NORTHERN INDIANA PASSENGER RAIL CORRIDOR

SERVICE ALTERNATIVES ANALYSIS REPORT

Tolleston (Gary, IN) to Lima, OH

Prepared for the City of Fort Wayne, IN

November 2017

HNTB

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1 INTRODUCTION

This Alternatives Analysis Report describes the service alternatives and screening analysis used to identify the reasonable service alternative(s) for future passenger rail service between Chicago and Fort Wayne, IN with an extension of service to Lima, OH (the Project).

This current study phase is undertaking early planning activities that include identifying the Project purpose and need, conducting an analysis of route, service and investment alternatives to develop an incremental approach to service implementation and completing conceptual engineering to understand Project infrastructure requirements and preliminary cost estimates. Decisions from these early planning activities will position the Project to complete an environmental review required under the National Environmental Policy Act (NEPA) for a potential future federally funded action. The Project sponsors anticipate requesting federal funds, requiring compliance with NEPA. The NEPA process is intended to help public officials make decisions that are based on an understanding of potential environmental consequences.

NEPA regulations also require the inclusion of an "alternative of no-action" along with the evaluation of all reasonable alternatives. The no-action alternative is not included in this screening analysis as it is required to be evaluated in any future environmental study that is intended to satisfy NEPA. Future NEPA analysis will indicate if the no-action alternative satisfies the Project's purpose and need of establishing direct and reliable passenger rail service to the communities who have invested in the planning of the Northern Indiana Passenger Rail Corridor (the Corridor). The no-action alternative will also provide a baseline for evaluating the environmental impacts of the proposed reasonable alternative(s).

1.1 Route Alternatives Analysis

The route alternatives analysis[1] for the Northern Indiana Passenger Rail Corridor concluded that implementing new passenger rail service on the Chicago, Fort Wayne & Eastern (CFER) Fort Wayne Line between Tolleston (Gary, IN) and Lima, OH best met the Project's purpose and need (see Figure 1). Between Chicago Union Station and Tolleston, the service would utilize the route proposed by the Midwest Regional Rail Initiative to take advantage of passenger rail planning already completed in the "South of the Lake" area, which includes the segment between Chicago Union Station and Tolleston (see Figure 2).[2] This identified route into Chicago is one of four routes evaluated in the *Chicago-Detroit/Pontiac Passenger Rail Corridor Program Tier 1 Draft EIS* published in September 2014.[3] The *Chicago-Detroit/Pontiac Passenger Rail Corridor Program* was commissioned by the Michigan Department of Transportation to identify a preferred route for passenger rail in the South of the Lake. Verification of the South of the Lake route will be needed once a Record of Decision is published by the Federal Railroad Administration (FRA).

[1] City of Fort Wayne, IN. *Northern Indiana Passenger Rail Corridor: Route Alternatives Analysis Report*. August 2017.
[2] The "South of the Lake" describes the extensive railroad network that is located south of Lake Michigan between Chicago and Porter, IN and includes the section between Chicago Union Station and Tolleston.
[3] It is expected that the FRA will complete and publish the Final EIS and Record of Decision in 2017.

Figure 1: Identified Reasonable Route Alternative for the Northern Indiana Passenger Rail Corridor (Tolleston – Lima)

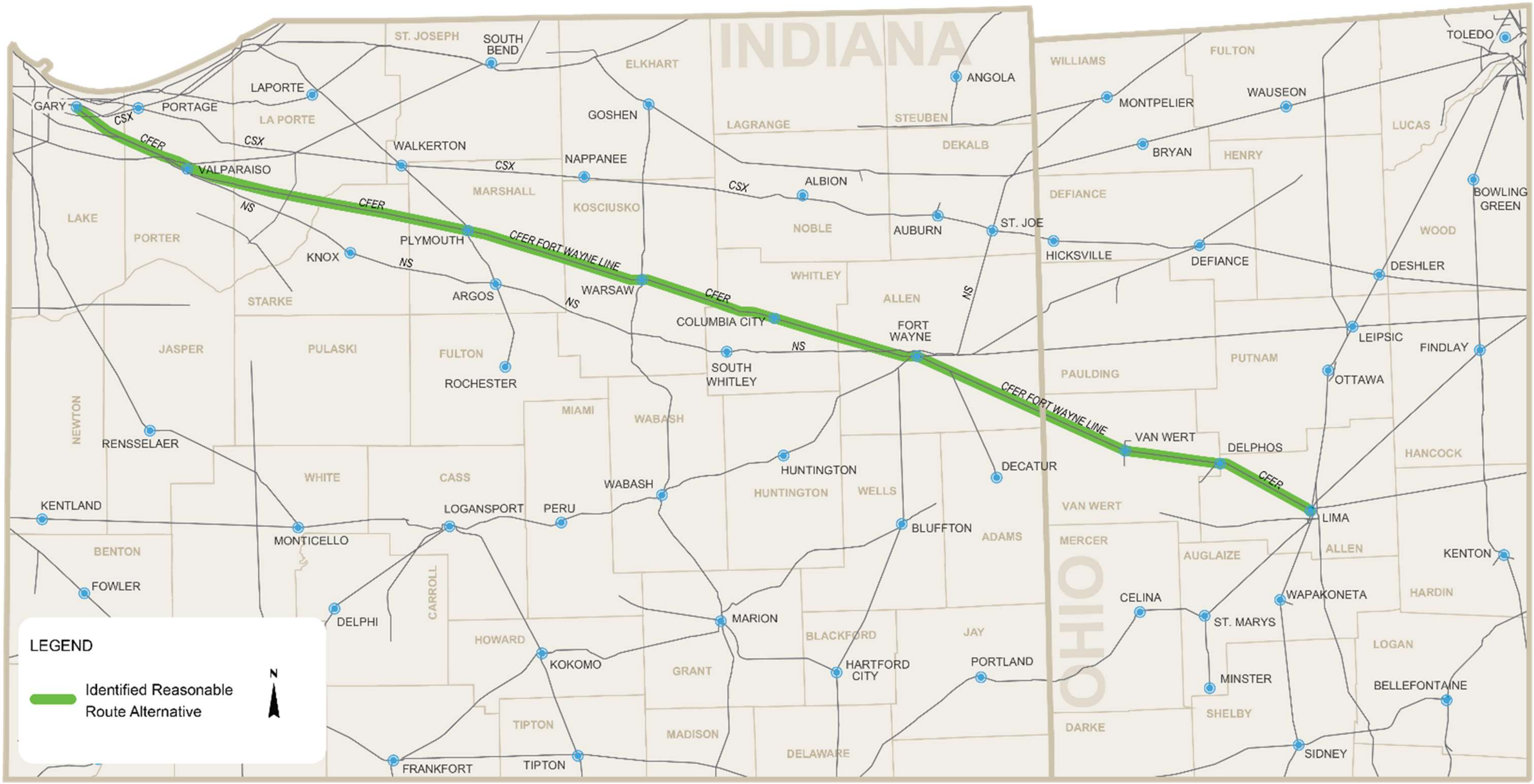
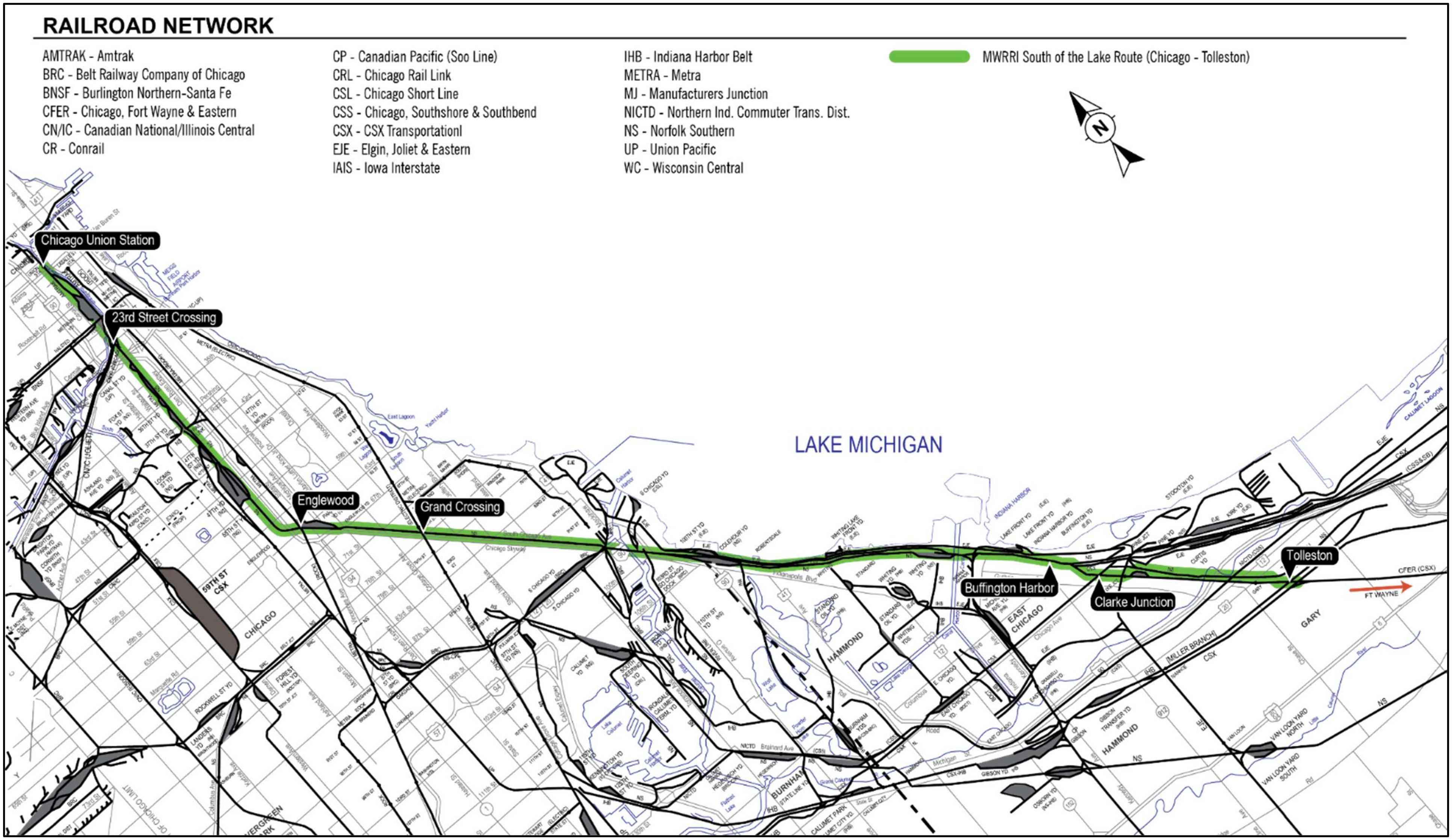


Figure 2: Identified Reasonable Route Alternative for the Northern Indiana Passenger Rail Corridor (Chicago Union Station - Tolleston)



2 SERVICE ALTERNATIVES

This alternatives screening evaluates the five proposed service alternatives identified in Table 1 for the Northern Indiana Passenger Rail Corridor. These five service alternatives were selected for analysis because they represent logical speeds and frequencies for a new service while also considering opportunities to provide a more robust and faster service. Analysis of the service alternatives will provide a better understanding of the type of service the Corridor can best support.

Table 1: Service Alternatives

Frequency	79 MPH	110 MPH
2 Daily Roundtrips	X	
4 Daily Roundtrips	X	X
6 Daily Roundtrips	X	X

The range of service alternatives in Table 1 was developed by assessing the existing conditions of the corridor and the planned improved passenger rail service in the South of the Lake area, as part of the *Chicago-Detroit/Pontiac Passenger Rail Corridor Program.* No passenger rail service currently exists within the Corridor, and therefore, the feasibility of initiating start-up conventional train service at speeds up to 79 mph was evaluated. Two daily round trip (DRT) service represents the typical lower risk startup service and is accompanied by incremental increases in frequency at four and six roundtrips that could potentially be supported by the Corridor population.

Service at speeds up to 110 mph is also examined, as the preferred route for the Corridor provides the opportunity to connect to planned 110 mph improvements between Gary, IN and Chicago. The 110 mph South of the Lake Corridor is a planned double track passenger route that would accommodate all passenger train service between Chicago and trains to/from the east. The ability to connect to these planned improvements between Tolleston and Chicago provides the Northern Indiana Passenger Rail Service with a unique opportunity to work towards 110 mph operations in coordination with other established corridor services in the Midwest.

The purpose of the Project is to establish a new intercity passenger rail service from Chicago through the cities of Gary, Valparaiso, Plymouth, Warsaw, and Fort Wayne, IN and Lima, OH. Therefore, each service alternative is planned to stop at each of these cities as indicated in the planning level train schedules provided in Appendix A. The alternatives in this study are developed to respond to a need for transportation alternatives to meet travel needs in corridor communities, provide reliable travel times in a congested travel corridor, meet anticipated travel demand due to population and employment growth and facilitate economic development goals.

To further support the alternatives analysis and screening process, as stated in the Project purpose and need statement, the range of reasonable alternatives must maintain cost-effectiveness. The new intercity passenger rail service would operate within existing freight railroad right of way to minimize infrastructure investments needed to provide attractive and reliable passenger rail service, while also avoiding interference with existing and future freight service. The reasonable alternatives reflect a cost-effective operating plan that balances ongoing financial operating support with available funding levels, proposed service levels and estimated passenger utilization (ridership).

3 METHODOLOGY

Each service alternative is analyzed based on the screening criteria described in Section 3.1. The selected screening criteria provide insight into the expected performance of each service alternative. The results of the screening analysis are used to compare the service alternatives among each other and identify the best full build-out service alternative. It is anticipated that the implementation of this service would be phased over time to start service as quickly as possible while spreading the cost of construction over a series of years. Therefore, this analysis identifies a preferred full build-out service alternative and suggests a reduced level of service as the interim start-up service.

Data for this analysis of service alternatives is based on the hypothetical train schedules provided in Appendix A. The year 2035 is used for comparing forecasts of ridership, revenues, and operating costs. All costs are presented in 2016 dollars.

3.1 Screening Criteria

Each service alternative will be analyzed using quantitative and qualitative data gathered for the following screening criteria:

Forecasted Ridership – Forecasted ridership provides a measure of the relative attractiveness of each service alternative to the traveling public. One of the goals of the operator is to provide a service that maximizes the number of paying customers at a given fare. The 2035 ridership forecasts will be considered when comparing and scoring alternatives to provide a consistent baseline among all alternatives.

Frequency – The frequency of train service is a measure of mobility benefits to the consumer. Frequent train service enables passengers to more freely travel within their own timeline. Infrequent service is inconvenient, and may require passengers to adjust their timeline to conform to the train service's prescribed schedule or seek other modes of transportation.

Travel Time – Intercity passenger rail service becomes more attractive to consumers as it becomes competitive with the travel time of other modes of transportation, especially the automobile. Each service alternative will be analyzed on travel time in comparison to each other service alternative and automobile travel times.

Equipment Needs – The equipment needs of a passenger rail service are based on frequency, corridor length, and scheduled departures. Additional equipment is typically needed on a corridor as frequencies increase, which results in increased capital expenditure. The resulting increase in ridership and revenue due to increases in frequency will be considered when analyzing the justification for equipment needs of a service alternative.

Equipment Utilization – Consideration should be given to how often equipment is utilized when making equipment investments. Investment in additional equipment may be justifiable when the equipment is being utilized efficiently and is gaining significant revenue. Equipment utilization will be measured in average daily revenue hours per train consist.

Forecasted Annual Revenue – Includes passenger ticket revenue as well as revenue from food and beverage sales. Revenue forecasts are based on ridership, the distance each passenger travels, and the cost for passengers to travel a certain distance. Similar to ridership, the goal of the operator is to maximize revenue to sustain the operation of the service. The 2035 passenger revenue forecasts will be considered when comparing and scoring alternatives to provide a consistent baseline among all alternatives.

Operating and Maintenance Costs – Preliminary operating and maintenance (O&M) cost estimates will be developed for all five service alternatives. The O&M cost estimates will be based on standard Amtrak cost categories developed from the implementation of Section 209 of the Passenger Rail Investment and Improvement Act of 2008 (PRIIA) that is intended to ensure equitable allocation of operating costs among states supported routes. The screening evaluation will compare O&M costs and consider the main differences in cost.

Operating Ratio and Surplus or Deficit - The operating ratio is the comparison of a service alternatives revenues to O&M costs. The operating ratio is an overall measures the service's operating efficiency. This evaluation will also consider the overall operating surplus or deficit to obtain an understanding of any costs that cannot be covered by operating the service and would need to be covered by other funding resources, such as from state and/or local entities.

Infrastructure Capital Needs – A high-level cost estimate was developed based on the relative infrastructure investment determined for the five service alternatives by considering the following three factors:

1. Freight operations versus passenger service alternative frequency
2. Passenger service alternative operating speed within the corridor
3. Passenger only conflicts

Engineering judgement, operational rules of thumb, and general understanding of how the various service alternatives impact the operations and infrastructure in the project corridor were applied in effort to compare the service alternatives. The high-level cost estimate is reported in a "base-cost, plus increment" format to understand the incremental cost difference between service alternatives. The lowest cost alternative is reported as the base and each other alternative is reported as the base cost, plus an additional cost increment.

3.2 Criteria Scoring

The service alternatives are scored on how well the alternative satisfies the screening criteria described above. The screening criteria are scored on a scale of high, medium, and low, as signified by the green, yellow, red, color code described below.

- (green) The service alternative provides a substantially better outcome in comparison to the average of all alternatives.
- (yellow) The service alternative does not provide a substantially better or worse outcome in comparison to the average of all alternatives.
- (red) The service alternative provides a substantially worse outcome in comparison to the average of all alternatives.

The scoring system is based on an analytical standard deviation process that indicates if an alternative is one standard deviation better or worse than the average of all service alternatives. The number of standard deviations better or worse than the average is known as the "standard score". For this analysis, service alternatives that have a standard score that is at least one standard deviation better than the average receive the highest score (green). Those service alternatives that are one standard deviation worse than the average receive the lowest score (red), and data that is within one standard deviation (positive or negative) of the average of all service alternatives receives a medium score (yellow). The red and green scores do not identify statistical outliers, but rather suggest which alternatives are considerably better or worse than average given a certain criterion.

The standard deviation of the data for each criterion was calculated and used to set the upper and lower thresholds that are used to score each service alternative. The following formula was used to calculate standard deviation.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

$\sigma = Standard\ Deviation \qquad \mu = Average\ of\ all\ Service\ Alternative\ Values$
$N = Number\ of\ Values \qquad x_i = Each\ Service\ Alternative\ Value$

Once the upper and lower thresholds were established, the standard score was calculated for each data point within a given criterion. The standard score is based on the standard deviation as seen in the equation below, and indicates how close the service alternative is to the average of all service alternatives.

$$z = \frac{(x - \mu)}{\sigma}$$

$Z = Standard\ Score \qquad x = Service\ Alternative\ Value$
$\mu = Average\ of\ all\ Values \qquad \sigma = Standard\ Deviation$

A ranking of one through five is also provided to help understand the order of the outcome of each analysis. The data has been ranked in a fashion where one (1) is considered the best service alternative and five (5) is considered the worst within each criterion. As with the standard deviation analysis, the ranking is meant help provide an understanding of which alternative is better or worse given a specific criterion.

3.3 Identification of Reasonable Service Alternatives to be Included in Future Environmental Analysis

The evaluation of the screening criteria will be used to assess each service alternatives ability to serve the purpose and need of the Project. The service alternatives that can serve the purpose and need will be identified as reasonable service alternatives to be Included in future environmental analysis. The following purpose statements are established in the Project's purpose and need statement:

1. The Project provides daily roundtrip service from Chicago through the cities of Gary, Valparaiso, Plymouth, Warsaw, and Fort Wayne, IN and Lima, OH
2. The passenger rail service provides a convenient mode of travel by providing station access in central locations within the communities along the Corridor.
3. The service provides departures that accommodate a person's typical daily schedule and same-day trips between destinations

4. The operating plan for the service will be cost-effective by balancing service levels, service utilization (ridership) and ongoing financial operating support.

All service alternatives have the ability to serve the initial three purpose statements above. Therefore, the identification of reasonable service alternatives is based on the alternatives ability to provide a cost-effective service that balances service levels, service utilization (ridership) and ongoing financial operating support. The assessment of cost-effectiveness is addressed in Section 5: Identification of Reasonable Service Alternatives.

4 Evaluation of Screening Criteria

4.1 Forecasted Ridership

The analysis of ridership is based on a forecasted ridership for the year 2035 that was developed by Transportation Economics & Management Systems, Inc (TEMS) with the use of the COMPASS™ Travel Market Forecast Model. The model generates annual ridership (and revenue) forecasts for the proposed rail service by analyzing total travel demand in the Corridor and preference to transportation modes that are available in the Corridor. Forecasted changes in travel demand and mode preference within the Corridor consider socioeconomic variables, such as population, employment, and income as well as travel time, frequency, and cost of available transportation modes. Greater detail about the development of the ridership (and revenue) forecasts can be found in Appendix B.

The forecasted ridership for this Corridor increases as frequency and speed increases. The lowest forecasted ridership is 430,000 annual riders on two daily roundtrips (DRT) at 79 mph, and increases to a high of 1,120,000 annual riders on six DRT at 110 mph. The remaining three service alternatives range from 640,000 to 920,000 forecasted annual riders as shown in Table 2. Passenger rail service with faster travel times and frequent departures attract more ridership as the service becomes more convenient and attractive to prospective riders.

Six DRT at 110 mph is scored the highest because it attracts the greatest number of riders and is substantially greater than the average of all service alternatives. Conversely, two DRT at 79 mph is scored the lowest because it attracts the least number of riders and is substantially lower than the average. The remaining service alternatives are given a “medium” score as they are not substantially greater or lesser than the average.

The data indicates that the largest incremental increase in ridership is captured when frequency increases from two to four DRT at 79 mph, as ridership increases 49 percent. An additional ridership increase of 22 percent is forecasted when frequency is increased from four to six DRT at 79 mph. The same 22 percent increase in ridership is forecasted when increasing from four to six DRT at 110 mph.

The second largest incremental increase in ridership occurs as speed is increased from 79 to 110 mph. The resulting 52 minutes of travel time savings creates a 44 percent increase in forecasted annual riders while maintaining the level of frequency.

Table 2: Ridership - Forecasted Annual Riders in 2035

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Ridership	430,000	640,000	780,000	920,000	1,120,000
	RANK 5	RANK 4	RANK 3	RANK 2	RANK 1

Source: Transportation Economics & Management Systems, Inc. Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Preliminary Forecasts. April 13, 2017.

4.2 Frequency

Passenger rail service becomes more convenient for its users as frequency increases. The increase in frequency results in a greater number of departures, which makes scheduling travel easier for passengers. The service alternatives with more daily round trips are scored more favorably as they provide a more flexible and attractive transportation service to prospective travelers. The promotion of increased frequency is also supported by the resulting increase in ridership described in Section 4.1.

Based on the data in Table 3, six DRT service at 79 and 110 mph provides service that is considerably better than the average. Four DRT service at 79 and 110 mph is considered average service in comparison to the other considered alternatives. Two DRT at 79 mph provides the least amount of flexibility for passengers, and therefore is the least desirable alternative in terms of frequency.

Table 3: Frequency - Scheduled Daily Roundtrips

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Frequency	2	4	6	4	6
	RANK 3	RANK 2	RANK 1	RANK 2	RANK 1

4.3 Travel Time

The travel times in Table 4 were developed using the Train Performance Calculator (TPC) tool within the Rail Traffic Controller computer-based model developed by Berkeley Simulation Software, LLC. TPC is used to create optimized train schedules that are based on travel times that assume no train interference, as is the goal of a passenger rail service. The TPC tool accounts for the proposed equipment type, train consists, and horizontal and vertical track alignments.

Passenger rail becomes more attractive to travelers as travel time decreases and becomes competitive with travel times for other modes of transportation. Table 4 shows that the 110 mph service provides travel times that are nearly a full hour less than the 79 mph service. Among the service alternatives, the 110 mph service alternatives provide travel times that are substantially better than the 79 mph service alternatives as well as the average of all service alternatives. The ridership forecast described in Section 4.1 also supports the implementation of 110 mph service, as the 52 minutes in travel time savings results in a 44 percent increase in forecasted annual ridership.

A car trip from Lima, OH to Chicago with a 9 a.m. departure can range from 3 hours and 50 minutes to 5 hours and 20 minutes.[4] Therefore, passenger rail at speeds of 79 and 110 mph provide a competitive alternative to automobile travel as all service alternatives provide a travel time that is less than the time needed to travel by automobile.

[4] Google. Google Maps. https://www.google.com/maps/. Retrieved September 20, 2017.

Table 4: Travel Time – Chicago to Lima, OH (Hours:Minutes)

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Travel Time	3:27 Rank 2	3:27 Rank 2	3:27 Rank 2	2:35 Rank 1	2:35 Rank 1

4.4 Equipment Needs

The amount of equipment needed can have a significant impact on the capital cost of a given level of service if coaches and locomotives are purchased. One full trainset can cost between $25 million and $35 million when purchased new. Equipment can also have a significant impact on operating cost if equipment is provided by Amtrak and an annual capital equipment charge is included in Amtrak's bill to the service operator. This capital charge can be in the range of 10 percent of overall annual operating costs.

Equipment needs are based on the number of locomotives needed to haul a train at a desired speed, the number of coach cars needed to haul forecasted ridership, and the number of train consists required to cover the proposed schedules included in Appendix A. Based on current Amtrak locomotive equipment, it is expected that 79 mph service alternatives will require one locomotive per train consist, while 110 mph service alternatives will require two locomotives to fully maximize higher allowable speeds. Coach car needs are based on the seating capacity needed to accommodate forecasted average daily ridership per train for each service alternative, shown in Table 5 as well as Table 6 below. Therefore, the train consist is sized to accommodate the greatest average daily segment ridership along the route, which is between Chicago and Gary, IN for all service alternatives. The data shows the average number of riders that are forecasted to be on each train between each station city, assuming that all passengers return to their origin on the same day. Seating capacity within each coach car is based on current Amtrak equipment, including the 68 seat Horizon single-level coach and 14 seat Amfleet 1 Business/Café coach.

Table 5: Forecasted Average Daily Segment Ridership per Train (2035)

Route Segment	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Chicago – Gary	233	178	146	260	212
Gary – Valparaiso	226	175	142	250	201
Valparaiso - Plymouth	219	164	135	236	192
Plymouth – Warsaw	205	158	128	223	178
Warsaw – Ft. Wayne	178	137	112	195	155
Ft. Wayne - Lima	82	65	53	92	73

Source: Based on data from Transportation Economics & Management Systems, Inc. Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Preliminary Forecasts. April 13, 2017.

One consequence of increasing frequency is the need to invest in additional train equipment. Table 6 indicates that as frequency and speed increases, additional train consists are needed to cover the scheduled turns at the termini. The need for equipment is compounded by the locomotive and coach car needs to support the forecasted ridership for each service alternative. A service alternative with less equipment needs is considered more desirable as it requires less maintenance while operating the service, and potentially less initial capital expenditure. The data reported in Table 6 does not include the need for spare equipment, typically one additional train consist, which would either be included in a leasing agreement or Amtrak equipment charge, or included in a procurement agreement if the service provider chooses to purchase equipment.

Table 6 indicates that the six DRT at 110 mph service alternative requires substantially more equipment than the average need of all service alternatives, while the two DRT at 79 mph service alternative requires substantially less equipment than the average. The equipment needs of the four and six DRT at 79 mph and four DRT at 110 mph alternatives is not substantially more or less than the average based on the needs of all service alternatives.

Table 6: Total Equipment Needs (not including spares)

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Total train consists	2	3	4	3	4
Locomotives	2	3	4	6	8
Single-level coach car	8	9	12	12	16
Business/café car	2	3	4	3	4
	(green) RANK 1	(yellow) RANK 2	(yellow) RANK 3	(yellow) RANK 4	(red) RANK 5

4.5 Equipment Utilization

The average daily revenue hours per train consist measures the efficiency of equipment utilization by calculating the average number of hours each train consist is in revenue service for one day. This criterion is dependent on the number of train consists needed to operate the service, the number of frequencies, the length of the corridor, and the travel time. The service alternatives with the higher average daily revenue hours per train consist are considered more desirable, as the equipment spends more time generating revenue and less time waiting for the next departure.

The data in Table 7 indicates that the six DRT at 79 mph service alternative provides the greatest equipment utilization by averaging 10 hours 21 minutes of daily revenue service per train consist. However, it should be recognized that the 110 mph service alternatives average less daily revenue hours because they are traveling at faster speeds and are therefore averaging less time in revenue service each scheduled departure. The equipment utilization for the remaining service alternatives is not substantially greater than average, but still provide good equipment utilization.

Table 7: Equipment Utilization - Average Daily Revenue Hours Per Consist (Hours:Minutes)

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Equipment Utilization	6:54	9:12	10:21	6:53	7:45
	(yellow) RANK 4	(yellow) RANK 2	(green) RANK 1	(yellow) RANK 5	(yellow) RANK 3

4.6 Forecasted Revenue

Annual revenue is dependent on ridership, the length of each rider's trip, and the amount of food consumed. Revenue increases as ridership and the average trip length increases. Service alternatives that generate greater amounts of revenue score the highest as it is typically a goal of the service operator to maximize revenue. The average fare used to develop the revenue forecasts is 28 cents per mile[5] and was identified as the optimal fare to maximize annual ridership and revenue to help offset annual operating and maintenance costs.

The lowest forecasted revenue is $15.41 million generated by two DRT at 79 mph, and increases to a high of $40.95 million for six DRT at 110 mph. The remaining three service alternatives range from $23.57 million to $33.86 million in forecasted revenue, as shown in Table 8. The six DRT at 110 mph service alternative scores the best as it generates the greatest amount of revenue and is substantially better than the average of all service alternatives. However, incremental increases in forecasted revenue start to diminish as frequency increases from four to six DRT, in comparison to increasing frequency from two to four DRT. This suggests that operating at six DRT at 110 mph may not be worth the additional revenue if operating expenses increase at a greater rate than revenue is gained. See Section 4.8 for additional analysis on each service alternative's ability to cover operating expenses with generated revenue.

The revenue forecasts correlate with the forecasted ridership trends discussed in Section 4.1. As with ridership, the largest incremental increase in revenue is captured when frequency increases from two to four DRT at 79 mph. The frequency increase generates an additional 53 percent in annual forecasted revenue. An additional revenue increase of 22 percent is forecasted when frequency is increased from four to six DRT at 79 mph. A similar 21 percent increase in revenue is forecasted when increasing from four to six DRT at 110 mph.

The second largest incremental increase in revenue occurs as speed is increased from 79 to 110 mph. The resulting 52 minutes of travel time savings creates a 42 to 44 percent increase in forecasted annual revenue while maintaining the level of frequency.

Table 8: Forecasted Annual Revenue in 2035 (2016$)

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Annual Revenue	$15,410,000	$23,574,000	$28,865,000	$33,857,000	$40,948,000
	RANK 5	RANK 4	RANK 3	RANK 2	RANK 1

Note: The total revenue includes revenue from passenger ticket sales and food and beverage sales. Food and beverage revenue forecasts are based on food and beverage sales from Amtrak similar service.
Source of Ticket Revenue Forecasts: Transportation Economics & Management Systems, Inc. Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Preliminary Forecasts. April 13, 2017.

4.7 Operating and Maintenance Costs

The annual operating and maintenance costs reported in Table 9 consider all standard Amtrak Section 209 cost categories, including annualized equipment overhaul costs. The operating and maintenance costs reported in Table 9 and Appendix C are conceptual estimates, and are subject to negotiation with the operator and host railroad. The data in Table 9 indicates that operating and maintenance costs increase as speed and frequency increase. This trend can mainly be attributed to the need for more crew to operate the service, the greater amount of equipment to maintain, and the higher standard of rail maintenance needed to operate at 110 mph.

Service alternatives with lower operating and maintenance costs are rated higher, as it requires less funding to operate the service. Two DRT at 79 mph is considered substantially less than the average for this given

[5] Transportation Economics & Management Systems, Inc. Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Preliminary Forecasts. April 13, 2017.

criterion, and therefore scored the best. Six DRT at 110 mph is considerably greater than the average, while all other service alternatives are not substantially better or worse than the average of all service alternatives.

Table 9: Annual Operating and Maintenance Costs (2016$)

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Operating & Maintenance Costs	$17,641,000	$29,455,000	$41,821,000	$36,534,000	$51,682,000
	(green) RANK 1	(yellow) RANK 2	(yellow) RANK 3	(yellow) RANK 4	(red) RANK 5

4.8 Operating Ratio and Surplus or Deficit

The operating surplus/deficit compares the annual operating and maintenance costs to the annual operating revenue, which includes passenger ticket revenue and food and beverage revenue. The data in Table 10 shows that all service alternatives are estimated to operate at a deficit, indicating that total operating revenue will not cover the cost of operating the service. The operating deficit is the annual total that the funding partners would be required to pay to operate the service after the operating revenue is considered. The operating ratio indicates the percentage of the annual operating and maintenance costs that are covered by the operating revenue.

A lower operating deficit (or higher surplus) and a higher operating ratio is more desirable, as it is advantageous to minimize service subsidy. Table 10 indicates that the four DRT at 110 mph service alternative has the second lowest operating deficit and highest operating ratio, which is substantially better than the average of all service alternatives despite having the third highest annual operating and maintenance cost (as seen in Section 4.7). Operating six DRT at 79 mph has a substantially worse operating deficit and ratio in comparison to the average of all service alternatives, while the remaining service alternatives neither substantially better or worse than the average of all service alternatives considered.

Table 10: Operating Ratio and Surplus/Deficit

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Operating Surplus/Deficit[6]	$(2,231,000)	$(5,881,000)	$(12,956,000)	$(2,677,000)	$(10,734,000)
Operating Ratio[7]	0.87	0.80	0.69	0.93	0.79
	(yellow) RANK 2	(yellow) RANK 3	(red) RANK 5	(green) RANK 1	(yellow) RANK 4

Note: Scores and rankings are based on operating ratio.

4.9 Infrastructure Capital Needs

The infrastructure capital needs shown in Table 11 are based on a high-level evaluation of the existing corridor characteristics and provides a comparison level analysis between the service alternatives. At this early stage, rather than providing absolute cost numbers, the analysis focuses on the differences in cost between the alternatives. This is done by comparing a base case (in this case two DRT at 79 mph) with increases in costs associated with the other alternatives. A final, more detailed, cost estimate will be developed for the preferred alternative selected as a result of this service alternatives analysis.

[6] Operating surplus or deficit is calculated subtracting operating expenses from revenues, including ticket revenue and revenue from the sale of food and beverage.
[7] Operating ratio is calculated by dividing total annual revenue by annual operating and maintenance costs.

The high-level evaluation reviewed the existing infrastructure; operating speeds; signalization; corridor bottle necks; industrial switching locations; and proposed passenger frequencies; and proposed passenger speeds. The key elements evaluated and addressed in the analysis were: upgrading mainline track to appropriate classification of track (Class 4 and 6) for proposed service alternative operating speeds; installing or upgrading communications and signalization for proposed operating speeds; existing siding spacing within the corridor; and proposed passenger meets per the service alternative schedules in Appendix A.

As passenger train frequencies increase, the need for additional infrastructure to mitigate operational conflicts increases. The conflicts considered in the analysis include freight and passenger conflicts or conflicts between two passenger trains. Additionally, enough infrastructure needs to be implemented to maintain reliability for both freight and passenger operations within the corridor. The high-level analysis approach to mitigate anticipated operation conflicts between freight and passenger was to build infrastructure that allows freight trains to clear the mainline track and allow scheduled passenger trains to pass freight traffic on the mainline. Proposed infrastructure was primarily applied at freight bottle necks and segments where freight volumes increase at Wheeler and Fort Wayne, IN; existing industrial switching at Warsaw, IN, Coesse, IN and Delphos, OH; and tightening and lengthening existing siding spacing along the corridor. Per the proposed passenger schedules, a majority of the passenger meets for each service occur at proposed station locations. This requires some of the proposed stations to be double tracked to accommodate proposed passenger meets. This schedule strategy also reduces the amount of infrastructure specifically necessary to accommodate passenger meets.

As displayed in Table 11, two DRT at 79MPH service alternative requires the least amount of infrastructure capital within the corridor to accommodate the proposed passenger service and 6 DRT at 110MPH requires the most. The data suggests that the two DRT at 79 mph alternative is considerably better than the average of all service alternatives, six DRT at 110 mph is considerably worse than the average, and the remaining three alternatives are not considerably better or worse than the average. The largest portion of the initial capital needs for the 79 MPH and 110MPH service alternatives comes from the need to rehabilitate the existing mainline to Class 4 and 6 standards and implement a Positive Train Control (PTC) signaling system to accommodate the proposed passenger operating speeds. The cost differences as frequencies increase is due to adding additional infrastructure above the base case along the corridor for reasons previously mentioned.

Table 11: Infrastructure Capital Needs

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Infrastructure Capital Needs	Base (green) RANK 1	+$44.6M (yellow) RANK 2	+$88.6M (yellow) RANK 3	+$94.6M (yellow) RANK 4	+$178.6M (red) RANK 5

5 IDENTIFICATION OF REASONABLE SERVICE ALTERNATIVES

Based on the data reported in Section 4 and summarized in Table 12, it is recommended that six DRT at 79 and 110 mph should not be considered in future planning for passenger rail in the Corridor. The incremental increase in frequency beyond four DRT is not a cost-effective solution. This conclusion is supported by the comparatively high capital investment and annual operating deficit, coupled with diminishing incremental increases in ridership and revenue, compared to the ridership increases at the four DRT service level. Ridership and revenue each increase approximately 22 percent when frequency is increased from four to six DRT, which is about half of the return seen when increasing from two to four DRT. Approximately $44 million in additional capital funding would be needed to increase from four to six DRT at 79 mph, and an additional $84 million to increase frequency from four to six DRT at 110 mph to obtain the relatively small increase in ridership and revenue. Additionally, the six DRT service alternatives result in the two largest annual operating deficits, making it more difficult to sustain the system after implementation.

The two and four DRT at 79 mph and four DRT at 110 mph service alternatives are recommended to be carried forward as the range of reasonable alternatives for further analysis in a future environmental document as required by NEPA. The three service alternatives serve all aspects of the Project's purpose and need. Each service alternative establishes direct and reliable passenger rail service to the communities who have invested in the planning of the Northern Indiana Passenger Rail Corridor, and are cost-effective solutions that balance ridership and revenue with the cost of providing the service.

The three reasonable service alternatives provide logical incremental steps to gradually improving service, while maintaining cost-effectiveness and long-term sustainability. It is anticipated that the implementation of this service would be phased over time to start service as quickly as possible while spreading the cost of construction over a series of years. To save on up-front capital costs the Project could be initiated with two or four DRT at 79 mph, providing a lower-risk alternative to initiating service at 110 mph. However, there is a trade-off between lower capital costs and annual operating efficiency. The up-front capital cost savings would result in a lower annual forecasted operating ratio compared to the four DRT at 110 mph, which has the highest forecasted operating ratio. However, the operating payment for four DRT at 110 mph is very similar to the payment to operate two DRT at 79 mph, which is a logical start-up service. Depending on the frequency of service, operating at 79 mph would require approximately $2.2 to $5.9 million in annual payment to the operator. Approximately $2.7 million in annual payment would be required to operate four DRT at 110 mph.

Improving service to four DRT at 79 or 110 mph would approximately require an additional $44.6 to $94.6 million over the cost to build the base service alternative of two DRT at 79 mph. The additional capital cost is a result of increased need for equipment and railroad infrastructure to operate more trains at higher speeds. However, the incremental costs to increase service from the base two DRT to four DRT ($44.6M) and speed from 79 to 110 mph (an additional $50M) provides considerable value as it would increase ridership 114 percent over the base of two DRT at 79 mph. The 114 percent increase in ridership can be realized incrementally by increasing frequency and speed in separate phases, or all at once if all required funding is available. If the service is phased, forecasted ridership and revenue increases 49 percent and 53 percent, respectively as frequency is increased from two to four DRT. Ridership and revenue increase another 42 to 44 percent each as speed is increased from 79 to 110 mph.

The four DRT at 110 mph service alternative also provides the most sustainable operating scenario that best balances ridership, revenue, and annual operating costs. The four DRT at 110 mph alternative carries an operating ratio of 0.93 and has the second lowest required operating subsidy, suggesting a relatively high level of efficiency and cost-effectiveness. Therefore, it should be a goal to identify and obtain funding that can be invested in the Corridor's rail infrastructure so that it can be operated at four DRT at 110 mph to ease the annual operating cost burden. Additionally, the implementation of the four DRT at 110 mph service will also fully leverage the proposed investment between Gary, IN (near Tolleston) and Chicago as identified in the *Chicago-Detroit/Pontiac Passenger Rail Corridor Program Tier 1 EIS*, which is planned to be fully constructed by 2035.

Table 12: Summary of Screening Analysis

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Ridership	430,000	640,000	780,000	920,000	1,120,000
	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1

Evaluation Summary:

- Two DRT at 79 mph creates the lowest forecasted ridership, while six DRT at 110 mph creates the highest forecasted ridership.
- The largest incremental increase in ridership is captured when frequency increases from two to four DRT at 79 mph (49 percent increase).
- The second largest incremental increase in ridership occurs as speed is increased from 79 to 110 mph (44 percent increase).

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Frequency	2	4	6	4	6
	Rank 3	Rank 2	Rank 1	Rank 2	Rank 1

Evaluation Summary:

- The service alternatives with more daily round trips are scored more favorably as they provide a more attractive transportation service to prospective travelers.
- Six DRT service provides the best service in terms of frequency, four DRT is considered average service among the evaluated service alternatives, and two DRT provides the worst service in terms of frequency.

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Travel Time	3:27	3:27	3:27	2:35	2:35
	Rank 2	Rank 2	Rank 2	Rank 1	Rank 1

Evaluation Summary:

- Passenger rail travel becomes more attractive to travelers as it decreases and becomes competitive with travel times for other modes.
- All service alternatives provide travel times that are competitive with automobile travel, the most common form of regional transportation in the Corridor.
- The 110 mph service alternatives save 52 minutes in travel time compared to the 79 mph service alternatives.

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Equipment Needs (Total train consists)	2	3	4	3	4
Locomotives	2	3	4	6	8
Single-level coach car	8	9	12	12	16
Business/café car	2	3	4	3	4
	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5

Evaluation Summary:

- As frequency and speed increases, additional train consists are needed to cover the scheduled turns at the termini. The need for equipment is compounded by the locomotive and coach car needs to support the service alternative.
- The six DRT at 110 mph service alternative requires substantially more equipment than all other service alternatives, while the two DRT at 79 mph service alternative requires substantially less equipment.

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Equipment Utilization	6:54	9:12	10:21	6:53	7:45
	Rank 4	Rank 2	Rank 1	Rank 5	Rank 3

Evaluation Summary:

- All service alternatives provide good equipment utilization. The six DRT at 79 mph is statistically better than the other service alternatives, but is due to the approximately one hour longer trip time in comparison to the 110 mph service alternatives.

Criteria	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Annual Revenue	$15,410,000	$23,574,000	$28,865,000	$33,857,000	$40,948,000
	Rank 5	Rank 4	Rank 3	Rank 2	Rank 1

Evaluation Summary:

- Two DRT at 79 mph creates the lowest forecasted revenue, while six DRT at 110 mph creates the highest forecasted revenue.
- The largest incremental increase in revenue is captured when frequency increases from two to four DRT at 79 mph (53 percent increase).
- The second largest incremental increase in revenue occurs as speed is increased from 79 to 110 mph (42 to 44 percent increase).

CRITERIA	2 DRT 79 MPH	4 DRT 79 MPH	6 DRT 79 MPH	4 DRT 110 MPH	6 DRT 110 MPH
Operating & Maintenance Costs	$17,641,000 RANK 1	$29,455,000 RANK 2	$41,821,000 RANK 3	$36,534,000 RANK 4	$51,682,000 RANK 5

Evaluation Summary:

- Operating and maintenance costs increase as speed and frequency increase.
- Two DRT at 79 mph is considered substantially better than all considered service alternatives for this given criterion, while six DRT at 110 mph is considered substantially worse. All other service alternatives are not substantially better or worse than the average of all service alternatives.

Operating Surplus/Deficit	$(2,231,000)	$(5,881,000)	$(12,956,000)	$(2,677,000)	$(10,734,000)
Operating Ratio	0.87 RANK 2	0.80 RANK 3	0.69 RANK 5	0.93 RANK 1	0.79 RANK 4

Evaluation Summary:

- All service alternatives are estimated to operate at a deficit, indicating that total operating revenue will not cover the cost of operating the service.
- The four DRT at 110 mph service alternative has the second lowest operating deficit, highest operating ratio, and is substantially better than all other service alternatives despite having the third highest annual operating and maintenance cost.
- Operating six DRT at 79 mph has a substantially worse operating deficit and ratio in comparison to all other service alternatives, while the remaining service alternatives neither substantially better or worse than the average of all service alternatives considered.

Infrastructure Capital Needs	Base RANK 1	+$44.6M RANK 2	+$88.6M RANK 3	+$94.6M RANK 4	+$178.6M RANK 5

Evaluation Summary:

- The data suggests that the two DRT at 79 mph alternative is considerably better than the average of all service alternatives, six DRT at 110 mph is considerably worse than the average, and the remaining three alternatives are not considerably better or worse than the average.
- The infrastructure capital needs are based on a high-level evaluation of the existing corridor characteristics and provides a comparison level analysis between the service alternatives.
- As passenger train frequencies increase, the need for additional infrastructure to mitigate operational conflicts increases.

APPENDIX A: PLANNING LEVEL TRAIN SCHEDULES

All times are reported in Central Time.

Two Daily Roundtrips at 79 mph

Station - Read Down	Miles	1	3
CHICAGO, IL - UNION STATION	0	16:30	17:40
Gary, IN - Regional Airport	23	17:01	18:11
Valparaiso, IN	44	17:22	18:32
Plymouth, IN	85	18:00	19:10
Warsaw, IN	110	18:25	19:35
Ft. Wayne, IN	149	19:03	20:13
Lima, OH	208	19:57	21:07

Station - Read Down	Miles	2	4
Lima, OH	0	4:20	8:00
Fort Wayne, IN	59	5:14	8:54
Warsaw, IN	98	5:52	9:32
Plymouth, IN	123	6:17	9:57
Valparaiso, IN	164	6:55	10:35
Gary, IN - Regional Airport	185	7:16	10:56
CHICAGO, IL -UNION STATION	208	7:47	11:27

Four Daily Roundtrips at 79 mph

Station - Read Down	Miles	5	7	1	3
CHICAGO, IL - UNION STATION	0	8:27	13:30	16:35	18:41
Gary, IN - Regional Airport	23	8:58	14:01	17:06	19:12
Valparaiso, IN	44	9:19	14:22	17:27	19:33
Plymouth, IN	85	9:57	15:00	18:05	20:11
Warsaw, IN	110	10:22	15:25	18:30	20:36
Ft. Wayne, IN	149	11:00	16:03	19:08	21:14
Lima, OH	208	11:54	16:57	20:02	22:08

Station - Read Down	Miles	2	4	6	8
Lima, OH	0	4:20	8:00	13:03	18:14
Fort Wayne, IN	59	5:14	8:54	13:57	19:08
Warsaw, IN	98	5:52	9:32	14:35	19:46
Plymouth, IN	123	6:17	9:57	15:00	20:11
Valparaiso, IN	164	6:55	10:35	15:38	20:49
Gary, IN - Regional Airport	185	7:16	10:56	15:59	21:10
CHICAGO, IL -UNION STATION	208	7:47	11:27	16:30	21:41

Six Daily Roundtrips at 79 mph

Station - Read Down	Miles	11	5	7	1	3	9
CHICAGO, IL - UNION STATION	0	6:21	8:27	13:30	16:35	18:41	19:15
Gary, IN - Regional Airport	23	6:52	8:58	14:01	17:06	19:12	19:46
Valparaiso, IN	44	7:13	9:19	14:22	17:27	19:33	20:07
Plymouth, IN	85	7:51	9:57	15:00	18:05	20:11	20:45
Warsaw, IN	110	8:16	10:22	15:25	18:30	20:36	21:10
Ft. Wayne, IN	149	8:54	11:00	16:03	19:08	21:14	21:48
Lima, OH	208	9:48	11:54	16:57	20:02	22:08	22:42

Station - Read Down	Miles	2	10	4	12	6	8
Lima, OH	0	3:56	5:54	8:00	11:05	13:03	18:14
Fort Wayne, IN	59	4:50	6:48	8:54	11:59	13:57	19:08
Warsaw, IN	98	5:28	7:26	9:32	12:37	14:35	19:46
Plymouth, IN	123	5:53	7:51	9:57	13:02	15:00	20:11
Valparaiso, IN	164	6:31	8:29	10:35	13:40	15:38	20:49
Gary, IN - Regional Airport	185	6:52	8:50	10:56	14:01	15:59	21:10
CHICAGO, IL -UNION STATION	208	7:23	9:21	11:27	14:32	16:30	21:41

Four Daily Roundtrips at 110 mph

Station - Read Down	Miles	5	7	1	3
CHICAGO, IL - UNION STATION	0	9:15	13:40	16:35	18:34
Gary, IN - Regional Airport	23	9:40	14:05	17:00	18:59
Valparaiso, IN	44	9:58	14:23	17:18	19:17
Plymouth, IN	85	10:25	14:50	17:45	19:44
Warsaw, IN	110	10:44	15:09	18:04	20:03
Ft. Wayne, IN	149	11:11	15:36	18:31	20:30
Lima, OH	208	11:50	16:15	19:10	21:09

Station - Read Down	Miles	2	4	6	8
Lima, OH	0	5:40	9:00	13:25	19:51
Fort Wayne, IN	59	6:19	9:39	14:04	20:30
Warsaw, IN	98	6:46	10:06	14:31	20:57
Plymouth, IN	123	7:05	10:25	14:50	21:16
Valparaiso, IN	164	7:32	10:52	15:17	21:43
Gary, IN - Regional Airport	185	7:50	11:10	15:35	22:01
CHICAGO, IL -UNION STATION	208	8:15	11:35	16:00	22:26

Six Daily Roundtrips at 110 mph

Station - Read Down	Miles	11	5	7	1	9	3
CHICAGO, IL - UNION STATION	0	7:43	9:15	13:40	16:35	17:00	18:34
Gary, IN - Regional Airport	23	8:08	9:40	14:05	17:00	17:25	18:59
Valparaiso, IN	44	8:26	9:58	14:23	17:18	17:43	19:17
Plymouth, IN	85	8:53	10:25	14:50	17:45	18:10	19:44
Warsaw, IN	110	9:12	10:44	15:09	18:04	18:29	20:03
Ft. Wayne, IN	149	9:39	11:11	15:36	18:31	18:56	20:30
Lima, OH	208	10:18	11:50	16:15	19:10	19:35	21:09

Station - Read Down	Miles	2	10	4	12	6	8
Lima, OH	0	5:30	7:28	9:00	11:55	13:25	19:51
Fort Wayne, IN	59	6:09	8:07	9:39	12:34	14:04	20:30
Warsaw, IN	98	6:36	8:34	10:06	13:01	14:31	20:57
Plymouth, IN	123	6:55	8:53	10:25	13:20	14:50	21:16
Valparaiso, IN	164	7:22	9:20	10:52	13:47	15:17	21:43
Gary, IN - Regional Airport	185	7:40	9:38	11:10	14:05	15:35	22:01
CHICAGO, IL -UNION STATION	208	8:05	10:03	11:35	14:30	16:00	22:26

APPENDIX B: PRELIMINARY RIDERSHIP AND REVENUE FORECASTS

CHICAGO-FORT WAYNE-LIMA

PASSENGER RAIL CORRIDOR STUDY

PRELIMINARY FORECASTS

APRIL 13, 2017

PREPARED BY:

TEMS

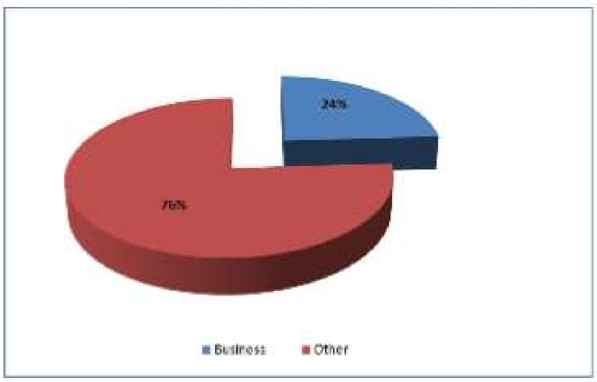
TRANSPORTATION ECONOMICS & MANAGEMENT SYSTEMS, INC.

1 OVERVIEW OF EXISTING TRAVEL MARKET

The Chicago-Ft. Wayne-Lima corridor is an important corridor in the Midwest region. It covers the states of Illinois, Indiana, and Ohio, with a population of 11.85 million in 2015. The Chicago-Ft. Wayne-Lima corridor is distinguished for its high population density and high employment. The region hosts a large number of finance and business services, manufacturing facilities, universities, military bases, and research and high-tech industry. The corridor area currently has nearly seven million jobs and per capita income was $47,194 in 2015 dollars. Projections show that the Chicago-Ft. Wayne-Lima corridor's demographic and economic growth will continue over the next several decades, the population is projected to be 14.5 million in 2040, employment will be nine million in 2040, and per capita income is projected to be $69,966 in 2040 in 2015 dollars.

The Chicago-Ft. Wayne-Lima corridor has a high level of business and commuter travel among its urban areas together with significant social and tourists travel. The total annual intercity trips in the corridor were estimated to be 54 million in 2015. As shown in Exhibit 1, 24 percent of the intercity trips were business trips and 76 percent trips were non-business commuter, social, and tourist trips in 2015.

Exhibit 1: 2015 Corridor Intercity Trips by Purpose



2 BASIC STRUCTURE OF THE COMPASS™ TRAVEL MARKET FORECAST 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 air, bus or high-speed rail into markets. Exhibit 2 shows the structure and working process of the COMPASS™ Model. As shown, the inputs to the COMPASS™ Model are base and proposed transportation networks, base and projected socioeconomic data, value of time and value of frequency from Stated Preference surveys, and base year travel data obtained from government agencies and transportation service operators.

The COMPASS™ Model structure incorporates two principal models: a Total Demand Model and a Hierarchical Modal Split Model. These two models are calibrated separately. In each case, the models are calibrated for origin-destination trip making in the study area. The Total Demand Model provides a mechanism for replicating and forecasting the total travel market. The total number of trips between any two zones for all modes of travel is a function of (1) the socioeconomic characteristics of the two zones and (2) the travel opportunities provided by the overall transportation system that exists (or will exist) between the two zones. Typical socioeconomic variables include population, employment and income. The quality of the transportation system is measured in terms of total travel time and travel cost by all modes.

The role of the COMPASS™ Modal Split Model is to estimate relative modal shares of travel given the estimation of the total market by the Total Demand Model. The relative modal shares are derived by comparing the relative levels of service offered by each of the travel modes. Three levels of binary choice were used in this study (see Exhibit 3). The first level separates rail services from bus services. The second level of the hierarchy separates air travel, the fastest and most expensive mode of travel, from surface modes of rail and bus services. The third level separates auto travel with its perceived spontaneous frequency, low access/egress times, and highly personalized characteristics, from public modes (i.e., air, rail and bus). The model forecasts changes in riders, revenue and market share based on changes travel time, frequency and cost for each mode.

Exhibit 2: Structure of the COMPASS™ Model

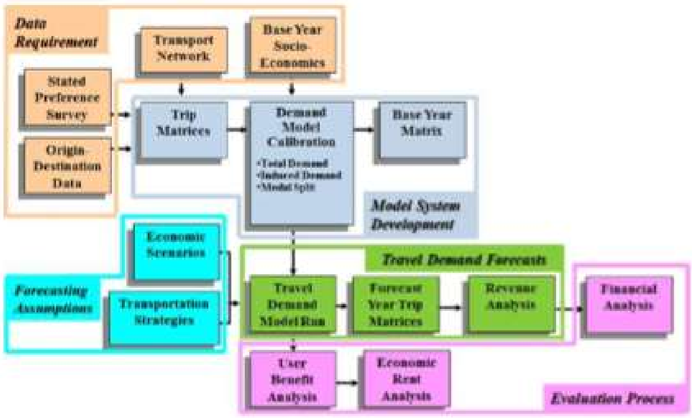
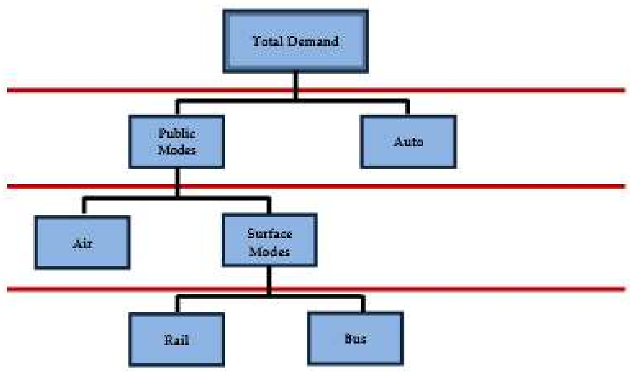


Exhibit 3: Hierarchical Structure of the Modal Split Model



A key element in evaluating passenger rail service is the comprehensive assessment of the travel market in the corridor under study, and how well the passenger rail service might perform in that market. For the purpose of this study, this assessment was accomplished using the following process:

- Building the zone system that enables more detailed analysis of the travel market and developing base year and future socioeconomic data for each zone.
- Compiling information on the travel market in the corridor for auto, air, bus, and the proposed passenger rail travel.
- Identifying and quantifying factors that influence travel choices, including future gas

price, future vehicle fuel efficiency improvement, and highway congestion.

- Developing and calibrating total travel demand and modal split models for travel demand forecasting.
- Forecasting travel, including total demand and modal shares.

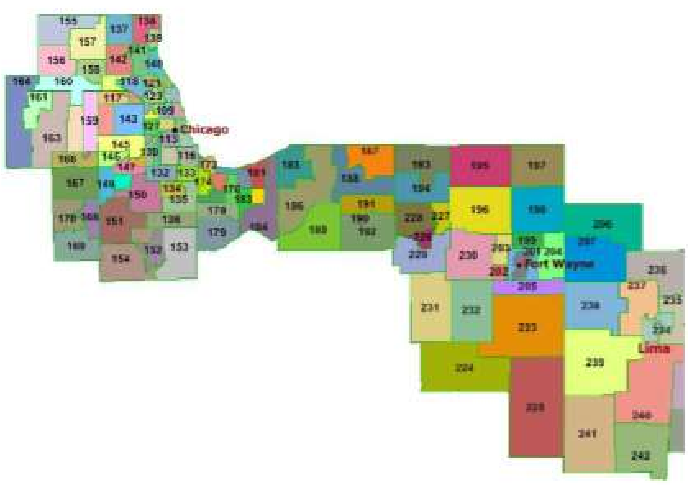
The following sections document the modeling process and the forecasting results.

3 ZONE DEFINITION

The zone system provides a representation of the market areas among which travel occurs from origins to destinations. For intercity passenger rail planning, most rural zones can be represented by larger areas. However, where it is important to identify more refined trip origins and destinations in urban areas, finer zones are used. The travel demand model forecasts the total number of trip origins and destinations by mode and by zone pair.

A 120-zone system was developed for the Chicago-Ft. Wayne-Lima corridor region based on the 2010 census tracts and traffic analysis zones of local metropolitan planning agencies. The study area includes the states of Indiana, Ohio, and Illinois. In the zone system, there are 45 zones in Indiana, 13 zones in Ohio, and 62 zones in Illinois. Exhibit 4 shows the 142-zone system for the corridor study area.

Exhibit 4: Study Area Zone System



4 SOCIOECONOMIC BASELINE AND PROJECTIONS

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 (2015) and for each of the future years (2020-2055). The data was developed at five-year intervals using the most recent census data, as well as the latest economic forecasts.

Base-year estimates were developed using U.S. Census data and recent estimates from the Bureau of Economic Analysis (U.S. Department of Commerce), socioeconomic data of local planning agencies, and Woods & Poole Economics, a firm that specializes in long-term demographic and economic projections that have been widely used by government agencies, consulting firms and retailers. Forecasts by zone were made using the Bureau of Economic Analysis historical data, local planning agency forecasts, and Woods & Poole Economics socioeconomic forecasts.

Exhibit 5 shows the base year and projected socioeconomic data in the study area. According to the data developed from these sources, the population of the study area will increase from 11.85 million in 2015 to 16.56 million in 2055, the total employment of the study area will increase from 6.88 million to 10.77 million in 2055, and per capita income will increase from $47,194 in 2015 to $87,523 in 2055 in 2015 dollars.

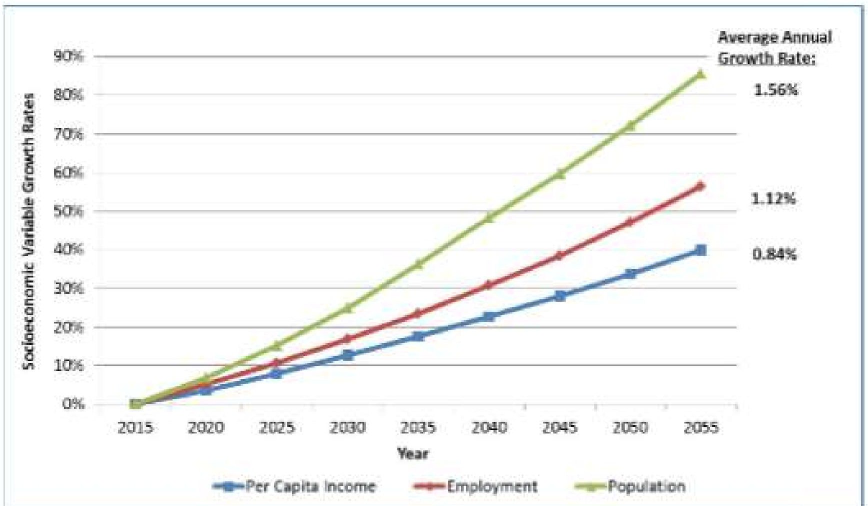
Exhibit 5: Study Area Base and Projected Socioeconomic Data

Year	2015	2020	2025	2030	2035	2040	2045	2050	2055
Population	11,849,797	12,286,297	12,785,748	13,337,449	13,921,425	14,539,898	15,156,913	15,837,941	16,564,856
Employment	6,887,638	7,239,944	7,623,627	8,042,711	8,502,079	9,007,576	9,538,449	10,137,063	10,773,245
Per Capita Income (2015$)	47,194	50,434	54,363	58,971	64,237	69,966	75,418	81,245	87,523

Exhibit 6 shows the socioeconomic growth projections for the study area. The exhibit shows that there is higher growth of employment and income than population. However, travel increases are historically strongly correlated to increases in employment and income, in addition to changes in population. Therefore, travel in the corridor 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 for traveling.

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 of the individual 120 zones 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.

Exhibit 6: Study Area Socioeconomic Data Growth Rates



5 EXISTING TRAVEL MODES

In transportation analysis, travel desirability is measured in terms of cost and travel time. These variables are incorporated into the basic transportation network elements. 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 attributes. 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 transportation service data of different modes available in the study corridor were obtained from a variety of sources and coded into the COMPASS™ networks as inputs to the demand model.

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

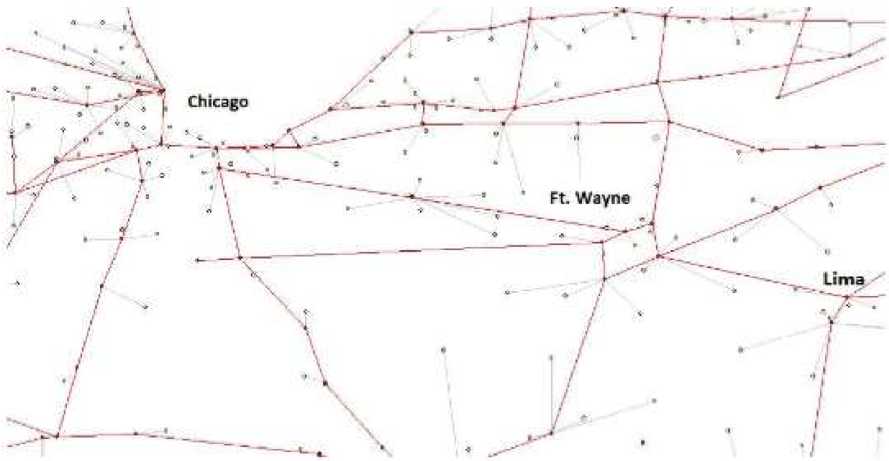
The main roads included in the highway network are shown in Exhibit 7.

Exhibit 7: Major Roads in the COMPASS™ Highway Network

Road Name	Road Description
Interstate 94	Chicago-Gary
Interstate 90	Gary-South Bend
Interstate 65	Gary-Indianapolis
Interstate 70	Indianapolis -Columbus
Route 130	Gary-Valparaiso
Route 30	Valparaiso-Lima

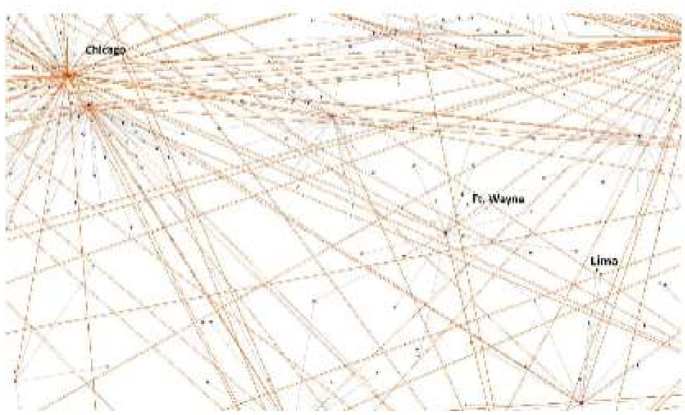
The highway network of the corridor area coded in COMPASS™ is shown in Exhibit 8.

Exhibit 8: COMPASS™ Highway Network for the Corridor Area



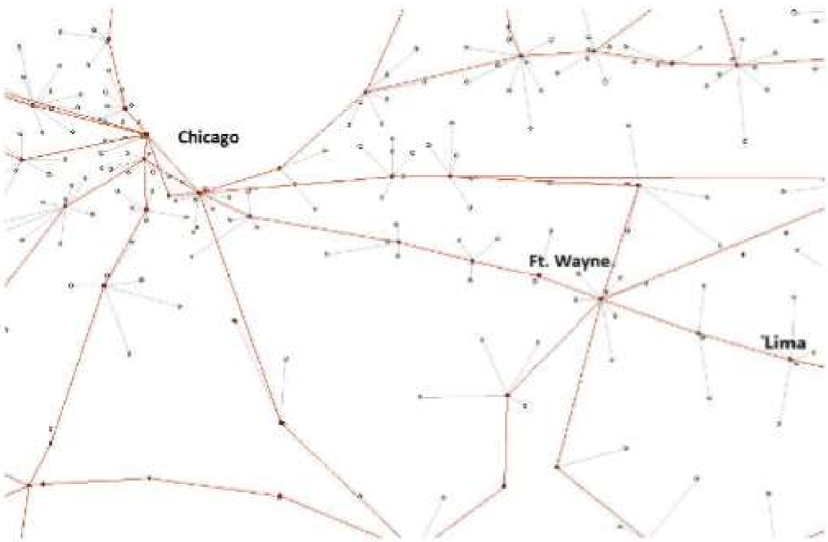
American Airlines, Delta, United Airlines, US Airways, and Southwest Airlines provide air service in the corridor area. Air network attributes contain a range of variables that include time and distance between airports, airfares, and connection times. Travel times, frequencies and fares were derived from official airport websites, websites of the airlines serving airports in the study area, and the BTS 10% sample of airline tickets. Exhibit 9 shows the air network of the corridor area coded in COMPASS™

Exhibit 9: COMPASS™ Air Network for the Corridor Area



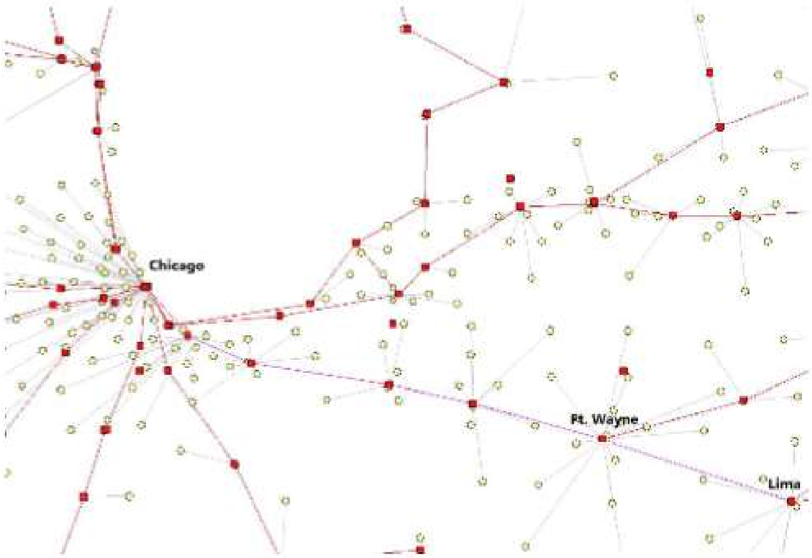
Bus travel data of travel time, fares, and frequencies, were obtained from official schedules of the Greyhound, Megabus, and Lakefront operators. Exhibit 10 shows the bus network of the corridor area coded in COMPASS™

Exhibit 10: COMPASS™ Bus Network for the Corridor Area



There is no existing passenger rail service in the Chicago-Ft. Wayne-Lima corridor. The proposed passenger rail service in the corridor will have stations in Chicago Union Station, Gary Airport, Valparaiso, Plymouth, Warsaw, Fort Wayne, and Lima. There are four service scenarios: 79 MPH 2 DRTs, 79 MPH 4 DRTs, 79 MPH 6 DRTs, 110 MPH 4 DRTs, and 110 MPH 6 DRTs. The 79 MPH service will begin in 2025 and the 110 MPH service will be in operation in 2035. Exhibit 11 shows the proposed passenger rail network in the corridor.

Exhibit 11: COMPASS™ Passenger Rail Network for the Corridor Area



6 ORIGIN-DESTINATION TRIP DATABASE

The multi-modal intercity travel analyses model requires the collection of base year 2015 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 (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.

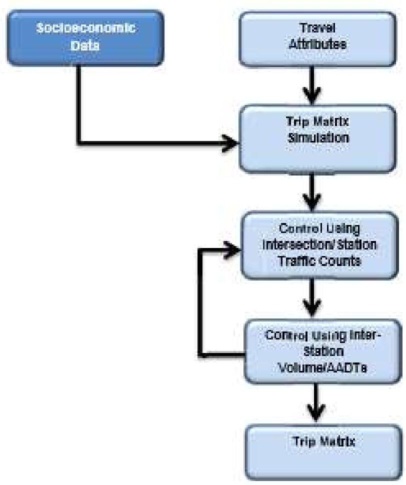
TEMS extracted, aggregated and validated data from a number of sources in order to estimate base travel between origin-destination pairs in the study area. The data sources for the origin-destination trips in the study are:

- 2004 MWRRI Study Database
- Amtrak station-to-station trip and station volume data
- Annual average daily traffic (AADT) from state DOTs
- BTS ten percent Ticket Samples

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 12.

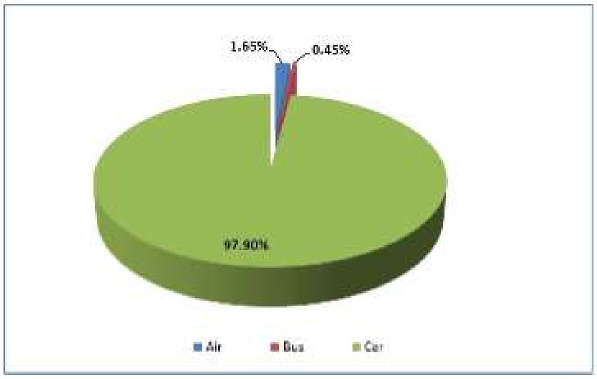
For the auto mode, the quality of the origin-destination trip data was assured by comparing it to AADTs and traffic counts on major highways and adjustments have been made when necessary. For public travel modes, the origin-destination trip data was validated by examining station volumes and segment loadings.

Exhibit 12: Zone-to-Zone Origin-Destination Trip Matrix Generation and Validation



The 2015 intercity and interurban travel market of the Chicago-Ft. Wayne-Lima corridor was estimated to be 54 million. Exhibit 13 shows the base 2015 travel market share of air, bus, and auto modes. It can be seen that auto mode dominates the travel market with nearly 98 percent of market share. Public modes have less than three percent of travel market share.

Exhibit 13 2015 Base Travel Market Share by Mode



7 FUTURE TRAVEL MARKET STRATEGIES

7.1 FUEL PRICE FORECASTS

An important factor in the future attractiveness of passenger rail is fuel price. Exhibit 3-14 shows the Energy Information Agency (EIA)[1] projection of crude oil prices for three oil price cases, namely high world oil price case that is aggressive oil price forecast, reference world oil price case that is moderate and is also known as the central case forecast, and the conservative low world oil price case. In this study, the reference case oil price projection was used to estimate transportation cost in future travel market. EIA projects oil price to 2040, the oil price projections after 2040 were estimated based on historical prices and EIA projections. The EIA reference case forecast suggests that crude oil prices is expected to be $92 per barrel (2015$) in 2025 and will remain at that high level and will increase to $136 per barrel (2015$) in 2040.

EIA has also developed future retail gasoline price forecast, which is shown in Exhibit 3-15. The implication of this is a reference case gasoline price of $3 per gallon (2015$) in 2025, with a high case price of $4.9 per gallon and a low case price of $2 per gallon. The estimated $5 per gallon once the economy starts to grow again seems realistic, while the $2 per gallon has been a 'floor' price throughout the last eight years since the recession.

[1] EIA periodically updates historical and projected oil prices at www.eia.gov/forecasts/aeo/tables_ref.cfm

Exhibit 14: Crude Oil Price Forecast by EIA

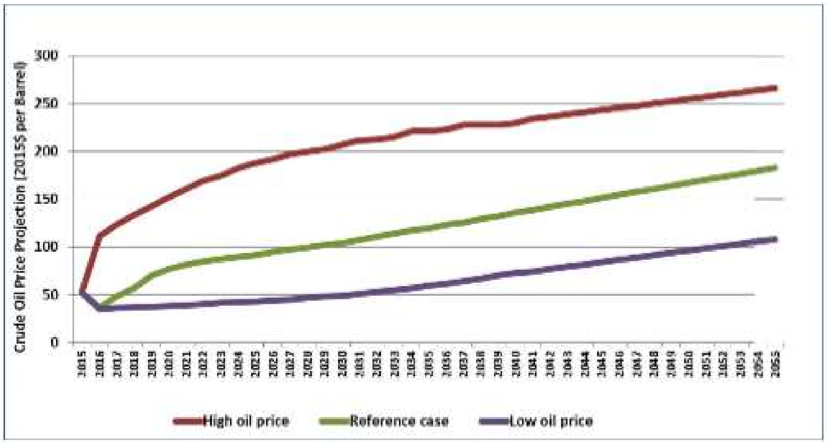
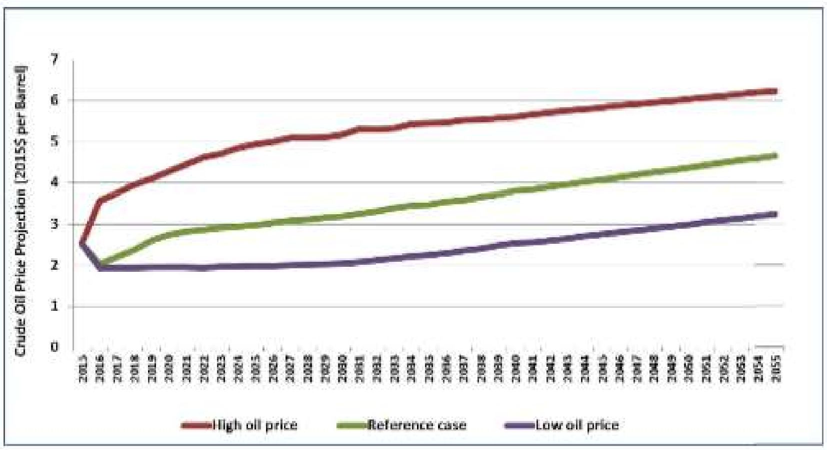


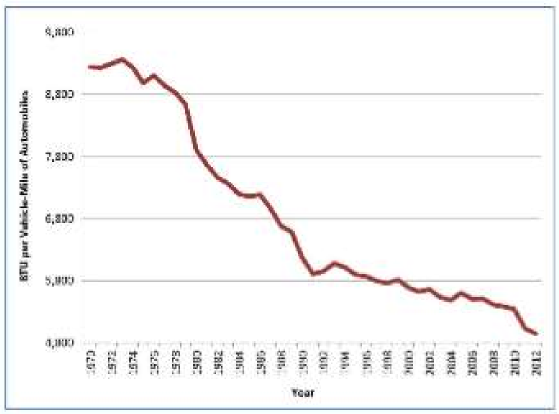
Exhibit 15: U.S. Retail Gasoline Prices Forecast by EIA



7.2 VEHICLE FUEL EFFICIENCY FORECASTS

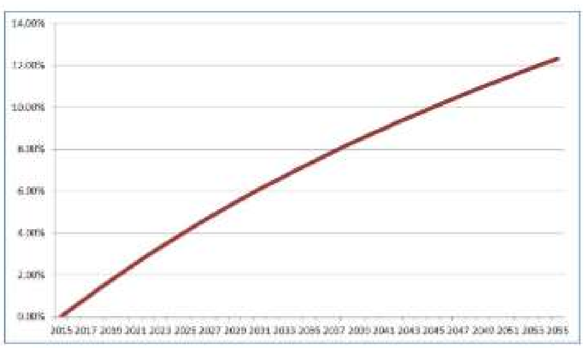
Future improvement in automobile technology is likely to reduce the impact of high gas prices on automobile fuel cost with better fuel efficiency. The EIA Energy Intensities of Highway Passenger Modes Data Table has the historical Btu (British thermal unit) per vehicle-mile data for automobiles since 1970 as show in Exhibit 16.

Exhibit 16: EIA Historical Highway Automobile Energy Intensities Data



From Exhibit 16 it can be seen that automobile fuel efficiency has been improving gradually during the past few decades but the improvement has slowed down in recent years. Future automobile fuel efficiency improvement that was projected and shown in Exhibit 17 was based on the historical automobile fuel efficiency data. It shows that automobile fuel efficiency is expected to improve by nearly 13 percent by 2055

Exhibit 17: Auto Fuel Efficiency Improvement Projections



7.3 HIGHWAY TRAFFIC CONGESTION

The level of service of auto and bus travel incorporates the highway congestion scenarios to ensure that the automobile traveling impedances are properly reflected. The average highway travel time in the Chicago-Ft. Wayne-Lima corridor was estimated to have an average annual growth rate of 0.4% due to increased travel demand and congestion. This means that the auto travel time from Chicago to Lima will increase by 17 percent in 2055.

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.

$$T_a = T_d * [1 + \alpha * \left(\frac{V}{C}\right)^{\beta}]$$

where

T_a is actual travel time,

T_d is highway design travel time,

V is traffic volume,

C is highway design capacity,

α is a calibrated coefficient and is often set to 0.15 for highway segments,

β is a calibrated coefficient and is often set to 4.0 for highway segments.

Future travel times then can be calculated based on historical data for each segment of the highway route with assumptions as shown below:

- $\alpha = 0.15$
- $\beta = 4.0$
- Highway lane capacity = 1600 vehicles/hour
- Number of lanes is based on actual situation of each highway segment

As a result, passenger rail offers an increasing time advantage over auto and bus travel markets that rely upon highway infrastructure and are affected by increasing congestion and travel times. The time advantage will have greater impact on business and commuter travel purposes which have higher values of time and which makes the high speed rail more competitive with these travelers.

7.4 PROPOSED PASSENGER RAIL SERVICE

The running times of the passenger rail service scenarios in the Chicago-Ft. Wayne-Lima corridor are shown in Exhibit 18.

Exhibit 18: Chicago-Ft. Wayne-Lima Corridor Passenger Rail Service Scenarios

	79 MPH	110 MPH
Chicago Union, IL	0:00:00	0:00:00
Gary Airport, IN	0:30:34	0:25:25
Valparaiso, IN	0:52:20	0:43:17
Plymouth, IN	1:29:26	1:10:15
Warsaw, IN	1:55:15	1:28:36
Fort Wayne, IN	2:33:18	1:55:29
Lima, OH	3:27:04	2:34:54

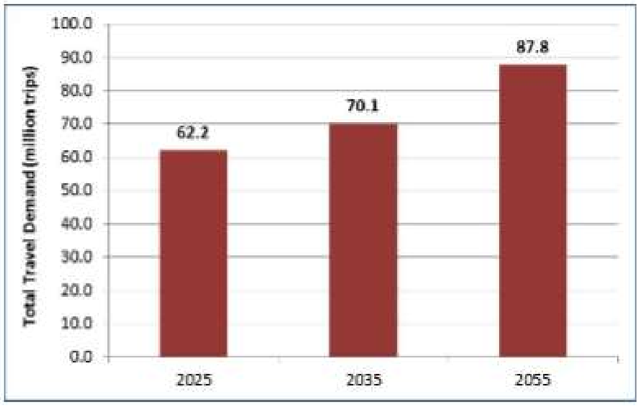
The preliminary passenger rail forecasts include 79 MPH 2 DRTs, 4 DRTS, and 6 DRTS in 2025, 2035, and 2055 and 110 MPH 4 DRTs and 6 DRTs in 2035 and 2055. The average fare used in the forecasts is 28 cents per mile.

8 CORRIDOR TRAVEL MARKET FORECASTS WITHOUT PASSENGER RAIL SERVICE

This section presents the Chicago-Ft. Wayne-Lima corridor travel market forecast without the passenger rail service. In the 2015 base year, the available transportation modes available for the corridor intercity travel market are auto, air, and bus with 54 million trips per year. The auto mode has 97.9 percent market share of the intercity and inter-urban travel market, air mode has 1.65 percent share of the intercity and inter-urban travel market, and bus has 0.45 percent of the market share. By applying the *COMPASS™* mode choice and total demand models without the passenger rail mode, the travel market with the existing modes can be estimated for future years.

Exhibit 19 shows the Chicago-Ft. Wayne-Lima corridor total travel demand forecasts for 2025, 2035, and 2055 It can be seen that with the existing transportation modes, the corridor travel demand will increase to 62.2 million in 2025, to 70.1 million in 2035, and increases to 87.8 million in 2055. The average annual corridor travel market growth rate is 1.2 percent, which is in line with the socioeconomic growth within the corridor.

Exhibit 19: Chicago-Ft. Wayne-Columbus Corridor Travel Demand Forecast (million trips)



9 CORRIDOR TRAVEL MARKET FORECASTS WITH PASSENGER RAIL SERVICE

Exhibit 20 presents the passenger rail ridership forecasts for the Chicago-Ft. Wayne-Lima corridor for years 2025, 2035, and 2055. The 110 MPH service will start in 2035. The rail mode has 330 thousand trips in 2025 for the 79 MPH 2 DRTS service and will be two million in 2055 if 110 MPH 6 DRTs is in operation.

Exhibit 20: Rail Ridership Forecasts (million)

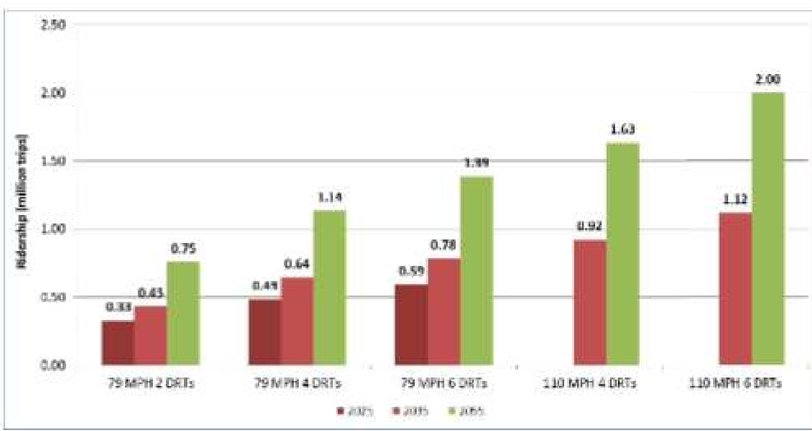
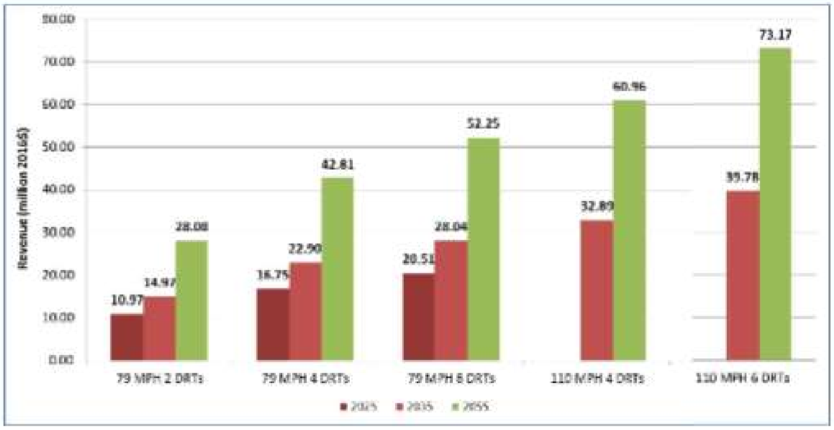


Exhibit 21 shows the annual fare-box revenue for years 2025, 2035, and 2055. The 110 MPH service will start in 2035. The rail mode has 10.97 million dollars of revenue in 2025 for the 79 MPH 2 DRTS service and will be 73.17 million in 2055 for the 110 MPH 6 DRTs service.

Exhibit 21: Rail Fare-Box Revenue Forecasts (million $2016)



The corridor transportation mode market share forecasts of 2035 are shown in Exhibit 22. The auto mode continues to demonstrate its dominance in the corridor maintaining a market share above 95 percent in 2035. Rail market share will be 0.6 percent for 79 MPH 2 DRTs service and will increase to 1.6 percent for 110 MPH 6 DRTs service. Air market share will be 2.5 percent to 2.6 percent in the corridor, and the market share growth is due to increased congestion and fuel prices. Bus market share will be at 0.4 to 0.6 percent.

Exhibit 22: Chicago-Ft. Wayne-Lima Corridor Travel Market Share Forecast – 2035

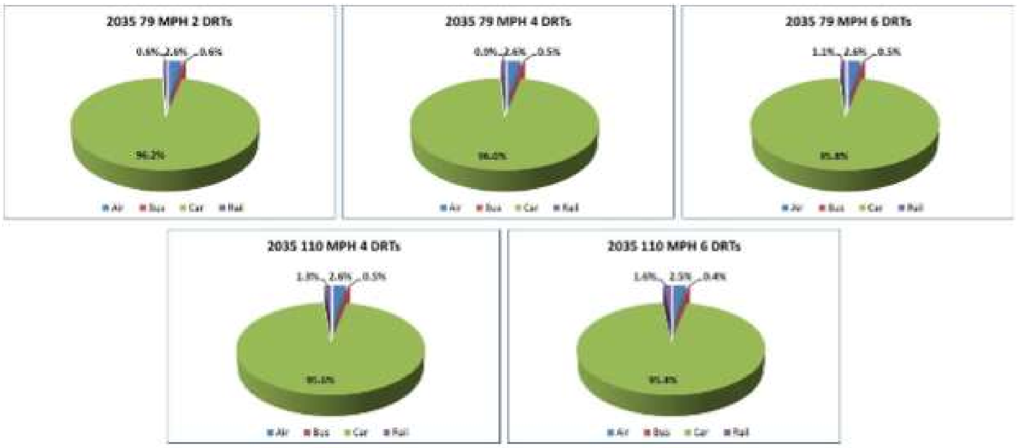


Exhibit 23 illustrates the sources of the rail trips in 2035. The trips diverted from other modes are the most important source of rail trips, which accounts for over 90 percent of overall rail travel market. Induced travel demand in the corridor as result of the new passenger rail service is 1.7 percent for the 79 MPH 2 DRTs service and will increase to 8.4 percent for the 110 MPH 6 DRTs service. As for the diverted trips from other modes, 86 to 97 percent trips are from auto mode, but the auto driving still dominates future travel market, this is because auto driving has a strong base in the current Chicago-Ft. Wayne-Lima corridor.

Exhibit 23: Chicago-Ft. Wayne-Lima Corridor Rail Trip Sources Forecast – 2035

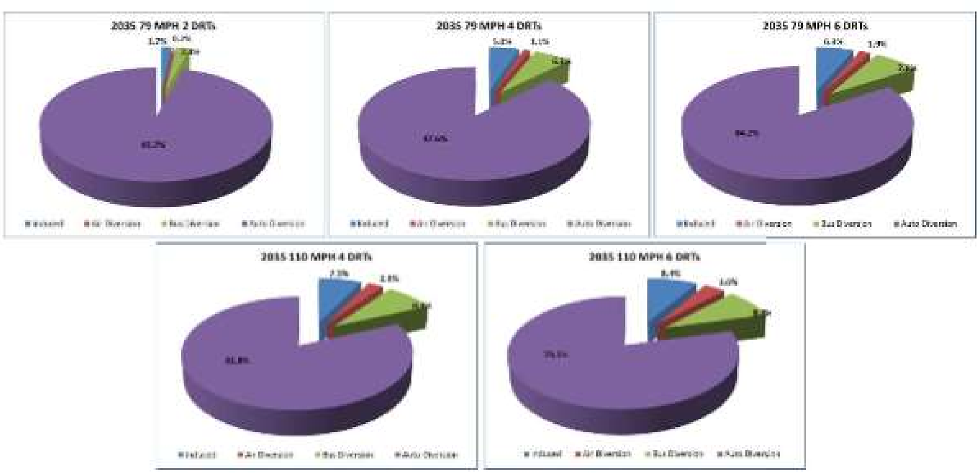


Exhibit 24 shows the station volumes of 79 MPH 2 DRTs, 4 DRTs, and 6 DRTs and 110 MPH 4 DRTs and 6 DRTs in 2035. It can be seen that Chicago has the highest station volume. Gary Airport, Ft. Wayne, and Lima as major stations have higher station volumes than stations in Valparaiso, Plymouth, and Warsaw.

Exhibit 24: Passenger Rail Station Volume Forecast – 2035 (million ons and offs)

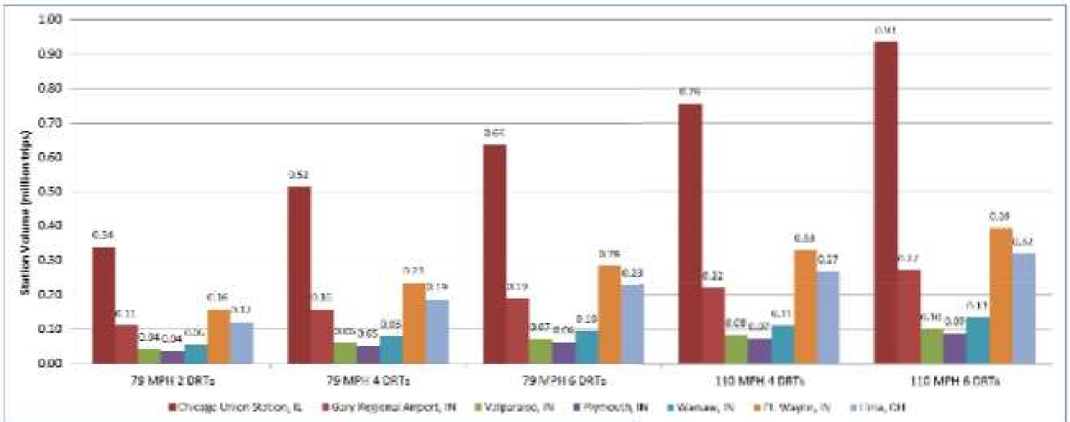
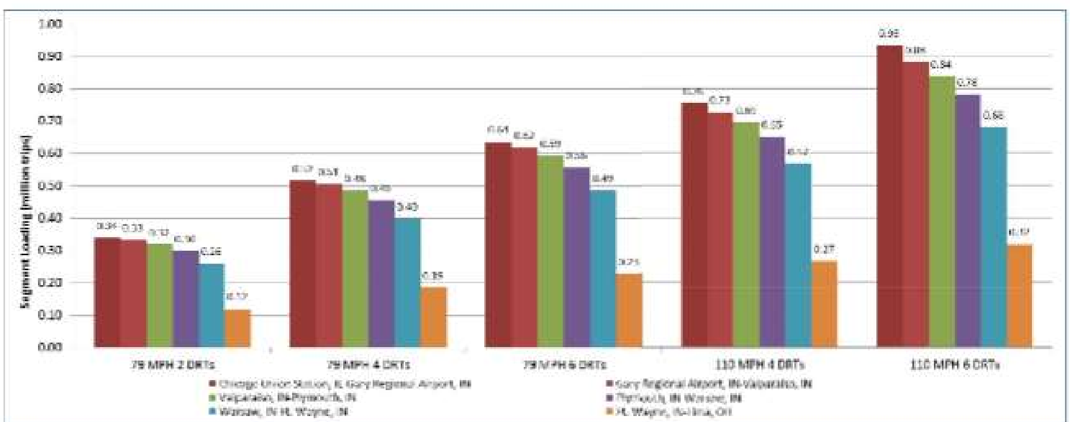


Exhibit 25 shows the segment loadings of 79 MPH 2 DRTs, 4 DRTs, and 6 DRTs and 110 MPH 4 DRTs and 6 DRTs in 2035.

Exhibit 25: 2035 Passenger Rail Segment Loading Forecast –2035 (million trips)



APPENDIX C: OPERATING & MAINTENANCE COST ESTIMATES

2035 Operating & Maintenance Cost Estimate - (2016$)

	2 DRT at 79 mph	4 DRT at 79 mph	6 DRT at 79 mph	4 DRT at 110 mph	6 DRT at 110 mph
Section 209 Line Item					
Revenue					
Ticket Revenue	$ 14,970,000	$ 22,900,000	$ 28,040,000	$ 32,890,000	$ 39,780,000
Food & Beverage	$ 440,000	$ 674,000	$ 825,000	$ 967,000	$ 1,168,000
Other Revenue	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ 15,410,000**	**$ 23,574,000**	**$ 28,865,000**	**$ 33,857,000**	**$ 40,948,000**
Expenses					
Third Party Costs					
Host Railroad	$ 2,123,000	$ 4,245,000	$ 6,368,000	$ 7,174,000	$ 10,761,000
Synthetic Host Railroad Charge	$ -	$ -	$ -	$ -	$ -
Fuel and Power	$ 701,000	$ 1,401,000	$ 2,102,000	$ 1,401,000	$ 2,102,000
Subtotal: Third Party Costs	**$ 2,824,000**	**$ 5,646,000**	**$ 8,470,000**	**$ 8,575,000**	**$ 12,863,000**
Fixed Route Costs					
Train & Engine Crew Labor	$ 2,286,000	$ 4,571,000	$ 6,857,000	$ 3,423,000	$ 5,134,000
Car & Locomotive Maintenance and Turnaround	$ 3,460,000	$ 5,766,000	$ 8,649,000	$ 8,072,000	$ 12,109,000
Onboard Passenger Technology	$ 87,000	$ 175,000	$ 262,000	$ 131,000	$ 196,000
OBS - Crew	$ 531,000	$ 1,063,000	$ 1,594,000	$ 796,000	$ 1,193,000
Commissary Provisions	$ 105,000	$ 209,000	$ 314,000	$ 157,000	$ 235,000
Route Advertising	$ 157,000	$ 234,000	$ 285,000	$ 336,000	$ 409,000
Reservations & Call Centers	$ 1,254,000	$ 1,866,000	$ 2,274,000	$ 2,682,000	$ 3,266,000
Stations	$ 1,497,000	$ 1,497,000	$ 1,497,000	$ 1,497,000	$ 1,497,000
Station Technology	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Commissions	$ 246,000	$ 365,000	$ 445,000	$ 525,000	$ 639,000
Customer Concession	$ 24,000	$ 37,000	$ 46,000	$ 54,000	$ 65,000
Connecting Motor Coach	$ -	$ -	$ -	$ -	$ -
Regional/Local Police	$ 58,000	$ 116,000	$ 174,000	$ 116,000	$ 174,000
Block & Tower Operations	$ -	$ -	$ -	$ -	$ -
Terminal Yard Operations	$ 55,000	$ 92,000	$ 138,000	$ 129,000	$ 193,000
Terminal M o W	$ 113,000	$ 188,000	$ 282,000	$ 263,000	$ 395,000
Insurance	$ 515,000	$ 788,000	$ 965,000	$ 1,131,000	$ 1,366,000
Subtotal: Fixed Route Costs	**$ 10,393,000**	**$ 16,972,000**	**$ 23,787,000**	**$ 19,317,000**	**$ 26,876,000**
Additives					
Marketing (2.3% of ticket revenue)	$ 344,000	$ 527,000	$ 645,000	$ 756,000	$ 915,000
T&E (30.4% of Train & Engine Crew Labor)	$ 695,000	$ 1,390,000	$ 2,085,000	$ 1,041,000	$ 1,561,000
M o E (27.1% of Car & Loco Maintenance/Turnaround)	$ 938,000	$ 1,563,000	$ 2,344,000	$ 2,188,000	$ 3,281,000
OBS (10.0% of OBS - Crew and Provisions)	$ 64,000	$ 127,000	$ 191,000	$ 95,000	$ 143,000
Police ($0.005 per passenger mile)	$ 270,000	$ 413,000	$ 506,000	$ 593,000	$ 716,000
Shared Support Services (3.25% of route costs)	$ 338,000	$ 552,000	$ 773,000	$ 628,000	$ 873,000
Subtotal: Additives	**$ 2,649,000**	**$ 4,572,000**	**$ 6,544,000**	**$ 5,301,000**	**$ 7,489,000**
Total Expenses	**$ 15,866,000**	**$ 27,190,000**	**$ 38,801,000**	**$ 33,193,000**	**$ 47,228,000**
Estimated Operating Payment	$ 456,000	$ 3,616,000	$ 9,936,000	$ (664,000)	$ 6,280,000
Estimated Equipment Capital Cost	$ 1,775,000	$ 2,265,000	$ 3,020,000	$ 3,341,000	$ 4,454,000
Total Estimated Payment	**$ 2,231,000**	**$ 5,881,000**	**$ 12,956,000**	**$ 2,677,000**	**$ 10,734,000**
Operating Ratio	**0.87**	**0.80**	**0.69**	**0.93**	**0.79**