is required for these federal capital funds, and state funds will be needed for operations. Identifying a stable and reliable source of state funding for passenger rail capital and operating costs will be very challenging in the current economic environment. MDOT is struggling to find adequate funding to support its existing programs for all modes of transportation. The 2011 State Rail plan suggests the following priorities:

- Regional rail service. Continue with the implementation of the proposed regional rail services between Ann Arbor and Detroit and between Ann Arbor and Howell (North-South Commuter Rail line). Investigate opportunities for expanding these services by adding more frequencies and extending the Ann Arbor to Detroit service to Jackson.
- New intercity routes. Conduct feasibility studies of new rail service routes. Critical analysis should include strict criteria for determining whether or not benefits are sufficient to warrant investment. Proposed studies include assessment of the feasibility of new service to:
  - Traverse City/ Petoskey with consideration of a route to Chicago via Grand Rapids or Detroit
  - Grand Rapids to Detroit via Lansing and Ann Arbor (the Coast-to-Coast corridor)
  - Expanded service on the current Pere Marquette route, or on a new direct alignment between Kalamazoo and Grand Rapids and continuing on to Holland.
  - Detroit to Toledo, Ohio.
  - True high-speed rail service (220-mph) in the Chicago to Detroit to Toronto corridor.


2012 – Intercity Passenger Rail, Chicago to Detroit/Pontiac EIS

The purpose of the Chicago to Detroit/Pontiac environmental study is to enhance intercity mobility along the corridor from Chicago to Detroit/Pontiac, Michigan by providing an improved passenger rail service that would be a competitive transportation alternative to automobile, bus and air service. The need for the project arises from the inadequacies of existing passenger rail service and other modes of transportation to meet current and future mobility needs within the Corridor including:

- Limited ability to accommodate current or anticipated travel demand on the Corridor, resulting in the deterioration of transportation service quality as a result of congestion, longer trip times and decline of service reliability
- Limited intercity travel options restrict the mobility of the resident populations and the potential for economic development near station locations.
- Inadequate rail capacity in the Corridor provides uncompetitive trip times, poor reliability, and low levels of passenger comfort and convenience for travelers
- Lack of competitive advantages for modern intercity passenger service resulting in the inability to attract passenger rail travelers within the Corridor who may be currently choosing other modes of transportation.

Addressing needed infrastructure and facility improvements would bring the ability to allow higher speeds in the Corridor and increase access to passengers. Additional infrastructure investment needed to increase train speed will also allow an increase in the frequency of service. This would make the service more reliable and more likely to succeed in attracting ridership, increasing mobility and enhancing station area development opportunities near proposed stations.

Development of the Chicago to Detroit/Pontiac corridor is an integral part of the complete MWRRS system and would allow rail passengers in the Corridor to connect to all the other destinations within the system. The complete MWRRS would provide access to over 100 Midwest cities and 80% of the region’s 65 million residents. It is for this reason that it is important that the Preferred Alternative identified as part of the Tier 1 EIS provide direct connection into Chicago Union Station, as this facility is envisioned as the central hub where intercity passenger rail connections can be made to other Midwest cities and regions of the country.

Development of the EIS, including the preliminary full build-out schedule is based on work that had been previously done in the Midwest Regional Rail Initiative Plan (June 2004) and updated by MDOT staff. Train performance calculator runs were used to confirm travel times. Updated ridership forecasts reflecting more recent market and demographic conditions were used to confirm schedule frequencies. Running times between Porter, Indiana and Pontiac, Michigan are based on the proposed Build Alternative improvements described in Chapter 2 of the Tier 1 EIS. The train schedule will be updated to reflect the time savings gained from infrastructure improvements in the South-of-the-Lake corridor through Indiana once a Preferred Route Alternative is selected and all of the proposed infrastructure improvements for the Corridor are confirmed.

The Chicago to Detroit/Pontiac EIS is important to the Coast-to-Coast rail corridor due to the sharing of track access into downtown Detroit, the potential under some options for sharing track as far west as Jackson, and also due to the interconnecting ridership issue. This would boost the ridership of both systems, if both the Coast-to-Coast and Chicago to Detroit/Pontiac rail corridors were fully developed.

2014 – Michigan House Bill #5308 (Ref. #9)

This is an appropriations bill for the Department of Transportation for the fiscal year ending September 30, 2015. The transportation budget supports state and local highway programs, public transportation programs, aeronautics programs, and administration of the Michigan Department of Transportation (MDOT). Approximately 60% of the revenue in this budget comes from state restricted revenue, with approximately one-third from federal sources. Most of the state-restricted revenue in this budget is constitutionally restricted – from motor fuel taxes and vehicle registration taxes – and is first credited to the Michigan Transportation Fund (MTF) and then distributed in accordance with 1951 PA 51 (Act 51) to other state transportation funds and programs, including the State Trunkline Fund (STF) and the Comprehensive Transportation Fund (CTF), and to local road agencies. Language in HB 5308 (2014) directing a feasibility study of passenger rail service between Holland and Detroit, via Grand Rapids and Lansing, was written into this bill. Through the legislative process, HB 5308 (2014) and the other parallel fiscal year appropriations bills for each department of the State of Michigan were combined into House Bill 5313 (2014).

2014 – Public Act #252 (Ref. #10)

Also known as Enrolled House Bill 5313 (2014), this is the appropriations bill for all state departments and agencies, the judicial branch, and the legislative branch for the fiscal year ending September 30, 2015. Article XVII, Part 2, Section 712 directs Michigan Department of Transportation (MDOT) to conduct a feasibility study of passenger rail service between Holland and Detroit, via Grand Rapids and Lansing, including projections of corridor ridership, service capital and operating costs, as well as revenue estimates. The language in Section 712 originated in HB 5308 (2014). The Coast-to-Coast study fulfills PA 252 (2014) Article XVII, Part 2, Section 712.

2015 – North-South Commuter Rail Line Studies

Initially studied in 2008 by R.L. Banks & Associates; a second series of studies of the North-South Commuter Rail line are now underway by Smith Group JJR and are expected to be completed in 2016. Like Ann Arbor to Detroit commuter rail, the North-South Commuter Rail line project as currently comprised would also be funded by a combination of local, state, and federal funds.

2.3 Conclusions

This Chapter summarized the results of studies in the corridor linking Grand Rapids with Detroit dating back for almost 35 years. Early studies projected weak ridership to Detroit and recommended focusing only on Chicago-oriented corridors. However, there have been fundamental market shifts due to the development of Detroit as well as factors driving higher rail demand:

- Socioeconomic growth (Population, Income, Employment) in the Michigan market region
Increasing highway congestion

Rising fuel costs

Since the length of the Coast-to-Coast corridor substantially exceeds the limit of 100 miles for commuter service, the route will need to be analyzed using FRA’s criteria for intercity rail service. Although a conventional 79-mph option will also be assessed, it is expected that these criteria will be optimized in the range of 110-mph rail service and tilting train on existing corridors, as was shown by the previous MWRRS studies. In addition, to the extent that the development of an intercity passenger rail service may improve the existing rail infrastructure, it could actually facilitate the introduction of a commuter rail service at a lower cost. It has generally been found that the introduction of commuter along with intercity rail systems will boost the ridership of both systems, due to the greater potential of linked interconnecting trips, and the ability of the two systems working together to provide more and better travel options to the public.

Based on the results of the earlier 1981 Transmark and 1999 Lansing to Detroit studies it is possible to propose a set of reasonable routes for the current study. As shown in Exhibit 2-7:

- The two southern options (Options 1 and 2) that were part of the original 1981 Transmark and 1999 Lansing to Detroit Passenger Rail Studies are retained and will be updated.
  - Track upgrades might make the Lansing - Jackson route faster and improve its viability as an option for connecting Lansing to Detroit. The utility of this option also depends on the statewide decision for how best to link Lansing and Flint to Chicago, as well as to Detroit.
  - The Lansing - Howell - Ann Arbor option will be assessed again. The key infrastructure needed for developing this route is a new bridge in downtown Ann Arbor linking the Norfolk Southern line over to the former Ann Arbor Railroad right-of-way. If built, this bridge could also link the two prospective Michigan commuter rail systems (North-South Commuter Rail and Ann Arbor - Detroit, currently being advanced separately) into a single corridor. The bridge could also provide a way to link Detroit to the proposed Traverse City corridor via Ann Arbor and Howell.

- The two northern options (Options 3 and 4) that were part of the original 1981 Transmark and 1999 Lansing to Detroit Passenger Rail Studies have been modified or dropped.
  - The CSX Alternative via Plymouth (Option 3) has been modified by routing trains via Wayne, MI so that they enter Detroit via Dearborn. Modifying the CSX route option via Plymouth bypasses the CSX Detroit terminal trackage, utilizes the existing passenger access into Detroit and adds the important Dearborn station to the route.
  - The 1999 Lansing to Detroit study showed that the CN Alternative (Option 4, not shown in Exhibit 2-7) via Durand is such a weak option that it is proposed that is should be dropped altogether. Any of the other Options 1-3 can easily be extended to serve Pontiac from the south as Amtrak's current service does. For a future study, it is recommended to consider extending some of the trains north from Pontiac, at least to Flint and possibly as far north as Saginaw. This extension would develop a single seat ride from Saginaw and Flint not only to Detroit, but also to points west of Detroit along either the Chicago or Coast-to-Coast corridors. Extending the current service north from Pontiac would be much more effective at developing an effective service to Flint than developing a Lansing - Durand - Pontiac route, which misses Flint altogether. However, as an alternative routing from Traverse City to Detroit, possible routings via Durand and
Pontiac, or even via Saginaw, Flint and Pontiac might make sense. These could be considered as alternatives to a Howell - Ann Arbor routing in a future study of Traverse City to Detroit route options.

Early analysis and discussion prompted the study team to determine three routes for further analysis: Routes 1-3 (Exhibit 2-7) and omit Route 4 from inclusion in this study. As a conceptual, pre-feasibility study, this analysis does in no way exclude Route 4, or any other route option for that matter, from being included in future analyses, nor does it identify a “preferred alternative” route. It does however, seek to understand the strengths and weaknesses of Routes 1-3 for consideration in potential future studies.

Exhibit 2-7: Three Coast-to-Coast Route Options Selected for the Current Study
Chapter 3
Service and Operating Plan

SUMMARY

This chapter discusses the development of the Service and Operating Plan including identifying the route and technology options that should be considered for Coast-to-Coast study. This chapter also describes the operating plan, station stopping patterns, frequencies, train times and train schedules for each route and technology option. Operating costs were also calculated for each year the system is planned to be operational using operating cost drivers such as passenger volumes, train miles, and operating hours. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to evaluate an affordable set of options that provide good service at a reasonable price.

3.1 Introduction

Exhibit 2-7 shows the route options proposed for the Coast-to-Coast Rail Corridor that will be used for determining Ridership and Revenue forecasts in this study. Three possible Holland to Detroit routes have been proposed: Option 1 - Norfolk Southern (NS) via Lansing/Jackson; Option 2 - Ann Arbor (AA) via Howell/Ann Arbor, or Option 3 - CSX Transportation (CSX) via Plymouth/Wayne. For supporting the development of the Ridership and Revenue forecasts, the development of the operating plan and preliminary train running times based on a range of technology options are needed.

The development of the operating plan and train running times will be used as the input to the evaluation process for each of the route options. This section of the report will focus on the development of the train technology options for each route option.

3.2 Train Technology Options

For this study, TEMS’ TRACKMAN™ software has been used to electronically catalog the base track infrastructure and proposed improvements for all three route options (Exhibit 3-1), thus providing a detailed track database that allows a full range of technology and train service options to be assessed.
Exhibit 3-1: Base Track Infrastructure for the North Lansing Area as Shown in TRACKMAN™

The Technology Database for the Coast-to-Coast corridor includes existing 79-mph conventional trains with one locomotive as are currently operated from Chicago to Grand Rapids; existing conventional trains with two locomotives as are currently operated up to 110-mph from Chicago to Pontiac; and proposed 110-mph tilting trains with high-speed diesel\textsuperscript{37} engines (such as the engines that power the Siemens Charger locomotives shown on the cover of this report, which as of the date of this report are on-order for the Chicago-Pontiac corridor) along with tilting railcars, as was assumed by the earlier Midwest Regional Rail System (MWRRS) study.

The operating analysis will assess three different possible diesel train technologies that might be employed in the Coast-to-Coast rail corridor. These include:

**Conventional Rail – 79-mph or less:** Conventional trains, as shown in Exhibit 3-2, typically operate at up to 79-mph on existing freight tracks. 79-mph represents the highest speed at which trains can legally operate in the United States without having a supplementary cab signaling system on board the locomotive. The key characteristics of these trains are that they:

- Are designed for economical operation at conventional speeds
- Can be diesel or electric powered
- Are non-tilting for simplified maintenance

Conventional rail is used by Amtrak in corridors across the country outside the Northeast corridor (Exhibit 3-3) including, for example the current Chicago to Grand Rapids service. For the Coast-to-Coast corridor study, conventional trains with one locomotive will be used for assessing the 79-mph option.

\textsuperscript{37} The term High-speed diesel, as used in this context does not refer to the speed of the train; rather, it refers to the revolutions per minute (RPM) at which the diesel engine is designed to operate. High speed diesel engines are lighter and produce more power than the heavy, lower RPM marine diesel engines that are typically used for rail freight applications.
Exhibit 3-2: Conventional Rail – Representative 79-mph Trains and Current Corridor Service

Conventional Rail – 90-mph: Conventional trains are able to operate at 90-mph and up to 110-mph in developing corridors in Illinois and Michigan. For operating above 79-mph, the trains need to be equipped with Positive Train Control (PTC) safety equipment, and an extra locomotive needs to be added in order to attain satisfactory acceleration or braking performance. Improved grade crossing protection (quad gates) also needs to be provided along the corridor where train speeds exceed 90-mph. However, the high center of gravity of the P-42 locomotive limits its safe speed around curves, as compared to purpose-built trainsets such as the Siemens Charger, where the locomotives are designed to have a lower center of gravity. Exhibit 3-3 shows that for the Coast-to-Coast corridor study, conventional trains with two locomotives and PTC, as are currently used on the Chicago to Detroit corridor, will be used for developing a 90-mph option.

Exhibit 3-3: Conventional Rail – Representative 90-mph Trains and Current Corridor Service

Accelerated Rail – 110-mph: A 110-mph plus service can often be incrementally developed from an existing conventional rail system by improving track conditions, adding a supplementary Positive Train Control safety system, and improving grade crossing protection. Tilt capability and a low center of gravity built into the equipment can allow trains to go around curves faster, and has proven to be very effective for improving service on existing track, often enabling a 20-30 percent reduction in running times. Trains operating at or above 110 mph, such as those proposed for the Midwest, Ohio Hub and New York State systems (See Exhibit 3-4), have generally been found to be affordable, produce auto-competitive travel times, and are typically able to generate sufficient revenues to cover their operating costs.
Higher speed trains:

- Are designed for operation at or above 110-mph on existing rail lines.
- Can be diesel or electric powered.
- Are usually tilting unless the track is very straight.

In the United States, 110-mph service, called “Accelerated Rail” in Michigan and in this report, has been seen to provide a low cost infrastructure option by using existing lightly used railroad rights-of-way that have good geometry and by upgrading highway crossings, which are relatively low cost options.

However, it may contradict some existing freight railroad passenger principles unless additional improvements are made. For example, while Norfolk Southern’s passenger principles do not prohibit the operation of higher speed tilting trains, they do prohibit speeds above 79-mph on Norfolk Southern-owned rights of way. CSX policies have generally prohibited operations above 90-mph. If geometry allows 110-mph speeds or higher on a high density freight corridor, an alternative arrangement, such as the purchasing of a parallel strip of right way or right-of-way easement and separate ownership of the track like the MDOT agreement for tracks in Michigan on the Detroit-Chicago line, may be needed to comply with the requirements of the freight railroads.

For the Coast-to-Coast corridor study, tilting diesel trains with two locomotives and PTC, as were originally proposed for the MWRSS, will be used for assessing the 110-mph option.

Exhibit 3-4: Accelerated Rail Shared Use (Diesel) – Representative Trains and Corridor Service

3.2.1 Rolling Stock and Operational Assumptions

Consistent with the assumptions customarily made in feasibility-level planning and Tier I EIS studies, the following general assumptions are proposed regarding operating requirements for rolling stock for the Coast-to-Coast rail corridor for all train technology options are as follows:

- Trains will be reversible for easy push-pull operations (able to operate in either direction without turning the equipment at the terminal stations);
- Trains will be accessible from low-level station platforms for passenger access and egress, which is required to ensure compatibility with freight operations;
Trains will have expandable capacity for seasonal fluctuations and will allow for coupling two or more trains together to double or triple capacity as required;

Train configuration will include galley space, accommodating roll-on/roll-off cart service for on-board food service. Optionally, the trains may include a bistro area where food service can be provided during the entire trip;

On-board space is required for stowage of small, but significant, quantities of mail and express packages, and also to provide for an optional checked baggage service for pre-arranged tour groups;

Each end of the train will be equipped with a standard North American coupler that will allow for easy recovery of a disabled train by conventional locomotives;

Trains will not require mid-route servicing, with the exception of food top-off. Refueling, potable water top-off, interior cleaning, required train inspections and other requirements will be conducted at night, at the layover facilities located at or near the terminal stations. Trains would be stored overnight on the station tracks, or they would be moved to a separate train layover facility. Ideally, overnight layover facilities should be located close to the passenger stations and in the outbound direction so a train can continue, without reversing direction, after its final station stop; and

Trains must meet all applicable regulatory requirements including:

- FRA safety requirements for crash-worthiness,
- Requirements for accessibility for disabled persons,
- Material standards for rail components for high-speed operations, and
- Environmental regulations for waste disposal and power unit emissions.

### 3.3 Operating Plan Development

Given the development of the route options and the range of technology, operating plans can be developed for the range of alternatives. TEMS uses an Interactive Analysis (Exhibit 1-2) that first simulates the train times on the route and technology, and will then develop train schedules and operating plans that include train stopping patterns, slack time for freight train interaction and train loads between individual stations.
3.4 Train Technology Operating Characteristics

In terms of assessing rail technologies, there are two main criteria that need to be considered – type of propulsion and source of power:

- **Type of Propulsion:** Trains can be either locomotive-hauled or self-propelled. Self-propelled equipment has each individual railcar powered whereas conventional coaches rely on a separate locomotive to provide the power.

- **Source of Power:** Trains can be either diesel or electrically-powered. Diesel or electric power can be used with either the locomotive hauled or self-propelled equipment options. Turbine power has also been considered for high-speed trains, and the Rohr Turboliners in fact operated in Michigan at one time. However, due to high fuel prices turbine power does not offer any clear advantage over diesel at this time.

- **Train performance curves for the three representative equipment types are shown in Exhibit 3-5.** The curves reflect the acceleration capabilities of three rail technologies that are included in this study.

*Exhibit 3-5: Comparative Train Acceleration Curves*

Purpose-built Diesel Trains, such as the Talgo T21, can offer considerably improved performance over conventional diesel trains that are based on freight-derived designs. Conventional diesel trains with one locomotive can barely achieve 100-mph, and with two locomotives are just able to achieve a maximum of 110-mph; whereas purpose-built high-speed diesel trains can easily achieve 125-mph to 135-mph and can accelerate much faster than a conventional diesel train. Up to about 80-mph the acceleration capability of the high-speed diesel is in fact similar to that of an electric train. This type of train could even run at 130-mph on a fully grade separated corridor, but this or development of greenfield alignments is beyond the scope of the current study. However, it should be apparent from the above
Train timetables can be developed from running times and can be used to calculate rolling stock requirements. Train frequencies and the required train seating capacity are determined via an interactive process using the demand forecast COMPASS™ Model.

The results taken from LOCOMOTION™ will be faster than the actual times, since they are based on optimized performance of trains under ideal conditions. While it is assumed that passenger trains will have dispatching priority over freight, practical schedules still need to allow 5-10 percent slack time in case of any kind of operating problem, including the possibility of freight or commuter train interference, depending on the degree of track sharing with freight. Since the proposed accelerated rail route is based on shared freight track, an 8% Slack time allowance will be included in the train running times.

### 3.5 Train Schedule Development

After the track data was collected and catalogued using TRACKMAN™ (Exhibit 3-2), the LOCOMOTION™ train performance program was used to assess the performance of various train technologies at different speeds or levels of investment. The LOCOMOTION™ program reflects the different train operating characteristics (train acceleration, curving and tilt capabilities, etc.) that are associated with the different types of train technologies assumed. Speed Profiles for each of the nine combinations of route and train technology are detailed in Exhibits 3-7 through 3-15 below.

#### 3.5.1 Option 1: NS via Lansing/Jackson

Exhibit 3-6 shows the speed profile for NS Lansing/Jackson Option 1 using a conventional Amtrak train with one locomotive and a top speed of 79-mph. East of Jackson, this train could be allowed to run faster than 79-mph but due to the limitations of having only one locomotive, it could not practically attain a top speed much higher than shown and could save only a few minutes relative to the calculated running time.

Exhibit 3-7 shows the speed profile for NS Lansing/Jackson Option 1 using a conventional Amtrak train with two locomotives and a top speed of 90-mph. The assumed top speed of 90-mph from Holland to Lansing is allowable on upgraded track according to CSX principles; but since NS owns the line from Lansing to Jackson, would likely require that this track be purchased from NS by Michigan. East of Jackson, this train is allowed to run up to 110-mph as according to current Amtrak practice and speed limits.

Exhibit 3-8 shows the speed profile for NS Lansing/Jackson Option 1 using a tilting diesel train with two locomotives and a top speed of 110-mph. In this speed profile and those to follow, the red line shows the speed limit, and the black line shows the simulated speed obtained by the train at that point. A 110-mph top speed would likely require that the Holland to Lansing track be purchased from CSX, and the Lansing to Jackson track be purchased from NS by another entity since it violates both railroads’ freight principles for the tracks that they own. East of Jackson, this train is allowed to run up to 110-mph and is able to run faster than the current Amtrak trains due to its tilting capability.
Exhibit 3-6: NS Lansing/Jackson Option 1 at 79-mph

Exhibit 3-7: NS Lansing/Jackson Option 1 at 90-mph (110-mph east of Lansing)
3.5.2 Option 2: AA via Howell/Ann Arbor

Exhibit 3-9 shows the speed profile for AA Howell/Ann Arbor Option 2 using a conventional Amtrak train with one locomotive and a top speed of 79-mph. East of Ann Arbor, this train could be allowed to run faster than 79-mph but due to the limitations of having only one locomotive, it could not practically attain a top speed much higher than shown and could save only a few minutes relative to the calculated running time.

Exhibit 3-10 shows the speed profile for AA Howell/Ann Arbor Option 2 using a conventional Amtrak train with two locomotives and a top speed of 90-mph. The assumed top speed of 90-mph from Holland to Howell is allowable on upgraded track according to CSX principles; Michigan already owns the track from Howell to Ann Arbor. East of Ann Arbor, this train is allowed to run up to 110-mph as according to current Amtrak practice and speed limits.

Exhibit 3-11 shows the speed profile for AA Howell/Ann Arbor Option 2 using a tilting diesel train with two locomotives and a top speed of 110-mph. This speed would likely require that the Holland to Howell track be purchased from CSX since it violates CSX freight principles for tracks that they own. From Howell to Ann Arbor, Michigan already owns the track so train speed would only be limited by track geometry and the existence of level grade crossings. East of Ann Arbor, this train is allowed to run up to 110-mph and could run faster than the current Amtrak trains due to its tilting capability.
Exhibit 3-9: AA Howell/Ann Arbor Option 2 at 79-mph

Exhibit 3-10: AA Howell/Ann Arbor Option 2 at 90-mph (110-mph east of Howell)
3.5.3 Option 3: CSX via Plymouth/Wayne

Exhibit 3-12 shows the speed profile for CSX Plymouth/Wayne Option 3 using a conventional Amtrak train with one locomotive and a top speed of 79-mph. East of Wayne, this train could be allowed to run faster than 79-mph but due to the limitations of having only one locomotive, it could not practically attain a top speed much higher than shown and could save only a few minutes relative to the calculated running time.

Exhibit 3-13 shows the speed profile for CSX Plymouth/Wayne Option 3 using a conventional Amtrak train with two locomotives and a top speed of 90-mph. The assumed top speed of 90-mph from Holland to Plymouth to Wayne is allowable on upgraded track according to CSX principles. East of Wayne, this train is allowed to run up to 110-mph as according to current Amtrak practice and speed limits.

Exhibit 3-14 shows the speed profile for CSX Plymouth/Wayne Option 3 using a tilting diesel train with two locomotives and a top speed of 110-mph. This speed would likely require that the Holland to Plymouth track be purchased from CSX. For the relatively short distance from Plymouth to Wayne, either a dedicated track alongside the CSX main line would need to be constructed, or train speed would need to be reduced to 90-mph in line with CSX principles. East of Wayne, this train is allowed to run up to 110-mph and could run faster than the current Amtrak trains due to its tilting capability.
Exhibit 3-12: CSX Plymouth/Wayne Option 3 at 79-mph

Exhibit 3-13: CSX Plymouth/Wayne Option 3 at 90-mph (110-mph east of Wayne)
3.6 Comparative Running Times Summary

The travel times for the 79-mph conventional and 110-mph diesel tilt train technologies were evaluated for each route. The comparative train running times are summarized in Exhibit 3-15. It can be seen that Route 3 via Plymouth and Wayne is the fastest, and Route 1 via Jackson is the slowest route alternative despite benefits from being able to use the upgraded Detroit-Chicago track for the longest distance (Jackson-Detroit). Route 2 running times are intermediate to those of Routes 1 and 3; however, Route 2 is the fastest alternative which includes the major station of Ann Arbor.
Exhibit 3-15: Coast-to-Coast Running Times Summary

<table>
<thead>
<tr>
<th>From-To</th>
<th>Route 1-79 Conv</th>
<th>Route 1-90 Conv</th>
<th>Route 1-110 Talgo</th>
<th>Route 2-79 Conv</th>
<th>Route 2-90 Conv</th>
<th>Route 2-110 Talgo</th>
<th>Route 3-79 Conv</th>
<th>Route 3-90 Conv</th>
<th>Route 3-110 Talgo</th>
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<tr>
<td>Jackson-Ann Arbor</td>
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</tr>
<tr>
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<tr>
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<tr>
<td>Greenfield Village-Detroit</td>
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<td>0:16</td>
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</tr>
</tbody>
</table>

*The Holland-Grand Rapids segment includes 10 minutes additional time for backing in and out of the Grand Rapids train station. Route 2 assumes the construction of a new bridge to allow Route 2 to connect the Ann Arbor North-South Commuter line to the Chicago-Detroit/Pontiac mainline.
3.6.1 Benchmark Comparison

There are several benchmarks to which these results could be compared. These will be addressed in turn.

- Jackson to Detroit: Amtrak today averages 1:42 to run from Jackson to Detroit. According to the Tier I EIS for the Chicago to Detroit/Pontiac corridor, this time is to be reduced to 1:15. The Route 1 90-mph option has exactly the same time of 1:15 for this route segment as does the Tier I EIS. However, as estimated by the Route 1 110-mph option, a tilting train could run the segment approximately 4 minutes faster than the non-tilting Amtrak train that was assumed by the Tier I EIS.

- Holland to Grand Rapids: Amtrak today needs one hour to run from Holland to Grand Rapids. The MWRRS plan developed a 79-mph option that would make the run in 27 minutes. Including a 10-minute allowance for backing in and out of the Grand Rapids train station, the time allowed here for making that run would range from 32 to 47 minutes.

- Plymouth to Grand Rapids: In 1941, the historical Pere Marquette timetables showed the Plymouth to Grand Rapids time as 2 hours 39 minutes. In 1946 it was 2 hours 28 minutes for an Express train. In 1970, the schedule was 2 hours 40 minutes with four intermediate stops. With track upgrades to 79-mph and two stops, the time projected here would be 2 hours and 12 minutes, which is slightly faster than the historical schedules. However, the Transmark/GM 1982 study had estimated a 1 hour 51 minute time for the same run, so the Coast-to-Coast study is considerably more conservative than Transmark’s earlier assessment.

- Lansing to Detroit: The 1999 study had a 1:57 time for a 79-mph Option 1 via Lansing; the comparable time for this study is 2:17. For Option 2, the 1999 study had a 1:43 time; this study has 2:01. For Option 3, the 1999 study had 1:29; this study has 1:48 for a comparable 79-mph option. It can be seen that the train performance modeling assumed here is considerably more conservative than what was assumed by either the 1982 Transmark or 1999 Lansing-Detroit studies.

3.6.2 Conclusion

The analysis of train running times shows that the 79-mph options are all significantly slower, while the 90 to 110-mph options have travel times that are within 10-15 minutes of one another. As a result, it is proposed (as was done for the MWRRS study) to evaluate the three 79-mph options along with the three 110-mph options. This will fully bracket the range of potential study outcomes; any 90-mph option will have an intermediate value in terms of train schedule, ridership, revenue, operating cost, and financial and economic performance. It will allow a 90-mph option to be considered in future work.
3.7 Operating and Maintenance Cost Methodology

This section describes the build-up of the unit operating costs that have been used in conjunction with the operating plans, to project the total operating cost of each corridor option. A costing framework originally developed for the Midwest Regional Rail System (MWRRS) was adapted for use in this study. However, it has also been validated against current Amtrak Passenger Rail Investment and Improvement Act of 2008 Costs (PRIIA) costs as described in the following sections.

Following the MWRRS methodology\(^\text{38}\), nine specific cost areas have been identified. As shown in Exhibit 3-17, variable train-mile driven costs include equipment maintenance, energy and fuel, and train and onboard service (OBS) crews. Passenger miles drive insurance liability, while ridership influences marketing, and sales. Fixed costs include administrative costs, station costs, and track and right-of-way maintenance costs. Signals, communications and power supply are included in the track and right-of-way costs.

This framework enables the direct development of costs based on directly-controllable and route-specific factors, and allows sensitivity analyses to be performed on the impact of specific cost drivers. It also enables direct and explicit treatment of overhead cost allocations, to ensure that costs which do not belong to a corridor are not inappropriately allocated to the corridor, as would be inherent in a simple average cost-per-train mile approach. It also allows benchmarking and direct comparability of Michigan Coast-to-Coast corridor costs with those developed by other high-speed rail studies across the nation, including those with which the proposed corridor route would connect.

### Exhibit 3-16: Operating Cost Categories and Primary Cost Drivers

<table>
<thead>
<tr>
<th>Drivers</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Train Miles</td>
<td>Equipment Maintenance</td>
</tr>
<tr>
<td></td>
<td>Energy and Fuel</td>
</tr>
<tr>
<td></td>
<td>Train and Engine Crews</td>
</tr>
<tr>
<td></td>
<td>Onboard Service Crews</td>
</tr>
<tr>
<td>Passenger Miles</td>
<td>Insurance Liability</td>
</tr>
<tr>
<td>Ridership and Revenue</td>
<td>Sales and Marketing</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>Service Administration</td>
</tr>
<tr>
<td></td>
<td>Track and ROW Maintenance</td>
</tr>
<tr>
<td></td>
<td>Station Costs</td>
</tr>
</tbody>
</table>

Operating costs can be categorized as variable or fixed. As described below, fixed costs include both Route and System overhead costs. Route costs can be clearly identified to specific train services but do not change much if fewer or additional trains were operated.

\(^{38}\) Follow the links under “Midwest Regional Rail Initiative (MWRRI)” at [http://www.dot.state.mn.us/planning/railplan/studies.html](http://www.dot.state.mn.us/planning/railplan/studies.html)
Variable costs change with the volume of activity and are directly dependent on ridership, passenger miles or train miles. For each variable cost, a principal cost driver is identified and used to determine the total cost of that operating variable. An increase or decrease in any of these will directly drive operating costs higher or lower.

Fixed costs are generally predetermined, but may be influenced by external factors, such as the volume of freight tonnage, or may include a relatively small component of activity-driven costs. As a rule, costs identified as fixed should remain stable across a broad range of service intensities. Within fixed costs are two sub-categories:

- Route costs such as track maintenance, train control and station expense that, although fixed, can still be clearly identified at the route level.
- Overhead or System costs such as headquarters management, call center, accounting, legal, and other corporate fixed costs that are shared across routes or even nationally. A portion of overhead cost (such as direct line supervision) may be directly identifiable but most of the cost is fixed. Accordingly, assignment of such costs becomes an allocation issue that raises equity concerns. These kinds of fixed costs are handled separately.

Operating costs have been developed based on the following premises:

- Based on results of recent studies, a variety of sources including suppliers, current operators’ histories, testing programs and prior internal analysis from other passenger corridors were used to develop the cost data. However, as the rail service is implemented, actual costs will be subject to negotiation between the passenger rail authority and the contract rail operator(s).
- Freight railroads will maintain track and right-of-way that they own, but ultimately, the actual cost of track maintenance will be resolved through negotiations with the railroads. For this study, a track maintenance cost model will be used that reflects actual freight and passenger railroad cost data.
- Maintenance of train equipment will be contracted out to the equipment supplier.
- Train operating practices follow existing work rules for crew staffing and hours of service. Average operating expenses per train-mile for train operations, crews, management and supervision were estimated through a bottoms-up staffing approach based on typical passenger rail organizational needs.

The MWRRS costing framework was originally developed in conjunction with nine states that comprised the MWRRS steering committee and with Amtrak. In addition, freight railroads, equipment manufacturers and others provided input to the development of the costs. However, the costing framework has been validated with recent operating experience based on publicly available data from other sources, particularly the Midwest 403B Service trains Northern New England Passenger Rail Authority’s (NNEPRA) Downeaster costs and data on Illinois operations that was provided by Amtrak. It has been updated and brought to a 2013 costing basis.
The original concept for the MWRRS was for development of a new service based on operating methods directly modeled after state-of-the-art European rail operating practice. Along with anticipated economies of scale, modern train technology could reduce operating costs when compared to existing Amtrak practice. In the original 2000 MWRRS Plan, European equipment costs were measured at 40 percent of Amtrak’s costs. However, in the final MWRRS plan that was released in 2004, train-operating costs were significantly increased to a level that is more consistent with Amtrak’s current cost structure. However, adopting an Amtrak cost structure for financial planning does not suggest that Amtrak would actually be selected for the corridor operation. Rather, this selection increases the flexibility for choosing an operator without excluding Amtrak, because multiple operators and vendors will be able to meet the broader performance parameters provided by this conservative approach.

### 3.7.1 Variable Costs

Variable costs include those that directly depend on the number of train-miles operated or passenger-miles carried. They include train equipment maintenance, train crew cost, fuel and energy, onboard service, and insurance costs.

#### 3.7.1.1 Train Equipment Maintenance

Equipment maintenance costs include all costs for spare parts, labor and materials needed to keep equipment safe and reliable. The costs include periodical overhauls in addition to running maintenance. It also assumes that facilities for servicing and maintaining equipment are designed specifically to accommodate the selected train technology. This arrangement supports more efficient and cost-effective maintenance practices. Acquiring a large fleet of trains with identical features and components, allows for substantial savings in parts inventory and other economies of scale. In particular, commonality of rolling stock and other equipment will standardize maintenance training, enhance efficiencies and foster broad expertise in train and system repair.

The MWRRS study developed a cost of $9.87 per train mile for a 300-seat train in 2002. This cost was increased to $12.70 per train mile in 2013. The 79-mph conventional Amtrak train benchmarked at a higher cost of $15.43 due primarily to a lack of economies of scale associated with typical lighter density Amtrak corridors. For this study:

- The low frequency corridor options are only running two to four round-trips daily, so the higher $15.43 cost will be assumed for these options.
- The lower $12.70 cost will be assumed for the high frequency 8 round-trip options because of better economies of scale and better equipment utilization in these options, both of which tends toward lower average equipment unit costs.

#### 3.7.1.2 Train and Engine Crew Costs

The train operating crew incurs crew costs. Following Amtrak staffing policies, the operating crew would consist of an engineer, a conductor and an assistant conductor and is subject to federal hours of service regulations. Costs for the crew include salary, fringe benefits, training, overtime and additional pay for split shifts and high mileage runs. An overtime allowance is included as well as scheduled time-off, unscheduled absences and time required for operating, safety and passenger handling training. Fringe benefits include health and welfare, Federal Insurance Contributions Act (FICA) and pensions. The cost of employee injury claims under Federal Employers Liability Act (FELA) is also treated as a fringe benefit for
this analysis. The overall fringe benefit rate was calculated as 55 percent. In addition, an allowance was built in for spare/reserve crews on the extra board. Costing of train crews was based on Amtrak’s 1999 labor agreement, adjusted for inflation to 2013.

Crew costs depend upon the level of train crew utilization, which is largely influenced by the structure of crew bases and any prior agreements on staffing locations. Train frequency strongly influences the amount of held-away-from-home-terminal time, which occurs if train crews have to stay overnight in a hotel away from their home base. Since a broad range of service frequencies and speeds have been evaluated here, a parametric approach was needed to develop a system average per train mile rate for crew costs. Such an average rate necessarily involves some approximation, but to avoid having to reconfigure a detailed crew-staffing plan whenever the train schedules change, an average rate is appropriate for a Feasibility study. A more specific and detailed level of assessment would be appropriate for a Tier 2 EIS. For this study:

- A value of $4.92 per train mile was assumed for the high frequency 110-mph 8 round-trip options that are being assessed for the Greenfield and I-85 alignments. This reflects improved crew utilization due to higher train speeds and more train frequencies. This is a moderate level of crew cost that still includes the need for some away from home layover.
- The low frequency two and four round-trip scenarios cost $6.59 per train mile. With trains operating less frequently there is less opportunity to return crews to their home base on the same day, leading to more split shifts and overnight layovers.

### 3.7.1.3 Fuel and Energy

An average consumption rate of 2.42 gallons/mile was estimated for a 110-mph 300-seat train, based upon nominal usage rates of all three technologies considered in Phase 3 of the MWRRS Study. While fuel prices were $3.60 a gallon in late 2012 for diesel fuel according to Energy Information Administration (EIA)\(^{39}\), at the time of this analysis, they had fallen to approximately $3/gallon, and the EIA price forecast has been lowered. Currently a fuel cost of $7.21 per train mile is being assumed rising to $10.28 per mile by 2040, consistent with the latest EIA forecasts that were used for preparation of the ridership forecasts. Even so, this more than triples (311%) the cost of diesel fuel that was prevalent at the time of the earlier MWRRS study. Obviously these much higher fuel costs will have a corresponding favorable impact on the ridership forecast as well. These energy costs are then adjusted each year in line with the relevant Energy Information Administration forecasts.

### 3.7.1.4 Onboard Services (OBS)

Onboard service (OBS) costs are those expenses for providing food service onboard the trains. OBS adds costs in three different areas: equipment, labor and cost of goods sold. Equipment capital and operating cost is built into the cost of the trains and is not attributed to food catering specifically. Small 200-seat trains cannot afford a dedicated dining or bistro car. Instead, if food service were to be offered, an OBS employee or food service vendor would move through the train with a trolley cart, offering food and beverages for sale to the passengers.

The goal of OBS franchising should be to ensure a reasonable profit for the provider of on-board services, while maintaining a reasonable and affordable price structure for passengers. In previous studies, it has

\(^{39}\) EIA diesel retail price in 2012 excluding the taxes [http://www.eia.gov/petroleum/gasdiesel/](http://www.eia.gov/petroleum/gasdiesel/)
been found that the key to attaining OBS profitability is selling enough products to recover the train mile related labor costs. For example, if small 200-seat trains were used, given the assumed OBS cost structure, even with a trolley cart service the OBS operator will be challenged to attain profitability. However, the expanded customer base on larger 300-seat trains can provide a slight positive operating margin for OBS service.

Because the trolley cart has been shown to double OBS revenues, it can result in profitable OBS operations in situations where a bistro-only service would be hard-pressed to sell enough food to recover its costs. While only a limited menu can be offered from a cart, the ready availability of food and beverages at the customer’s seat is a proven strategy for increasing sales. Many customers appreciate the convenience of a trolley cart service and are willing to purchase food items that are brought directly to them. While some customers prefer stretching their legs and walking to a bistro car, other customers will not bother to make the trip.

The cost of goods sold is estimated as 50 percent of OBS revenue, based on Amtrak’s route profitability reports. Labor costs, including costs for commissary support and OBS supervision, have been estimated at:

- An intermediate value of $2.56 per train mile was assumed for the high frequency 8 round trip 110-mph diesel options. This is a moderate level of crew cost that includes the need for some away from home layover.
- The low frequency 2 and 4 round trip scenarios cost $3.66 per train mile. With trains operating less frequently there is less opportunity to return crews to their home base on the same day, leading to more split shifts and overnight layovers.

These costs are generally consistent with Amtrak’s level of wages and staffing approach for conventional bistro car services. However, this study recommends that an experienced food service vendor provide food services and use a trolley cart approach. A key technical requirement for providing trolley service is to ensure the doors and vestibules between cars are designed to allow a cart to easily pass through. Since trolley service is a standard feature on most European railways, most European rolling stock is designed to accommodate the carts. Although convenient passageways often have not been provided on U.S. equipment, the ability to support trolley carts is an important equipment design requirement for the planned service.

### 3.7.1.5 Insurance Costs

Liability costs were estimated at 1.4¢ per passenger-mile, the same rate that was assumed in the earlier MWRRS study brought to 2013. Federal Employees Liability Act (FELA) costs are not included in this category but are applied as an overhead to labor costs.

The Amtrak Reform and Accountability Act of 1997 (§161) provides for a limit of $200 Million on passenger liability claims. Amtrak carries that level of excess liability insurance, which allows Amtrak to fully indemnify the freight railroads in the event of a rail accident. This insurance protection has been a key element in Amtrak’s ability to secure freight railroad cooperation. In addition, freight railroads perceive that the full faith and credit of the United States Government is behind Amtrak, while this may not be true of other potential passenger operators. However, a General Accounting Office (GAO) review⁴⁰ has concluded that this $200 Million liability cap applies to commuter railroads as well as to Amtrak. If the

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GAO’s interpretation is correct, the liability cap may also apply to potential franchisees. If this limitation were in fact available to potential franchisees, it would be much easier for any operator to obtain insurance that could fully indemnify a freight railroad at a reasonable cost. It is recommended that Michigan DOT seek qualified legal advice on this matter.

### 3.7.2 Fixed Route Costs

This cost category includes those costs that, while largely independent of the number of train-miles operated, can still be directly associated to the operation of specific routes. It includes such costs as track maintenance, which varies by train technology, and station operations.

#### 3.7.2.1 Track and Right-of-Way Costs

Currently, it is industry practice for passenger train operators providing service on freight-owned rights-of-way to pay for track access, dispatching and track maintenance. Rates for all these activities are ultimately based upon a determination of the appropriate costs that result from negotiations between the parties. The purpose here is to provide estimates based on the best available information; however, as the project moves forward, additional study and discussions with the railroads will be needed to further refine these costs.

The costing basis assumed in this report is that of incremental or avoidable costs\(^{41}\) for shared tracks. The passenger operator, however, must take full cost responsibility for maintaining any tracks that it must add to the corridor either for its own use, or for mitigating delays to freight trains. The following cost components are included within the Track and Right-of-Way category:

- **Track Maintenance Costs.** Costs for track maintenance were estimated based on Zeta-Tech’s January 2004 draft technical monograph Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors\(^ {42}\). Zeta-Tech costs have been adjusted for inflation to 2013. However, Zeta-Tech’s costs are conceptual and subject to negotiation with the freight railroads.

- **Dispatching Costs and Out-of-Pocket Reimbursement.** Passenger service must also reimburse a freight railroad’s added costs for dispatching its line, providing employee efficiency tests and for performing other services on behalf of the passenger operator. If the passenger operator does not contract a freight railroad to provide these services, it must provide them itself. As a result, costs for train dispatching and control are incurred on dedicated as well as shared tracks and are now shown under a separate "Operations and Dispatch" cost category.

- **Costs for Access to Track and Right-of-Way.** Access fees, particularly train mile fees incurred as an operating expense, are specifically excluded from this calculation. Any such payments would have to be calculated and negotiated on a route-specific and railroad-specific basis. Such a calculation would have to consider the value of the infrastructure improvements made to the corridor for balancing up-front capital with ongoing operating payments.\(^ {43}\)

---

\(^{41}\) Avoidable costs are those that are eliminated or saved if an activity is discontinued. The term incremental is used to reference the change in costs that results from a management action that increases volume, whereas avoidable defines the change in costs that results from a management action that reduces volume.

\(^{42}\) Zeta-Tech, a subsidiary of Harsco (a supplier of track maintenance machinery) is a rail consulting firm who specializes in development of track maintenance strategies, costs and related engineering economics. See a summary of this report at http://onlinepubs.trb.org/onlinepubs/trnews/trnews255rpo.pdf. The full report is available upon request from the FRA.

\(^{43}\) For 110-mph service, the level of infrastructure improvements to the corridor called for in this study should provide enough capacity to allow superior on-time performance for both freight and passenger operations.
Exhibit 3-17 shows the conceptual relationship between track maintenance cost and total tonnage that was calibrated from the 2004 Zeta-Tech study. It shows a strong relationship between tonnage, FRA track class (4 through 6, corresponding to a 79-mph to 110-mph track speed) and maintenance cost. At low tonnage, the cost differential for maintaining a higher track class is not very large, but as tonnage grows, so too does the added cost. For shared track, if freight needs only Class 4 track, the passenger service would have to pay the difference, called the “maintenance increment”, which for a 25 MGT line as shown in Exhibit 3-17, would come to about $22,000 per mile per year, including capital costs\textsuperscript{44}. The required payment to reimburse a freight railroad for its added cost would be less for lower freight tonnage, more for higher freight tonnage.

\textbf{Exhibit 3-17: Zeta-Tech 2004 Calibrated Track Class vs. Tonnage Total Cost Function}

\textit{“Middle Line” Case, in 2002}

<table>
<thead>
<tr>
<th>TOTAL COST</th>
<th>LOW</th>
<th></th>
<th>MIDDLE</th>
<th></th>
<th>HIGH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intercept</td>
<td>Slope</td>
<td>Intercept</td>
<td>Slope</td>
<td>Intercept</td>
<td>Slope</td>
</tr>
<tr>
<td>Class 3</td>
<td>$17,880</td>
<td>$0.917</td>
<td>$21,683</td>
<td>$1.231</td>
<td>$25,487</td>
<td>$1.548</td>
</tr>
<tr>
<td>Class 4</td>
<td>$26,294</td>
<td>$1.348</td>
<td>$31,887</td>
<td>$1.810</td>
<td>$37,481</td>
<td>$2.277</td>
</tr>
<tr>
<td>Class 5</td>
<td>$28,072</td>
<td>$1.509</td>
<td>$33,937</td>
<td>$2.020</td>
<td>$39,801</td>
<td>$2.530</td>
</tr>
<tr>
<td>Class 6</td>
<td>$31,714</td>
<td>$1.837</td>
<td>$38,446</td>
<td>$2.440</td>
<td>$45,178</td>
<td>$3.035</td>
</tr>
</tbody>
</table>

\textsuperscript{44} Calculated as $38,446 - $31,887 + ($2.440 − $1.810) * 25 = $22,309 per year. Note that the yellow highlighted cells in the table correspond to the three lines shown on the graph.

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\* Intercept is where the line meets the Y axis at the 0 ton level. The slope represents the added cost per MGT.
Exhibit 3-17 shows the total track maintenance cost per mile as a function of traffic density, it also breaks out the operating versus total cost, showing that capital (the difference between total and operating cost) is a significant share of the total cost. For track maintenance:

- **Operating Costs** cover expenses needed to keep existing assets in service and include both surfacing and a regimen of facility inspections.
- **Capital Costs** are those related to the physical replacement of the assets that wear out. They include expenditures such as for replacement of rail and ties, but these costs are not incurred until many years after construction. In addition, the regular maintenance of a smooth surface by reducing dynamic loads actually helps extend the life of the underlying rail and tie assets.

Exhibit 3-17 shows that the cost of shared track depends strongly on the level of freight tonnage, since passenger trains are relatively lightweight and do not contribute much to the total tonnage. In fact, following the Zeta-Tech methodology, the “maintenance increment” is calculated based on freight tonnage only, since a flat rate of $1.56 per train mile as used in the Zeta-Tech report (in 2002) was already added to reflect the direct cost of added passenger tonnage regardless of track class. This cost, which was developed by Zeta-Tech’s TrackShare® model, includes not only directly variable costs, but also an allocation of a freight railroad’s fixed cost. Accordingly, it complies with the Surface Transportation Board’s definition of “avoidable cost.” Inflated to 2013 (an approximate 52% increase, a higher rate of inflation than CPI, reflecting the energy-intensity of construction materials) this avoidable cost allocation would come to $2.37 per train mile.

On top of this, an allowance of 39.5¢ per train-mile (in 2002) was added by Zeta-Tech for freight railroad dispatching and out-of-pocket costs. Inflated to 2013 based on the Consumer Price Index (approx. 29% increase) this dispatching and out-of-pocket cost now comes to 50.8¢ per train mile, which is applied both to dedicated and shared tracks. This cost is now separated from track maintenance under the “Operations and Dispatch” category.

The same cost function shown in Exhibit 3-17 can also be used for costing dedicated passenger track. With dedicated track, the passenger system is assumed to cover the entire operating cost for maintaining its own track. (Freight may then have to reimburse the passenger operator on a car-mile basis for any damage it causes to the passenger track.) Because passenger train tonnage is very low however, it can be seen that the cost differential between Class 4, 5 and 6 track is very small.

Adjusting Zeta-Tech’s 2002 costs shown in Exhibit 3-19 up to 2013:

- The Total Cost per track-mile for maintaining dedicated Class 4 track is about $48,468; the cost for Class 6 track rises to $58,438. The shared-use scenario assumes that the owning freight railroad will require this level of support each year for maintaining the additional tracks that it must add to its existing rail corridor, for supporting the needs of passenger rail service.
- The Operating Cost per track-mile for maintaining dedicated Class 4 track is about $18,365; the cost for Class 6 track rises to $27,924. This figure is used for Amtrak or State owned tracks since these entities will bear the maintenance cost directly. In this case a Cyclic Maintenance additive is included in the Cost Benefit ratio calculation to account for the timing of needed capital maintenance expenditures that will not need to be incurred until much later in the project life.
- The Capital Cost per track-mile for maintaining dedicated Class 4 track reflects the difference of about $30,103; similarly for Class 6 track is $30,514. The capital cost for maintaining Class 4
versus Class 6 track under light tonnage density is not much different; most of cost differential is in operating cost needed to maintain the more precise alignment of the higher class track.

While operating costs are needed every year, capital maintenance costs for dedicated tracks are gradually introduced using a table of ramp-up factors provided by Zeta-Tech, see Exhibit 3-18.

<table>
<thead>
<tr>
<th>Year</th>
<th>% of Capital Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0%</td>
</tr>
<tr>
<td>12</td>
<td>0%</td>
</tr>
<tr>
<td>13</td>
<td>0%</td>
</tr>
<tr>
<td>14</td>
<td>20%</td>
</tr>
<tr>
<td>15</td>
<td>20%</td>
</tr>
<tr>
<td>16</td>
<td>20%</td>
</tr>
<tr>
<td>17</td>
<td>35%</td>
</tr>
<tr>
<td>18</td>
<td>35%</td>
</tr>
<tr>
<td>19</td>
<td>35%</td>
</tr>
<tr>
<td>20</td>
<td>50%</td>
</tr>
</tbody>
</table>

A fully normalized capital maintenance level is not reached until 20 years after completion of the rail construction program. This is used for calculating “Cyclic Maintenance” in the Benefit Cost Analysis. But because Cyclic Maintenance is not an Operating Cost under generally accepted accounting principles (GAAP) accounting methodology, it is not normally included in the Operating Ratio calculation.

### 3.7.2.2 Station Operations

A simplified fare structure, heavy reliance upon electronic ticketing and avoidance of a reservation system will minimize station personnel requirements. Station costs include personnel, ticket machines and station operating expenses.

- **Staffed stations** will be assumed at major stations. All stations will be assumed open for two shifts. The cost for the staffed stations includes eight positions at each new location, costing $644,640 per year, as well as the cost of utilities, ticket machines, cleaning and basic facility maintenance.

- The cost for unstaffed stations covers the cost of utilities, ticket machines, cleaning and basic facility maintenance, costing $80,580 per year. (These costs are also included in the staffed station cost.) Volunteer personnel such as Traveler’s Aid, if desired could staff these stations.

It should be noted that the proposed Coast-to-Coast system would share most of its stations with existing Amtrak services. However, Route 1 would need an additional station in downtown Lansing, since this route alternative cannot use the existing Lansing station at Trowbridge. Route 2 would add a new station at Howell, and Route 3 would add stations at both Howell and Plymouth. All the other stations used by the Coast-to-Coast service would be existing Amtrak stations.
3.7.2.3 System Overhead Costs

The category of System Overhead largely consists of Service Administration or management overheads, covering such needs as the corporate procurement, human resources, accounting, finance and information technology functions as well as call center administration. A stand-alone administrative organization appropriate for the operation of a corridor system was developed for the MWRRS and later refined for the Ohio Hub studies. This organizational structure, which was developed with Amtrak’s input and had a fixed cost of $8.9 Million plus $1.43 per train-mile (in 2002) for added staff requirements as the system grew. Inflated to 2013, this became $11.45 Million plus $1.84 per train mile. However, the Sales and Marketing category also has a substantial fixed cost component for advertising and call center expense, adding another $2.9 Million per year fixed cost, plus variable call center expenses of 70.9¢ per rider, all in 2013 dollars. Finally, credit card (1.8% of revenue) and travel agency commissions (1%) are all variable. In addition, the system operator was allowed a 10 percent markup on certain direct costs as an allowance for operator profit.

Therefore, the overall financial model for a stand-alone organization therefore has $14.35 Million ($11.45 + $2.9 Million) annually in fixed cost for administrative, sales and marketing expenses. If costed on an incremental basis the $14.35 Million in fixed administrative, sales and marketing expenses can be ignored since the rail operator would incur these costs regardless of whether the new service is added or not. The $1.84 per train mile cost for incremental management staff is still included however, along with the variable call center (70.9¢ per rider), credit card and travel agency commissions (combined, 2.8% of revenue) and 10% markup on selected items that was agreed by the MWRRS committee as a reasonable allocation to operator profit.

3.7.3 Operating Cost Breakdown and the Cost of Dedicated Tracks

79-mph vs. 110-mph services have different cost structures. The most important difference is that the proposed 110-mph service would be based on dedicated passenger tracks, where the passenger train operator has full cost responsibility for the tracks. For 79-mph services it is assumed that the existing freight operator would continue to be responsible for the track, but would be paid on a train-mile basis for its use. A key result is that dedicated tracks are very expensive unless the system runs enough trains to effectively utilize the investment. But if the rail system effectively utilizes the capacity, then owning track can be less expensive than paying someone else to provide it. This generally imposes minimum volume thresholds on the effective operation of dedicated systems, giving better economic results for higher service frequencies. Exhibit 3-19 compares the 2030 Operating Cost distribution of Route 2 – 79-mph – 2 round trips as compared to Route 2 – 110-mph – 8 round trips.

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45 In the MWRRS cost model, call center costs were built up directly from ridership, assuming 40 percent of all riders call for information, and that the average information call will take 5 minutes for each round trip. Call center costs, therefore, are variable by rider and not by train-mile. Assuming some flexibility for assigning personnel to accommodate peaks in volume and a 20 percent staffing contingency, variable costs came to 57¢ per rider. These were inflated to 66¢ per rider in $2008 and now 70.9¢ per rider in 2013.
Equipment, fuel, track, and crews are seen to be the largest cost drivers; in each case these five categories comprise about 75% of the total cost although the order of the categories are different. Track costs comprise a significant share of operating expenses; for the 79-mph service running two round trips the track cost is $2.18 Million per year or $1.09 Million per round trip frequency. But for the 110-mph service it is $5.06 Million per year or $0.63 Million per round trip frequency. If capital maintenance costs were included the track cost would rise to $10.53 Million per year which for 8 round trips comes to $1.32 Million per round trip frequency. This is seen to still be competitive with the cost of shared tracks provided 8 or more daily round trips are operated over those tracks.

If a service is running enough passenger trains, the comparison shows that dedicated tracks are actually more cost effective than shared tracks. This is especially true if the freight railroad is still making a contribution towards the cost of track maintenance which can potentially offset a significant share of the track maintenance cost that must otherwise be borne by the passenger service.
3.7.4 Comparison to the Passenger Rail Investment and Improvement Act of 2008 Costs (PRIIA)

TEMIS was asked to develop a comparison of its MWRRS-derived costs to a PRIIA costing basis. PRIIA costs are the result of a complex calculation based on Amtrak proprietary data. As a result it is impossible to precisely replicate PRIIA costs in a planning study. However, a benchmark was found in the Michigan Detroit/Chicago EIS\(^{46}\) that offers a PRIIA cost basis that is suitable for comparison purposes. This reference gives the important cost drivers like revenue, ridership and train size which enabled a direct comparison between the MWRRS-derived costs used here, and a PRIIA-derived costing basis. This comparison could be developed for the three operating scenarios that were developed for the Chicago to Detroit/Pontiac rail corridor: No Build, Interim Service and Full Build and in three categories: Direct, Track and Overhead Operating Costs. This comparison was developed by entering the Cost Driver factors from the Michigan Detroit/Chicago EIS into TEMIS costing model. This enables a direct comparison of the results of the two different costing approaches.

The results are shown in Exhibit 3-20, 3-21 and 3-22. Exhibits 3-20 and 3-21 show that MWRRS direct and track costs match PRIIA costs very closely. For the low frequency No Build operation, the MWRRS costing basis starts a little higher and ends a little lower. This has to do with the exact economies of scale projected for the proposed 110-mph train options. Track costs similarly match closely with PRIIA costs. This should come as no surprise since the PRIIA and MWRRS methodologies use very similar approaches for estimating track cost.

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Exhibit 3-22 tells a somewhat different story. In the area of overhead cost allocations, PRIIA costs are allocating a greater share of overhead costs to Amtrak than are actually added by the system. This means that Amtrak is charging more than its actual incremental cost for running the additional service. As Michigan adds more trains, this means that Michigan must also bear more of Amtrak’s existing overhead costs. As shown in Exhibit 3-23, MWRRS overhead costs are running in the 17-20% range including the 10% set-aside for operator profit; under PRIIA, overhead and administrative costs comprise about 21-26% of the total.
By increasing the level of overhead cost allocated to a route, the PRIIA methodology reduces the operating ratio and operating surplus. PRIIA costs are seen to add about $4.50 per train mile in added overhead cost by comparison to the MWRRS methodology. In terms of understanding the impact of this, Exhibit 3-24 shows the impact on the forecasted Operating Surplus of the Route 2 8-Round Trip 110-mph Coast-to-Coast options.
This suggests that for an 8-train 110-mph service, the PRIIA cost allocation methodology will likely reduce forecasted operating surpluses by 25%, due to additional overhead expenses allocated to the corridor. For this service, the impact of this larger PRIIA overhead allocation will not completely wipe out the operating surplus. But for a weaker corridor or more marginal service, this overhead allocation difference could tip the balance. For a 79-mph service that cannot even cover its direct operating cost, adding even more overhead cost allocations would further increase the level of operating subsidy needed to sustain the service.

A key point, therefore, is that Amtrak would charge an additional $4.50 per track mile over a private sector franchise. As a result, the decision on who operates the potential Coast-to-Coast Corridor severely affects the ability of the system to cover its operating cost.
Chapter 4
Prioritized Capital Plan

SUMMARY

This chapter estimates Capital Costs for the Coast-to-Coast Study alternatives and includes a discussion of the Capital Cost methodology and breakdowns of costs by rail segment. The focus of this analysis will be on development of the capital costs for each route, train speed and frequency option. These costs are consistent with the operating plan and train running times that were used as the input to the evaluation process. The unit capital costs for estimating infrastructure, equipment, and maintenance facility capital costs are also described. Planning level costs were developed by updating earlier engineering assessments of corridor segments, as well as by recent cost estimates and construction costs on comparable projects.

4.1 Introduction

Exhibit 2-7 shows the route options proposed for the Coast-to-Coast Rail Corridor that were used to estimate Capital Costs for the Coast-to-Coast Corridor. Three possible Holland to Detroit routes have been assessed: Route 1, using Norfolk Southern (NS)-owned track via Lansing/Jackson; Route 2 using Ann Arbor (AA)-owned track via Howell/Ann Arbor, and Route 3 using CSX Transportation (CSX)-owned track via Plymouth/Wayne.
For each of three route alternatives shown in Exhibit 2-7, Capital Costs were developed for:

- 79-mph services
- 110-mph services

Due to project scope and budget, the 90 mph option presented in earlier parts of this report is not included in the capital cost analysis, but could be included in further study of the corridor.

In addition, each route and technology option was also evaluated for 2 frequency options. Thus, overall, Capital Costs were developed for twelve distinct routes options as follows:

3 routes x 2 technology-speeds options x 2 frequency options = 12 options

### 4.2 Train Operating Assumptions

#### 4.2.1 Sharing with Freight Railroads

For development of a 110-mph option in this study, it has been assumed that certain segments of rail line would be purchased by a public entity such as Michigan Department of Transportation (MDOT) under terms similar to what Norfolk Southern agreed for its recent conveyance of the Dearborn to Kalamazoo rail line for the accelerated rail program. This could enable the proposed 110-mph services to be operated over MDOT tracks without violating any freight railroad principles. However, the final capital plan and capital costs for shared segments as well as the possibility of track and/or right-of-way conveyance will need to be worked out in negotiations with the freight railroads. Because of this, it is possible real costs could vary greatly from this estimate.

In the meantime, this report contains preliminary data which is subject to review, verification and approval by both CSX and Norfolk Southern Railroad. As of the date of this report, this review process has not taken place. Findings are not to be construed as a commitment on the part of either CSX or Norfolk Southern to operate additional service.

#### 4.2.2 Consistency with Train Operating Assumptions

As described in Service and Operating Plan (Chapter 3), speed profiles for the Coast-to-Coast corridor route and technology alternatives were derived using LOCOMOTION™ and MISS-IT™ rail simulation software. For this analysis, the achievable train speeds were limited based on the curvature of the track as well as civil speed restrictions. Civil speed restrictions are imposed due to non-geometric limitations such as grade crossings, rail yards, urban areas or other operating constraints where train speeds must be limited.

- Currently, train operations are slowed through the freight yards at Grand Rapids and Lansing due to track conditions. It has been assumed that main line speeds could be raised to 60-mph around the yards.
- U.S Department of Transportation, Federal Rail Administration (FRA) regulations allow operations up to 90-mph through conventional gated highway crossings, or up to 110-mph through
improved highway crossings. As a result, the 79-mph option will be assessed using conventional gated crossings, and the 110-mph option with improved-crossings.

4.3 Capital Cost Engineering Assessment Methodology

The Capital Cost Engineering Assessment Methodology for the proposed Coast-to-Coast Rail Corridor has been conducted at a feasibility level of detail and accuracy. Exhibit 4-2 highlights the levels of accuracy associated with typical phases of project development and engineering design. A 30% level of accuracy is associated with the evaluation of project feasibility; while the level of accuracy of 10% is achieved during final design and production of construction documents. This phase of the study is only the first step in the project development process. As shown in Exhibit 4-1, the cost estimate is intended to be a mid-range projection with equal probability of the actual cost moving up or down.

Exhibit 4-1: Engineering Project Development Phases and Levels of Accuracy Development

<table>
<thead>
<tr>
<th>Development Phases</th>
<th>Approximate Engineering Design Level*</th>
<th>Approximate Level of Accuracy**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility Study</td>
<td>0%</td>
<td>+/- 30% or worse</td>
</tr>
<tr>
<td>Project Definition/Advanced Planning</td>
<td>1-2%</td>
<td>+/- 25%</td>
</tr>
<tr>
<td>Conceptual Engineering</td>
<td>10%</td>
<td>+/- 20%</td>
</tr>
<tr>
<td>Preliminary Engineering</td>
<td>30%</td>
<td>+/- 15%</td>
</tr>
<tr>
<td>Pre-Final Engineering</td>
<td>65%</td>
<td>+/- 15%</td>
</tr>
<tr>
<td>Final Design/Construction Documents</td>
<td>100%</td>
<td>+/- 10% or better</td>
</tr>
</tbody>
</table>

*Percent of final design  **Percent of actual costs to construct

In addition to the field inspections and extensive work with the geographic information system (GIS) and railroad track charts, the Coast-to-Coast corridor also has a long history of previous engineering studies that provide costs for upgrades along the whole route or portions of the route. For consistency with this previous work, these studies have been extensively relied upon, but updated as appropriate, in the development of the current engineering costs for each line segment.

4.3.1 Infrastructure Unit Costs

The infrastructure capital unit costs used in the development of the preliminary capital cost estimates were developed from TEMS library of Conventional and High-Speed Rail unit costs, as well as from previous studies of segments of the Coast-to-Coast corridor and from current Michigan engineering benchmarks. Some of the unit costs were estimated by updating previously developed representative unit costs from previous TEMS work in the Midwest Regional Rail studies and for the Rocky Mountain Rail Authority. Peer panels, freight railroads and construction contractors have reviewed these costs in numerous previous studies. The unit cost database and corridor infrastructure costs are appropriate for a feasibility-level planning study. The costs will need to be further refined in future phases of work if an Alternatives Analysis for the Environmental Impact Statement (EIS) work are undertaken.
Since revenues and operating costs in this study are expressed in 2013 dollars, infrastructure capital costs are also expressed in 2013 dollars for consistency in use in the Cost Benefit analysis.

The base set of unit costs addresses typical passenger rail infrastructure construction elements including: roadbed and track work, systems, facilities, structures, and grade crossings. In the following tables (Exhibits 4-3 to 4-6), only a subset of these costs were actually used in Capital Cost development.

### 4.3.1.1 Track

Exhibit 4-2 shows the unit costs used for track work.

**Exhibit 4-2: Unit Capital Costs, Trackwork and Right-of-Way in 2013**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Cost (Thousands of 2013$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Single Track on Existing Roadbed (141# CWR, Conc. TF)</td>
<td>per mile</td>
<td>$1,246.11</td>
</tr>
<tr>
<td>1.2</td>
<td>Double Track on Existing Roadbed</td>
<td>per mile</td>
<td>$2,492.42</td>
</tr>
<tr>
<td>1.3</td>
<td>Single Track on New Roadbed &amp; New Embankment</td>
<td>per mile</td>
<td>$1,872.29</td>
</tr>
<tr>
<td>1.4</td>
<td>Single Track 15' offset added to existing corridor on 15' fill</td>
<td>per mile</td>
<td>$2,532.29</td>
</tr>
<tr>
<td>1.8</td>
<td>Double Track 15' offset added on 15' fill</td>
<td>per mile</td>
<td>$4,807.82</td>
</tr>
<tr>
<td>1.9</td>
<td>Double Track 30' offset added on 15' fill</td>
<td>per mile</td>
<td>$5,599.85</td>
</tr>
<tr>
<td>1.10</td>
<td>HSR New Double Track on 15' Retained Earth Fill</td>
<td>per mile</td>
<td>$17,724.11</td>
</tr>
<tr>
<td>1.11</td>
<td>Timber &amp; Surface w/ 33% Tie Replacement</td>
<td>per mile</td>
<td>$278.62</td>
</tr>
<tr>
<td>1.12</td>
<td>Timber &amp; Surface w/ 66% Tie Replacement</td>
<td>per mile</td>
<td>$415.33</td>
</tr>
<tr>
<td>1.13</td>
<td>Relay Track w/ 136# CWR</td>
<td>per mile</td>
<td>$444.29</td>
</tr>
<tr>
<td>1.14</td>
<td>Freight Siding</td>
<td>per mile</td>
<td>$1,144.50</td>
</tr>
<tr>
<td>1.40</td>
<td>#33 High-Speed Turnout (Swing Nose Frog)</td>
<td>each</td>
<td>$712.73</td>
</tr>
<tr>
<td>1.41</td>
<td>#24 High-Speed Turnout (Swing Nose Frog)</td>
<td>each</td>
<td>$564.67</td>
</tr>
<tr>
<td>1.42</td>
<td>#15 Turnout Timber</td>
<td>each</td>
<td>$261.00</td>
</tr>
<tr>
<td>1.43</td>
<td>#11 Turnout Timber</td>
<td>each</td>
<td>$220.4</td>
</tr>
<tr>
<td>1.44</td>
<td>#33 Crossover</td>
<td>each</td>
<td>$1,425.56</td>
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<tr>
<td>1.45</td>
<td>#20 Crossover</td>
<td>each</td>
<td>$625.76</td>
</tr>
<tr>
<td>1.46</td>
<td>Interlockings and Crossovers every 10 miles (average)</td>
<td>Per mile</td>
<td>$265.00</td>
</tr>
<tr>
<td>1.47</td>
<td>Elastic Fasteners</td>
<td>per mile</td>
<td>$102.88</td>
</tr>
</tbody>
</table>

### 4.3.2 Structures: Approaches, Flyovers and Bridges

An inventory of bridges has been developed for each existing rail route from railroad track charts. The most important bridge project in this study is the major bridge in Ann Arbor in Route 2 that would be needed to connect the Amtrak line to the former Ann Arbor line towards Howell. While some representative bridge costs are provided below, the costs for this bridge were based on a previous
detailed engineering estimate\textsuperscript{47}. This cost has been included as a placeholder in the current estimate. Exhibit 4-3 shows the structural unit costs.

### Exhibit 4-3: Unit Capital Costs, Structures in 2013

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description (Bridges-under)</th>
<th>Unit</th>
<th>Unit Cost (Thousands of 2013$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Four Lane Urban Expressway (Rail over Highway)</td>
<td>each</td>
<td>$6,067.52</td>
</tr>
<tr>
<td>2.2</td>
<td>Four Lane Rural Expressway (Rail over Highway)</td>
<td>each</td>
<td>$5,051.03</td>
</tr>
<tr>
<td>2.3</td>
<td>Two Lane Highway (Rail over Highway)</td>
<td>each</td>
<td>$3,832.50</td>
</tr>
<tr>
<td>2.4</td>
<td>Rail (New Rail over Existing Rail)</td>
<td>each</td>
<td>$3,832.50</td>
</tr>
<tr>
<td>2.5</td>
<td>Double Track High (50’) Level Bridge</td>
<td>per LF</td>
<td>$15.27</td>
</tr>
<tr>
<td>2.6</td>
<td>Convert open deck bridge to ballast deck (single track)</td>
<td>per LF</td>
<td>$5.83</td>
</tr>
<tr>
<td>2.7</td>
<td>Convert open deck bridge to ballast deck (double track)</td>
<td>per LF</td>
<td>$11.77</td>
</tr>
<tr>
<td>2.8</td>
<td>Single Track on Flyover/Elevated Structure</td>
<td>per LF</td>
<td>$5.30</td>
</tr>
<tr>
<td>2.9</td>
<td>Single Track on Embankment w/ Retaining Wall</td>
<td>per LF</td>
<td>$3.71</td>
</tr>
<tr>
<td>2.10</td>
<td>Double Track on Flyover/Elevated Structure</td>
<td>per LF</td>
<td>$8.48</td>
</tr>
<tr>
<td>2.12</td>
<td>Double Track on Embankment w/ Retaining Wall</td>
<td>per LF</td>
<td>$6.89</td>
</tr>
<tr>
<td>2.13</td>
<td>Ballasted Concrete Deck Replacement Bridge</td>
<td>per LF</td>
<td>$2.65</td>
</tr>
</tbody>
</table>

#### 4.3.2.1 Train Control Systems

The capital cost estimates for this study include costs to upgrade the train control and signal systems. Signal systems include train borne components and wayside equipment such as track circuits, switch operators, and wayside detectors for protection against intrusion, high water, hot bearings and dragging equipment.

Modern signal systems rely on digital communication systems for data transmission using radio, fiber optic cables or a combination of the two. In addition, the communication system provides radio for operations, supervisory control and data acquisition for power systems, passenger station public address, etc. Wayside space must be provided for ducts and enclosures to house signal and communication components. Exhibit 4-4 shows the unit costs for systems.

\textsuperscript{47} From Lansing to Detroit Passenger Rail Study, Phase III Report, page 5-16; see http://semcog.org/Pages/0/Documents/Plans-For-The-Region/Transportation/Transit/Ann-Arbor-To-Detroit-Regional-Rail/LansingToDetroitCommuterRailStudyPhaseIIIReport.pdf, retrieved on 9/17/2015
### Exhibit 4-4: Unit Capital Costs, Systems, in 2013

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit Cost (Thousands of 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Signals for Siding w/ High-Speed Turnout</td>
<td>$1,591.23</td>
</tr>
<tr>
<td>3.2</td>
<td>Install CTC System (Single Track)</td>
<td>$229.62</td>
</tr>
<tr>
<td>3.3</td>
<td>Install CTC System (Double Track)</td>
<td>$376.52</td>
</tr>
<tr>
<td>3.4</td>
<td>Install PTC System Overlay on top of CTC</td>
<td>$181.36</td>
</tr>
<tr>
<td>3.5</td>
<td>Control Points</td>
<td>$870.00</td>
</tr>
<tr>
<td>3.6</td>
<td>Intermediate Signals</td>
<td>$348.00</td>
</tr>
<tr>
<td>3.7</td>
<td>Equipment Defect Detectors (Every 20 miles)</td>
<td>$348.00</td>
</tr>
<tr>
<td>3.8</td>
<td>At-grade Active Warning Devices</td>
<td>$580.00</td>
</tr>
<tr>
<td>3.9</td>
<td>Switch Heaters, Propane Tanks, Generators</td>
<td>$116.00</td>
</tr>
<tr>
<td>3.10</td>
<td>CTC - Dispatch Center</td>
<td>$232.00</td>
</tr>
<tr>
<td>3.11</td>
<td>CTC Upgrade of ABS Territory</td>
<td>$580.00</td>
</tr>
<tr>
<td>3.12</td>
<td>Communications</td>
<td>$46.00</td>
</tr>
<tr>
<td>3.13</td>
<td>Electric Lock for Industry Turnout</td>
<td>$129.29</td>
</tr>
<tr>
<td>3.14</td>
<td>Signals for Crossover</td>
<td>$878.39</td>
</tr>
<tr>
<td>3.15</td>
<td>Signals for Turnout</td>
<td>$501.98</td>
</tr>
<tr>
<td>3.16</td>
<td>Signals, PTC, Communications &amp; Dispatch (Double Track)</td>
<td>$1,602.00</td>
</tr>
</tbody>
</table>

### 4.3.3 Crossings

Highway/railroad crossing safety plays a critical role in future project development phases. A variety of devices were considered to improve safety including roadway geometric improvements, median barriers, barrier gates, traffic channelization devices, wayside horns, fencing and the potential closure of crossings. Exhibit 4-5 shows the unit costs for highway and railroad grade crossings.
### Exhibit 4-5: Unit Capital Costs, Crossings, in 2013

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Cost (Thousands of 2013$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Private Closure</td>
<td>each</td>
<td>$104.15</td>
</tr>
<tr>
<td>4.2</td>
<td>Four Quadrant Gates w/ Trapped Vehicle Detector</td>
<td>each</td>
<td>$617.38</td>
</tr>
<tr>
<td>4.3</td>
<td>Four Quadrant Gates</td>
<td>each</td>
<td>$361.45</td>
</tr>
<tr>
<td>4.4</td>
<td>Convert Dual Gates to Quad Gates</td>
<td>each</td>
<td>$188.26</td>
</tr>
<tr>
<td>4.5</td>
<td>Conventional Gates single mainline track</td>
<td>each</td>
<td>$208.30</td>
</tr>
<tr>
<td>4.6</td>
<td>Conventional Gates double mainline track</td>
<td>each</td>
<td>$257.30</td>
</tr>
<tr>
<td>4.7</td>
<td>Convert Flashers Only to Dual Gate</td>
<td>each</td>
<td>$62.79</td>
</tr>
<tr>
<td>4.8</td>
<td>Single Gate with Median Barrier</td>
<td>each</td>
<td>$225.91</td>
</tr>
<tr>
<td>4.9</td>
<td>Convert Single Gate to Extended Arm</td>
<td>each</td>
<td>$18.77</td>
</tr>
<tr>
<td>4.10</td>
<td>Precast Panels without Roadway Improvements</td>
<td>each</td>
<td>$100.44</td>
</tr>
<tr>
<td>4.11</td>
<td>Precast Panels with Roadway Improvements</td>
<td>each</td>
<td>$188.26</td>
</tr>
</tbody>
</table>

#### 4.3.4 Other Costs

Contingency costs have been included as an overall percentage of the total construction cost. Contingencies are an allowance added to the estimate of costs to account for items and conditions that cannot be realistically anticipated. The contingency is estimated at 30 percent of the construction cost elements. This contingency included 15%+ for design contingency and 15%+ for construction contingency. Contingency and professional service allowances are added for infrastructure capital costs only. They are not added for land acquisition, property taking, wetland remediation or placeholder costs since these factors are the results of benchmarking rather than engineering cost comparisons.

The project elements included in the Professional Services category are design engineering, program management, construction management and inspection, engineering during construction, and integrated testing and commissioning. For a project of this size, an overall program manager with several section designers is needed to provide conceptual engineering, preliminary engineering, environmental studies, geotechnical engineering, final engineering and engineering during construction. Field and construction management services and integrated testing services and commissioning of various project elements also are required. Professional services and other soft costs required to develop in this study have been estimated as a percentage of the estimated construction cost and are included in the overall cost estimates as a separate line item. Overall this adds 28% on top of the base cost and contingency.
These costs include:

- Design engineering and related studies: 10%
- Insurance and Bonding: 2%
- Program Management: 4%
- Construction management and inspection: 6%
- Engineering services during construction: 2%
- Integrated Testing and Commissioning: 2%
- Erosion Control and Water Quality Mgmt.: 2%

The unit costs already include built-in allowances for contingency and soft costs. That is, the unit costing basis already includes the necessary additives, so these allowances do not need to be added a second time. This is the same approach to costing that was used in the Midwest Regional Rail Study because it simplifies the presentation of the cost estimates and makes them easier to understand.

Capital Costs include allocations for special elements (placeholders) as conservative estimates for large and/or complex engineering projects that have not been estimated on the basis of unit costs and quantities. Placeholders provide lump sum budget approximations based on expert opinion rather than on an engineering estimate and are shown in the unit costs as lump sum items. Since many of these placeholders are based on benchmarking to actual projects rather than on an engineered unit cost approach, they do not include any additional allowance for contingency or soft costs. Placeholders are used where detailed engineering requirements are not fully known. These costs will require special attention as part of the environmental planning process.

### 4.4 Segment and Route Infrastructure Costs

Exhibits 4-6 and 4-7 summarize the infrastructure costs that were developed for each track segment that make up the Coast-to-Coast route alternatives. Some segments are common to multiple routes, so for consistency the Engineering analysis was done on a segmented basis. Then, the infrastructure summary totals for each of the three route alternatives are calculated by summing the segment-level costs. These costs along with the segments that make up the alternative are also shown.
4.4.1 Costing Segment #1 – Holland to Grand Rapids

The 2004 MWRRS study estimated the capital cost for implementing a 79-mph service on this segment as $12.3 Million in 2002 dollars. MWRRS assumed gates would be installed at all remaining ungated crossings, which comprised about 25% of the total, and raised the speed to 79-mph by replacing 33% of the crossties and resurfacing track. It is assumed that the existing welded rail would not need to be replaced. Train speeds would be raised to 60-mph through and around the freight yards at Waverley and Grand Rapids.

This study updates the cost to $28.0 Million in 2013 dollars for a 79-mph based on similar assumptions, but also includes a $20 Million allowance for a train servicing facility at Waverly yard and station improvements at Holland, as were described in the 2004 MWRRS study (Exhibit 7-27) reproduced below in Exhibit 4-8.
The cost for 110-mph service has been estimated as $78.6 Million. It is assumed that a public entity would be able purchase this track segment under similar terms to those recently offered Norfolk Southern for the Dearborn to Kalamazoo segment. A rate of $1 Million a mile was assumed based on this benchmark. This assumes that rail would not need to be replaced, but curves would be resurfaced and spirals adjusted for allowing higher speeds, a PTC overlay system capable of supporting 110-mph operations would be installed and all crossings would need to be improved for compliance with FRA regulations.

4.4.2 Costing Segment #2 – Grand Rapids to Lansing
This segment uses assumptions that are very similar to those for segment #1 since the existing conditions are very similar. For 79-mph service, about 25% of the crossings would receive new gates. 33% of the crossties would be replaced and the track resurfaced. It is assumed that the existing welded rail would not need to be replaced. Train speeds would be raised to 60-mph through and around the freight yard at Lansing. Five miles of double track would be added for allowing meets between passenger trains as well as between freight and passenger trains. This would cost $34.2 Million.

For the 110-mph option, curves would be resurfaced and spirals adjusted for allowing higher speeds, a PTC overlay system capable of supporting 110-mph operations would be installed and all crossings would be improved for compliance with FRA regulations. Ten miles of double track would be added between Grand Rapids and Lansing for allowing train meets at speed. It is assumed that a public entity would be able purchase this track segment under similar terms to those recently offered Norfolk Southern for the Dearborn to Kalamazoo segment. A rate of $1 Million a mile was assumed based on this benchmark. The overall cost for doing this would come to $156.9 Million.

4.4.3 Costing Segment #3 – Lansing to Jackson
The Lansing to Jackson rail line is owned by Norfolk Southern, but is leased and operated by the Jackson and Lansing Railroad Company (JAIL.) A key concern for both the Norfolk Southern (NS) Lansing to Jackson segment #3, as well as for the Great Lakes Central (GLC) Howell to Ann Arbor segment #8 (North-South
Commuter Rail line) is whether the existing jointed rail must be replaced to support 79-mph passenger service. In May 2015, rail line segments #3 and #8 were inspected. The rail condition was a special focus of these inspections\(^\text{48}\). As shown in Exhibit 4-9, the field inspection showed that with heavy rail and light traffic on the Lansing to Jackson line, the rail still looked to be in good shape overall, although there may be some isolated pockets where rail conditions may be a concern. The inspection did not show any immediate need for a wholesale rail replacement to support the needs of 79-mph passenger service. As standards for rail replacement, on page 8-5 the 1982 GM Study recommended:

- All new rail that is to be installed is continuous welded rail that weighs 132 pounds per yard of length. This rail is to be installed whenever the following conditions prevail:
  - If the maximum passenger train speed is 79-mph, when the rail in the existing track weighs less than 90 pounds per yard of length;
  - If the maximum passenger train speed is 100-mph, when the rail in the existing track weighs less than 115 pounds per yard of length;
  - If the maximum passenger train speed is to be 125-mph, when the existing FRA track class is 1 or 2 regardless of the type of rail presently installed and when the existing FRA track class is 3, 4, or 5 and the existing rail is either bolted rail or weighs less than 115 pounds per yard of length;
  - If the maximum passenger trains speed is to be 150-mph, when the existing FRA track class is 1 or 2 regardless of the type of rail presently installed and when the existing FRA track class is 3, 4, or 5 and the existing rail is either bolted rail or weighs less than 132 pounds per yard of length.

R. L. Banks’ 2008 assessment of the Washtenaw–Livingston Rail Line (North-South Commuter Rail Line) also found that wholesale rail replacement was not needed, but R. L. Banks did recommend replacing 0.3 miles of 100 pounds per yard rail located west of Whitmore Lake Siding\(^\text{49}\). This is consistent with GM’s


\(^{49}\) See R. L. Banks (June 2008) Washtenaw Livingston Rail Line (North-South Commuter Rail line) Technical Review, Subtask 2.3. Track, Signal and Grade Crossing, page 5. Retrieved from
recommendation to change out light rail, which GM defined as 90- pounds per yard weight or less, but R. L. Bank defined as 100 pounds per yard or less. Based on the R. L. Bank’s proposal for upgrading the line, as shown in Exhibit 4-10, an "All In" Rate of $820,000 per mile\(^\text{50}\) has been developed. This (North-South Commuter Rail Comp) covers the cost for rehabilitation of jointed rail track\(^\text{51}\), grade crossings\(^\text{52}\), and installation of signals and PTC\(^\text{53}\) for operations up to 79-mph. \(^\text{54}\)


\(^\text{50}\) From the same R. L. Banks reference cited above, the projected capital costs on Page 10 were $32.4 Million, but include $2.6 Million for a layover facility, $4.3 million for stations and $4.4 Million in Other costs. The 20% contingency associated with these costs is $2.2 Million. Removing these leaves $18.9 Million for track infrastructure, grade crossings, signals and PTC for a 26.9 mile rail corridor, or $702,000 per mile in 2008 dollars. Bringing this to 2013 dollars the cost is $820,000 per mile.

\(^\text{51}\) Track cost was compared to a recent engineering assessment of the North-South Commuter Rail corridor performed by Quandel. Quandel’s estimate is more detailed than R. L. Banks, since it details the cost in four sections; two southern AA and two northern GLC. However, a lot of the track rehabilitation cost is south of the Huron River because the AA track is very bad. But the Coast-to-Coast rail system does not use this track because it uses the new Huron River Bridge to connect to the MDOT Michigan line. Looking only at the northern GLC segments where the track condition is better. Quandel’s new cost is $176.8 thousand per mile. With the same 20% contingency that R. L. Banks used, Quandel’s cost for the northern GLC segment would be $212 thousand per mile which is actually less than the $270K per mile R. L. Banks estimated. TEMS believes that R.L. Banks 20% engineering contingency is appropriate for basic track rehabilitation work for which costs are very well known. TEMS Segment 8 Track Cost for 79-mph is $6.9 million rising to $31.8 million for our 110-mph option. Even given the higher soft costs and contingency rate that Quandel used, the updated North-South Commuter Rail line $7.5 million cost lies toward the lower end of TEMS cost range for the northern GLC segments. As a result, Quandel’s updated North-South Commuter Rail line track costs are within the range of TEMS estimates.

\(^\text{52}\) Quandel replaced all the grade crossings for 60-mph speed; R. L. Banks did not since it is not a regulatory requirement at this speed. R. L. Banks allowed $2.2 Million for upgrading North-South Commuter Rail line crossings whereas Quandel’s cost is twice that. TEMS does not agree that replacing all the crossing devices is actually needed for 60 to 79-mph operation and so has adopted R. L. Banks number for the slow speed option. However TEMS did replace all the grade crossing devices for 110-mph service. TEMS Segment 8 Crossings Cost for 79-mph is $2.1 million rising to $13.3 million for our 110-mph option. Even given the higher soft costs and contingency rate that Quandel used, the updated North-South Commuter Rail line $4.0 million cost lies toward the lower end of TEMS cost range for the northern GLC segments. As a result, Quandel’s grade crossing costs are within the range of the TEMS estimates.

\(^\text{53}\) Quandel’s proposed PTC costs for the North-South Commuter Rail line are at $1.02 million per mile based on construction of a CTC system with a PTC overlay. The overlay including back office server, wayside interface unit functionality and vitality is priced at 82% of the signal system hardware based on Quandel’s analysis of the MDOT GE pricing. However, other comparables suggest that the price for the wayside PTC components should be lower, more in line with R. L. Banks’ original estimates:

- On Oct 2, 2015, NICTD awarded a $79.9 million contract to Parsons Corp for a 75 route-mile system or $1.06 million per mile. See: http://www.chicagotribune.com/suburbs/post-tribune/news/ct-pb-nictd-shutdown-resolution-st-1003-20151002-story.html Of this, the wayside and back office components together cost $39.7 million, but NICTD is about 40% double track, so the average comes to $378K per track mile which is actually less than TEMS assumed PTC unit cost per track mile. The NICTD contract is turn-key and fixed-price, since the vendor was asked to assume all the business risk associated with the contract, undoubtedly raised the price. NICTD was advised that their existing control center and software could not be used, so the price includes a whole new control center. Finally, mobilization, training and approvals constitutes a very large (20% share) of the cost for such things as training manuals.
  - Wayside and Testing accounts for 36% of the project cost, $379,218 per route mile
  - Back Office accounts for 14% of the project cost, $510,244 per route mile
  - Vehicles account for 22% of the project cost, 131 cabs for $131,327 per cab
  - The remainder of 29% of the project cost is for training and back office software
- Alaska Railroad is implementing the I-ETMS system, which uses Track Warrant Control in dark territory and also interfaces with signals in those locations where the Alaska Railroad has them. As according to: http://www.alaskajournal.com/business-and-finance/2015-02-11/railroad-cuts-ptc-ask-aims-finance-remaining-need the total capital cost of the Alaska Railroad system is $160 million. Over $25 miles of track that would come to a capital cost of $305K per mile (for everything including control center, wayside and vehicles.) which again is substantially less than the $467K per mile that R. L. Banks estimated. Alaska Railroad is running passenger trains at 60-mph, so this solution would work for the North-South Commuter Rail line as well.

TEMS Costs for PTC and signaling in the Coast-to-Coast study are in the $410-470K per mile range, which is in line with accepted industry comparable costs. For keeping PTC cost at manageable levels in the future, it is recommended that Michigan DOT consider installing non-overlay versions of PTC (such as Alaska Railroad’s system) and also obtain industry certification for the freight railroad standard I-ETMS up to 110-mph. Doing this would avoid having to install redundant (ITCS + I-ETMS) systems in shared-used territory, since the freight railroads do not want to have to equip their locomotive fleets for ITCS. FRA does not require installation of block signals in conjunction with PTC: 49 CFR § 236.1007 requires appropriate fouling circuits and broken rail detection (or equivalent safeguards) for speeds greater than 60-mph and split-point derail or equivalent for speeds greater than 90-mph. (see https://www.law.cornell.edu/cfr/text/49/236.1007)
Exhibit 4-10: Development of North-South Commuter Rail Line Comparable Cost

<table>
<thead>
<tr>
<th>Costs in $thousands</th>
<th>Yr 2008 RLB Base</th>
<th>Yr 2008 RLB w/ 20% Contingency</th>
<th>Yr 2013 RLB w/ 20% Contingency</th>
<th>/ mile 26.9 miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track Subtotal</td>
<td>$194</td>
<td>$232</td>
<td>$270</td>
<td></td>
</tr>
<tr>
<td>Crossings</td>
<td>$59</td>
<td>$71</td>
<td>$83</td>
<td>/ mile</td>
</tr>
<tr>
<td>Signals</td>
<td>$336</td>
<td>$403</td>
<td>$467</td>
<td></td>
</tr>
<tr>
<td>Cost/Mile</td>
<td>$588</td>
<td>$706</td>
<td>$820</td>
<td>/ mile</td>
</tr>
</tbody>
</table>

The GM Study did not assume rail replacement for either the NS Lansing to Jackson segment #3 or GLC Howell to Ann Arbor segment #8, and the 2008 North-South Commuter Rail line studies did not recommend rail replacement for the GLC Howell to Ann Arbor segment #8 either. There is a ride quality issue depending on the exact condition of the jointed rail, but not a safety issue if track is maintained to FRA Class IV standards.

For planning purposes, the overall track condition of segments #3 and #8 are considered to be very similar since the rail conditions look good, although both line segments require major tie work and surfacing, as well as installation of signals, PTC and highway grade crossing improvements. Since the exact rail conditions are not known, if it is decided to further pursue 79-mph options, then as R. L. Banks recommended a more detailed Engineering inspection, including an internal rail flaw detection test should be performed on both line segments. This can be accomplished during Environmental studies of the corridor.

For the 79-mph cost estimate: as applied to the 37.6 miles from Lansing to Jackson the unit cost of $820,000 per mile would result in a cost of $30.8 Million for upgrading the line segment to passenger standards. However, an additional 5-mile long passing siding also needs to be added for train meets and overtakes to occur along this segment. Since the existing Amtrak station at Trowbridge cannot be used in conjunction with this alignment, the cost estimate also includes an allowance for a new station platform in downtown Lansing. The cost of this station platform, passing siding and related signaling equipment adds another $15.4 Million to the cost, bringing the overall estimated cost of the 79-mph Lansing-Jackson upgrade to $46.2 Million.

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54 R. L. Banks assessed the corridor at a top speed of 60-mph: “At present GLC, with MDOT assistance, is maintaining its track infrastructure to Federal Railroad Administration (FRA) class 3 standards. Since Class 3 standards support passenger train speeds up to 60 mph, little should change from a maintenance point of view. The track structure likely will be maintained to the upper end of Class 3 standards, with some repairs performed to improve ride quality for passengers, such as flash-butt welding to eliminate joints.” As FRA Class 3 track, the current track condition is already good enough to support passenger service at 60-mph, so very little upgrading should be needed. Nonetheless, as shown in Exhibit 4-10, R. L. Banks average cost was $270,000 per mile for the whole corridor (R. L. Banks did not provide any breakdown of their costs by segment) and this is what was used for development of the North-South Commuter Rail line comparable cost. Welded rail is not needed for 79-mph operations but because the cost for flash-butt welding existing rail was already included by R. L. Banks, it is also included in TEMS 79-mph estimate. This overall level of cost was validated by comparison to Item 1.11 in Exhibit 4-2. This shows a rate of $278,620 per mile with full contingencies for 33% tie replacement and surfacing. This is very close to the number that was derived from the R. L. Banks study. Based on the agreement of these two sources, and because track conditions north of the Huron River are much better than those south of the river, TEMS believes that this amount should be more than sufficient for bringing the track to 79-mph. We concluded that the average level of cost recommended by R. L. Banks for the whole corridor (which is higher than Quandel’s track cost for the segments north of the river) and which we used in our analysis, would in fact, be sufficient to upgrade the north end of the line to 79-mph. So, we have developed it as a 79-mph cost.

55 From the same R. L. Banks reference cited above on page 5, “GLC confirmed that it had not performed an internal rail flaw detection test within recent history and agrees with the RLBA assertion that a thorough test must be performed to determine how much rail needs to be replaced (if any) before passenger operations begin.”
COAST-TO-COAST PASSENGER RAIL RIDERSHIP AND COST ESTIMATE STUDY: FINAL REPORT

For upgrading the line condition for 110-mph (although in many places the existing route geometry won’t allow this speed on Segment #3) the cost rises to $170.5 Million. This includes a $37.6 Million allowance ($1 million per mile) for purchasing this branch line track from Norfolk Southern. This provides Michigan DOT ownership of the corridor along with all new track, a 10-mile passing siding, PTC and grade crossing upgrades.

### 4.4.4 Costing Segment #4 – Jackson to Ann Arbor

This segment follows the existing Amtrak route from Jackson to Ann Arbor. Currently this line handles three round trip Chicago-to-Pontiac Amtrak trains each day, which are planned to increase to six round trips and finally to ten daily round trips upon completion of Chicago area line capacity improvements.

This line from Jackson to Detroit follows the former Michigan Central main line right of way, which at one time was completely double-traacked. As a result, the track bed and many of the bridge structures remain in place and can easily accommodate replacement of the double track. Even so, the average cost per mile (based on the recent Dearborn to Wayne project) is $3.32 Million per mile\(^{56}\) for restoring double track on the existing Michigan Central track bed. This includes the cost for switches, signals and PTC, as well as highway grade crossing modifications needed to accommodate the new track and connect it into the existing rail line.

A 79-mph option would add 4 daily round trips leading to a combined total of 14 daily passenger round trips east of Jackson. A 110-mph option would add 8 round trips east of Jackson so 18 daily round trips would be operated. Clearly this exceeds the capacity of a single tracked line:

- For a 79-mph option it is assumed that a single 10-mile long passing area would be added between Jackson and Ann Arbor. This costs $33.2 Million.
- For a 110-mph option it is assumed that complete restoration of the double track east of Jackson would be needed to support the operation of up to 18 daily round trips. This costs $103.9 Million.

### 4.4.5 Costing Segment #5 – Ann Arbor to Wayne

This segment follows the existing Amtrak route from Ann Arbor to Wayne. This line segment is already being equipped for 110-mph train operations, and double track already extends from Wayne as to Ypsilanti. As such there is only a short 9.1 mile single track segment.

- For a 79-mph option, it is assumed that passenger trains can be scheduled to avoid meeting in this short stretch of track so no improvements to this line segment are proposed.
- For the 110-mph option it is proposed to complete double tracking this segment to provide enough capacity for operating up to 18 intercity passenger round trips per day. Doing this would also likely provide enough capacity to allow the operations some local commuter trains as well. Applying the same benchmark cost of $3.32 Million per mile, this would cost $30.2 Million.

---

4.4.6 Costing Segment #6 – Wayne to Detroit

As a result of the Norfolk Southern railroad purchase agreement, the Wayne to Detroit line segment is currently being completely double tracked; and a new shorter connection is under construction that will provide a conflict-free route at West Detroit for getting the passenger trains over to Detroit New Center station. Additional improvements such as additional platform, and train storage tracks are already planned within the Detroit to Chicago EIS and it is assumed that these improvements will proceed.

With all these improvements, both underway and proposed, it is assumed that this segment will be able to support the needs of the Coast-to-Coast Rail Corridor without needing significant additional cost. This is of course, subject to confirmation by a detailed capacity analysis which will need to occur as part of the environmental planning process.

4.4.7 Costing Segment #7 – Lansing to Howell

This segment uses assumptions that are very similar to those for segments #1 and #2 since the existing conditions are very similar. For 79-mph service, about 25% of the crossings would receive new gates. 33% of the crossties would be replaced and the track resurfaced. It is assumed that the existing welded rail would not need to be replaced. Five miles of double track would be added for allowing meets between passenger trains as well as between freight and passenger trains. Since there is no current train station at Howell, the estimate also includes $1 Million for the cost of station platforms. This would cost $25.8 Million.

For the 110-mph option, curves would be resurfaced and spirals adjusted for allowing higher speeds, a PTC overlay system capable of supporting 110-mph operations would be installed and all crossings would be improved for compliance with FRA regulations. Ten miles of double track would be added between Grand Rapids and Lansing for allowing train meets at speed. It is assumed that Michigan DOT would be able purchase this track segment under similar terms to those recently offered Norfolk Southern for the Dearborn to Kalamazoo segment. A rate of $1 Million a mile was assumed based on this benchmark. The overall cost for doing this would come to $92.7 Million.

4.4.8 Costing Segment #8 – Howell to Ann Arbor

Most of this route segment (also known as the North-South Commuter Rail line) is already owned by the State of Michigan and is operated by the Great Lakes Central railroad. It has received extensive rehabilitation over the past 10 years or so and operates effectively as a rail freight branch line, but the track is not up to passenger standards.

For this segment, it is important to note that service proposed for the Coast-to-Coast passenger rail line is very different from the North-South commuter rail service that (at the time of this report) is being studied at a detailed, feasibility level. First, this study assumes that the Coast-to-Coast passenger rail service will have limited stations in this corridor, most likely stopping only south of Howell at Ann Pere junction and north of downtown Ann Arbor near the existing Amtrak station. The North-South commuter rail service would have additional stops in downtown Howell and Ann Arbor, as well as Genoa Township, Hamburg and Whitmore Lake. The North-South commuter rail service would also require a new freight yard, two layover facilities, connecting bus service and costs of more complicated track and signal work south of Barton drive which at this time are assumed not to be required for the more limited-stop, longer trip service proposed in this study for the Coast-to-Coast passenger rail line.
For 79-mph service, a new track connection to the CSX line at Ann Pere junction would be needed. Track rehabilitation, grade crossing improvements and a new PTC signal system would be installed. R. L. Banks has developed a recent detailed Engineering assessment of this line (as discussed earlier under Segment #3) – the R. L. Banks benchmark rate of $820,000 per mile was used for developing the 79-mph cost estimate for this line. In addition, the Ann Arbor railroad still owns several miles of track in Ann Arbor which are needed to make the connection to Michigan DOT’s current Amtrak line. The cost estimate includes the purchase of 2 miles of track at a rate of $1 million per mile.

A critical improvement needed is the construction of a new bridge at Ann Arbor (Exhibit 4-11) connecting the North-South Commuter Rail line to the former Michigan Central Amtrak route. By updating the estimate provided in the Lansing to Detroit Phase III report the cost of this bridge and track connection has been estimated as $20 Million.

The $20 million Ann Arbor bridge cost estimate includes the structure only and does not include possible land acquisition or environmental mediation that may be required at this relatively complex site. These requirements would need to be addressed in a later, more in-depth engineering study.

Exhibit 4-11: Ann Arbor Bridge and Connection

As a result, the overall cost for upgrading the Howell to Ann Arbor segment for 79-mph service has been estimated as $42.9 Million. For upgrading the line condition for 110-mph (although in many places the

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57 The map is taken from the Lansing to Detroit Passenger Rail Study, Phase III Report, page 5-19 by Parsons Transportation Group, a reputable engineering firm; see http://www.semcog.org/Portals/0/Documents/Plans-For-The-Region/Transportation/Transit/Ann-Arbor-To-Detroit-Regional-Rail/LansingToDetroitCommuterRailStudyPhaseIIIReport.pdf retrieved on 9-17-2015. Parsons states that “The new bridge construction involves a 12-degree curve and a 1.98 percent grade. This could be traversed at 25 mph.” These curves and grades are well within the capabilities of trains. In Exhibit 3-3 the unit cost of a “Double Track High (50’) Level Bridge” is $15,270 per foot so a double tracked 1,200’ bridge would be costed as $18.3 million -- which is still less than the $20 million that TEMS developed for a single tracked bridge by applying inflation factors to Parsons’ estimate. As a result, TEMS believes the cost for the bridge and connection is in the right range.
existing route geometry won’t allow this speed on Segment #8) the cost rises to $77.6 Million. This provides public ownership of the corridor along with all new track connections at Ann Pere and Ann Arbor, PTC and grade crossing upgrades.

**4.4.9 Costing Segment #9 – Howell to Wayne via Plymouth**

This segment uses assumptions that are very similar to those for segments #1, #2 and #7 since the existing conditions are very similar. For 79-mph service, about 25% of the crossings would receive new gates. 33% of the crossties would be replaced and the track resurfaced. It is assumed that the existing welded rail would not need to be replaced. Since there is no current train station at Plymouth, the estimate also includes $1 Million for the cost of station platforms. For the 110-mph option, curves would be resurfaced and spirals adjusted for allowing higher speeds, a PTC overlay system capable of supporting 110-mph operations would be installed and all crossings would be improved for compliance with FRA regulations.

However, capacity as well as compliance with CSX’s Letters of Principle becomes a special concern for this segment, particularly for the stretch of track between Plymouth and Wayne, which continues to remain a very busy route for freight trains and still has an approximate 2 mile section of single track in the middle. It should be noted that the earlier Ohio Hub studies that shared this same mainline corridor south of Wayne did not assume that the existing track could be shared. Rather they assumed the development of a new passenger-dedicated track from Wayne to Toledo paralleling the existing freight main line at a minimum spacing of 28’. However for the purpose of this assessment it will be assumed that the Plymouth to Wayne segment can be shared with freight trains, in accordance with CSX principles and based on the complete double tracking of the line south of Plymouth to Wayne.

The cost estimate includes 7 miles of added double track for the 79-mph option and 12 miles for the 110-mph option. The 110-mph estimate also includes an assumed $1 Million per mile payment to CSX for purchasing the rail corridor from Howell to Plymouth and for purchasing a right-of-way easement from Plymouth to Wayne.

Overall, this results in a cost of $36.7 Million for a 79-mph option and $100.9 Million for a 110-mph option.

**4.5 Equipment and Overall Capital Cost Summary**

For completing the Capital Cost estimate it is necessary to estimate equipment costs for each Alternative. Two speed options were developed for each of the three routes; however, two train frequency sub-options were also developed, leading to a total of 12 alternatives to be assessed.\(^{58}\)

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\(^{58}\) It is not known at this time exactly what size trainset will be procured. Capacity could be as low as 30 seats per car for a Talgo coach; conventional single level coaches seat 65-72 passengers, and bi-level cars have 100 or more seats per car. Because of this uncertainty, equipment was priced on an average cost-per-seat basis based on the size of train that would be needed to accommodate demand in 2030. This results in a consistent comparison of capital costs, that is free of the rounding errors that would otherwise be introduced by assuming a fixed seats per car configuration.
The cost of 79-mph equipment was benchmarked at $62,000 per seat; 110-mph tilting trains are slightly more expensive at $72,000 per seat due primarily to their higher horsepower requirement. Based on the estimation of required train size and equipment rotation cycles, this led to an overall equipment cost as shown in Exhibit 4-11. Based on the equipment cost calculations summarized in Exhibit 4-12 the overall capital cost for the Route Alternatives and options is summarized in Exhibit 4-13.

### Exhibit 4-12: Estimation of Equipment Cost

<table>
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<th></th>
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<th></th>
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<tbody>
<tr>
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<td>2</td>
<td>307,138</td>
<td>290</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>869</td>
<td>$62</td>
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<td>244</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>1,461</td>
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<td>351</td>
<td>4</td>
<td>2</td>
<td>6</td>
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<td>265</td>
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<td>3</td>
<td>9</td>
<td>2,384</td>
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<td>3</td>
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<td>6</td>
<td>2,044</td>
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<td>253</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>2,277</td>
<td>$72</td>
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<td>265</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>796</td>
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<td>3</td>
<td>9</td>
<td>1,967</td>
<td>$72</td>
<td>$141.7</td>
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### Exhibit 4-13: Capital Cost Summary by Alternative

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<tbody>
<tr>
<td>Route 1 79-mph</td>
<td>2</td>
<td>$53.9</td>
<td>$141.6</td>
<td>$195.5</td>
</tr>
<tr>
<td>Route 1 79-mph</td>
<td>4</td>
<td>$90.6</td>
<td>$141.6</td>
<td>$232.2</td>
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<tr>
<td>Route 1 110-mph</td>
<td>4</td>
<td>$151.5</td>
<td>$540.1</td>
<td>$691.6</td>
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<tr>
<td>Route 1 110-mph</td>
<td>8</td>
<td>$171.6</td>
<td>$540.1</td>
<td>$711.7</td>
</tr>
<tr>
<td>Route 2 79-mph</td>
<td>2</td>
<td>$54.7</td>
<td>$130.9</td>
<td>$185.6</td>
</tr>
<tr>
<td>Route 2 79-mph</td>
<td>4</td>
<td>$89.8</td>
<td>$130.9</td>
<td>$220.7</td>
</tr>
<tr>
<td>Route 2 110-mph</td>
<td>4</td>
<td>$147.2</td>
<td>$436.0</td>
<td>$583.2</td>
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<tr>
<td>Route 2 110-mph</td>
<td>8</td>
<td>$163.9</td>
<td>$436.0</td>
<td>$599.9</td>
</tr>
<tr>
<td>Route 3 79-mph</td>
<td>2</td>
<td>$49.4</td>
<td>$124.7</td>
<td>$174.1</td>
</tr>
<tr>
<td>Route 3 79-mph</td>
<td>4</td>
<td>$80.4</td>
<td>$124.7</td>
<td>$205.1</td>
</tr>
<tr>
<td>Route 3 110-mph</td>
<td>4</td>
<td>$130.2</td>
<td>$429.0</td>
<td>$559.2</td>
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<tr>
<td>Route 3 110-mph</td>
<td>8</td>
<td>$141.7</td>
<td>$429.0</td>
<td>$570.7</td>
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</table>
Chapter 5
Demographics, Socioeconomic & Transportation Databases

SUMMARY

This chapter is divided into subsections of: introduction, zone system, socioeconomic data, transportation network data, origin-destination data, the stated preference survey process, and the results of the analysis. Specifically, this chapter describes the steps for developing the market data which includes developing a zone system and socioeconomic database of the Study Area, and describes how the transportation networks were developed, how the origin and destination databases were obtained and validated, and the methodology used to conduct the stated preference surveys.

5.1 Introduction

To better represent the travel market that covers a large area, the study area is divided into zones to reflect the characteristics of travelers and trips of different origin-destinations pairs which are the basic building blocks of the COMPASS™ Model (Exhibit 1-1 in Chapter1). In order to forecast the future Total Travel Demand in the study area, base year and future socioeconomic data for each zone are developed and inputted into the model. All databases: socioeconomic characteristics, transportation networks, and trips, are also built at the zonal level. In particular, the main drivers of the travel market, namely, population, employment and income, are developed at the zonal level. The COMPASS™ Model then processes the data and outputs the Travel Demand Forecast including passenger rail ridership and revenue results, at the zonal level.

In order to understand the level of intercity travel in a corridor, a zone system is defined that allows the number of trips between one location (zone) and another (zone) to be measured. As such, the system provides a representation of the travel occurring from zone origins to zone destinations for any given market in the corridor (e.g., business, social travel). For intercity passenger rail planning, most rural zones are represented by larger areas. However, where it was important to identify more refined trip origins and destinations in urban areas, finer zones are typically used. The Travel Demand Model forecasts the total number of trip origins and destinations by mode and by zone pair.
5.2 Zone System

For the current Coast-to-Coast study, an effective zone system was developed based on the zone system that had been used for the MWRRI and the Chicago-Detroit/Pontiac Passenger Rail Corridor Investment Plan Alternatives Identification and Evaluation Study. Because the MWRRI developed an integrated rail network for the Midwest, a zone system was needed that incorporated all the corridors of MWRRI. To meet this need, a 662-zone system was developed for the Midwest study area that covers 11 states. The state of Michigan has 212 of those zones. Exhibit 5-1 lists the states included in the entire study area and the number of zones for each.

The zones were developed based on aggregation of the 2010 census tracts and traffic analysis zones (TAZs) of local transportation planning agencies. Exhibit 5-2 shows the zone system for the Midwest study area. Exhibit 5-3 shows the zones in Michigan.

See Appendix 1 for a detailed description of the Zone System.

Exhibit 5-1: Study Area Description

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>44</td>
</tr>
<tr>
<td>Illinois</td>
<td>107</td>
</tr>
<tr>
<td>Indiana</td>
<td>74</td>
</tr>
<tr>
<td>Kansas</td>
<td>4</td>
</tr>
<tr>
<td>Kentucky</td>
<td>3</td>
</tr>
<tr>
<td>Michigan</td>
<td>212</td>
</tr>
<tr>
<td>Minnesota</td>
<td>37</td>
</tr>
<tr>
<td>Missouri</td>
<td>44</td>
</tr>
<tr>
<td>Nebraska</td>
<td>19</td>
</tr>
<tr>
<td>Ohio</td>
<td>64</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>54</td>
</tr>
<tr>
<td><strong>Total Number of Zones</strong></td>
<td><strong>662</strong></td>
</tr>
</tbody>
</table>

Exhibit 5-2: Study Area Zone System
Exhibit 5-3: Michigan Zone System
5.3 Socioeconomic Database Development

In order to estimate the base and future travel market total demand, the travel demand forecasting model requires base year estimates and future growth forecasts of three socioeconomic variables of population, employment and per capita income for each of the zones in the study area. A socioeconomic database was established for the base year (2013) and for each of the forecast years (2015-2055).

5.3.1 Data Collection and Analysis

The data was developed at five-year intervals using the most recent data collected from the following sources:

- U.S. Census Bureau 2010 Census Data
- 2009-2013 American Community Survey 5-Year Estimates
- U.S. Bureau of Economic Analysis
- Woods & Poole Economics
- Michigan Department of Transportation
- Southeast Michigan Council of Governments
- Region 2 Planning Commission
- Tri-County Regional Planning Commission
- Grand Valley Metropolitan Council
- Battle Creek Area Transportation Study
- Kalamazoo Area Transportation Study
- Southwest Michigan Commission
- Chicago Metropolitan Agency for Planning

Exhibit 5-4 shows the base year and TEMS socioeconomic projections for Michigan. According to the data developed by TEMS, the population of Michigan will increase from 9.89 million in 2013 to 11.42 million in 2055, the total employment of Michigan will increase from 5.44 million to 6.45 million in 2055, and per capita income will increase from $39,055 in 2013 to $79,622 in 2055 in 2013 dollars.

| Exhibit 5-4: Michigan Base and Projected Socioeconomic Data |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | 2013             | 2015             | 2020             | 2025             | 2030             | 2035             | 2040             | 2045             | 2050             | 2055             |
| Employment      | 5,325,800        | 5,373,522        | 5,503,802        | 5,634,415        | 5,765,056        | 5,897,677        | 6,044,993        | 6,169,847        | 6,306,105        | 6,448,947        |
Exhibit 5-5 shows the socioeconomic growth projections for the study area. The exhibit shows that there is higher growth of employment and income than population. Furthermore, travel increases are historically strongly correlated to increases in employment and income, in addition to changes in population. Therefore, travel in the study area is likely to continue to increase faster than the population growth rates, as changes in employment and income outpace population growth, and stimulate more demand.

The exhibits in this section show the aggregate socioeconomic projection for the whole study area. It should be noted that in applying socioeconomic projections to the model, separate projections were made for each individual zone using the data from the listed sources. Therefore, the socioeconomic projections for different zones are likely to be different and thus may lead to different future travel sub-market projections. A full description of socioeconomic data of each zone can be found in the Appendix 2: Zonal Socioeconomic Data.

### Exhibit 5-5: Study Area Socioeconomic Data Growth Rates

**5.3.2 Regional Demographics and Growth**

Exhibit 5-6 shows a map depicting superzones that are used to identify regional growth of population, employment, and income along the Coast-to-Coast corridor for the different options.
Exhibit 5-6: Coast-to-Coast Corridor Superzone Map
5.3.2.1 Population

In Exhibit 5-7 it can be seen that the population growth rates vary significantly across the corridor with negative growth in the Detroit-Dearborn region at the eastern end of the corridor, strong growth in Holland, Grand Rapids and Lansing in the west, and more modest growth in Plymouth, Wayne, Ann Arbor, and Brighton-Howell.

5.3.2.2 Employment

The growth in employment as shown in Exhibit 5-8 largely reflects the growth in population, with negative growth in Detroit-Dearborn, strong growth in Lansing, Grand Rapids, and Holland, and modest growth in Plymouth, Wayne, and Jackson. Ann Arbor and Brighton-Howell however, are the exception and have stronger growth than suggested by their population growth.
5.3.2.3 Per Capita Income

As shown in Exhibit 5-9, it is anticipated that there will be strong income growth across the corridor and particularly in the Detroit exurban areas like Wayne Plymouth and Ann Arbor. Growth is also strong in Holland, Grand Rapids, and Lansing. Even Detroit – Dearborn sees growth on a per-capita basis.

Exhibit 5-9: Per Capita Income by Superzone
5.3.3 Socioeconomic Analysis Summary

The corridor shows a mixture of high and low growth. Grand Rapids and Lansing are rapidly growing while Detroit declines in population and employment. Since these are the variables typically used for forecasting urban travel, this would suggest a very modest level of growth in intercity travel. However, the growth in per capita income, which is consistently positive across the corridor will mean much stronger growth in intercity travel, as disposable income is a critical driver for particular business, long distance commuting and social and tourist intercity trips. As a result of the overall increase in demographic and socioeconomic factors, it is likely that there will be a steady increase in intercity trip making over the next forty years.

5.4 Base Transportation Database Development

To understand the existing travel market of the Coast-to-Coast Passenger Rail corridor, the existing travel networks and travel demand by mode and travel purpose in the corridor are developed. The travel modes include passenger rail, auto, bus, and air. The travel purposes are business and non-business (commuter, social, tourist and etc.) trips. This separation of business and non-business trips is important since business trips are paid for by firms who have a willingness to use more expensive options and have a high value of time (VOT), while non-business trips are paid for by individuals who look for less expensive travel choices and who typically have a much lower value of time (VOT). In addition to calculating values of time (VOTs) for different travel purposes and travel modes, generalized costs for values of frequency (VOFs) and values of access time (VOAs) are also developed for the corridor.

5.4.1 Base Transportation Networks

In transportation analysis, travel desirability/utility is measured in terms of travel cost and travel time. These variables are incorporated into the basic transportation network elements that provide by mode the connections from any origin zone to any destination zone. Correct representation of the existing and proposed travel services is vital for accurate travel forecasting. Basic network elements are called nodes and links. Each travel mode consists of a database comprised of zones and stations that are represented by nodes, and existing connections or links between them in the study area. Each node and link is assigned a set of travel attributes (time and cost). The network data assembled for the study included the following attributes for all the zone pairs.

For public travel modes (air, rail, bus):

- Access/egress times and costs (e.g., travel time to a station, time/cost of parking, time walking from a station, etc.)
- Waiting at terminal and delay times
- In-vehicle travel times
- Number of interchanges and connection times
- Fares
- Frequency of service
For private mode (auto):

- Travel time, including rest time
- Travel cost (vehicle operating cost)
- Tolls
- Parking Cost
- Vehicle occupancy

The highway network was developed to reflect the major highway segments within the study area. The sources for building the highway network in the study area are as follows:

- State and Local Departments of Transportation highway databases
- The Bureau of Transportation Statistics HPMS (Highway Performance Monitoring System) database

The main roads included in the highway network are shown in Exhibit 5-10.

### Exhibit 5-10: Major Roads in the COMPASS™ Highway Network

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<th>Road Name</th>
<th>Road Description</th>
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<td>Chicago to Toledo</td>
</tr>
<tr>
<td>Interstate-90</td>
<td>Chicago to Toledo</td>
</tr>
<tr>
<td>Interstate-94</td>
<td>Chicago to Detroit</td>
</tr>
<tr>
<td>Interstate-75</td>
<td>Toledo to Saginaw</td>
</tr>
<tr>
<td>Interstate-96</td>
<td>Detroit-Grand Rapids</td>
</tr>
<tr>
<td>Interstate-69</td>
<td>Indianapolis-Sarnia</td>
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</tbody>
</table>

The highway network of the study area coded in COMPASS™ is shown in Exhibit 5-11. Two networks were developed: one for business travel, one for non-business travel (commuter, social, tourist and etc.)
United Airlines, Delta, US Airways, and American Airlines serve study area. Air network attributes contain a range of variables that include time and distance between airports, airfares, and connection times. Travel times, frequencies and fares were derived from official airport websites, websites of the airlines serving airports in the study area, and the BTS 10% sample of airline tickets. Exhibit 5-12 shows the air network of the study area coded in COMPASS™. Again, two networks were developed: one for business travel, one for non-business travel.
Bus travel data of travel time, fares, and frequencies, were obtained from official schedules of Greyhound, MegaBus, Indian Trails, and Lamers operators. Exhibit 5-13 shows the bus network of the study area coded in COMPASS™. Again, two networks (business, non-business) were developed.

Exhibit 5-13: COMPASS™ Bus Network for the Study Area

Passenger rail travel data of travel time, fares, and frequencies, were obtained from official schedules of Amtrak. Exhibit 5-14 shows the passenger rail network of the study area coded in COMPASS™. Two networks were developed for both business and non-business forms of travel.

Exhibit 5-14: COMPASS™ Passenger Rail Network for the Study Area
5.4.2 Origin-Destination Trip Database

The multi-modal intercity travel analyses model requires the collection of base origin-destination (O-D) trip data describing annual personal trips between zone pairs. For each O-D zone pair, the annual personal trips are identified by mode (rail, auto, air, and bus) and by trip purpose (business and non-business). Because the goal of the study is to evaluate intercity travel, the O-D data collected for the model reflects travel between zones (i.e., between counties, neighboring states and major urban areas) rather than within zones.

TEMS extracted, aggregated and validated data from a number of sources in order to estimate base travel between origin-destination pairs in the Coast-to-Coast Passenger Rail corridor. The data sources for the origin-destination trips in the study are:

- Michigan Department of Transportation
- Southeast Michigan Council of Governments
- Region 2 Planning Commission
- Tri-County Regional Planning Commission
- Battle Creek Area Transportation Study
- Kalamazoo Area Transportation Study
- Grand Valley Metropolitan Council
- Southwest Michigan Commission
- Chicago Metropolitan Agency for Planning
- Bureau of Transportation Statistics 10% Ticket Sample
- TEMS 2012 Michigan Travel Survey
- Midwest Regional Rail Initiative Study (2004)

The travel demand forecast model requires the base trip information for all modes between each zone pair. In some cases this can be achieved directly from the data sources, while in other cases the data providers only have origin-destination trip information at an aggregated level (e.g., AADT data, station-to-station trip and station volume data). Where that is the case, a data enhancement process of trip simulation and access/egress simulation needed to be conducted to estimate the zone-to-zone trip volume. The data enhancement process is shown in Exhibit 5-15.

For the auto mode, the quality of the origin-destination trip data was validated by comparing it to AADTs and traffic counts on major highways and adjustments have been made when necessary. For public travel modes, the origin-destination trip data was validated by examining station volumes and segment loadings.
Exhibit 5-16 shows the base 2013 study area travel market share of rail, air, bus, and auto modes. It can be seen that auto mode dominates the travel market with more than 96 percent of market share. Public modes have less than four percent of travel market share, the Amtrak service in Michigan had 795,996 trips in 2013, which accounted for 0.57% of the total intercity travel market in the study area.

5.4.3 Values of Time, Values of Frequency, and Values of Access Times

Generalized cost of travel between two zones estimates the impact of improvements in the transportation system on the overall level of trip making. Generalized Cost includes all the factors that are key to an individual's travel decision (such as travel time, fare, frequency) that are all included in the Generalized Cost equation for the COMPASS™ Model. Generalized Cost is typically defined in travel time (i.e., minutes) rather than cost (i.e., dollars). Costs are converted to time by applying appropriate conversion factors such as Value of Time, derived from Stated Preference Surveys. In this case the Michigan DOT Chicago-Detroit/Pontiac Stated Preference Survey. The generalized cost (GC) of travel between zones i and j for mode m and trip purpose p is defined as follows:
\[ GC_{ijm} = TT_{ijm} + \frac{TC_{ijm}}{VOT_{mp}} + \frac{VOF_{mp} \times OH}{VOT_{mp} \times F_{ijm}} \]

Where,

- \( TT_{ijm} \) = Travel Time between zones i and j for mode m (in-vehicle time + station wait time + connection time + access/egress time), with waiting, connect and access/egress time multiplied by a factor (waiting and connect time factors is 1.8, access/egress factors were determined by VOA/VOT ratios from the Michigan Detroit-Chicago SP survey) to account for the additional disutility felt by travelers for these activities.

- \( TC_{ijm} \) = Travel Cost between zones i and j for mode m and trip purpose p (fare + access/egress cost for public modes, operating costs for auto)

- \( VOT_{mp} \) = Value of Time for mode m and trip purpose p

- \( VOF_{mp} \) = Value of Frequency for mode m and trip purpose p

- \( F_{ijm} \) = Frequency in departures per week between zones i and j for mode m

- \( OH \) = Operating hours per week (sum of daily operating hours between the first and last service of the day)

Value of Time (VOT) is the amount of money (dollars/hour) an individual is willing to pay to save a specified amount of travel time, the Value of Frequency (VOF) is the amount of money (dollars/hour) an individual is willing to pay to reduce the time between departures when traveling on public transportation, and the Value of Access (VOA) is the amount of money (dollars/hour) an individual is willing to pay for reducing access time to a mode (e.g. the airport, HSR station, railroad station, bus station) to gain easier access to someplace (e.g., an airport). Access/Egress time is weighted higher than in-vehicle time in generalized costs calculation, and its weight is derived from value of access stated preference surveys. Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found in previous stated preference surveys.

Exhibits 5-17, 5-18, and 5-19 shows the values of time, values of frequency, and values of access results from the TEMS Michigan Chicago-Detroit/Pontiac Stated Preference Travel Survey. These will be used in the Coast-to-Coast study, which has considerable overlap with the existing rail services.

**Exhibit 5-17 VOT values by Mode and Purpose of Travel ($2013/hour)**

<table>
<thead>
<tr>
<th>Value of Time (VOT)</th>
<th>Business</th>
<th>Non-business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>$27.89</td>
<td>$25.15</td>
</tr>
<tr>
<td>Bus</td>
<td>$20.73</td>
<td>$15.27</td>
</tr>
<tr>
<td>Rail</td>
<td>$39.77</td>
<td>$28.46</td>
</tr>
<tr>
<td>Air Access</td>
<td>$50.15</td>
<td>$39.86</td>
</tr>
</tbody>
</table>
Exhibit 5-18: VOF values by Mode and Purpose of Travel ($2013/hour)

<table>
<thead>
<tr>
<th>Value of Frequency (VOF)</th>
<th>Business</th>
<th>Non-business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>$5.40</td>
<td>$5.36</td>
</tr>
<tr>
<td>Rail</td>
<td>$10.59</td>
<td>$8.96</td>
</tr>
<tr>
<td>Air Access</td>
<td>$25.97</td>
<td>$18.68</td>
</tr>
</tbody>
</table>

Exhibit 5-19: VOA values by Mode and Purpose of Travel ($2013/hour)

<table>
<thead>
<tr>
<th>Value of Access (VOA)</th>
<th>Business</th>
<th>Non-business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>$28.28</td>
<td>$26.06</td>
</tr>
<tr>
<td>Rail</td>
<td>$54.71</td>
<td>$36.43</td>
</tr>
<tr>
<td>Air Access</td>
<td>$59.67</td>
<td>$47.51</td>
</tr>
</tbody>
</table>

5.5 Summary

The database for the COMPASS™ Model was successfully assembled and updated to base year 2013. This database included socioeconomic data, transportation networks, origin-destination trip data, and Values of Time, Access and Frequency and will be used by the COMPASS™ Demand Model to forecast ridership and revenue in the Coast-to-Coast Corridor.
Chapter 6
Coast-to-Coast Travel Demand Forecast

SUMMARY

This chapter describes the Travel Demand Forecast for the Coast-to-Coast Passenger Rail Corridor including discussing the results of the ridership, revenue and market share analyses. These Forecasts were generated from the COMPASS™ Model based on the data that was assembled and inputted from the Demographics, Socioeconomics and Transportation databases described in Chapter 5. Two sets of projections incorporating socioeconomic and transportation network changes were used to develop the forecasts. These sets of socioeconomic projections were used to identify the overall growth of travel in the corridor. The transportation model also considered future energy cost, congestion, and vehicle fuel efficiency together with the passenger rail service improvements.

Forecasts were made on a ten year basis and then interpolated for interval years. The forecast results of rail passenger ridership were disaggregated to provide train loads between stations for capacity analysis, and station volumes for station planning.

6.1 Future Travel Market Strategies

In order to forecast the future potential for rail ridership, consideration has to be given to how future travel markets will be impacted by changing transportation conditions. The critical factors that will change future travel conditions include: fuel price, vehicle fuel efficiency, as well as highway traffic congestion. In addition, the forecasts need to assess the different levels of rail service that might be developed, and how it will compete with auto, air, and bus markets. This includes the improvements planned as part of the Detroit-Chicago improvement program that are relevant to the different route options.

6.1.1 Fuel Price Forecasts

One of the important factors in the future attractiveness of passenger rail is fuel price. Exhibit 6-1 shows the Energy Information Agency (EIA) projection of crude oil prices for three oil price cases: namely a high world oil price case that is for an aggressive oil price forecast; a reference world oil price case that is moderate and is also known as the central case forecast; and a conservative low world oil price case. In

60 EIA periodically updates historical and projected oil prices at www.eia.gov/forecasts/aeo/tables_ref.cfm
this study, the reference case oil price projection is used to estimate transportation cost in future travel market. EIA projects oil price to 2040, the estimation of oil price projections after 2040 is based on historical prices and EIA forecast trends. The EIA reference case forecast suggests that crude oil prices are expected to be $79 per barrel (2013$) in 2020 and will increase to $141 per barrel (2013$) in 2040.

Exhibit 6-1: Crude Oil Price Forecast by EIA

EIA has also developed a future retail gasoline price forecast, which is shown in Exhibit 6-2. The implication of this is a reference case gasoline price of $2.74 per gallon (2013$) in 2020, with a high case price of $4.17 per gallon, and a low case price of $2.33 per gallon. The reference case gasoline price will increase to $3.90 per gallon (2013$) in 2040. The impact of rising energy prices will clearly impact the competition between the modes of travel in the Coast-to-Coast Corridor. Typically rising energy and therefore gas prices will most severely impact auto travel followed by air mode, bus mode and finally rail. Rail is very fuel efficient and its market share typically increases with rising energy and gas prices. Increasing energy prices has been largely responsible for the recent dramatic increases in Amtrak traffic. The Detroit-Chicago Corridor increased demand by 57 percent between the year 2000 and 2011.

Exhibit 6-2: U.S. Retail Gasoline Prices Forecast by EIA
6.1.2 Vehicle Fuel Efficiency Forecasts

Future improvement in automobile technology is likely to reduce the impact of high gas prices on automobile fuel cost with better fuel efficiency. The Oak Ridge National Laboratory (ORNL) Center for Transportation Analysis (CTA) provides historical automobile highway energy usage in BTU (British thermal unit) per vehicle-mile data for automobiles since 1970 (Exhibit 6-3).

Exhibit 6-3: ORNL Historical Highway Automobile Energy Intensities Data

Exhibit 6-3 shows the historical highway automobile energy intensities from 1970 to 2012. It can be seen that automobile fuel efficiency has been improving gradually during the past few decades but the improvement perhaps surprisingly has slowed down in recent years. Future automobile fuel efficiency improvement was projected by TEMS as shown in Exhibit 6-4. The TEMS forecast reflects the actual performance of the vehicle fleet, which is much lower and slower to be implemented than the regulated Corporate Average Fuel Economy (CAFE) standards for new cars. The auto fleet simply changes at a much slower pace than the standards for new cars. It was based on the historical automobile fuel efficiency data. The TEMS forecast shows a slow but consistent increase in car fuel efficiency to 2050, and beyond. It shows that the automobile fleet fuel efficiency is expected to improve by nearly 13 percent by 2055 as compared to fuel efficiency of today.
6.1.3 Highway Traffic Congestion

The average annual auto travel time growth in the corridor was estimated with the projected highway traffic volume data and the Bureau of Public Roads (BPR) function that can be used to calculate travel time growth with increased traffic volumes:

\[ T_f = T_b \times [1 + \alpha \times \left( \frac{V}{C} \right)^\beta] \]

where
- \( T_f \) is future travel time,
- \( T_b \) is highway Average travel time,
- \( V \) is traffic volume,
- \( C \) is highway Average capacity,
- \( \alpha \) is a calibrated coefficient (0.56), it describes the volume of traffic required for the capacity of the road to become limited by traffic (i.e., when it will begin to slow traffic speed)
- \( \beta \) is a calibrated coefficient (3.6), it describes the slope or sensitivity of the highway to congestion once capacity becomes limited (i.e., how quickly traffic speed falls as traffic increases).

The capacity and projected highway link volumes are derived from the Michigan 2008 Base Statewide Travel Demand Model. Historic volume data are obtained from Michigan Department of Transportation, Illinois Department of Transportation and 2012 Annual Urban Mobility Report from Transportation Institute of Texas A&M University.
The projected travel times were calculated by computing travel time on each segment of the highway route between two cities. The key assumptions are as follows:

- $\alpha = 0.56$
- $\beta = 3.6$

The above two coefficients are from the Highway Capacity Manual, they determine how traffic volume will affect travel speed. As an example, the highway links between Chicago and Detroit are expected to see intercity traffic volume increase from 5.7 million of vehicle miles traveled (VMT) per day to 6.0 million VMT per day between 2008 to 2035. By applying the BPR function while assuming same route intercity capacity between these two cities in the future, it can be calculated that travel time on this highway segment will increase by 0.24% per year with the BPR function.

### 6.2 The Travel Demand Forecast Results

Applying the COMPASS™ Total Demand Model with the data inputs discussed in Chapter 5 (demographics, socio-economics and transportation databases), generated the Total Demand Forecast presented in the follow sections of this chapter, including the rail Ridership and Revenue results.

#### 6.2.1 Rail Scenarios

Six rail scenarios were developed for evaluation in the Ridership and Revenue Analysis. These are detailed in chapters two and three of this report and are based on three route alignments (Exhibit 2-7):

- Route 1: Holland-Grand Rapids-Lansing-Jackson-Ann Arbor-Detroit Route
- Route 2: Holland-Grand Rapids-Lansing-Howell-Ann Arbor-Detroit Route
- Route 3: Holland-Grand Rapids-Lansing-Howell-Plymouth-Detroit Route

For the purpose of the analysis, 79-mph and 110-mph technologies will be used.

#### 6.2.2 Total Demand

Exhibit 6-5 shows the Coast-to-Coast Corridor total intercity Travel Demand Forecasts for 2020, 2030, and 2040. It can be seen that the Coast-to-Coast Corridor travel demand will increase from 84 million in 2020, to 94 million in 2030, and increases to 107 million in 2040. The average annual corridor travel market growth rate is 1.26 percent per year, which is in line with the socioeconomic growth within the travel market for the corridor.
6.2.3 Ridership Forecasts

Exhibit 6-6 shows the range of the 12 forecasts produced for the calendar years 2020, 2030, and 2040 respectively. For the conventional 79-mph technology of each route, the rail ridership and revenue forecasts were produced for 2-daily roundtrips (DRTs) and 4 DRTs. For the 110-mph diesel tilt technology, the rail ridership and revenue forecasts of 4 DRTs and 8 DRTs were produced.

The passenger rail ridership for each scenario and year is shown in Exhibits 6-7 through 6-9 for Route 1, Route 2, and Route 3 respectively.

For Route 1:

- The 79-mph (2 DRTs) service is estimated to have 0.34 million trips in 2020, 0.4 million trips in 2030, and 0.47 million trips in 2040.

- The 79-mph (4 DRTs) service is estimated to have 0.57 million trips in 2020, 0.68 million trips in 2030, and 0.81 million trips in 2040.
The 110-mph diesel tilt (4 DRTs) service is estimated to have 0.8 million trips in 2020, 0.95 million trips in 2030, and 1.14 million trips in 2040.

The 110-mph diesel tilt (8 DRTs) service is estimated to have 1.21 million trips in 2020, 1.43 million trips in 2030, and 1.71 million trips in 2040.

Exhibit 6-7: Coast-to-Coast Passenger Rail Ridership Forecast for Route 1 (annual millions of trips)

For Route 2:

The 79-mph (2 DRTs) service is estimated to have 0.31 million trips in 2020, 0.37 million trips in 2030, and 0.43 million trips in 2040.

The 79-mph (4 DRTs) service is estimated to have 0.54 million trips in 2020, 0.63 million trips in 2030, and 0.75 trips in 2040.

The 110-mph diesel tilt (4 DRTs) service is estimated to have 0.75 million trips in 2020, 0.88 million trips in 2030, and 1.05 million trips in 2040.

The 110-mph diesel tilt (8 DRTs) service is estimated to have 1.13 million trips in 2020, 1.33 million trips in 2030, and 1.59 million trips in 2040.
For Route 3:

- The 79-mph (2 DRTs) service is estimated to have 0.26 million trips in 2020, 0.3 million trips in 2030, and 0.35 million trips in 2040.

- The 79-mph (4 DRTs) service is estimated to have 0.45 million trips in 2020, 0.52 million trips in 2030, and 0.61 trips in 2040.

- The 110-mph diesel tilt (4DRTs) service is estimated to have 0.62 million trips in 2020, 0.73 million trips in 2030, and 0.86 million trips in 2040.

- The 110-mph diesel tilt (8 DRTs) service is estimated to have 0.93 million trips in 2020, 1.08 million trips in 2030, and 1.29 million trips in 2040.
6.2.4 Revenue Forecasts

The passenger rail revenue forecast is shown in Exhibits 6-10 through 6-12. It can be seen that revenues increase strongly as both travel speed and frequency increase. In addition, as the socioeconomics, highway congestion, and gas prices increase, rail revenues are anticipated to increase by some 40-45 percent for all options over the twenty year period 2020 through 2040. This increases the ability of the options to pay for operating costs in the future as market conditions become increasingly favorable to rail.

For Route 1:

- The 79-mph (2 DRTs) service is estimated to have $7.5 million revenue in 2020, $8.94 million revenue in 2030, and $10.89 million revenue in 2040.

- The 79-mph (4 DRTs) service is estimated to have $12.88 million revenue in 2020, $15.35 million revenue in 2030, and $18.7 million revenue in 2040.

- The 110-mph diesel tilt (4DRTs) service is estimated to have $24.09 million revenue in 2020, $28.77 million revenue in 2030, and $35.11 million revenue in 2040.

- The 110-mph diesel tilt (8 DRTs) service is estimated to have $37.56 million revenue in 2020, $44.8 million revenue in 2030, and $54.56 million revenue in 2040.

Exhibit 6-10: Coast-to-Coast Passenger Rail Revenue Forecast for Route 1 (annual millions of 2013$)

For Route 2:

- The 79-mph (2 DRTs) service is estimated to have $6.66 million revenue in 2020, $7.85 million revenue in 2030, and $9.43 million revenue in 2040.

- The 79-mph (4 DRTs) service is estimated to have $11.67 million revenue in 2020, $13.84 million revenue in 2030, and $16.76 million revenue in 2040.

- The 110-mph diesel tilt (4DRTs) service is estimated to have $22.04 million revenue in 2020, $26.24 million revenue in 2030, and $31.89 million revenue in 2040.
The 110-mph diesel tilt (8 DRTs) service is estimated to have $33.75 million revenue in 2020, $40.11 million revenue in 2030, and $48.6 million revenue in 2040.

Exhibit 6-11: Coast-to-Coast Passenger Rail Revenue Forecast for Route 2

For Route 3:

- The 79-mph (2 DRTs) service is estimated to have $5.36 million revenue in 2020, $6.21 million revenue in 2030, and $7.29 million revenue in 2040.

- The 79-mph (4 DRTs) service is estimated to have $9.84 million revenue in 2020, $11.48 million revenue in 2030, and $13.63 million revenue in 2040.

- The 110-mph diesel tilt (4DRTs) service is estimated to have $18.46 million revenue in 2020, $21.7 million revenue in 2030, and $26.01 million revenue in 2040.

- The 110-mph diesel tilt (8 DRTs) service is estimated to have $27.74 million revenue in 2020, $32.73 million revenue in 2030, and $39.38 million revenue in 2040.
6.2.5 Station Volumes

The strongest station volumes are projected to be at Grand Rapids and Ann Arbor, with over 500,000 passengers each for eight round trips per year in 2030. Holland, Lansing, Dearborn and Detroit would likely have proximate volumes at about 350,000 passengers each for eight round trips per year in 2030. A review of the OD matrix shows that there is substantial traffic from Lansing to Chicago and it could be that an increase in passengers using the Lansing station in Route 1 could be due to individuals going to Jackson to make Chicago connections. Also, it can be seen by comparing Exhibits 6-15 and 6-16 show that the Plymouth station does not attract the same volume of passengers as Ann Arbor.

Exhibits 6-13 through 6-15 show the 2030 station volumes of each route.
6.2.6 Segment Loadings

An important factor in planning a train service is the segment loadings that reflect the number of passengers traveling between stations. This is used to size trains and ensure that there are significant seats in peak travel hours.

The segment loadings are projected to be strongest between Grand Rapids, Lansing and Ann Arbor reflecting with strong growth occurring most intensely in the middle of the corridor. From Holland to Grand Rapids and from Dearborn to Detroit, volumes would probably be weaker with volumes estimated to be half of those in the rest of the corridor.
Exhibits 6-16 through 6-18 show the 2030 segment loadings of each route as previously described.

**Exhibit 6-16: 2030 Segment Loadings for Route 1 (millions of passengers)**

**Exhibit 6-17: 2030 Segment Loadings for Route 2 (millions of passengers)**
Exhibit 6-18: 2030 Segment Loadings for Route 3 (millions of passengers)

6.3 Market Shares

For rail market shares in 2030:

- 79-mph (2 DRTs) service is projected to have 0.32 percent to 0.42 percent market share in 2030,
- 79-mph (4 DRTs) service is projected to have 0.55 percent to 0.72 percent market share in 2030,
- 110-mph (4 DRTs) service is projected to have 0.77 percent to 1.00 percent market share in 2030.
- 110-mph (8 DRTs) service is projected to have 1.15 percent to 1.51 percent market share in 2030.

The 2030 Coast-to-Coast Corridor passenger rail market shares of Route 1, Route 2, and Route 3 are shown in Exhibit 6-19.

Exhibit 6-19: 2030 Coast-to-Coast Passenger Rail Market Share
6.3.1 Purpose Split

For passenger rail business travel shares in 2030, business trips would likely account for about 9 to 12 percent for the 79-mph (2 DRTS) service, the 79-mph (4 DRTS) service would likely account for about 13 to 17 percent of business travel, the 110-mph (4 DRTS) service would likely account for about 19 to 22 percent of business travel, and the 110-mph (8 DRTS) service would likely account for about 25 to 28 percent of business travel that year. As anticipated, business travel by rail increases with speed and frequency.

The 2030 Coast-to-Coast Corridor passenger rail business travel shares of Route 1, Route 2, and Route 3 are illustrated in Exhibit 6-20.

Exhibit 6-20: 2030 Coast-to-Coast Passenger Rail Purpose Split (Business Travel Percent)

6.3.2 Source of Trips

Trips diverted from other modes are the most important source of new rail trips, which is estimated to be over 90 percent of the overall rail travel market in 2030. Induced travel demand in the corridor as a result of the new passenger rail service is projected to be approximately 6 to 7 percent of the rail travel market then as well. As for the diverted trip from other modes, most trips are expected to be from personal vehicle travel. It should be noted however that driving still dominates the future travel market because it is the most popular travel choice in the corridor.

Exhibits 6-21 through 6-23 illustrate the sources of the rail trips for the Coast-to-Coast Corridor 79-mph (2 DRTs), 79-mph (4 DRTs), 110 (4 DRTs) and 110-mph (8 DRTs) services in 2030.
Exhibit 6-21: 2030 Coast-to-Coast 79-mph (2 DTRs) Passenger Rail Trip Sources Forecast

Exhibit 6-22: 2030 Coast-to-Coast 79-mph (4 DTRs) Passenger Rail Trip Sources Forecast
### 6.4 Critical Factors that Drive the Rail Forecast

In 2030 projections, levels-of-service improvement (travel time, frequency, on time performance, connectivity, schedule convenience) for passenger rail accounted for over 70 percent of total rail ridership. In addition, gas price and highway congestion increases account for 20 to 22 percent of rail ridership, or a 26 percent increase on what the ridership would be if gas prices and highway congestion remained at today’s levels.

Exhibits 6-24 through 6-27 show the contributing factors of the increased passenger rail ridership for the Coast-to-Coast Corridor for 79-mph (2 DRTs), 79-mph (4 DRTs), 110-mph (4 DRTs) and 110-mph (8 DRTs) services in 2030.
Exhibit 6-24: 2030 Coast-to-Coast Passenger Rail Trip Sources Forecast 79-mph (2 DRTs)

Route 1: 79-mph (2 DRTs)

Route 2: 79-mph (2 DRTs)

Route 3: 79-mph (2 DRTs)

Exhibit 6-25: 2030 Coast-to-Coast Passenger Rail Trip Sources Forecast – 79 mph (4 DRTs)

Route 1: 79-mph (4 DRTs)

Route 2: 79-mph (4 DRTs)

Route 3: 79-mph (4 DRTs)
Exhibit 6-26: 2030 Coast-to-Coast Passenger Rail Trip Sources Forecast – 110 mph (4 DRTs)

Exhibit 6-27: 2030 Coast-to-Coast Contributing Factors of Rail Trips for 110 MPH (8 DRTs)
6.5 Consistency with Regional Plans and Planning Practices for the Sensitivity Option Route 2

The development of intercity passenger rail frequently uses USDOT Federal Railroad Administration (FRA) funds for planning and construction. As such, in the planning process it is useful to be consistent with the process and procedures that they provide. This process is not, however, always in accordance with state planning process; and, as a result, it is frequently important to show the project from a state perspective to see how it relates to the state’s planning framework. To meet this need TEMS reviewed the state planning process and prepared a sensitivity analysis that is compliant with the states own planning process.

6.5.1 Demographic Issues

Both the Michigan Statewide Travel Demand Model and the TEMS COMPASS™ Model use population, employment and income to forecast traffic for the state. However, while there is little difference between the employment and income forecasts used in the COMPASS™ Model and the Michigan Statewide Travel Demand Model, there is a significant difference in the population forecasts used for estimating population growth (Exhibit 6-28). The MDOT 2012 REMI forecasts (a demographic forecast prepared by the University of Michigan for MDOT, using the REMI model) which are used in the Michigan Statewide Travel Demand Model are lower than the COMPASS™ Model which uses historically based US Bureau of Economic Analysis (BEA) data for the state and for the Detroit area, in particular. Consequently, the use of Michigan Statewide Travel Demand Model forecasts reduces traffic estimates for the Coast-to-Coast corridor.

Exhibit 6-29 shows that using the state forecasts reduces the train traffic estimates in 2030 from 1.33 to 1.30 million riders. The difference gets bigger over time, as the Statewide Travel Demand Model’s population growth rate increasingly diverges from the COMPASS™ Model’s forecast.

Exhibit 6-29: Route 2 110 MPH 8 DRTs Ridership Forecast Results

The impact on revenue estimates is to reduce it from $40.1 million to $39.2 million in 2030. See Exhibit 6-30.

Exhibit 6-30: Route 2 110 MPH 8 DRTs Revenue Forecast Results
In terms of market share estimates, the lower population numbers reduce it from 1.41% to 1.37%. See Exhibit 6-31.

Exhibit 6-31: Route 2 110 MPH 8 DRTs Market Share Forecast Results

The percent of trips by business increases slightly to 26.91% versus 26.34% in 2030 (Exhibit 6-32) due to the slight reduction in discretionary travel associated with a lower population. The contributing factors to rail trips remain largely constant, although the impact of rail service improvements is marginally stronger, since natural growth is marginally weaker with the lower population growth. See Exhibit 6-33.

Exhibit 6-32: Route 2 110 MPH 8 DRTs Business Travel Forecast Results
Finally, the source of trips is similar with a small decline in natural growth due to lower population forecasts. See Exhibit 6-34.
6.5.2 Conclusion

Overall, the Sensitivity Analysis shows that the Original Demand Forecast is comparable to the Statewide Model’s with the original forecast having slightly higher ridership, revenue and market share results. However, the Statewide Model shows a higher percent share for business travel.
6.6 Benchmark Analysis

A detailed benchmark analysis was completed for 79-mph and 110-mph service in order to ensure the validity of the forecasts within a range of ± 30 percent.

6.6.1 79-mph Service

Exhibit 6-35 shows how the forecasts for Route 1, which are the highest forecasts of each of the routes, compared with the actual results for existing Amtrak service. The Amtrak 2013 ridership figures were obtained from several sources. The forecasts for the Coast-to-Coast Route were reduced from 2020 to 2013 by eliminating the effects of Natural and Socioeconomic growth, and increases in gas prices and highway congestion. It can be seen that the forecasts for 2 trains per day and 4 trains per day at 79-mph are below the Amtrak average (as represented by the regression line). The Coast-to-Coast route forecast is below the current carryings of Chicago-Carbondale route, and the Washington-Newport News Route. At a frequency of 4 trains at 79-mph the Coast-to-Coast route is lower than the Downeaster with 5 trains, and only 68 percent of the Lincoln train. The forecast for the 4 train option is slightly lower than the Wolverine, which only has 3 trains per day, but the Wolverine train has suffered from poor On-Time Performance (OTP) at 50 percent in terms of access to Chicago. The Coast-to-Coast Route forecast assumes a 90-95 percent OTP, which increases its ridership by 14.3 percent over the On-Time Performance currently offered by Amtrak services.

The comparison of the Wolverine can be seen in the next section where the Coast-to-Coast is compared on an apples-to-apples basis with the Wolverine. When this comparison is made, the difference between the Coast-to-Coast and Wolverine is very large, with the Coast-to-Coast being only 55 percent of the Wolverine Traffic.

Exhibit 6-35: Comparison Amtrak 2013/Coast-to-Coast 2013

61 Amtrak Published Schedules: http://www.amtrak.com/train-schedules-timetables
62 Amtrak Press Release: Amtrak sets ridership record and moves the nation’s economy forward. ATK-13-122, October 14, 2013
6.6.2 110-mph Service

The Coast-to-Coast rail ridership in 2030 is projected to be only 54 percent that of the Chicago-Detroit/Pontiac Corridor. This is a key benchmark as both the Chicago-Detroit/Pontiac analysis and the Coast-to-Coast rail service scenarios are almost identical in terms of travel speeds (time), frequency, connectivity and schedule convenience, as well as equipment. Equally, almost the same gas price increase and highway congestion assumptions are used. As a result the difference in trips is mainly due to lower socioeconomic levels of population and employment in the Coast-to-Coast Corridor. The Coast-to-Coast is very similar to the Chicago-Detroit/Pontiac Corridor in terms of trip rate, with an annual trip rate of 5 per 10,000 population compared to a trip rate of 5.3 per 10,000 population in the Chicago-Detroit/Pontiac Corridor. However, it lacks the anchor of the large city of Chicago, and this reduces population in the corridor by 43 percent with the associated changed in rail ridership of just over 45 percent.

Exhibit 6-36 shows the comparison of 2030 rail ridership of the Coast-to-Coast Corridor and the Chicago Detroit/Pontiac Corridor.

Exhibit 6-36: 2030 Forecast Comparison with Chicago-Detroit/Pontiac Corridor

To provide a check on the reasonableness for the Coast to-Coast forecasts a comparison has been made with other studies’ rail trip rates.

Exhibit 6-37 shows the comparison of 2030 Coast-to-Coast 110-mph (8 DRTs) service forecast with the results of previous studies. The rail trips rates (i.e., the number of trips per 10,000 persons per day) are listed and it can be seen that the rail trip rate of the Coast-to-Coast Corridor as might be expected with a similar train service, is similar (but slightly lower) to those of the Chicago-Detroit/Pontiac and Chicago-St. Louis Corridors. This is due to the similarities of socioeconomics and rail proposals (110-mph option) in each corridor. However, as previously noted the smaller population of the Coast-to-Coast study corridor compared to that of Chicago-Detroit results in a much lower level of ridership overall.
Exhibit 6-37: 2030 Forecast Comparison with Previous Studies

<table>
<thead>
<tr>
<th>Rail Trip Rate (trips per 10,000 persons per day)</th>
<th>2030 Michigan Coast-to-Coast 110-mph</th>
<th>2030 Chicago-Detroit/Pontiac 110-mph</th>
<th>2030 Milwaukee-Green Bay 110-mph</th>
<th>2030 Chicago-St. Louis 110-mph</th>
<th>2030 Georgia 130-mph</th>
<th>2030 Hampton Roads 130-mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Round Trains (DRT)</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

1 The Chicago-Detroit/Pontiac EIS, 2014
2 Midwest Regional Rail Initiative Project Notebook, TEMS Inc., 2004
3 Chicago to St. Louis 110-mph EIS, 2003
4 Atlanta to Charlotte Passenger Rail Corridor EIS, Steer Davies Gleave, 2013
5 Hampton Roads Passenger Rail Vision Plan Alternatives Analysis, TEMS Inc., 2014

The forecast results for the 110-mph options are much lower than the high-speed rail options developed for other corridors. The rail trip rate forecast for the Coast-to-Coast Corridor is 47 percent of the Georgia (Atlanta-Charlotte) 130-mph passenger rail forecast, and 70 percent of the Hampton Roads (Hampton Roads-Richmond-Washington) 130-mph passenger rail forecast. The difference is due to the higher speeds and frequency of train service in these other corridors, which in the Georgia and Hampton Roads cases, is the result of the building of a dedicated right-of-way that will give a very high OTP of 95 percent. The Northeast Corridor also has much higher population density.

6.7 Conclusion

The forecasts show that in the evolving environment of increased gas prices and highway congestion, passenger rail can play a larger and larger role in intercity travel in the Coast-to-Coast Corridor.

Overall, by 2020 the ridership and revenue will be greatest for Route 1 despite the fact it has the slowest timetable. The addition of the cities of Jackson and Ann Arbor, add significant ridership over Route 3 that lacks both cities. Route 2, which has a faster timetable than Route 1 and goes through Ann Arbor, has ridership and revenues that are only slightly lower by 5 to 10 percent.

Route 1 does well compared to Route 2 because its ridership benefits from individuals who want to go to Chicago using the train between Lansing and Jackson as a way to connect with trains going to Chicago from Detroit. This adds to ridership in the short term, but this traffic may well disappear if frequency is increased on the Bluewater train that gives direct access to Battle Creek and the Detroit-Chicago service, or if the Grand Rapids-Chicago service were improved. As a result, the marginal increase in ridership now shown for Route 1 would be reduced to a level comparable or less than Route 2.

In terms of technology, higher frequency and higher speeds generated the greatest ridership and revenue. At 79-mph, increasing train frequency from 2 to 4 trains per day in each direction almost doubles ridership, while at 110-mph, increasing train frequency from 4 to 8 trains per day in each direction...
increases demand by 30-40 percent. The impact of higher speed is to double ridership as the train service becomes more and more competitive with the automobile. Over the forecast period auto travel becomes more expensive due to increasing gas prices and congestion rises significantly.

In terms of station volumes, Grand Rapids, Lansing and Ann Arbor have the greatest volumes of close to 0.5 million (on and offs) passengers per year at 110-mph and 8 trains per day. Holland, Dearborn, Plymouth and Detroit have slightly fewer passengers, and the weakest is Howell. With respect to segment loadings, the greatest loads of passengers as might be expected are in the middle of the corridor between Grand Rapids-Lansing-Jackson/Howell-Ann Arbor.

The critical factors that drive the forecasts are the quality of the rail service such as time, frequency, on-time performance, which represents 40 percent of the rail demand, while gas prices and congestion, represent over 20 percent of the demand, and increase the rail forecast by 25 percent.

The Sensitivity Analysis shows that the ridership and revenue forecasts generated by the COMPASS™ Model are comparable to the Statewide Model, with the exception that the COMPASS™ forecast has slightly higher ridership, revenue and market share results. The differences here are very small and are not significant. However, the Statewide Model shows a higher share of business travel.

In terms of benchmarks and “apple-to-apples” comparisons, the forecast is 55 percent of the Chicago-Detroit/Pontiac Corridor Environmental Impact Statement (EIS) forecast. The difference in travel reflects the socioeconomic of the Coast-to-Coast Corridor. Since the corridor has a very similar trip rate to both the Chicago-Detroit/Pontiac, and Chicago-St. Louis Corridors. Clearly people in Lansing, Grand Rapids, Holland and Brighton/Howell respond very similarly to the potential for rail service. It is the fact that the corridors socioeconomics are about 55 percent of the Detroit-Chicago Corridor results in the ridership being about half of the Detroit-Chicago Corridor.
Chapter 7
Assessment of Benefits – Preliminary Economic and Financial Analysis

SUMMARY

This chapter presents a detailed financial and economic analysis for the Coast-to-Coast Passenger Rail Line, including key financial measures such as Operating Surplus and Operating Ratio. A detailed Economic Analysis was carried out using criteria set out by the 1997 FRA Commercial Feasibility Study and including key economic measures such as NPV Surplus and Benefit/Cost Ratio at a 3% discount rate which are also presented in this chapter.

7.1 Financial Analysis

7.1.1 Introduction

The operating financial performance of the system is a key driver of the economic evaluation.

- **System Revenues**: These include the fare box revenues and revenues from onboard sales. For 110-mph dedicated track options it also includes freight railroad payments for track maintenance which can help offset a portion of the track maintenance cost.

- **Operating Costs**: These are the operating and maintenance costs associated with running the train schedules and include onboard service costs, as defined by MWRRS cost structure that would reflect the likely costs for a franchised operation.

As a result, the Operating Surplus, which is defined as Revenues minus Operating Cost, makes an important contribution to the overall business case for building the system:

- **If the operating surplus is positive**, the system will not require any operating subsidy, and it will even be able to make a contribution towards its own Capital cost. In addition because the system is generating a positive cash flow, a Private-Public Partnership or other innovative financing methods can be used to construct and operate the system. This absolves the local entity of any

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63 High-Speed Ground Transportation for America: Commercial Feasibility Study Report To Congress: [https://www.fra.dot.gov/elibrary/details/02519](https://www.fra.dot.gov/elibrary/details/02519)
need for providing an operating subsidy but more than this, it is not uncommon for the operating cash flow to be sufficient to cover the local match requirement as well.

➢ **If the operating surplus is negative**, the system will not only require a grant of capital to build the system, but in addition it will also require an ongoing operating subsidy. An operating subsidy not only prevents the project from being a Public Private Partnership, but casts doubt on the efficiency of the system and the reason for the project. In addition, a subsidy will reduce the economic performance of the system as it will actually offset part of the economic benefits of the system (e.g. Consumer Surplus, Environmental Benefits). This will depress the Benefit Cost ratio. If the subsidy is not too great and the capital cost is not too high, in some cases it may still be possible to maintain a positive Benefit Cost ratio. But the larger the subsidy and the higher the capital cost, the harder it is to show a positive Benefit Cost ratio. It is not uncommon for slow passenger rail systems to fail both FRA's Operating Ratio and Benefit Cost criteria.

### 7.1.2 Financial Results

Exhibit 7-1 shows the projected 2025 to 2050 financial results for the three route alternatives expressed in Net Present Value terms. These numbers reflect the discounted value of the operating subsidy/surplus and average operating ratio over the economic life of the system. Four train speed and frequency sub-options were assessed for each alternative: 2030 represents an early year in the implementation of the system, and so it reflects the likely financial performance of the system soon after opening.

➢ As can be seen, all of the **79-mph options** have negative NPV and Operating Ratios less than 1.0. This indicates that they will need subsidy through the life of the system.

➢ On the other hand, the **110-mph options** have operating surpluses throughout the life of the system. They will generate positive operating cash flows that can be used to recover even a portion of the capital investment made in these systems.

#### Financial Results Summary of Route Options

<table>
<thead>
<tr>
<th>Corridor</th>
<th>3% Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NPV $Millions</td>
</tr>
<tr>
<td><strong>Route Option 1</strong></td>
<td></td>
</tr>
<tr>
<td>79 mph (2 RT)</td>
<td>($53.55)</td>
</tr>
<tr>
<td>79 mph (4 RT)</td>
<td>($70.13)</td>
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<tr>
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<td>110 mph (8 RT)</td>
<td>$200.10</td>
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<tr>
<td><strong>Route Option 2</strong></td>
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<tr>
<td>79 mph (2 RT)</td>
<td>($40.82)</td>
</tr>
<tr>
<td>79 mph (4 RT)</td>
<td>($58.44)</td>
</tr>
<tr>
<td>110 mph (4 RT)</td>
<td>$75.59</td>
</tr>
<tr>
<td>110 mph (8 RT)</td>
<td>$175.75</td>
</tr>
<tr>
<td><strong>Route Option 3</strong></td>
<td></td>
</tr>
<tr>
<td>79 mph (2 RT)</td>
<td>($38.05)</td>
</tr>
<tr>
<td>79 mph (4 RT)</td>
<td>($63.74)</td>
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<tr>
<td>110 mph (4 RT)</td>
<td>$52.77</td>
</tr>
<tr>
<td>110 mph (8 RT)</td>
<td>$111.15</td>
</tr>
</tbody>
</table>
Exhibits 7-2 and 7-3 summarize the financial results for all the options:

- **79-mph Options** - due to the low speed of these options, a 2030 operating subsidy of $3-$6 Million per year will be needed. Infrastructure improvements, introducing diesel tilting trains and raising the top speed to 90-mph may reduce the subsidy, but will not likely eliminate it.

- **110-mph Options** - Overall the 110-mph options are forecast to generate $5-$15 Million per year in free cash flow in 2030, some of which could be applied towards meeting the capital costs of the system, such as equipment and track capital maintenance costs.
7.2 Economic Results

7.2.1 Introduction

A demandside economic evaluation was completed for the twelve options being assessed in this study Alternatives Analysis. This included three route alternatives, two technology options and two train frequency options for each route. This followed typical financial/economic cash flow analysis, and USDOT-Tiger Grant guidelines, as well as OMB discount procedures for the economic analysis. The analysis was completed using data derived from the Ridership and Revenue Analysis, the Infrastructure Analysis, and the Operating Analysis. This provided:

- System Revenues: Fare box, onboard and freight railroad revenue
- Operating Costs: Operating and maintenance costs
- Capital costs: Infrastructure costs

In addition, the Economic Analysis calculated other factors that are required for the analysis:

- Consumer Surplus - benefit to system users
- Highway Congestion Savings - benefits to road users of less congestion
- Airport Delay Savings - benefits to air travelers
- Safety Benefits - benefit of less accidents
- Reduced Emissions - benefit of lower emissions levels

7.2.2 Measures of Financial and Economic Benefits

Two measures, net present value (NPV) and Benefit Cost ratio were used to evaluate the economic returns of the system. Similar measures, net present value (NPV) and Operating ratio, were used to evaluate the financial returns and the potential for franchising the operations.

Both measures require the development of a project’s year-by-year financial and economic returns, which are then discounted to the base year to estimate present values (PV) over the lifetime of the project. For this analysis, a 25-year project life from 2025 to 2050 was assumed, with a ten year implementation period from 2015-2024. Revenues and cost cash flows were discounted to the 2013 base year using a 3 percent discount rate. The 3 percent discount rate reflects the real cost of money in the market as reflected by the long term bond markets (5 percent).

The operating ratios reported here in this chapter, follow a commercial criteria definition; but are different from the commercial operating ratio calculations that are typically presented by freight railroads and intercity bus companies. For the current analysis, the selected feasibility criteria were as follows:

- The Operating Ratio as calculated here includes direct operating costs only. The operating ratio calculations presented here do not include capital costs, depreciation or interest. The costs used are incremental costs.
- The Operating Ratio presented here is defined as Revenues/Costs. It should be noted that freight railroads and intercity bus companies typically define it as the reciprocal Costs/Revenues.
As defined by this analysis, a positive operating ratio does not imply that a passenger service can attain full financial profitability by covering its capital costs, but it does allow the operation to be franchised and operated by the private sector. The definition puts passenger rail on the same basis as other passenger transportation modes, such as intercity bus and air, where the private sector operates the system but does not build or own the infrastructure it uses. It does, however, pay access fees to the freight railroads where they own the track. In the case of passenger rail, these would include track access costs. All calculations are performed using the standard financial formula, as follows:

**Financial Measure:**

\[
\text{Operating Ratio} = \frac{\text{Financial Revenues (by year or PV)}}{\text{Operating Costs (by year or PV)}}
\]

**Economic Measures:**

\[
\begin{align*}
\text{Net Present Value} &= \text{Present Value of Benefit} - \text{Present Values of Costs} \\
\text{Benefit Cost Ratio} &= \frac{\text{Present Value of Revenues}}{\text{Present Value of Costs}}
\end{align*}
\]

**Present Value is defined as:**

\[
PV = \sum_{t} \frac{C_t}{(1+r)^t}
\]

**Where:**

- \( PV \): Present value of all future cash flows
- \( C_t \): Cash flow for period \( t \)
- \( r \): Discount rate reflecting the opportunity cost of money
- \( t \): Time

In terms of Economic Benefits, a positive NPV and Benefit Cost Ratio imply that the project makes a positive contribution to the economy. Consistent with standard practice, Benefit Cost ratios are calculated from the perspective of the overall society without regard to who owns particular assets receives specific benefits or incurs particular costs.

### 7.2.3 Key Assumptions

The analysis projects travel demand, operating revenues and operating and maintenance costs for all years from 2025 through 2050. The financial analysis has been conducted in real terms using constant 2013 dollars. Accordingly, no inflation factor has been included and a real discounting rate of 3 percent was used. Revenues and operating costs have also been projected in constant dollars over the time frame of the financial analysis. A summary of the key efficiency measure inputs are presented below.
7.2.3.1 Ridership and Revenue Forecasts

Ridership and revenue forecasts were originally prepared for 2020, 2025 and 2040. Revenues in intervening years were projected based on interpolations, reflecting projected annual growth in ridership. Revenues included not only passenger fares, but also onboard service revenues.

7.2.3.2 Capital Costs

Capital costs include rolling stock, track, freight railroad right-of-way purchase or easement fees, bridges, fencing, signaling, grade crossings, maintenance facilities and station improvements. The capital cost projections are based on year-by-year projections of each cost element and include all of the capital costs, plus some selected elements of additional costs as needed to support year-by-year capacity expansion of the system. A year-by-year implementation plan was developed (as shown in Exhibit 7-14) which detailed the Capital cash flows and funding requirements. Using this information, the Benefit Cost calculations were able to be assessed. For the purpose of this study it is assumed that the Capital Costs will be spent over a nine year period with the distribution shown in Exhibit 7-4. It can be seen that the costs begin small and gradually build up during the planning period to 2018 and then accelerate during the design and construction period. Over 70 percent of funds are spent in the last four years of the implementation period as construction occurs.

Exhibit 7-4: Assumed Capital Spend Distribution

7.2.4 Operating Expenses

Major operating and maintenance expenses include equipment maintenance, track and right-of-way maintenance, administration, fuel and energy, train crew and other relevant expenses. Operating expenses were estimated in 2013 constant dollars so that they would remain comparable to revenues. However, these costs do reflect the year-by-year increase in expense that is needed to handle the forecasted ridership growth, in terms of not only directly variable expenses such as credit card
commissions, but also the need to add train capacity and operate either larger trains, or more train-miles every year in order to accommodate anticipated ridership growth.

Operating costs are included as a cost, whereas system revenues are included as a benefit in the discounting calculation over the life of the system. In this way they directly offset one another in the Net Present Value calculation and are also reflected in the Benefit Cost calculation. It can be seen that a system that requires an operating subsidy, e.g., where costs exceed revenues, will tend also to reflect this in the Benefit Cost ratio. This is why slow speed options such as conventional Amtrak services often fail on both the Operating Ratio and Benefit Cost ratio criteria.

### 7.2.5 User Benefits

The analysis of user benefits for this study is based on the measurement of Generalized Cost of Travel, which includes both time and money. Time is converted into money by the use of Values of Time. The Values of Time (VOT) used in this study were derived from stated preference surveys conducted in the Chicago-Detroit/Pontiac EIS and used in the COMPASS™ Multimodal Demand Model for the ridership and revenue forecasts. These VOTs are consistent with previous academic and empirical research and other transportation studies conducted by TEMS.

**Consumer Surplus and Revenues:** Benefits to users of the rail system are measured by the sum of system revenues and consumer surplus. Consumer surplus is used to measure the demand side impact of a transportation improvement on users of the service. It is defined as the additional benefit consumers (users of the service) receive from the purchase of a commodity or service (travel), above the price actually paid for that commodity or service. Consumer surpluses exist because there are always consumers who are willing to pay a higher price than that actually charged for the commodity or service, i.e., these consumers receive more benefit than is reflected by the system revenues alone. Revenues are included in the measure of consumer surplus as a proxy measure for the consumer surplus forgone because the price of rail service is not zero. This is an equity decision made by the USDOT to compensate for the fact that highway users pay zero for use of the road system (the only exception being the use of toll roads). The benefits apply to existing rail travelers as well as new travelers who are induced (those who previously did not make a trip) or diverted (those who previously used a different mode) to the new passenger rail system.

The RENTS™ financial and economic analysis estimates passenger travel benefits (consumer surplus) by calculating the increase in regional mobility, traffic diverted to rail, and the reduction in travel cost measured in terms of generalized cost for existing rail users. The term generalized cost refers to the combination of time and fares paid by users to make a trip. A reduction in generalized cost generates an increase in the passenger rail user benefits. A transportation improvement that leads to improved mobility reduces the generalized cost of travel, which in turn leads to an increase in consumer surplus. Exhibit 7-5 presents a typical demand curve in which Area A represents the increase in consumer surplus resulting from cost savings for existing rail users and Area B represents the consumer surplus resulting from induced traffic and trips diverted to rail.
Exhibit 7-5: Consumer Surplus Concept

The formula for consumer surplus is as follows –

$$\text{Consumer Surplus} = (C_1 - C_2)T_1 + ((C_1 - C_2)(T_2 - T_1))/2$$

Where:

- $C_1$ = Generalized Cost users incur before the implementation of the system
- $C_2$ = Generalized Cost users incur after the implementation of the system
- $T_1$ = Number of trips before operation of the system
- $T_2$ = Number of trips during operation of the system

The passenger rail fares used in this analysis are the average optimal fares derived from the revenue-maximization analysis that was performed for each alternative. User benefits incorporate the measured consumer surplus, as well as the system revenues, since these are benefits are merely transferred from the rail user to the rail operator.

**Other Mode and Resource Benefits:** In addition to rail-user benefits, travelers using auto or air will also benefit from the rail investment, since the system will contribute to highway congestion relief and reduce travel times for users of these other modes. For purposes of this analysis, these benefits were measured by identifying the estimated number of auto passenger trips diverted to rail and multiplying each by the updated monetary values derived from previous stated preference studies updated to 2013.

**Highway Congestion:** The highway congestion delay savings is the time savings to the remaining highway users that results from diversion of auto users to the rail mode. To estimate travel time increase within the corridor, historical highway traffic volumes were obtained from the State DOTs and local planning agencies. The average annual travel time growth in the corridor was estimated with the historical highway traffic volume data and the BPR (Bureau of Public Roads) function that can be used to calculate travel time growth with increased traffic volumes.
The Airport Congestion Delay Savings: The Airport Congestion Delay Savings were based on 1997 FRA Commercial Feasibility Study and updated to 2013 value. The Airport Congestion Delay Savings includes the airport operation delay saving and air passenger delay saving.

Auto Operating Cost (Non Business): Vehicle operating cost savings for non-business travelers have been included in the current analysis as an additional resource benefit. This reflects the fact that social/leisure travelers do not accurately value the full cost of driving when making trips. As a result, the consumer surplus calculation for commuters, social, leisure and tourist travelers has not fully reflected the real cost of operations of an automobile, but only the cost of gas. The difference between the cost of gas and the full cost of driving reflects a real savings that should be included in a Benefit Cost analysis.

Emissions: The diversion of travelers to rail from the auto mode generates emissions savings. The calculated emissions savings are based on changes in energy use with and without the proposed rail service. This methodology takes into account the region of the country, air quality regulation compliance of the counties served by the proposed rail service, the projection year, and the modes of travel used for access/egress as well as the line-haul portion of the trip. Highway Reduced Emissions were estimated from the vehicle miles traveled (VMT) and flight reductions derived from the ridership model. The assumption is that a reduction in VMT or flights is directly proportional to the reduction in emissions. The pollutant values were taken from the latest TIGER III Grant Benefit-Cost Analysis (BCA) Resource Guide.

Public Safety Benefits: Public Safety is calculated from the diverted Vehicle-Miles times the NHTSA fatality and injury rate per Vehicle mile and then times the values of fatality and injury from the latest TIGER III Grant Benefit-Cost Analysis (BCA) Resource Guide. This was calculated for 2025, 2035 and 2045 then interpolated or extrapolated for all other years.

7.2.6 Economic Results

The economic analysis results are shown in Exhibits 7-6 and 7-7. These exhibits summarize the results showing the overall Cost Benefit ratios calculated at 3% discount rate:

- **Option 1** via Jackson is forecasted to have the highest revenue, but also has the highest capital cost. As a result, although it has a positive NPV and a Benefit/Cost ratio greater than one, it does not have the best results of all the available options.

- **Option 3** has the lowest revenue and the lowest capital cost, but because of the lower ridership and revenue associated with this option (that misses Ann Arbor) again it does not have the best results of all the available options.

- **Option 2** via Howell and Ann Arbor optimizes the tradeoff between forecasted ridership and capital cost. It has the best results of all the available options, which optimizes the economic return for the project as a whole.

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Exhibit 7-6: Economic Results (NPV and B/C) at 3% Discount Rate

<table>
<thead>
<tr>
<th>Route Option</th>
<th>3% Discount Rate</th>
<th>NPV $Millions</th>
<th>Benefit/Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route Option 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79 mph (2 RT)</td>
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Exhibit 7-7: Economic Summary of Results
7.3 Financial and Economic Impacts of the Sensitivity Option

The previous sections of this report have presented the key methodologies used for developing Capital Costs, Operating Costs and Benefits, and for calculating the important Operating and Cost Benefit ratios for the different route, train technology and train frequencies that were assessed for this study. This section develops a sensitivity showing the impact of changing the demand forecasting assumptions to use the Michigan Statewide Travel Demand Model rather than projections based on historical U.S. Bureau of Economic Analysis (BEA) data that were used for the Federal assessment. In addition, section 3.7.3 of chapter 3 explained the difference between the previously adopted MWRRS costing methodology and more recent Amtrak PRIIA costs. This difference came down to an additional allocation of overhead costs which was estimated as the equivalent of $4.50 per train mile.

The study team was asked to develop a sensitivity analysis to assess the impacts of using these more conservative state ridership forecasting (zone demographics) assumptions along with Amtrak Passenger Rail Investment and Improvement Act of 2008 (PRIIA) costs. This comparison was developed for a single option: “Route 2/110-mph/8 RT” to show the potential impact of these slightly more conservative assumptions on the financial and economic viability of the Coast-to-Coast rail corridor.

7.3.1 Financial Impacts

In terms of the change on the input assumptions, slightly more conservative local demographic growth assumptions reduced the overall system revenues by 2.93% percent, while at the same time the operating cost increased by 9.00% due to allocation of additional Amtrak overhead costs to the corridor.

Exhibit 7-8: Sensitivity Impact on the Operating Ratio for Route 2 110-mph, 8 RT Options
Predictably as shown in Exhibit 7-8, this reduction in revenue and increase in operating costs reduces the operating ratio from 1.35 down to 1.20. However, the operating ratio remains positive which means that even with this increased Amtrak cost allocation, the system can still cover its operating cost and will not need an operating subsidy.

Similarly as shown in Exhibit 7-9, this reduction in revenue and increase in operating costs reduces the forecasted 2030 operating surplus from $12.43 million down to $7.02 million per year. However, the system is still able to develop a positive cash flow which means that not only can it cover all of its own operating cost and run without a subsidy, but it is even able to start covering some of its own capital costs.

Exhibit 7-9: Sensitivity Impact on the 2030 Operating Surplus for Route 2 110-mph, 8 RT Options

7.3.2 Economic Impacts

A sensitivity analysis was also developed to test the impact of the revenue reduction and increased operating cost on the economic viability of the project. (See Exhibit 7-10). Because of the ridership reduction, public benefits such as congestion relief also experienced a reduction and this had the effect of reducing the project Cost Benefit ratio from 1.75 to 1.60. However, even with PRIIA costs and reduced demographic growth rates the project remains viable and justified as a public investment since its benefits still exceed its costs by a wide margin.
Chapter 7: Assessment of Benefits-Preliminary Economic & Financial Analysis

The impact of the two adjustments population growth and PRIIA costing, is to lower the overall ridership and revenue forecasts (slightly) and the financial and economic returns. The financial operating ratio is reduced by 12 percent, the operating surplus by 44 percent and the cost benefit ratio by 9 percent.

The changes do not affect the ordering of the project alternatives, with Route 2 retaining the best results for the corridor. Under these more conservative assumptions the corridor is still viable as it continues to meet all the required USDOT FRA financial and economic criteria.

7.4 Conclusion

The results of the Preliminary Financial and Economic Analysis show that Route 2 via Howell and Ann Arbor has the best financial and economic results. The financial operating surplus for Route 1 and Route 2’s 110-mph 4 and 8 round trips per day service are comparable despite Route 1 having slightly higher ridership.

With respect to the economic results, Route 2 shows consistently higher returns than Route 1 and Route 3. (See Exhibits 7-6 and 7-7). Also, the impact of frequency is clear even with the 79-mph, 4 round trip options having a strongly positive economic result.

The Sensitivity Analysis performed on Route 2 also supports it as being a viable alternative that would be able to meet the required USDOT FRA financial and economic criteria despite being subjected to the MDOT Statewide Travel Demand Model’s more conservative demographic growth assumptions.
Chapter 8
Public Engagement

SUMMARY

This chapter discusses the Public Engagement aspect of the study.

8.1 Introduction

Public Engagement was an important element of the Coast-to-Coast Passenger Rail Ridership & Cost Estimate Study. The Michigan By Rail (MBR) team, an informal coalition led by Michigan Environmental Council (MEC) that works to advance passenger rail in Michigan, managed the public engagement portion of this study.

MBR hosted 16 public meetings across the corridor to meet with residents and community leaders to share information and gather feedback for the study. Eleven of the 16 meetings were traditional, town-hall style meetings held at popular local gathering places like schools, libraries and other community centers in the evenings. The remaining five meetings were held on college campuses across the corridor and designed as “open house” style meetings, allowing students to stop by to learn about the study and provide feedback as they were on their way to class, lunch or the library. Meetings were publicized widely through the traditional and social media via local community organizations and public entities.

The MBR team also used the online public engagement tool, mySidewalk, to gather feedback and share information about the Coast-to-Coast study. This tool, implemented by MEC, allowed the study team to gather feedback similar to that of the traditional public meetings, but reach a broader audience who may want to provide input but are not able to attend a public meeting.

Between traditional, campus and online engagement, 575 people participated in the public engagement process for this study.

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66 “Traditional, town-hall style” meetings took place in Holland, Grand Rapids, Cascade Township, Lansing, Howell, Brighton, Dearborn, Ypsilanti, Detroit, Ann Arbor, and Plymouth in June and July of 2015.
67 Campus meetings took place at Grand Valley State University (Grand Rapids), Michigan State University (East Lansing), University of Michigan (Ann Arbor), Hope College (Holland) and Wayne State University (Detroit) in September and October 2015.
68 mySidewalk is a free online civic engagement tool used by over 1400 organizations around the United States. Visit mysidewalk.com/organizations/289852/coast-to-coast-passenger-rail-study to view the Coast-to-Coast study engagement page, and www2.mysidewalk.com/ to learn more about the company.
8.2 Meeting Purpose

The goals of the public engagement portion of this study were:

1. To inform leaders, stakeholders, and the general public about the project, including the concept of the study and perceived next steps.

2. To garner public feedback to inform the study, which included:
   - Travel location and destination information
   - General support or opposition
   - Fare estimates / willingness to pay
   - Frequency of travel
   - Purpose of travel
   - Amenities required and desired
   - Other comments (open-ended)

3. To connect resident feedback and interests with local and state elected officials.\(^{69}\)

The information collected complements the quantitative analysis and will help inform next steps and identify gaps in this level of study. Perhaps most importantly, the public meetings and mySidewalk interface provided an opportunity for residents and stakeholders along the corridor to learn about the study and provide feedback.

8.3 Meeting Formats

As described in the introduction, the MBR team used two different meeting formats for our 16 public engagement sessions. For the “traditional, town hall style” meetings, MEC gave a short presentation, providing background on the scope of the study. Participants were then guided through group activities to gather feedback about current travel, qualities and amenities of service and potential community impacts. The meetings closed with an open-ended question and answer session. A total of 242 people attended these 11 meetings.

The campus meetings followed an “open house” format. This meeting format allowed for a high number of relatively short interactions with students and staff. The MBR team focused these interactions by sharing information about the Coast-to-Coast concept and study and asking participants complete a basic comment card. The comment cards asked two simple questions: “Would you use a passenger rail service connecting Detroit, Ann Arbor, Lansing, Grand Rapids, and Holland? Why or Why not?” and “What other comments would you like to share for the Coast-to-Coast Passenger Study?” A total of 283 people participated in the five campus meetings by completing comment cards.

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\(^{69}\) More than a dozen elected officials or their staff attended the public engagement meetings.
8.4 Public Feedback

8.4.1 Traditional Public Meetings

As described above, attendees of the “traditional, town hall style” meetings were asked to participate in small group activities to provide feedback about their travel patterns, potential impacts of the service and answer questions about their priorities of a service like the Coast-to-Coast.

Feedback from those three activities is summarized below.

1. Where and how often do you travel along the Coast-to-Coast corridor?

To get an anecdotal understanding of travel patterns along the corridor, participants were asked to use colored dots on a map of the proposed route to indicate the frequency and location of current travel in the corridor. The results are listed in Exhibit 8-1 below.

Meeting participants listed Grand Rapids, Lansing, Ann Arbor, and Detroit as the most frequently visited cities overall. This activity is helpful to get participants familiar with the proposed corridor and how it might impact their travel choices; however, because the sample size is not large enough to be statistically significant nor based on travel models and demographic data, it does not provide a statistically complete depiction of travel in the corridor.
2. Rank qualities of services and amenities are most important to you in passenger rail service like the Coast-to-Coast.

For this activity, participants were asked to rank—with 1 being the most important and 10 being the least important—qualities and amenities of service. Participants used a pre-developed worksheet with ten options to rank and blank lines to write in additional suggestions.

Below are the combined ranking results, listed in order of most frequently listed as most important to most often listed as least important.

1. **Frequency of Service**
2. **Proximity to my origin and destination**
3. **Low cost tickets**
4. **Train and seat舒适**
5. **Free Wi-Fi**
6. **Special event train service**
7. **Work space**
8. **Station amenities**
9. **Food and beverage service on board**

Participants also wrote-in the following service elements as important (in no particular order):

- Service reliability
- Bike storage
- Competitive with automobile travel
- Coordination with local transit service and other transportation options

3. What potential positive and negative impacts do you think the Coast-to-Coast service would have on your community?

For this activity, participants were invited to list impacts in an open-ended fashion; sometimes simply listing impacts and others providing anecdotes about perceived impacts. Exhibit 8-2 describes the most common positive and negative impacts listed by all participants.
Overall, respondents were more likely to respond positively to the proposed rail system. The total number of comments garnered was 389. Eighty-six percent of individuals stated that Michigan residents would in some way benefit from a Coast-to-Coast rail system. Thirteen percent of respondents listed potential negative community impacts that this service could have on their communities or the state.

**Exhibit 8-2: Top Positive & Negative Impacts Listed**

**POSITIVE IMPACTS**
1. Increased Economic Development
2. Less Stress
3. Increased access to recreation, schools and jobs
4. Positive Environmental Impact
5. Increased Productivity

**NEGATIVE IMPACTS**
1. Cost to taxpayers
2. Lack of local transit options to connect to train
3. Train Noise and increase traffic congestion

**Potential Community Impacts Listed by Town-hall Style Meeting Attendants**

*aggregated by general type*

- Listed positive impacts: 86%
- Listed negative impacts: 13%
- Unsure: 1%
Below is a sample of anecdotal responses to this question:

"Safer commute = less stress = healthier people"

"We are in the early phase of a highway funding crisis. There is not enough funding to support the road infrastructure that we have in place via gas taxes. Rail is more efficient and lower cost to maintain in the long run."

"Difficult to travel if not in city center with lack of public transportation options"

"Increased fun and spontaneity! Would be more likely to hop on a train to Detroit for a concert or game if didn’t have to deal with parking"

"Trains are safer, quieter, less stressful, and more productive but they do not usually pay for themselves"

Feedback from these small group activities provides general information about the public reaction to the Coast-to-Coast rail concept. It also allowed participants to take part in a conversation about the study and, more generally, transportation in Michigan; making it more likely that meeting attendees will continue to be involved in future public engagement efforts that may take place and inform the potential development of this service.

8.4.2 Campus Meetings

In contrast to the traditional public meetings, the campus meetings were aimed at interacting with a large amount of people in a short period of time to provide information and quickly and briefly collect general feedback for the study. The MBR team went to campuses to engage students directly in the process, as students are generally less likely to participate in a traditional town hall meeting and are frequent users of the existing passenger rail service in Michigan.\(^7\)

As depicted in Exhibit 8-3, 88 percent of college students stated that they would use a new passenger rail service like the Coast-to-Coast.

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\(^7\) Ridership statistics in college towns
COAST-TO-COAST PASSENGER RAIL RIDERSHIP AND COST ESTIMATE STUDY: FINAL REPORT

Like the traditional meetings, most students we spoke with were largely supportive of expanding passenger rail, citing convenience, greater ability to visit family and friends and increased access to other cities as top reasons why they would use a passenger rail system. Of the students who responded “No” on comment cards, many cited that they did not have a need for passenger rail in Michigan given that they lived out of state. Students who responded with “Maybe” generally cited cost and convenience as determining factors in whether or not they would use a passenger rail system in the future.

Below is a sample of comments students shared about the Coast-to-Coast concept:

“Would need to go faster and be more convenient than driving.”

“Reasonable, on time performance would be my number one priority.”

“It would be time consuming.”

“We must get our railroads together - creates another way of travel, saves fuel, can create more jobs. It is essential that we have an alternate other than cars and planes.”

“Great to go to sporting events”

“I have never really ridden a train to get anywhere because there are none in areas I need.”

Similar to the traditional public meetings, students had a variety of comments to share with common threads prioritizing reliability and competitiveness with automobile travel.

8.4.3 Online Engagement

mySidewalk provided an accessible online public engagement tool, which we used to complement the 16 public meetings. This interface spurred a surprising amount of activity from August through November 2015 with 3726 page views, 399 total responses, 7 “likes,” and 406 interactions (Exhibit 8-4). While many people visited the page, we estimate that about 50 people actively provided feedback through this medium.

Exhibit 8-4: Overall mySidewalk Activity

Similar to the activities in the traditional meetings, the following prompts were posted on the mySidewalk page and received the responses also included here:
Prompt: Where along the possible Coast-to-Coast corridor do you travel at least ONCE PER MONTH?

- Detroit: 10 responses
- Dearborn: 6 responses
- Ann Arbor: 20 responses
- Plymouth: 3 responses
- Jackson: 4 responses
- Howell: 5 responses
- Lansing: 24 responses
- Grand Rapids: 15 responses
- Holland: 10 responses

Total Responses (38 participants)

Exhibit 8-6: Community Impacts Question & Response

Prompt: What potential community impacts most concern or excite you about the Coast-to-Coast passenger rail proposal?

- Increased noise due to train frequency: 4 responses
- Traffic or parking congestion near stations: 5 responses
- Positive environmental impact: 38 responses
- Decreased congestion due to fewer cars on the road: 44 responses
- Access for people who do not drive: 43 responses
- More options to get around in bad weather: 34 responses
- Increased congestion due to railroad crossings: 2 responses
- Potential financial cost of the service: 12 responses
- Increased safety: 26 responses
- Productive travel time: 29 responses

Total Responses (51 participants)
Exhibit 8-7: General Input Question

Prompt: What do you think of the idea to reconnect Detroit, Lansing, Grand Rapids and Holland via passenger rail?

A sample of responses from the question posed in Exhibit 8-7 is listed below. There were eight participants that responded to this prompt.

“The coasts themselves are less important to me than the cities along the route -- the population, employment, and education hubs of the state. I regularly travel from Ann Arbor to Detroit, Lansing, and Grand Rapids for my job: having a coast-to-coast rail option running a few times daily would give me more productive time while I travel instead of contributing to congestion.”

“It would be SUCH A WONDERFUL thing to hop on a train in Lake Odessa and go to Detroit! Tiger games, the International Auto Show, concerts would all be easily in reach!!!!!”

“This train needs to go farther than Detroit in my honest opinion. Toledo or even Cincinnati would be much better end destinations…”

“This would be an excellent, for both transportation and development. Track and grade crossing improvements would also improve safety and attract industry.”

8.5 Conclusion

Through traditional, campus and online engagement, the MBR team connected with 575 people to share information and gather feedback for this study. The public engagement process for this study is crucial for informing next steps in the process, as well as bringing stakeholders and the general public into the conversation about expanding passenger rail in Michigan.
Chapter 9  
Conclusions and Next Steps

SUMMARY

This chapter outlines the key findings of the study, and the next steps that should be taken to move the Coast-to-Coast Passenger Rail Line project forward.

9.1 Conclusions

The results of the Ridership and Preliminary Financial and Economic Analyses support a recommendation for further study on Route 1 and Route 2. These specific study recommendations are outlined in section 9.2, but should aim to understand the environmental impacts and specific engineering requirements of the service, and further analyze the relationship of the proposed service with existing and developing services in the region.

Overall, the study found that there are two viable routes among the Coast-to-Coast route options considered in this analysis:

- Route 1 has the highest forecasted ridership, although many of the trips are Chicago oriented, and further analysis would be required to fully understand the ridership demand independent to the Wolverine corridor. This option also has a higher capital cost and longer transit time than Route 2.

- Route 2 via Howell and Ann Arbor has the best financial and economic results and the second best ridership forecast.

- Route 3 has a much weaker ridership forecast and financial and economic performance because it misses the important intermediate market of Ann Arbor.

However, the study finds that 110-mph options along any of the routes could meet USDOT FRA financial and economic thresholds. At the currently projected level of capital costs, 79-mph options with four round trips meet FRA economic criteria, but fail FRA financial criteria since all 79-mph options would continue to require an operating subsidy.

In the current forecast, Route 1 ridership benefits from individuals who want to go to Chicago using the train between Lansing and Jackson as a way to connect with trains going to Chicago from Detroit. This is why Route 1 shows the highest ridership of all the options. However, as shown in Exhibit 9-1:
If the Port Huron route via Battle Creek remains at its current level or if the current Blue Water service were ended, it is likely that the Jackson route would attract a significant Lansing to Chicago ridership.

If the Port Huron route via Battle Creek were improved to a level of four daily round trips, as called for by the MWRRS plan, Chicago riders would likely go directly via Battle Creek rather than via Jackson.

Alternatively, if a western outlet from Grand Rapids to Chicago were developed, then Lansing to Chicago riders could go via Grand Rapids rather than via Battle Creek. This would further bolster the economics of the west end of the proposed Coast-to-Coast intercity rail corridor.

As a result, the potential for Chicago traffic could add to Route 1 ridership in the short term, but this traffic may well disappear if either frequency were increased on the Bluewater train via Battle Creek, or if the Grand Rapids-Chicago service were fully developed. This makes the Route 1 forecast riskier than the forecasts for Route 2 and 3, which do not depend so much on Chicago traffic, although further study would be required to understand this relationship.

As a result, the network options for connecting Lansing, Saginaw, Flint, Port Huron and Grand Rapids to Chicago can only be finally determined by a statewide study, yet they may have a significant influence on the analytical results guiding selection of the best route option for the Coast-to-Coast corridor. For example, FRA’s PRIIA guidance suggests that State Rail Plans be updated every five years. Since Michigan’s State Rail Plan was last issued in 2011, the next update is due in 2016. It may be appropriate to address this issue in the next State Rail plan update.

Route 2 at 110-mph also offers a very strong option in that:

- It best meets USDOT FRA criteria having the best financial and economic performance
- The Route 2 ridership forecast is the least risky since this option serves all the major markets, and the ridership base is strongly focused on Holland to Detroit ridership. There is not much potential that it will be negatively affected if the Blue Water’s connections to Chicago were improved, as
would be the case for Route 1. But if the Grand Rapids to Chicago service were improved, there is a strong upside potential that the Coast-to-Coast corridor’s financials could be even better than have currently been projected.

- Because it produces an operating surplus, the operation can be franchised to be operated by one of a number of private passenger rail operators or Amtrak

- Offers very considerable economic and environmental benefits to the communities of southern Michigan, which is an area of very strong positive economic growth. Connecting these economically vibrant areas of Michigan to Detroit will also help Detroit, which has been economically battered by the decline in the traditional manufacturing sector, to participate in emerging "new economy" growth that Grand Rapids and Lansing have been enjoying.

Aside from the strength of Route 2 as an intercity corridor option, development of Route 2 has obvious synergy with Michigan DOT’s plans for developing commuter rail services both from Howell to Ann Arbor (e.g. North-South Commuter Rail line) and from Ann Arbor to Detroit. It also is synergistic with the ability to develop a Detroit to Cadillac rail service over the tracks of the Great Lakes Central railroad, as was proposed in the 2011 Michigan State Rail plan.

By using the proposed new Huron River bridge track connection in downtown Ann Arbor, the North-South Commuter Rail service could be redirected to serve the Medical Center, where it could effectively integrate with both intercity rail services as well as the proposed high-capacity corridor link. Operationally, this would enable through-routing commuter trains with the Ann Arbor to Detroit commuter service so that a rider from Howell could travel not only to Ann Arbor, but also to Detroit as well.

Furthermore, the joint development of the Coast-to-Coast intercity service along with the commuter rail component would substantially reduce the cost of the North-South Commuter Rail line by eliminating the need for rehabilitating track south of the Huron River to passenger standards. As well, the cost for all of the North South Commuter Rail’s proposed Ann Arbor stations would be eliminated if the decision to relocate the Ann Arbor Amtrak station to the Medical Center location moves forward. All of this offers the possibility for substantial improvements in ridership and also a reduction of both operating and capital cost by combining the two commuter rail lines into a single project, as compared to the current two separate and disconnected services.

This shows the criticality of completing the Huron River bridge track connection at the earliest possible date. Rail improvements on the Ann Arbor line south of the Huron River, including relocating the freight interchange, would not then be needed for passenger service but could be separately pursued using freight rail enhancement funds. This ability to restructure and integrate the proposed commuter rail service would be facilitated by the same infrastructure investment that is needed for the Route 2 intercity rail system. This synergy could be further developed and explored in a future study.
A final issue is a technical one having to do with the development and implementation of PTC technology in Michigan. Cost estimates for installation of PTC and signaling systems have recently experienced a rapid escalation as a result of the FRA’s PTC mandate for all passenger services. Michigan DOT must also ascertain CSX’s plans not only for retaining signaling, but also for installing PTC on its Plymouth to Grand Rapids line. It is understood that Michigan has been on the leading edge of PTC systems, since the Porter to Kalamazoo line has served as the test-bed for new PTC development and testing. This “R&D” aspect of PTC development undoubtedly reflects in Michigan’s PTC historical costs, but should not necessarily be replicated as the technology continues to mature in the future. TEMS costs for PTC and signaling in the C2C study are in the $410-470K per mile range, which is in line with accepted industry comparable costs. For keeping PTC cost at manageable levels in the future, it is recommended that Michigan DOT consider installing non-overlay versions of PTC (such as Alaska Railroad’s system) and also obtain industry certification for the freight railroad standard I-ETMS up to 110-mph. Doing this would avoid having to install redundant (ITCS + I-ETMS) systems in shared-used territory, since the freight railroads do not want to have to equip their locomotive fleets for ITCS. Further work is needed to determine the most appropriate PTC standard for new installations like those proposed for the North-South Commuter Rail line and Coast-to-Coast rail corridors.

9.2 Next Steps

In order to move the project forward as a public or public/private project TEMS would advise:

- Complete a comprehensive Environmental Study of the corridor. In some areas only a Categorical Exclusion may be needed rather than a full EIS, since the work would be accomplished within existing rail rights of way.

- Develop a technical assessment of PTC options for future Michigan passenger rail projects for better compatibility with freight rail systems and reduced cost.

- Consider the potential for a PPP/franchise in order to attract private capital to the project.

- Develop a detailed Implementation Plan, outlining the short and long term actions that might be taken to initiate service at 79 mph and over time, upgrade that service to the level proposed at 110-mph.

- Work closely with the Chicago-Detroit/Pontiac corridor and North-South Commuter Rail teams to identify the additional infrastructure and facilities that they might need or could be mutually beneficial if the Coast-to-Coast project moves forward. For example, one question to consider may be whether Coast-to-Coast trains ought to terminate in downtown Detroit, or if some of them should be extended through to Pontiac or even points north, such as Flint or Saginaw.

- Complete a Statewide Study to assess the future development options for passenger rail services for connecting Lansing, Saginaw, Flint, Port Huron, Cadillac, Muskegon and Grand Rapids to both Chicago and Detroit. As part of this study, also assess potential synergies between intercity and commuter rail corridor development needs.

Exhibit 9-2 provides a summary and comparison of the results from all analyses for each of the Coast-to-Coast Corridor Route Options: Option 1, Option 2 and Option 3.
<table>
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<tr>
<th>Operations / Ridership / Financial / Economic Results</th>
<th>ROUTE 1 79 mph</th>
<th>110 mph</th>
<th>ROUTE 2 79 mph</th>
<th>110 mph</th>
<th>ROUTE 3 79 mph</th>
<th>110 mph</th>
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<tr>
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<td>3:06</td>
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Note: All 79 & 110 mph trains use Diesel Technology. All financial and economic figures are in 2013$. Ridership is for rail corridor extending from Holland to Detroit. A trip is defined as a passenger making a one-way trip and a round trip generates two one way trips.
Technical Appendices

Appendix A: COMPASS™ Model

The COMPASS™ Model System is a flexible multimodal demand-forecasting tool that provides comparative evaluations of alternative socioeconomic and network scenarios. It also allows input variables to be modified to test the sensitivity of demand to various parameters such as elasticities, values of time, and values of frequency. This section describes in detail the model methodology and process used in the study.

Description of the COMPASS™ Model System

The COMPASS™ model is structured on two principal models: Total Demand Model and Hierarchical Modal Split Model. For this study, these two models were calibrated separately for two trip purposes, which are Business and Non-Business. For each market segment, the models were calibrated on base year origin-destination trip data, existing network characteristics and base year socioeconomic data.

Since the models were calibrated on the base year data, when applying the models for forecasting, an incremental approach known as the “pivot point” method is used. By applying model growth rates to the base data observations, the “pivot point” method is able to preserve the unique travel flows present in the base data that are not captured by the model variables. Details on how this method is implemented are described below.

Total Demand Model

The Total Demand Model, shown in Equation 1, provides a mechanism for assessing overall growth in the travel market.

Equation 1:

\[ T_{ijp} = e^{\beta_0 (SE_{ijp})^{\beta_1} e^{\beta_2 U_{ijp}}} \]

Where,

- \( T_{ijp} \) = Number of trips between zones \( i \) and \( j \) for trip purpose \( p \)
- \( SE_{ijp} \) = Socioeconomic variables for zones \( i \) and \( j \) for trip purpose \( p \)
- \( U_{ijp} \) = Total utility of the transportation system for zones \( i \) to \( j \) for trip purpose \( p \)
- \( \beta_{0p}, \beta_{1p}, \beta_{2p} \) = Coefficients for trip purpose \( p \)
Equation 1, the total number of trips between any two zones for all modes of travel, segmented by trip purpose, is a function of the socioeconomic characteristics of the zones and the total utility of the transportation system that exists between the two zones. For this study, trip purposes include Business and Non-Business. The socioeconomic characteristics consist of population, employment and average income. The utility function provides a measure of the quality of the transportation system in terms of the times, costs, reliability and level of service provided by all modes for a given trip purpose. The Total Demand Model equation may be interpreted as meaning that travel between zones will increase as socioeconomic factors such as population and income rise or as the utility (or quality) of the transportation system is improved by providing new facilities and services that reduce travel times and/or costs. The Total Demand Model can therefore be used to evaluate the effect of changes in both socioeconomic and travel characteristics on the total demand for travel.

### Socioeconomic Variables

The socioeconomic variables in the Total Demand Model show the impact of economic growth on travel demand. The COMPASS™ Model System, in line with most intercity modeling systems, uses three variables (population, employment, and average income) to represent the socioeconomic characteristics of a zone. Different combinations were tested in the calibration process and it was found, as is typically found elsewhere, that the most reasonable and statistically stable relationships consist of the following formulations:

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Socioeconomic Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>$E_i E_j (I_i + I_j) / 2$</td>
</tr>
<tr>
<td>Non-Business</td>
<td>$(P_i E_j + P_j E_i) / 2 (I_i + I_j) / 2$</td>
</tr>
</tbody>
</table>

The Business formulation consists of a product of employment in the origin zone, employment in the destination zone, and the average income of the two zones. Since business trips are usually made between places of work, the presence of employment in the formulation is reasonable. While the income factor is correlated to the type of employment, higher income levels generate more Business trips. The Non-Business formulation consists of all socioeconomic factors, this is because commuter trips are between homes and places of work, which are closely related to population and employment, and income factor is related to the wealth of the origin zone and the type of employment in the destination zone, leisure and social trip are correlated to population in the origin zone and destination zone and the average income of the two zones.

### Travel Utility

Estimates of travel utility for a transportation network are generated as a function of generalized cost (GC), as shown in Equation 2:

Equation 2:

$$U_{ijp} = f(GC_{ijp})$$

where,

$GC_{ijp}$=Generalized Cost of travel between zones $i$ and $j$ for trip purpose $p$

Because the generalized cost variable is used to estimate the impact of improvements in the transportation system on the overall level of trip making, it needs to incorporate all the key attributes that affect an individual’s decision to make trips. For the public modes (i.e., rail and bus), the generalized cost of travel includes all aspects of travel time (access, egress, in-vehicle times), travel cost (fares), and schedule convenience (frequency of service, convenience of arrival/departure times). For auto travel, full
average cost of operating a car is used for Business, while only the marginal cost is used for Commuter and Other trips. In addition, tolls and parking charges are used where appropriate.

The generalized cost of travel is typically defined in travel time (i.e., minutes) rather than dollars. Costs are converted to time by applying appropriate conversion factors, as shown in Equation 3. The generalized cost (GC) of travel between zones i and j for mode m and trip purpose p is calculated as follows:

Equation 3:

\[
GC_{ijmp} = TT_{ijm} \frac{TC_{ijmp}}{VOT_{mp}} + VOF_{mp} \frac{OH}{VOT_{mp} \cdot F_{ijm}}
\]

Where,

- \( TT_{ijm} \) = Travel Time between zones i and j for mode m (in-vehicle time + station wait time + connection time + access/egress time), with waiting, connect and access/egress time multiplied by a factor (waiting and connect time factors is 1.8, access/egress factors were determined by VOA/VOT ratios from the SP survey) to account for the additional disutility felt by travelers for these activities.

- \( TC_{ijmp} \) = Travel Cost between zones i and j for mode m and trip purpose p (fare + access/egress cost for public modes, operating costs for auto)

- \( VOT_{mp} \) = Value of Time for mode m and trip purpose p

- \( VOF_{mp} \) = Value of Frequency for mode m and trip purpose p

- \( F_{ijm} \) = Frequency in departures per week between zones i and j for mode m

- \( OH \) = Operating hours per week (sum of daily operating hours between the first and last service of the day)

Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found from previous studies. Wait times are weighted 70 percent higher than in-vehicle time.

Similarly, access/egress time has a higher disutility than in-vehicle time. Access time tends to be more stressful for the traveler than in-vehicle time because of the uncertainty created by trying to catch the flight or train. Based on previous work, access time is weighted 80 percent higher for rail and bus travel.

The third term in the generalized cost function converts the frequency attribute into time units. Operating hours divided by frequency is a measure of the headway or time between departures. Tradeoffs are made in the stated preference surveys resulting in the value of frequencies on this measure. Although there may appear to be some double counting because the station wait time in the first term of the generalized cost function is included in this headway measure, it is not the headway time itself that is being added to the generalized cost. The third term represents the impact of perceived frequency valuations on generalized cost. TEMS has found it very effective to measure this impact as a function of the headway.
**Calibration of the Total Demand Model**

In order to calibrate the Total Demand Model, the coefficients are estimated using linear regression techniques. Equation 1, the equation for the Total Demand Model, is transformed by taking the natural logarithm of both sides, as shown in Equation 4:

**Equation 4:**

\[
\log(T_{ij}) = \beta_0 + \beta_1 \log(SE_{ij}) + \beta_2(U_{ij})
\]

Equation 4 provides the linear specification of the model necessary for regression analysis.

The segmentation of the database by trip purpose resulted in two sets of models. The results of the calibration for the Total Demand Models are displayed in Exhibit 1.

**Exhibit 1: Total Demand Model Coefficients**

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Equation</th>
<th>R²</th>
<th>t-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>[\log(T_{ij}) = -7.4655 + 0.5298 \log(SE_{ij}) + 0.6236 \ U_{ij}]</td>
<td>0.87</td>
<td>(21)</td>
</tr>
<tr>
<td>Other</td>
<td>[\log(T_{ij}) = -4.1441 + 0.4466 \log(SE_{ij}) + 0.7103 \ U_{ij}]</td>
<td>0.92</td>
<td>(252)</td>
</tr>
</tbody>
</table>

where \[U_{ij} = \log[\exp(-9.8691+0.9976 U_{Public}) + \exp(-0.0046 GC_{Auto})]\]

where \[U_{ij} = \log[\exp(-4.7022+0.9711 U_{Public}) + \exp(-0.0056 GC_{Auto})]\]

(1) *t*-statistics are given in parentheses.

In evaluating the validity of a statistical calibration, there are two key statistical measures: *t*-statistics and R². The *t*-statistics are a measure of the significance of the model’s coefficients; values of 1.95 and above are considered “good” and imply that the variable has significant explanatory power in estimating the level of trips. R² is a statistical measure of the “goodness of fit” of the model to the data; any data point that deviates from the model will reduce this measure. It has a range from 0 to a perfect 1, with 0.3 and above considered “good” for large data sets. Based on these two measures, the total demand calibrations are good. The *t*-statistics are high, aided by the large size of the data set. The R² values imply good fits of the equations to the data.

As shown in Exhibit 1, the socioeconomic elasticity values for the Total Demand Model are 0.53 and 0.36 for business and non-business trips, meaning that each one percent growth in the socioeconomic term generates approximately a 0.53 and 0.36 percent growth in the total business and non-business travel market respectively.

The coefficient on the utility term is not strictly elasticity, but it can be considered an approximation. The utility term is related to the scale of the generalized costs, for example, utility elasticity can be high if the absolute value of transportation utility improvement is significant. This is not untypical when new transportation systems are built. In these cases, a 20 percent improvement in utility is not unusual and may impact more heavily on longer origin-destination pairs than shorter origin-destination pairs.

**Incremental Form of the Total Demand Model**

The calibrated Total Demand Models could be used to estimate the total travel market for any zone pair using the population, employment, per household income, and the total utility of all the modes. However, there would be significant differences between estimated and observed levels of trip making for many zone pairs despite the good fit of the models to the data. To preserve the unique travel patterns
contained in the base data, the incremental approach or “pivot point” method is used for forecasting. In the incremental approach, the base travel data assembled in the database are used as pivot points, and forecasts are made by applying trends to the base data. The total demand equation as described in Equation 1 can be rewritten into the following incremental form that can be used for forecasting (Equation 5):

**Equation 5:**

\[
\frac{T_{ijp}^f}{T_{ijp}^b} = \left( \frac{SE_{ijp}^f}{SE_{ijp}^b} \right)^{\beta_p} \exp(\beta_2 p (U_{ijp}^f - U_{ijp}^b))
\]

Where,

- \(T_{ijp}^f\) = Number of Trips between zones \(i\) and \(j\) for trip purpose \(p\) in forecast year \(f\)
- \(T_{ijp}^b\) = Number of Trips between zones \(i\) and \(j\) for trip purpose \(p\) in base year \(b\)
- \(SE_{ijp}^f\) = Socioeconomic variables for zones \(i\) and \(j\) for trip purpose \(p\) in forecast year \(f\)
- \(SE_{ijp}^b\) = Socioeconomic variables for zones \(i\) and \(j\) for trip purpose \(p\) in base year \(b\)
- \(U_{ijp}^f\) = Total utility of the transportation system for zones \(i\) to \(j\) for trip purpose \(p\) in forecast year \(f\)
- \(U_{ijp}^b\) = Total utility of the transportation system for zones \(i\) to \(j\) for trip purpose \(p\) in base year \(b\)

In the incremental form, the constant term disappears and only the elasticities are important.

**Hierarchical Modal Split Model**

The role of the Hierarchical Modal Split Model is to estimate relative modal shares, given the Total Demand Model estimate of the total market that consists of different travel modes available to travelers. The relative modal shares are derived by comparing the relative levels of service offered by each of the travel modes. The COMPASS™ Hierarchical Modal Split Model uses a nested logit structure, which has been adapted to model the interurban modal choices available in the study area. The hierarchical modal split model is shown in Exhibit 2.
Exhibit 2: Hierarchical Structure of the Modal Split Model

The main feature of the Hierarchical Modal Split Model structure is the increasing commonality of travel characteristics as the structure descends. The upper level of the hierarchy separates private auto travel—with its spontaneous frequency, low access/egress times, low costs and highly personalized characteristics—from the public modes. The lower separates Maglev—a faster and more comfortable public mode—from Transit, which provides slower conventional rail and bus services within the corridor.

Background of the Hierarchical Modal Split Theory

The modal split models used by TEMS derived from the standard nested logit model. Exhibit 3 shows a typical two-level standard nested model. In the nested model shown in Exhibit 3, there are four travel modes that are grouped into two composite modes, namely, Composite Mode 1 and Composite Mode 2.
Each travel mode in the above model has a utility function of $U_j, j = 1, 2, 3, 4$. To assess modal split behavior, the logsum utility function, which is derived from travel utility theory, has been adopted for the composite modes in the model. As the modal split hierarchy ascends, the logsum utility values are derived by combining the utility of lower-level modes. The composite utility is calculated by

$$U_{N_k} = \alpha_{N_k} + \beta_{N_k} \log \sum_{i \in N_k} \exp(\rho U_i)$$  \hspace{1cm} (1)$$

where

$N_k$ is composite mode $k$ in the modal split model,

$i$ is the travel mode in each nest,

$U_i$ is the utility of each travel mode in the nest,

$\rho$ is the nesting coefficient.

The probability that composite mode $k$ is chosen by a traveler is given by

$$P(N_k) = \frac{\exp(U_{N_k}/\rho)}{\sum_{i \in N_k} \exp(U_i/\rho)}$$  \hspace{1cm} (2)$$

The probability of mode $i$ in composite mode $k$ being chosen is

$$P_{N_k}(i) = \frac{\exp(\rho U_i)}{\sum_{j \in N_k} \exp(\rho U_j)}$$  \hspace{1cm} (3)$$
A key feature of these models is a use of utility. Typically in transportation modeling, the utility of travel between zones i and j by mode m for purpose p is a function of all the components of travel time, travel cost, terminal wait time and cost, parking cost, etc. This is measured by generalized cost developed for each origin-destination zone pair on a mode and purpose basis. In the model application, the utility for each mode is estimated by calibrating a utility function against the revealed base year mode choice and generalized cost.

Using logsum functions, the generalized cost is then transformed into a composite utility for the composite mode (e.g. Public modes in Exhibit 2). This is then used at the next level of the hierarchy to compare the next most similar mode choice (e.g. in Exhibit 2, Public mode is compared with Auto mode).

**Calibration of the Hierarchical Modal Split Model**

Working from the lower level of the hierarchy to the upper level, the first analysis is that of the Rail mode versus the Bus mode. As shown in Exhibit 4, the model was effectively calibrated for the two trip purposes, with reasonable parameters and R² and t values. All the coefficients have the correct signs such that demand increases or decreases in the correct direction as travel times or costs are increased or decreased, and all the coefficients appear to be reasonable in terms of the size of their impact.

**Exhibit 4: Rail versus Bus Modal Split Model Coefficients**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Log(PRail/PBus)</th>
<th>GCRail</th>
<th>GCBus</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>-5.7562 - 0.0134 GCRail + 0.0105 GCBus</td>
<td>(-303)</td>
<td>(322)</td>
<td>0.70</td>
</tr>
<tr>
<td>Other</td>
<td>0.9312 - 0.0062 GCRail + 0.0048 GCBus</td>
<td>(-309)</td>
<td>(377)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

(1) t-statistics are given in parentheses.

The coefficients for the upper levels of the hierarchy of Surface mode versus Air mode and Public versus Auto mode are given in Exhibits 5 and 6 respectively. The utility of the composite modes is obtained by deriving the logsum of the utilities of lower level modes from the model. The model calibrations for both trip purposes are statistically significant, with good R² and t values, and reasonable coefficients.
Exhibit 5: Surface versus Air Modal Split Model Coefficients

<table>
<thead>
<tr>
<th>Mode</th>
<th>Log Model</th>
<th>Coefficients</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>( \log(\frac{PSurface}{PAir}) = 5.6751 + 0.9795 USurf + 0.0088 GCAir )</td>
<td>R²=0.80</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>( \log(\frac{PSurface}{PAir}) = -0.2423 + 0.9815 USurf + 0.0053 GCAir )</td>
<td>R²=0.79</td>
<td></td>
</tr>
</tbody>
</table>

where \( USurf = \log[\exp(-5.7562-0.0134GCRail ) + \exp(-0.0105 GCBus)] \)

(1) t-statistics are given in parentheses.

Exhibit 6: Public versus Auto Modal Split Model Coefficients

<table>
<thead>
<tr>
<th>Mode</th>
<th>Log Model</th>
<th>Coefficients</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>( \log(\frac{PPublic}{PAuto}) = -9.8691 + 0.9976 UPublic + 0.0046 GCAuto )</td>
<td>R²=0.90</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>( \log(\frac{PPublic}{PAuto}) = -4.7022 + 0.9711 UPublic + 0.0056 GCAuto )</td>
<td>R²=0.88</td>
<td></td>
</tr>
</tbody>
</table>

where \( UPublic = \log[\exp(5.6751+0.9795USurface ) + \exp(-0.0088 GCAir)] \)

(1) t-statistics are given in parentheses.

Incremental Form of the Modal Split Model

Using the same reasoning as previously described, the modal split models are applied incrementally to the base year data rather than imposing the model-estimated modal shares. Different regions of the corridor may have certain biases toward one form of travel over another and these differences cannot be captured with a single model for the entire system. Using the “pivot point” method, many of these differences can be retained. To apply the modal split models incrementally, the following reformulation of the hierarchical modal split models is used (Equation 6):

\[
\begin{align*}
\frac{P_{A}^{f}}{P_{B}^{f}} & = e^{x \beta (GC_{A}^{f} - GC_{B}^{f}) + \gamma (GC_{A}^{o} - GC_{B}^{o})} \\
\frac{P_{A}^{o}}{P_{B}^{o}} & = e^{y \beta (GC_{A}^{o} - GC_{B}^{o}) + \gamma (GC_{A}^{f} - GC_{B}^{f})}
\end{align*}
\]

For hierarchical modal split models that involve composite utilities instead of generalized costs, the composite utilities would be used in the above formula in place of generalized costs. Once again, the constant term is not used and the drivers for modal shifts are changed in generalized cost from base conditions.
Another consequence of the pivot point method is that it prevents possible extreme modal changes from current trip-making levels as a result of the calibrated modal split model, thus avoiding over or under estimating future demand for each mode.

**Induced Demand Model**

Induced demand refers to changes in travel demand related to improvements in a transportation system, as opposed to changes in socioeconomic factors that contribute to growth in demand. The quality or utility of the transportation system is measured in terms of total travel time, travel cost, and worth of travel by all modes for a given trip purpose. The induced demand model uses the increased utility resulting from system changes to estimate the amount of new (latent) demand that will result from the implementation of the new system adjustments. The model works simultaneously with the mode split model coefficients to determine the magnitude of the modal induced demand based on the total utility changes in the system. It should be noted that the model will also forecast a reduction in trips if the quality of travel falls due to increased congestions, higher car operating costs, or increased tolls. The utility function acts like a demand curve, increasing or decreasing travel based on changes in price (utility) for travel. It assumes travel is a normal good and subject to the laws of supply and demand.

**References**

- [Daly, A., et.al., 2004], A. Daly, J. Fox and J.G. Tuinenga, *Pivot-Point Procedures in Practical Travel Demand Forecasting*, RAND Europe, 2005
Appendix B: Zone System and Demographics
Study Area Zone Map
Michigan Region Zone Map
# Zone System Description

<table>
<thead>
<tr>
<th>Zone ID</th>
<th>Centroid County</th>
<th>Centroid County FIPS</th>
<th>State</th>
<th>State FIPS</th>
<th>Area (square miles)</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WAYNE MI</td>
<td>26163</td>
<td>MI</td>
<td>26</td>
<td>17.60</td>
<td>Northville TWP</td>
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<td>65.24</td>
<td>Plymouth - Livonia</td>
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<td>Zone ID</td>
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<td>Area (square miles)</td>
<td>Name</td>
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## Appendix B: Zone System and Demographics

### Coast-to-Coast Passenger Rail Ridership and Cost Estimate Study: Final Report

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## Appendix B: Zone System and Demographics

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## Appendix B: Zone System and Demographics

### Coast-to-Coast Passenger Rail Ridership and Cost Estimate Study: Final Report

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Page B-49


## Appendix B: Zone System and Demographics

### COAST-TO-COAST PASSENGER RAIL RIDERSHIP AND COST ESTIMATE STUDY: FINAL REPORT

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## Appendix B: Zone System and Demographics

### COAST-TO-COAST PASSENGER RAIL RIDERSHIP AND COST ESTIMATE STUDY: FINAL REPORT

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## Appendix B: Zone System and Demographics

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Appendix B: Zone System and Demographics

February 2016

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Appendix B: Zone System and Demographics

February 2016
## Appendix B: Zone System and Demographics

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### Appendix B: Zone System and Demographics

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## Appendix B: Zone System and Demographics

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February 2016  
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## Appendix B: Zone System and Demographics

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## Appendix B: Zone System and Demographics

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Technical Appendix C: Capital Costs
Michigan Coast-to-Coast Infrastructure
Capital Costs: 79 mph
Michigan Coast-to-Coast Infrastructure
Capital Costs: 110 mph

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<th>MILES</th>
<th>CAPCOST ($2013 mil)</th>
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Michigan Coast-to-Coast Network
Equipment Capital Costs

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## Michigan Coast-to-Coast Network Capital Costs Summary

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Infrastructure Cost Estimates for 79 mph and 110 mph Options
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# Appendix C: Capital Costs

## Infrastructure Cost Estimate for Holland to Detroit at 79-mph maximum speed

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<th>Segment</th>
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<th>Segment 4</th>
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<td>CSX</td>
<td>NS/CSX</td>
<td>MDOT/NS</td>
<td>MDOT/NS</td>
<td>MDOT/NS/N</td>
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<td>Holland to Grand Rapids</td>
<td>Grand Rapids to Downtown Lansing</td>
<td>Downtown Lansing to Jackson</td>
<td>Jackson to Ann Arbor</td>
<td>Wayne to Detroit New Center</td>
<td>Ann Arbor to Ann Perez Jct</td>
<td>Ann Perez Jct to Ann Arbor to Detroit</td>
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<tr>
<td>24.8 miles</td>
<td>64.3 miles</td>
<td>37.8 miles</td>
<td>38.9 miles</td>
<td>19.5 miles</td>
<td>17.7 miles</td>
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### Trackwork

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<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Single Track on Existing Roadbed (114&quot; CWR, Conc. TP)</td>
<td>per mile</td>
<td>1,248</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>1.2</td>
<td>USP on New Roadbed &amp; New Embankment</td>
<td>per mile</td>
<td>1,070</td>
<td>5.0</td>
<td>9,364</td>
<td>5.0</td>
<td>9,364</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.0</td>
<td>13,110</td>
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<tr>
<td>1.3</td>
<td>Timber &amp; Surface w/ 35% Tie replacement</td>
<td>per mile</td>
<td>279</td>
<td>24.6</td>
<td>6,910</td>
<td>64.3</td>
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<td>-</td>
<td>-</td>
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**Total Track Costs:** $16,921

### Turnouts

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<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
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<tr>
<td>4.1</td>
<td>6.04 High Speed Turnout</td>
<td>each</td>
<td>565</td>
<td>-</td>
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**Total Turnout Cost:** $6,388

### Curves

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<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
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<tbody>
<tr>
<td>9.1</td>
<td>Elevate &amp; Surface Curves</td>
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<td>93</td>
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**Total Curves Cost:** $0

### Signals

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<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
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<tr>
<td>8.2</td>
<td>Install CTC System (Single Track)</td>
<td>per mile</td>
<td>230</td>
<td>-</td>
<td>5.0</td>
<td>1,148</td>
<td>5.0</td>
<td>1,148</td>
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<td>8.3</td>
<td>Install CTC System (Double Track)</td>
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<td>8.4</td>
<td>Install PTC System Overlay on top of CTC</td>
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<td>8.5</td>
<td>Control Points</td>
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<td>670</td>
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<td>1,740</td>
<td>2</td>
<td>1,740</td>
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<tr>
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<td>2</td>
<td>1,084</td>
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**Total Signals Cost:** $3,382

### Stations / Facilities

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<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
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**Total Station Cost:** $1,000

### Crossings

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<th>Quantity</th>
<th>Amount</th>
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<td>1,875</td>
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**Total Crossings Cost:** $1,000

### Segment Totals

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<td>48,217</td>
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<td>-</td>
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<td>25,767</td>
<td>42,910</td>
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### Placeholders

- **All in Rate for High Speed Double Track (Dearborn to Wayne Comp)**
  - each | 3,320 |
  - per mile | 820 | 37.6 | 30,832 |
  - Purchase Mainline Track (at MDOT NS Rate)
    - each | 1,000 |
  - Purchase Branchline Track (at MDOT NS Rate)
    - each | 1,000 |
  - Turnaround Servicing Base at Holland
    - each | 20,000 |
  - Bridge at Ann Arbor
    - each | 20,000 |

**TOTAL:** $25,767

**MDOT Purchased NS line $140 million for 135 miles of track or approx 1 million per mile**
<table>
<thead>
<tr>
<th>Item</th>
<th>YR 2015 Unit Cost (1000s)</th>
<th>Quantity</th>
<th>Amount</th>
<th>Quantity</th>
<th>Amount</th>
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<tr>
<td>8.2 Install CTC System (Single Track)</td>
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<td>10.0</td>
<td>3,725</td>
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<tr>
<td>8.3 Install PTC System Overlay on top of CTC</td>
<td>per mile $ 181</td>
<td>25</td>
<td>4,488</td>
<td>64.3</td>
<td>11,661</td>
<td>37.6</td>
<td>6,819</td>
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<td>34.3</td>
<td>6,221</td>
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<td>8.6 Control Points</td>
<td>each $ 870</td>
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<td>2</td>
<td>1,740</td>
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<td>8.7 Signals for Turnout</td>
<td>each $ 620</td>
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<td>2</td>
<td>1,240</td>
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<td><strong>Total Signals Cost</strong></td>
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<td>4,488</td>
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<td><strong>Stations / Facilities</strong></td>
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<td>2.1 Full Service - New</td>
<td>each $ 1,000</td>
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<td>1</td>
<td>1,000</td>
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<td>1,000</td>
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<tr>
<td><strong>Total Station Cost</strong></td>
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<td><strong>Crossings</strong></td>
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<td>7.3 Four Quadrant Gates</td>
<td>each $ 361</td>
<td>8.1</td>
<td>22,048</td>
<td>103</td>
<td>3,729</td>
<td>126</td>
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<td>16,269</td>
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<td><strong>Total Crossings Cost</strong></td>
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<td>78,672</td>
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Costing Segment Detail Maps
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Holland to Grand Rapids (Segment 1): 79 mph Upgrade

Capital Costs (in millions)

$6.9  Timber & Surface Whole Segment with 33% tie replacement (24.8 mi)
$1.1  Convert Flashes to Dual Gates – 15 Crossings
$20.0 Turnaround / Maintenance Base
$28.0 Segment Total
Holland to Grand Rapids (Segment 1): 110 mph Upgrade

Capital Costs (in millions)

$24.8  Purchase Track from CSX (24.8 mi)
$6.9  Timber & Surface Whole Segment with 33% tie replacement (24.8 mi)
$0.3  Elevate and Surface Curves
$4.5  PTC Overlay
$22.1  Quad Gate - 61 Crossings
$20.0  Turnaround / Maintenance Base
$78.6  Segment Total
Grand Rapids to Lansing (Segment 2): 79 mph Upgrade

Capital Costs (in millions)

$17.9  Timber & Surface Whole Segment with 33% tie replacement (64.3 mi)

$14.4  Extended Passing Track with Signals

$1.9   Convert Flashers to Dual Gates

$34.2  Segment Total
Grand Rapids to Lansing (Segment 2): 110 mph Upgrade

Capital Costs (in millions)

- $64.3  Purchase Track from CSX
- $17.9  Timber & Surface Whole Segment with 33% tie replacement (64.3 mi)
- $24.9  High Speed Passing Track with Signals
- $0.9  Elevate and Surface Curves
- $37.2  Quad Gates for 103 Crossings
- $11.7  PTC Overlay
- $156.9  Segment Total
Lansing to Jackson (Segment 3): 79 mph Option

Capital Costs (in millions)

- $30.8  Rehab and Signal for 79 mph (“North-South Commuter Rail” comp)
- $14.4  Extended Mason Siding with Signals
- $1.0   Stations (Platforms only)
- $46.2  Segment Total
Lansing to Jackson (Segment 3): 110 mph Option

Capital Costs (in millions)

- $37.6 Purchase Track from NS
- $46.9 Rebuild with Welded Rail
- $22.6 High Speed Passing Track with Signals
- $16.9 CTC with PTC Overlay
- $1.0 Stations (Platforms only)
- $45.5 Quad Gate - 103 Crossings
- $170.5 Segment Total
Jackson to Ann Arbor (Segment 4): 79 mph

Capital Costs (in millions)

$33.2  Double Track 10.0 miles
       “All In Rate from Dearborn to Wayne Comp”

$33.2  Segment Total
Jackson to Ann Arbor (Segment 4): 110 mph

Capital Costs (in millions)

$103.9  Double Track 31.3 miles
        “All In Rate from Dearborn to Wayne Comp”

$103.9  Segment Total
Ann Arbor to Wayne (Segment 5): 79 mph

No Improvement for the 79 mph Option
Ann Arbor to Wayne (Segment 5): 110 mph

Capital Costs (in millions)

$30.2  Double Track 9.0 miles
       “All In Rate from Dearborn to Wayne Comp”

$30.2  Segment Total
Wayne to Detroit (Segment 6): 79 mph

Capital Costs (in millions)

$0.0  All Chicago – Detroit EIS Improvements Assumed for the 79 mph Option.

No additional improvements beyond the EIS
Wayne to Detroit (Segment 6): 110 mph

Capital Costs (in millions)

$0.0  All Chicago – Detroit EIS Improvements Assumed for the 110 mph Option.

No additional improvements beyond the EIS
Lansing to Ann Pere Jct. (Segment 7): 79 mph Option

Capital Costs (in millions)

$9.6  Timber & Surface with 33% tie replacement (34.3 mi)
$14.4  Extend Passing Siding
$1.0  Elevate and Surface Curves
$1.0  Howell Station (Platform Only)
$0.8  Convert Flashers to Dual Gates – 11 Crossings
$25.8  Segment Total
Lansing to Ann Pere Jct. (Segment 7): 110 mph Option

Capital Costs (in millions)

$34.3  Purchase CSX Track
$9.6  Timber & Surface with 33% tie replacement (34.3 mi)
$24.9  High Speed Passing Siding with Signals
$0.5  Elevate and Surface Curves
$1.0  Howell Station (Platform Only)
$16.2  Quad Gates – 45 Crossings
$6.2  PTC Overlay
$92.7  Segment Total
Ann Pere Jct. to Ann Arbor (Segment 8): 79 mph

**Capital Costs (in millions)**

- **$20.9**  Rehab track and add signals for 79 mph at “North-South Commuter Rail Rate”
- **$2.0**  Purchase 2 miles of AA Track
- **$20.0**  Bridge at Ann Arbor
- **$42.9**  Segment Total
Ann Pere Jct. to Ann Arbor (Segment 8): 110 mph

Capital Costs (in millions)

- $31.8  Rebuild Track with Welded Rail (25.5 mi)
- $10.5  CTC with PTC Overlay
- $13.3  Quad Gates – 37 Crossings
- $2.0  Purchase 2 miles of AA Track
- $20.0  Bridge at Ann Arbor
- **$77.6**  Segment Total
Ann Pere Jct. to Wayne (Segment 9): 79 mph

<table>
<thead>
<tr>
<th>Capital Costs (in millions)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>$10.1</td>
<td>Timber &amp; Surface with 33% tie replacement (36.4 mi)</td>
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<tr>
<td>$24.6</td>
<td>Siding Extensions and Capacity Improvements</td>
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<tr>
<td>$1.0</td>
<td>Plymouth Station (Platform Only)</td>
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<td>$1.0</td>
<td>Convert Flashers to Dual Gates</td>
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<tr>
<td>$36.7</td>
<td>Segment Total</td>
</tr>
</tbody>
</table>
Ann Pere Jct. to Wayne (Segment 9): 110 mph

**Capital Costs (in millions)**

- **$36.4** Buy CSX Track (and/or Easement south of Plymouth
- **$10.1** Timber & Surface with 33% tie replacement (36.4 mi)
- **$35.1** High Speed Siding and Capacity Improvements
- **$0.8** Elevate and Surface Curves
- **$1.0** Plymouth Station (Platform Only)
- **$10.9** Quad Gates – 30 Crossings
- **$6.6** PTC Overlay
- **$100.9** Segment Total