A PROJECT OF THE **OHIO** RAIL DEVELOPMENT COMMISSION

The Ohio & Lake Erie Regional Rail Ohio Hub Study

TECHNICAL MEMORANDUM & BUSINESS PLAN

July 2007

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Prepared for

The Ohio Rail Development Commission

Indiana Department of Transportation

Michigan Department of Transportation

New York Department of Transportation

Pennsylvania Department of Transportation

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Transportation Economics & Management Systems, Inc.

In association with

HNTB, Inc.

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Foreword

The Ohio Hub Plan is a bold vision to invest in a network of fast, frequent and reliable passenger trains while increasing transportation capacity for moving more freight by rail. At a time when Ohio faces critical challenges to our mobility and economy, the Ohio Hub will link passenger and freight trains to Ohio's highway, aviation, transit and port facilities to create a seamless, multimodal transportation system that will benefit our citizens and businesses.

By advancing a policy of investing in our rail system to achieve public benefits and generate economic development activity, the Ohio Hub breaks with the traditional models of how to create and operate passenger rail service. Such a new paradigm is necessary if Ohio and the nation are to effectively address such issues as creating new options for moving both people and freight, growing the economy, creating new jobs, conserving energy and improving air quality.

To do this, we must look upon our railroad network as *"an essential transportation investment,"* just as we have done historically for highways, aviation, transit, waterways, communications, water, sewers and electrical power grids. The time for such investment is now.

Based on criteria established by the Federal Railroad Administration, the system envisioned in the Ohio Hub Plan would generate sufficient ridership to produce revenues that would cover the overall operating costs.

Investing in Ohio's rail infrastructure will help strengthen our state's assets as a premiere gateway to international markets and a North American hub for the distribution and logistics industries. Clearly, transportation planning and economic development in Ohio must go hand-in-hand. The Ohio Hub Plan not only recognizes this, but actively promotes and advances these objectives. It is time to harness our state's strengths and partner with the private railroads to create a regional rail hub that effectively addresses our critical mobility needs now and into Ohio's future.

We invite you to read the Ohio Hub Plan and discover a vision and hope for Ohio's transportation future.

Acknowledgements

The Ohio and Lake Erie Regional Rail - Ohio Hub Study is an ongoing, cooperative and collaborative effort. Transportation agencies from Ohio, Indiana, Michigan, Pennsylvania and New York, along with Amtrak and VIA Rail contributed to the feasibility planning for the Ohio Hub System. Norfolk Southern, CSX and Canadian National railroads also provided critical input into the planning process.

The Ohio Rail Development Commission (ORDC) led the planning effort and coordinated with the Ohio Department of Transportation (ODOT). Transportation Economics & Management Systems, Inc. (TEMS) and HNTB Corporation, Inc. provided consulting and engineering services. A technical committee was comprised of senior staff from the transportation agencies representing each participating state, as well as Amtrak, VIA Rail and the freight railroads. Project meetings included representatives from local governments, metropolitan planning organizations, transit and airport authorities and other interested parties. Engage Communications facilitated the Ohio Hub Citizen and Agency Participation Program. The Ohio Association of Regional Councils and the State's regional and metropolitan planning organizations hosted nearly 30 Ohio Hub public and agency meetings. Twenty-four Ohio municipalities have sent letters or passed resolutions in support of the Ohio Hub. In 2006, the Ohio Senate unanimously passed Concurrent Resolution No. 30 requesting Congressional support for funding an Ohio Hub Programmatic Environmental Impact Statement.

Funding for the Ohio Hub Study came from a variety of sources. The Ohio Department of Transportation and the Federal Government funded a majority of the study costs through the State Planning and Research Program. The ORDC, and the Indiana, Michigan, New York, and Pennsylvania Departments of Transportation, along with Amtrak and VIA Rail, contributed funds and/or in-kind services to the study.

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For related Ohio Hub project information, reports and documents visit

www.ohiohub.com

Ohio & Lake Erie Regional Rail - The Ohio Hub
Executive Summary

Improving the capacity and efficiency of the railroad system will help ensure that the regional economy continues to be served by an effective transportation system.

Intercity transportation in the Ohio and Lake Erie region, as in many other parts of the United States, is challenged by a rapidly changing travel market, forecasts of a substantial growth in traffic, a disparity between demand and available capacity, mounting costs for construction and fuel, and limited funding available for investment. Over the last twenty years, increasing highway congestion and inefficiencies in air travel have reduced the availability and utility of the transportation system, and in many cases these changes have affected local and state economic development activity and interstate commerce. As a result, state Departments of Transportation have recognized the potential for improving the railroad system in the region's most densely populated intercity corridors.

This Ohio Hub Study is part of an ongoing effort by the State of Ohio, led by the Ohio Rail Development Commission (ORDC), an independent commission within the Ohio Department of Transportation, and ODOT to further develop the concept of expanding transportation capacity by improving the railroad system for both passenger and freight trains. The initial Ohio Hub Study was released in 2004; this 2007 update culminates a multi-year effort to develop a feasibility-level business plan for the construction and operation of an intercity/interstate passenger rail system with connections to cities and regional rail systems in neighboring states.

The goal of the study is to determine, at a conceptual level, the financial and economic feasibility of developing a passenger rail system serving seven intercity travel corridors:

- Cleveland-Columbus-Dayton-Cincinnati
- Cleveland-Toledo-Detroit
- Cleveland-Pittsburgh
- Cleveland-Buffalo-Niagara Falls-Toronto
- Columbus-Pittsburgh
- Columbus-Toledo-Detroit
- Columbus-Lima-Ft Wayne-Chicago

System Concept and Service Goals

The passenger rail system would be integrated into the region's air, highway and local transit networks and would connect directly to international airports.

The envisioned rail system involves the construction and operation of a 1,244-mile intercity/interstate passenger rail service with 46 stations. It would serve over 22 million people in five states and southern Ontario, Canada. The seven rail corridors connect twelve major metropolitan areas and many smaller cities and towns. Stations would be located in downtown centers, in suburban areas near interstate highways, and adjacent to major international airports. Feeder bus service to smaller communities, universities and college towns would enhance the reach of the rail system.

The Ohio Hub passenger rail service would complement both automobile and air travel by offering a modern transportation alternative with competitive travel times, reliable and frequent service and new, comfortable passenger trains. In order to offer same-day, round-trip service throughout the region, the Ohio Hub System would reduce downtown-to-downtown travel times by increasing maximum train speeds on the lines from 79-mph to 110-mph.

Network Synergies

An interconnected national passenger rail network will create economies of scale that increase regional ridership and revenue and reduce overall system operating costs. Thirty percent of the estimated 9.3 million Ohio Hub rail trips (forecast in 2025) are connecting riders from other regional rail, air and feeder bus systems.

The Ohio & Lake Erie Regional Rail system would play an important role as part of a national network of regional rail services. The study assesses the ridership, operating and capital cost synergies by interconnecting the Ohio Hub to other existing and planned rail corridors including: the proposed 3,000-mile Midwest Regional Rail System (MWRRS), New York's Empire Service, Pennsylvania's Keystone Service, the Northeast Corridor and Canada's VIA Rail System. When linked together by the Ohio Hub, the regional rail corridors would serve over 140 million people or about half of the population of the United States. The study recommends that the Ohio Hub become part of the nation's federally recognized passenger rail network.

The Business Model and the Challenge for Management

Once fully implemented under FRA criteria the system's revenues should cover the operating costs.

The economic and financial feasibility of the Ohio & Lake Erie Regional Rail – Ohio Hub System is related to the business planning objectives. Ultimately, the business approach, the management team and the administration of the system will determine the success of the operation. The Ohio Hub Study advances a new business model for the provision of passenger rail services. This model serves to challenge the managers of the system to adopt a new commercial approach that should focus on all aspects of potential revenue generation while working effectively to reduce costs. The feasibility analysis assumes that the system will be aggressively managed, that the operator will be capable and that private sector providers of ancillary services will profit and contribute revenues to the system operation.

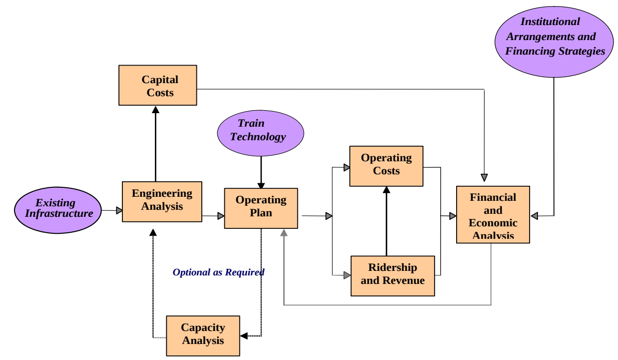
The significant investment in the infrastructure will also serve to re-capitalize the railroad network and offers management the opportunity to run an efficient and reliable service to which the market will respond.

Study Approach and Methodology

The analysis of potential passenger rail services in the Ohio and Lake Erie Region considered all of the factors that impact regional intercity travel.

The study utilized a railroad business-planning model to forecast the market response to various levels of passenger rail service. This software models railroad infrastructure investment, train operations, ridership and revenue, financial performance and economic analysis.

The feasibility of operating additional passenger trains on existing railroad corridors is dependent on the capacity of the infrastructure. The interactive analysis focuses on infrastructure requirements, train frequencies and running times to forecast corresponding levels of ridership and revenue attained in future years.



The business model estimates the full life-cycle operating and financial performance of the rail system, as well as its costs and benefits. The RightTrack™ evaluation is designed to be consistent with the Federal Railroad Administration's criteria for evaluating the commercial feasibility of passenger rail projects.

Improved Railroad Capacity

The new passenger service must not impair railroad operations or create chokepoints; rather, railroad improvements must increase capacity and improve the fluidity of the railroad operations.

An important objective in planning the Ohio Hub is to provide new transportation capacity for increasing volumes of freight traffic. The Ohio Hub will invest heavily in the railroad infrastructure which will help re-capitalize the railroad system along the routes. The capital plan for the Ohio Hub will improve railroad safety, remove impediments to efficient rail operations, increase operating speeds and expand line capacity sufficient to accommodate both freight and passenger trains. To a considerable extent, the passenger rail operation would use existing, privately held railroad rights-of-way and in some cases, passenger and freight trains would co-mingle on the same tracks.

Representatives from the freight railroads, Norfolk Southern (NS) and CSX, have participated in and provided critical input into the study. However, the feasibility planning is being advanced prior to negotiations with the freight railroad owners or the identification of specific federal, state or local funding sources. The study is conceptual and assumes that the railroads will be fairly compensated for the use of their land and facilities and these expenses have been incorporated into the capital and operating cost estimates.

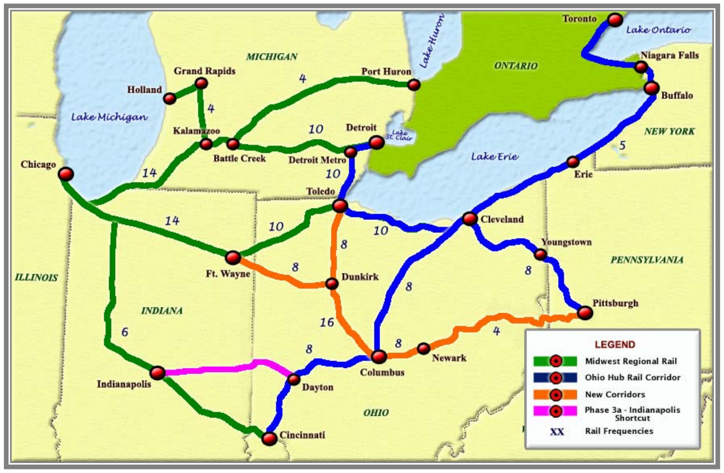
The Operating Plan and Fleet Requirements

The operating plan has been developed to accommodate the requirement for fast, frequent and reliable service with minimal delays for station stops or equipment servicing. The most important characteristic of the operating plan is the overall train travel time.

The study evaluates alternative train operating speed improvements for the rail corridors. Initially, three speed options were considered, 79-mph, 90-mph and 110-mph. However, based on the study findings, the 90-mph speed option did not significantly improve ridership, revenue or travel time above the 79-mph improvements and was eliminated from further analysis. The study focused on a 79-mph Modern Scenario and a 110-mph High-Speed Scenario. Timetables were developed for both speed scenarios.

The number of daily passenger train frequencies on each corridor is based on the forecast volume of trips. Train frequencies are illustrated on the map below. The green lines represent the proposed MWRRS corridors running east from Chicago; the blue lines show the original four Ohio Hub corridors which were studied in the initial report released in 2004; the orange lines are the newly added Ohio Hub corridors; and the purple line is the Dayton to Indianapolis segment that was analyzed using a parametric approach that did not include an engineering assessment.

Exhibit 3-10: Daily Train Frequencies on the Ohio Hub and MWRRS Corridors



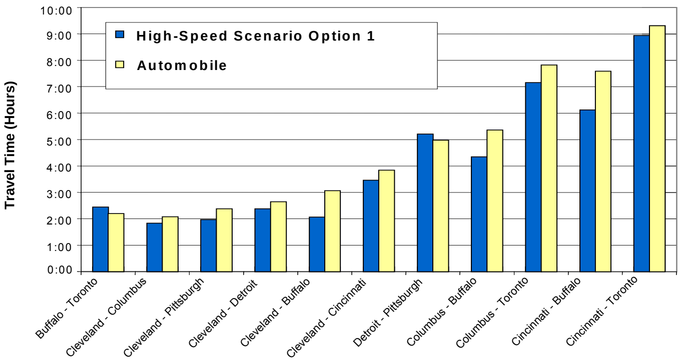
- The fleet requirement for operating the MWRRS eastern corridors is 33 trains. The four original Ohio Hub corridors require 14 trains and the incremental corridors require an additional 11 trains, for a total fleet size of 58 trains. Each train will have 300 seats and will cost approximately $18 million. The interior configuration will include galley space and roll-on/roll off carts for on-board, *at-your-seat* food service. Optionally, the trains may include a bistro area with a bar where over-the-counter food service can be provided.

Travel Times and Passenger Fares

With a top speed of 110-mph, the train travel times between the major city pairs will be competitive with the automobile.

Auto-competitive travel times, increased train frequencies, improved service reliability and intermodal connectivity are key to instituting new passenger rail service in the region. The Ohio Hub will provide a level of service, comfort, convenience, and a wide range of fares that will attract a broad spectrum of travelers.

Sample City-to-City Travel Times – Ohio Hub vs. Automobile



Passenger train fares will also be competitive with air travel and have the potential to generate revenue in excess of the rail system's operating costs. Ohio Hub tickets would cost 24 to 37 cents per mile - 50 percent higher than current fares on Amtrak's long distance trains, but still less expensive than Amtrak's Northeast corridor (NEC) fares. The fares would directly reflect the quality of the proposed rail service and the travel experience provided by modern, reliable and comfortable trains. Automobile costs and estimated rail fares are illustrated below.

Sample Estimated Fares between Major Stations (in 2002$)

Major City-Pairs	Distance (miles)	One-Way Fare/Cost				Round-Trip Fare	
		Ohio Hub System	Auto per Car (Business)	Auto per Car (Other)	NEC Acela Rate	Air (3-week Advance Fare)	Air (Business Fare)
Cleveland – Detroit	175	$43	$57	$18	$105	$157	$544
Cleveland – Pittsburgh	140	$45	$46	$14	$84	$232	$621
Cleveland – Buffalo	182	$68	$59	$18	$109	$174	$808
Cleveland – Columbus	135	$50	$44	$14	$81	$163	$706
Cleveland – Cincinnati	258	$95	$84	$26	$155	$186	$755

Notes:

1. *The one-way and round-trip fares are rounded to the nearest dollar.*
2. *Auto Business cost was calculated based on the Internal Revenue Service Standard Mileage Rate at $0.325 per mile.*
3. *Auto Other cost was calculated based on the Internal Revenue Service Standard Mileage Rate at $0.10 per mile.*
4. *The Acela Rate was calculated based on fare-per-mile between Washington, DC and New York City ($0.60 per mile).*
5. *Round trip airfares were web-listed fares as of October 25, 2002.*

Ridership and Revenue Forecasts

In 2025, with full implementation of the system, it is estimated that over 9.3 million riders will use a 110-mph passenger rail service. The annual operating revenue is estimated at $311 million, while the annual operating cost is estimated at $202 million.

The Ohio Hub Study evaluated multiple scenarios with different levels of rail service, train speeds (or travel times), train frequencies and alternative routes and assessed the ridership and revenue synergies from interconnecting the Ohio Hub to other existing and planned regional rail services.

Building on the results of the earlier 2004 Ohio Hub study, a *preferred system configuration* was identified. This interstate system included the route serving Youngstown on the line to Pittsburgh and the route serving the Detroit Metro Airport on the line to Detroit (see the System Map at the end of this Executive Summary). The preferred system became the base network for the additional planning work that evaluated the impact of adding three more "incremental" corridors.

The results of the analysis forecast strong ridership for both the original four Ohio Hub corridors as well as the three added incremental corridors. Moving from a 79-mph to an 110-mph system increases ridership by 50%, but more than doubles revenues since a faster service becomes much more attractive to higher fare-paying business travelers.

2025 Ridership Forecasts (In Millions)

Ridership, Passenger-Mile and Revenue all in Millions; MWRRS always 110-mph	79-mph OHIO HUB				110-mph OHIO HUB			
	Ridership	Pass-Miles	Revenue	Yield	Ridership	Pass-Miles	Revenue	Yield
Chicago-Michigan 110-mph	3.87	606.43	$136	$0.22	3.87	614.22	$136	$0.22
Chicago-FTW-Toledo 110-mph	2.11	324.98	$87	$0.27	2.39	371.95	$99	$0.27
Chicago-Cincinnati 110-mph	1.36	200.65	$59	$0.29	1.39	204.74	$60	$0.29
TOTAL MWRRS East Corridors	**7.34**	**1132.05**	**$282**	**$0.25**	**7.66**	**1190.90**	**$295**	**$0.25**
Cleveland-Cincinnati	1.60	167.53	$40	$0.24	2.56	267.34	$100	$0.38
Cleveland-Detroit	1.52	136.88	$28	$0.21	2.23	199.98	$51	$0.25
Cleveland-Niagara Falls	0.59	75.73	$18	$0.23	0.91	116.47	$45	$0.39
Cleveland-Pittsburgh	0.60	64.31	$17	$0.26	0.86	92.94	$30	$0.32
Subtotal OHIO Base	***4.30***	***444.45***	***$103***	***$0.23***	***6.56***	***676.73***	***$226***	***$0.33***
Pittsburgh-Columbus	0.62	62.11	$14	$0.22	0.92	90.86	$25	$0.27
Columbus-Ft Wayne	0.79	93.54	$20	$0.22	1.12	142.20	$36	$0.25
Columbus-Toledo	0.53	62.36	$14	$0.22	0.75	94.80	$24	$0.25
Subtotal OHIO Incremental	***1.94***	***218.01***	***$48***	***$0.22***	***2.78***	***327.85***	***$85***	***$0.26***
TOTAL OHIO HUB	**6.24**	**662.46**	**150.59**	**$0.23**	**9.34**	**1004.58**	**311.20**	**$0.31**

Operating Cost Recovery

Once fully implemented, the system revenues are forecast to exceed the estimated costs for operating the system.

Financial performance was evaluated by analyzing the annual operating cash flows for each Ohio Hub corridor. Two criteria have been identified by the Federal Railroad Administration (FRA) as critical to the evaluation of proposed passenger rail projects: 1) the operating ratio, and 2) the benefit/cost ratio (see Economic Benefits). The ratio of operating revenues to operating costs (i.e., operating ratio) provides a key indicator of the financial viability of the Ohio Hub System and is calculated as follows:

$$\text{Operating Ratio} = \frac{\text{Total Annual Revenue}}{\text{Total Annual Operating Cost}}$$

The table below lists the 2025 operating results for an interconnected network of corridors including three MWRRS lines along with the seven Ohio Hub corridors. For each corridor, the table identies: 1) annual revenue, 2) annual operating cost, 3) revenue per train mile, 4) operating cost per train mile, 5) revenue surplus, 6) operating cost ratio, 7) annual ridership, 8) passenger miles, 9) train load factors, 10) average trip length, and 11) the yield (or fare) per passenger mile.

2025 Operating Statistics and Operating Ratios for the 110-mph Ohio Hub System with MWRRS Connectivity

Corridor	Revenue	Cost	Rev/TM	Cost/TM	Surplus	Op Ratio	Riders	Psgr Miles	Load Fctr	Trip Len	Yield
Chicago-Michigan	$136	$97	$47.73	$34.12	$39	1.40	3.87	614.2	0.72	159	$0.22
Chicago-FTW-Toledo	$99	$64	$53.72	$34.81	$35	1.54	2.39	371.9	0.67	155	$0.27
Chicago-Cincinnati	$60	$40	$51.44	$34.42	$20	1.49	1.39	204.7	0.59	147	$0.29
Total MWRRS Eastern	**$295**	**$202**	**$50.36**	**$34.40**	**$94**	**1.46**	**7.66**	**1190.9**	**0.68**	**155**	**$0.25**
Cleveland-Cincinnati	$100	$55	$78.01	$42.88	$45	1.82	2.56	267.3	0.69	104	$0.38
Cleveland-Detroit	$51	$36	$46.44	$32.82	$15	1.41	2.23	200.0	0.61	90	$0.25
Cleveland-Niagara Falls	$45	$25	$69.49	$38.32	$20	1.81	0.91	116.5	0.60	128	$0.39
Cleveland-Pittsburgh	$30	$22	$43.17	$31.24	$8	1.38	0.86	92.9	0.44	108	$0.32
Subtotal OHIO Base	***$226***	***$138***	***$60.74***	***$36.96***	***$89***	***1.64***	***6.56***	***676.7***	***0.61***	***103***	***$0.33***
Pittsburgh-Columbus	$25	$20	$41.22	$32.98	$5	1.25	0.92	90.9	0.51	99	$0.27
Columbus-Ft Wayne	$36	$26	$45.40	$33.04	$10	1.37	1.12	142.20	0.59	127	$0.25
Columbus-Toledo	$24	$18	$42.85	$31.83	$6	1.35	0.75	94.80	0.56	127	$0.25
Subtotal OHIO Incremental	***$85***	***$64***	***$43.39***	***$32.67***	***$21***	***1.33***	***2.78***	***327.85***	***0.56***	***118***	***$0.26***
TOTAL OHIO HUB	**$311**	**$202**	**$54.76**	**$35.48**	**$110**	**1.54**	**9.34**	**1004.58**	**0.59**	**108**	**$0.31**

Network Feasibilty Results

On the basis of the Commercial Feasibility criteria that have been established by the FRA, all the proposed Ohio Hub and MWRRS corridors are viable.

All of the corridor operating ratios are forecast to be positive in 2025. Financially, the three eastern MWRRS routes, along with the 3-C and Columbus-Chicago corridors are the strongest performers; after this, as more Ohio Hub routes are added, the network synergies and interconnectivity results in a multiplier effect on revenue and ridership. The connecting ridership effect helps maintain high operating and cost benefit ratios as the network is expanded. This study has found that a 110-mph Ohio Hub system could meet the FRA *Commercial Feasibility* criteria and could even be developed separately from the MWRRS system, although clearly the results would be better if the two systems were developed together.

Cleveland–Columbus–Dayton–Cincinnati Results

The forecasts for the Cleveland–Columbus–Dayton–Cincinnati (3-C) Corridor produce the best operating results and a strong positive operating ratio.

The 3-C corridor is an attractive travel market because it has large end-point populations and many intermediate cities along the route. The population density along the line provides a balanced directional passenger flow and creates the potential to keep seats filled for the entire trip. The average trip length of 130 miles is much shorter than the length of the corridor, implying high passenger turnover in Columbus, with the ability to fill the seats twice between the corridor's end-point cities. These factors along with a high percentage of business travel, a lack of competitive air service, and the potential to serve multiple commuter markets boosts the projected ridership as well as the corridor's revenue yields. In all network options, the 3-C corridor has the highest projected load factors with the greatest revenue potential. The study concluded that this corridor should be implemented first and the results suggest that the 3-C may *stand-alone* only if it is interconnected with at least one additional corridor. This will ensure that the 3-C returns a positive operating ratio along with a positive cost benefit ratio.

Capital Cost Estimates

Project financing assumes a 20/80 state/federal funding split and implementation is contingent upon establishing a national program with federal funding for freight and passenger rail improvement projects.

An engineering assessment provided an evaluation of the current condition of the railroad infrastructure and rights-of-way, and identified the improvements needed to support the *Modern Scenario*, a 79-mph train speed option, and the *High-Speed Scenario*, a 110-mph train speed option. The assessment and the resulting capital cost estimates were developed at a feasibility level of detail and accuracy (+/-30%). The infrastructure improvements are needed to increase capacity, upgrade the track, signaling and communication systems, enhance grade crossing warning devices, and improve the overall operational efficiency needed to accommodate both freight and passenger trains.

The overall capital cost projection for the Ohio Hub System is approximately $4 billion or about $3.1 million per mile for a 79-mph system, and $4.9 billion or about $3.8 million per mile for a 110-mph system. The total estimated cost for a fleet of 25 trains, over and above the fleet requirement for the MWRRS corridors, is $448 million. The table below highlights the estimated capital cost for each corridor.

Capital Investment Requirement by Corridor (in thousands of 2002$)

System Configuration	Modern Scenario	High-Speed Scenario
Cleveland-Pittsburgh via Youngstown	$461,912	$484,968
Cleveland-Detroit via Detroit Airport	$540,490	$593,769
Cleveland-Niagara Falls	$603,915	$801,149
Cleveland-Columbus-Cincinnati	$660,977	$1,104,600
Pittsburgh-Columbus via Panhandle	$441,918	$488,216
Columbus-Ft. Wayne via Dunkirk	$426,006	$494,712
Dunkirk-Toledo	$178,544	$205,180
INFRASTRUCTURE SUB-TOTAL	**$3,313,762**	**$3,975,360**
Land	$320,447	$320,447
Maintenance Base	$18,973	$18,973
Train Fleet	$350,000	$447,500
GRAND TOTAL	**$4,003,182**	**$4,762,280**

Note*: Total infrastructure cost includes planning, engineering & design, and construction costs*

The costs for the installation of the upgraded Positive Train Control, passing sidings, and improved grade crossing warning systems account for the majority of the additional costs for the High-Speed operation. The cost differential for upgrading the 3-C Cleveland-Columbus-Dayton-Cincinnati route from 79-mph to 110-mph is significant because of the large number of highway/railroad grade crossings over this route. For most routes, the difference in cost between the Modern and High-Speed Scenarios is generally small and is due to the assumption that additional tracks would be added under both speed scenarios.

It must be noted that all the Ohio Hub costs are expressed in $2002, and some costs may have risen significantly due to increased prices for steel and concrete. The costs need to be brought up to current year basis in a future phase of work.

The capital plan for the three new Ohio Hub incremental corridors assumes co-mingling with existing freight at 110-mph; whereas the original four Ohio corridors were built alongside freight mainlines and mostly relied on construction of new dedicated track. However, the costs for adding the incremental corridors include significant investments for multiple rail/rail grade separations and the expansion of rail capacity in the congested endpoint yards and terminals, and bike trail relocation along some segments.

Capital Cost Shares by State

A state by state breakdown of the capital costs for the fully built-out MWRRS and Ohio Hub corridors is provided in the table below. The costs account for only those portions of the interstate routes that fall within the boundaries of the five states and Ontario, Canada.

Infrastructure Capital Costs by State:
Ohio Incremental Corridors + Eastern MWRRS System
(Thousands of $ 2002)

MWRRS CORRIDORS	Federal	Michigan	Indiana	Ohio	Pennsyl	New York	Canada	TOTAL
Michigan Lines	$453,500	$401,313	$22,665					$877,478
Chicago-Cincinnati[1]	$101,250		$354,400	$153,067				$608,717
Chicago-Toledo[2]	$101,250		$291,800	$316,077				$709,128
SUB-TOTAL MWRRS	$656,000	$401,313	$668,865	$469,144				$2,195,322
OHIO HUB CORRIDORS								
3-C[3]				$1,166,488				$1,166,488
Pittsburgh (Youngstown)				$406,342	$78,625			$484,967
Detroit (Metro Airport)[4]		$121,509		$367,205				$488,714
Niagara Falls [5,6]				$269,550	$164,014	$309,041	$58,544	$801,149
Panhandle				$305,637	$182,579			$488,216
Columbus-Ft Wayne[7]			$63,156	$431,555				$494,711
Dunkirk-Toledo				$205,180				$205,180
SUB-TOTAL OHIO HUB			$63,156	$3,151,957	$425,218	$309,041	$58,544	$4,129,425
STATE GRAND TOTALS	$656,000	$401,313	$732,021	$3,621,102	$425,218	$309,041	$58,544	$6,324,747

1- MWRRS assumed Ohio's share 50% of Cincinnati-Indianapolis segment. Nothing for Indianapolis-Louisville.
2- MWRRS Assumed a mileage-based proration on cost of Fort Wayne-Toledo segment
3- This 3-C cost includes 100% of the cost of Cleveland-Berea, which is later shared by the Detroit and MWRRS lines
4- Excludes costs for Wayne Jct-Detroit that have already been charged to MWRRS, but includes Toledo-Berea costs
5- Ohio Share 78% of Cleveland-Erie segment, based on 71 out of 91 miles
6- Pennsylvania Share 24% of Erie-Buffalo segment, based on 22 out of 91 miles

Ohio's share of the Ohio Hub capital cost would be $3.15 billion, or 76% of the total capital cost. The only intercity corridors that Ohio can develop independently are the Cleveland-Columbus-Dayton-Cincinnati corridor and Columbus-Toledo corridor. A segment of the state-owned Panhandle line from Columbus to Newark may also be advanced separately. All of the other Ohio Hub corridors will operate as interstate services and will require the cooperation of the other states as well as the federal government.

Ohio's share of the cost for the MWRRS rail lines is $470 million bringing the total cost for Ohio's intercity/interstate rail program to $3.62 billion. Adding the cost for land, trains and a maintenance facility would bring Ohio's total cost to $4.31 billion.

It should be noted that all of the Ohio Hub costs are expressed in $2002. Since 2002 costs have risen significantly due to increased prices for steel, concrete, and fuel. In the near future, the ORDC will need to bring the capital costs up to a current year basis.

Benefit/Cost Analysis

The ratio of benefits to costs is a substantial 2.0 reflecting the fact that the Ohio Hub region is one of the best candidates in the U.S. for developing a regional rail system.

The Ohio Hub economic forecasts were carried out to meet Federal Railroad Administration (FRA) criteria. For the purposes of the Ohio Hub Study the U.S. Department of Transportation Federal Railroad Administration (US DOT FRA) Cost Benefit Methodology was adopted. This methodology as set out in the FRA report *"High Speed Ground Transportation for America"* provides the most authoritative guide to the economic evaluation requirements for an intercity rail project to attract federal funds. Benefits are quantified in terms of passenger rail user benefits, other-mode user benefits, and resource savings benefits.

Transportation improvements provide user benefits in terms of time and costs savings, as well as convenience, comfort and reliability. User benefits include: a reduction in both travel times and costs that users receive; benefits that users of other modes receive as a result of lower congestion levels; and resource benefits such as savings in airline fares and reductions in emissions as a result of travelers being diverted from air, bus and auto to the regional rail system. At the feasibility level of study, when a benefit/cost ratio is above 1.2, the ratio validates the proposed system's economic feasibility.

Under the High-Speed Scenario the Ohio Hub system will obtain a benefit/cost ratio of 1.56 if only Ohio's direct costs and benefits are taken into account. If the impacts on the connecting MWRRS corridors are also included, the benefit/cost ratio rises well above 2.0.

In 2005, the Ohio Rail Development Commission initiated a comprehensive analysis of the economic impact of the Ohio Hub. The resulting *Ohio Hub Economic Impact Study*, completed in June 2007, is based on the original 860-mile Ohio Hub system with the four corridors.

The Ohio Hub Economic Impact Study was Based on the Four Corridor 860-Mile Ohio Hub System

The Economic Impact of the Ohio Hub

An improvement in the efficiency of moving people, goods and labor among markets and communities has the potential to improve the investment and business climate of the state which, in turn, can lead to a higher rate of economic growth.

A detailed benefit/cost anlaysis is presented in the June 2007 *Ohio Hub Economic Impact Study*. This study concludes that over the project's 30-year life, the Ohio Hub will create nearly $9 billion in user benefits with $4.9 billion in costs including capital, maintenance, and operating expenses, producing a 1.8 benefit/cost ratio. Moreover, the Ohio Hub will:

- Create 16,700 permanent jobs which is equivalent to more than 500,000 person years of work;
- Raise the region's income by over $1 billion over the life of the project;
- Increase the average annual household income in the region by at least $90;
- Generate more than $3 billion in development activity near stations;
- Increase land values and create the potential for communities to develop new retail, office and residential developments near the passenger rail stations;
- Create an annual $80 million impact on state tourism by generating 320,000 overnight trips;
- Increase Cleveland Hopkins Airport traffic by 5% and create a $500 million to $1 billion economic benefit;
- Create a potential benefit for freight operations in the range of $3 to $6 billion; and
- Generate an annual fuel savings of approximately 9.4 million gallons of fuel.

During the nine-year construction phase of the Ohio Hub, the economic benefits will be diffused across the entire industrial structure of Ohio's economy. The project will create 7,100 construction jobs and will generate a $1.84 billion increase in household earnings related to construction, manufacturing, health care, retail trade, and professional, financial and insurance services.

Key Study Findings

The Ohio & Lake Erie Regional Rail – Ohio Hub System is an appropriate extension of the nation's future intercity/interstate passenger rail system and should be federally designated as part of the national passenger rail network.

The 3-C corridor lies entirely within Ohio's borders and is financially the strongest corridor. Therefore, 3-C development is Ohio's obvious first priority. Beyond this, financial modeling shows that there is a lot of flexibility for determining which corridors should be added next. It is suggested that the actual prioritization of corridor extensions beyond 3-C be based on partnership potential with adjoining states, and on the level of cooperation that can be developed with the host freight railroads. It is recommended that ORDC begin to engage the neighboring states as well as freight railroads with the results of this expanded study, to determine which corridor(s) will actually be developed next.

Consistent with previous studies, this Ohio Hub update has recognized the importance of access to Chicago and has assumed connectivity to the three proposed MWRRS eastern corridors. The financial modeling work has shown that these three corridors would be operationally viable on a stand alone basis, and that their implementation would develop a solid system of core interstate routes that could be extended by the Ohio Hub system. However, since MWRRS development requires the cooperation of a number of states the Ohio Hub Study findings suggest that a stand-alone Ohio Hub network would be economically and financially viable.

Next Steps

Concurrent with continuing efforts to broaden and strengthen support for the Ohio Hub System from local, state and federal stakeholders, the business community and citizens, there is a need to advance the technical planning for the proposed system, refine the financing plan and strategies and develop institutional and interstate arrangements.

To summarize, the participating states need to take the following short-term actions:

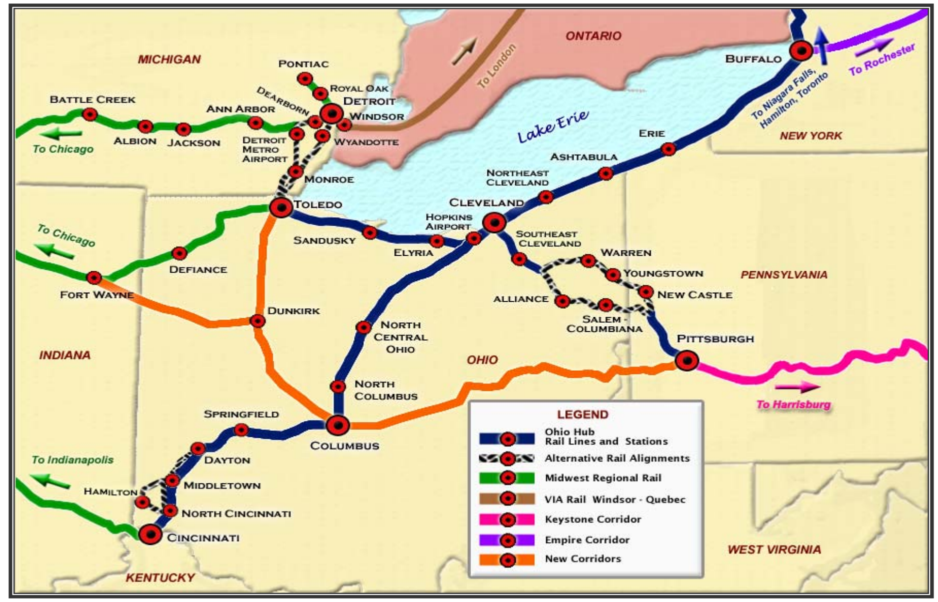
- Continue coordination with the railroads;
- Obtain plan endorsement by the affected local governments;
- Obtain plan endorsement by the states;
- Seek federal recognition of the Ohio Hub;
- Build grassroots support for the project by holding citizen participation and outreach meetings; and,
- Secure federal/state/local funds for advanced project planning, development and engineering.

The immediate next step in development of the Ohio Hub project involves advancing a Programmatic Environmental Impact Statement (PEIS) or a Tier 1 environmental review of the Ohio Hub rail corridors. The goal of an Ohio Hub PEIS would be to advance the corridors through the required steps under the National Environmental Policy Act (NEPA). This will resolve decisions regarding project location, capital improvements, community priorities, and environmental impacts, and will result in a list of project decisions to be approved by the Federal Railroad Administration.

The Ohio Hub Programmatic Environmental Impact Statement will:

- Provide federal recognition of the Ohio Hub as "*a funding-ready program of capacity improvement projects*;"
- Strengthen Ohio's partnership with the freight railroads by working to identify *"system wide"* improvements that will increase transportation capacity for growing volumes of freight while removing railroad bottlenecks, improving fluidity, and having a positive affect on highway capacity, shipping rates, and economic development;
- Identify critical railroad rights-of-way and facilities that must be preserved for Ohio's future long-term railroad capacity needs;
- Evaluate the capital and operating needs for an Ohio Hub passenger rail *"start-up"* service;
- Propose a project funding framework that will capture public and private transportation funds currently being spent on Ohio highway and railroad improvements, which will be leveraged to attract additional federal funds for construction when a federal rail funding program is finally put in place; and
- Strengthen interstate and local partnerships as state and local agencies and transit authorities work to share technical information, coordinate planning, and interconnect projects that offer joint-development potential.

Ohio Hub System with Incremental Corridors



1. Introduction

The Ohio Hub Study is part of an ongoing effort by the Ohio Rail Development Commission, and the Ohio Department of Transportation to further develop the concept of expanding transportation capacity by improving the railroad system for both passenger and freight trains. This report culminates a multi-year effort to determine, at a conceptual level, the financial and economic feasibility of developing an intercity/interstate passenger rail system serving all of the major metropolitan areas in the region while connecting to the proposed Midwest Regional Rail System (MWRRS)[1] and other developing rail corridors in neighboring states. Ohio's neighboring state DOT's have partnered in the study and contributed to the analysis.

The study examines the potential role that the Ohio Hub could play as part of an interconnected, international network of regional passenger rail services. As shown in Exhibit 1-1, the envisioned regional rail system would integrate the region's air, highway and transit networks and interconnect with New York's *Empire* Service, Pennsylvania's *Keystone* Service, the Northeast Corridor, Canada's VIA Rail as well as the MWRRS. The Ohio Hub system would become a critical component of the nation's intercity passenger rail network.

Exhibit 1-1: Regional Rail Corridors Connecting to the Ohio Hub System

1 The MWRRS calls for the development of a "Chicago Hub," envisioned as a 3,000-mile rail system with eight passenger rail corridors serving 60 million people in a nine-state region. Three MWRRS passenger rail corridors would connect to the Ohio Hub System: Chicago-Detroit, Chicago-Toledo-Cleveland and Chicago-Indianapolis-Cincinnati. The most current MWRRS report was issued in October 2004.

The Ohio & Lake Erie Regional Rail - Ohio Hub Study
Technical Memorandum & Business Plan

This Ohio Hub Study Update integrates the Midwest Regional Rail System into an overall plan for improving rail service in the Ohio and Lake Erie region. The original Ohio Hub Study, published in October 2004, focused on four interconnected corridors serving a hub in Cleveland:

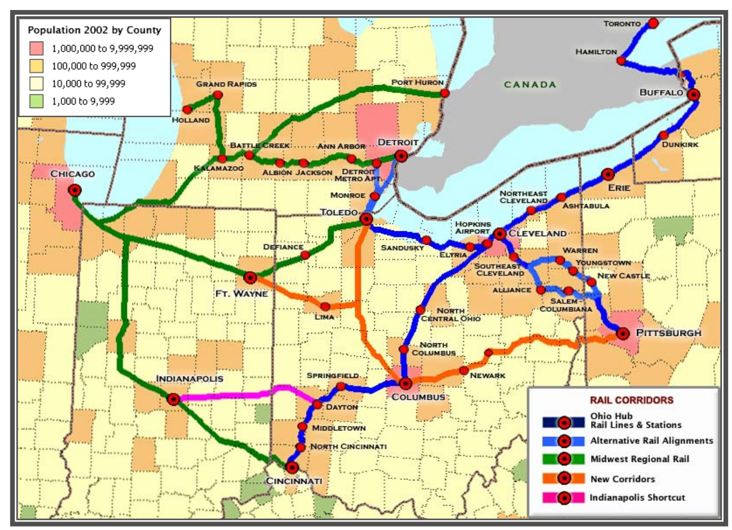
- Cleveland-Columbus-Dayton-Cincinnati
- Cleveland-Toledo-Detroit via the *"preferred"* route serving Detroit Metro Airport
- Cleveland-Pittsburgh via the *"preferred*" route serving Youngstown
- Cleveland-Erie-Buffalo-Niagara Falls-Toronto

This updated 2007 study carried the analysis forward by adding three "Incremental" corridors:

- Columbus-Pittsburgh via the "Panhandle" route
- Columbus-Toledo with through service continuing on to Detroit
- Columbus-Lima-Fort Wayne with through service continuing on to Chicago

Exhibit 1-2 shows the envisioned fully-built out MWRRS and Ohio Hub networks, overlaid on a population density map of the Upper Midwest region. The green lines represent the original MWRRS corridors running east from Chicago; the blue lines show the original four Ohio hub corridors (including in light blue, the route alternatives serving Detroit and Pittsburgh); the orange lines are the newly added incremental corridors; and the purple line is the Dayton to Indianapolis segment that was analyzed using the parametric approach.

Exhibit 1-2: MWRRS and Ohio Hub Rail Systems with Incremental Corridors Added



1.1 System Planning and Feasibility Goals and Objectives

The Ohio Hub Study is a feasibility analysis that envisions the construction and operation of a passenger rail system that is as of yet, unfunded and not negotiated. Therefore, the goal of the study is to determine, at a feasibility level, the financial and economic potential for developing the Ohio Hub System, with its original four Cleveland-based corridors along with the three newly-added Columbus-based corridors.

The study provides a comprehensive technical analysis of the system characteristics and the regional intercity travel market. The purpose of the analysis is to understand in broad terms the railroad engineering and capital requirements, train characteristics and operational issues, service levels, as well as operating and capital cost synergies and economies of scale.

A primary study objective is to determine if the Ohio & Lake Erie Regional Rail system is an appropriate expansion of the federally designated high-speed passenger rail network. Therefore, the study focuses on understanding the regional travel markets and the potential interaction between markets served by the Ohio Hub rail corridors and those served by other emerging corridors.

While the study advances the Ohio Hub as part of a national passenger rail network, it also examines the feasibility of a “stand-alone” operation. The stand-alone system assumes no operating synergies, cost or revenue benefits from interconnecting rail services. In addition, the study incorporates additional rail ridership generated by feeder bus services to outlying towns and cities. The Study examines two passenger rail service options – a *Modern Scenario* and a *High-Speed Scenario*. The Modern Scenario provides for passenger train speeds up to 79-mph; the High-Speed Scenario offers train speeds up to 110-mph.

The earlier 2004 study included an analysis of alternative routes on two of the Cleveland-based corridors: Two Cleveland-Pittsburgh routes were examined – one alternative via Alliance, the other via Youngstown. Two Cleveland-Toledo-Detroit routes were also analyzed – one runs via Wyandotte, Michigan, the other via Detroit Metro Airport. The study compares these routes and provides the estimated capital costs and ridership forecasts for each alternative. Exhibit 1-2 illustrates the Detroit and Pittsburgh corridor alternatives that were analyzed in the study. A primary result of the 2004 study was the finding that the Youngstown and Detroit Metro alternatives were the two routes that generated the best financial performance, so these were the preferred corridors that were advanced into the 2007 update.

While the primary purpose of the study is to assess the feasibility of the Ohio Hub system, the study also advances a *preliminary system plan* for implementing rail service. With respect to the evaluation of alternative routes, the study recommends a *preferred system configuration* with specific routes, however, there remains many railroad, environmental, and project development activities that require further study, analysis, and public and stakeholder input. Production of a *final system plan* is beyond the scope of this feasibility study. A full environmental study that includes freight railroad input, local input and public comment is needed. It is anticipated that the final selection of the Ohio Hub routes will be decided as part of a Programmatic Environmental Impact Statement.

1.2 Business Planning Objectives

In order to maintain consistency among regional rail planning efforts, the Ohio Hub was planned in conjunction with the proposed Midwest Regional Rail System (MWRRS). The Ohio Hub Study uses the same assumptions as the MWRRS with respect to engineering and capital costs, forecasting ridership and revenues, and financial and cost/benefit analyses.

The economic and financial feasibility of the Ohio & Lake Erie Regional Rail – Ohio Hub System is related to the business planning objectives. Ultimately, the business approach, the management team and the administration of the system will determine the success of the operation. The Ohio Hub Study advances a new business model for the provision of passenger rail services. This model serves to challenge the managers of the system to adopt a new commercial approach that should focus on all aspects of potential revenue generation while working effectively to reduce costs. The feasibility analysis assumes that the system will be aggressively managed, that the operator will be capable and that private sector providers of ancillary services will profit and contribute revenues to the system operation.

The significant investment in the infrastructure improvements will serve to re-capitalize the railroad network and offers management the opportunity to run an efficient and reliable service to which the market will respond. The Ohio Hub Study is based on the premise that a paradigm shift in the business of managing a large-scale passenger rail operation is possible and ultimately achievable.

There are currently no state-supported Amtrak trains operating in the Ohio and Lake Erie region. Current long-distance Amtrak passenger trains are presumed to continue during implementation of the Ohio Hub. Over the long-term, the Ohio Hub goal is to eliminate the need for states to provide operating subsidies since taxpayer assistance can take the form of capital grants and stronger routes can cross-subsidize operating losses of the weaker corridors, especially during the early implementation years. Funding for infrastructure and equipment is being used to improve service to the point where revenues cover operating costs, but some direct operating subsidies may still be required during the ramp-up period. These subsidies can be provided either by direct state support, or by financing that is repaid from the operating surplus that will be generated in later years.

Long-distance Amtrak service may benefit from speed and line capacity improvements created by the system. However, the riders, revenue, operating costs and frequencies in the Ohio Hub Business Plan and Technical Memorandum include only those for the Ohio Hub System. Long-distance trains are assumed to be a federal responsibility and are not included in the Ohio Hub financial results.

1.3 Study Approach and Methodology

The analysis for the Ohio Hub Study follows an interactive approach that considers all factors that impact supply and demand-related market issues to ensure a comprehensive analysis of return on investment. The Study utilized TEMS’ business planning software that consists of a series of models for conducting an interactive analysis of track investment, train operations, ridership and revenue, financial performance and economic analysis. The infrastructure capabilities determine what train frequencies can be operated. Running times are jointly dependent on both the infrastructure and train technology capabilities. In turn, these frequencies and running times determine what level of ridership and revenue can be attained. The TEMS' *RightTrack*™ System is described in detail in the Appendices.

This Business Plan and Technical Memorandum documents the feasibility planning methods and describes the analytic processes used in the Ohio Hub Study and builds upon and consolidates the results of the technical findings. The Study results should support subsequent decision-making by Ohio, Michigan, Pennsylvania, New York, Ontario, Canada and the federal government regarding the advancement of the project.

1.4 Railroad Infrastructure Analysis

To a considerable extent, the potential passenger rail system would use existing, privately held railroad rights-of-way and in some cases, passenger and freight trains would co-mingle on the same tracks. Therefore, the approach to planning a passenger rail service must be sensitive to the railroad's capacity and operational needs. New passenger service must not impair railroad operations, create impediments or bottlenecks nor should it constrain future growth; rather, passenger rail improvements must increase capacity and improve the fluidity of railroad operations. Moreover, the railroads should be fairly compensated for the use of their land and facilities.

Clearly, the most important goal in planning the Ohio Hub is to enhance mobility and increase transportation system capacity by improving the railroad system for passenger and freight trains. The underlying planning objectives for improving the railroad infrastructure are:

- To separate freight from passenger operations where possible and to minimize the number of locations where freight and passenger trains must co-mingle on the same tracks
- To improve railroad fluidity and operational efficiency and to expand railroad capacity at those locations where freight and passenger operations must co-mingle on the same tracks
- To utilize low density or abandoned rail rights-of-way where appropriate
- To improve safety, remove impediments to efficient rail operations, increase operating speeds and expand line capacity sufficient to accommodate both freight and passenger needs

Representatives from the freight railroads have participated in and provided critical input into this study. However, the feasibility planning for the Ohio Hub is being advanced prior to negotiations with the freight railroad owners or the identification of specific federal, state or local funding sources. As project planning and design advances, a variety of complex issues will need to be resolved including the cost for access to railroad property and tracks; cost for track maintenance; train dispatching; construction and utility relocation; safety and insurance; and recognition and adoption of the Ohio Hub within the context of the freight railroads' corporate long term strategic plans. These issues will be addressed with the freight railroads as part of the project development process, should the implementation of the project be pursued.

The study used *TRACKMAN*™ a track management system to analyze the required railroad infrastructure improvements and the capital costs associated with a Modern (79-mph) and a High-Speed (110-mph) Scenarios.

1.5 Passenger Train Operations Analysis

The Ohio Hub corridors require significant infrastructure improvements to enable higher train speed operations. Following an engineering assessment of the rail corridors, the required infrastructure improvements were identified. The improvements, as well as the route configurations, were developed in consultation with participating state officials, ORDC staff, Amtrak and railroad representatives. Details of the proposed engineering improvements are described in Section 2 - Engineering Assessment and Capital Cost Estimates.

The study evaluated several different scenarios for Ohio Hub train service patterns. The feasibility of each scenario was examined with regard to its ability to generate ridership and provide cost-effective operations. A train simulation model, which takes both infrastructure and train technology characteristics into account, was used to determine achievable transit times. The TEMS' *LOCOMOTION*™ train simulation model is described in the Appendices. Operating strategies, station locations, and fleet requirements are discussed in detail in Section 3.

1.6 Travel Demand and Ridership and Revenue Forecasts

The Ohio and Lake Erie Regional Rail Study evaluates different levels of rail service, including train frequency, train speed, (or travel time) and assess the ridership and revenue synergies from interconnecting the Ohio Hub to other existing and planned regional rail service. The ridership model incorporates four intercity travel modes – air, rail, bus and auto – along with socioeconomic, network and trip databases relevant to the region. Survey data was also collected to provide insight into the travel market and travel behavior within the market.

The stated preference survey provided a key input into the modeling system and resulted in an independent assessment of the values of time for business, social and commuter travelers. In addition to values of time, the analysis estimates values of frequency, values of accessibility and the value of reliability. The model allows the ridership and revenue forecasts to be developed for base and forecast years for the different corridors and different system operating scenarios.

The base year for the study is 2000 and ridership and revenue model runs were generated for 2003, 2010, 2012, 2015, 2020, 2025, 2030, 2035 and 2040. The forecast years of 2015, 2020 and 2025 are cited most often in the study. Forecasts for intermediate years could be estimated by interpolating between the above years. The Ohio Hub travel demand and forecasting model, including the data bases, zones, and networks is described in Section 4. The resulting ridership and revenue forecasts are provided in Section 5.

1.7 Financial and Economic Feasibility Analysis

The Ohio Hub financial and economics forecasts were carried out to meet Federal Railroad Administration criteria and requirements. For the purposes of the Ohio Hub Study the United States Department of Transportation Federal Railroad Administration (US DOT FRA) Cost Benefit Methodology was adopted. This methodology as set out in the US DOT FRA report *"High Speed Ground Transportation for America,"* September 1997,[1] and is also used in the assessments of the "Maglev Deployment Program," October 1999[2] provides the most

[1] The report is available online on www.fra.dot.gov/Downloads/RRDev/cfs0997all.pdf

[2] For more details see: http://www.fra.dot.gov/us/content/567

authoritative guide to the US DOT FRA economic evaluation requirements for an intercity rail project to attract federal funds.

It should be noted that the US DOT FRA regards these requirements as the minimum to attract funding. The analysis also recognizes that there are often benefits that it has not considered, e.g. land use impacts. The TEMS' *RENTS™* model is the economic analysis model that was used to synthesize the value of the different route investments, taking into account both a comprehensive financial analysis and an economic analysis of user benefits.

As part of the financial forecasts, the study provides an assessment of the various costs associated with operating the Ohio Hub passenger rail system. The operating costs are described in Section 6 and the economic benefits are quantified in Section 7. The results of the financial and economic viability analysis are also presented in Section 7.

1.8 Project Implementation and Funding

Given the scale of the Ohio and Lake Erie Regional Rail-Ohio Hub system, it is assumed that the implementation of the system will be accomplished in phases. One of the primary purposes of the Implementation Plan is to provide a framework for organizing and analyzing the cash flow in the financial analysis. It is expected that the Implementation Plan will evolve as the project advances into the detailed planning and engineering phases.

The Implementation Plan, described in Section 8 has been refined so that a positive operating cash flow can be assured as early in the implementation schedule as possible. Thus, those corridors with the highest operating returns are implemented in earlier phases of the plan. The phasing, described in Section 8, takes the development of the project through design and manufacture of rolling stock, alternatives analysis, preliminary engineering, final design and construction of the rail system's infrastructure. Project development includes all environmental reviews and/or the steps necessary under the National Environmental Policy Act (NEPA), including public involvement and necessary engineering to obtain a *record of decision* under NEPA requirements. Such an approach allows the states to secure funding and to develop the infrastructure as needed.

The Ohio Hub Study assumes that full privatization of the system will be extremely difficult to achieve, due to the government capital support provided to other modes of transportation, such as highway and air. However, the private sector can play a major role in operating the system, running station and train facilities, and in maintaining the track and equipment.

Recognizing that intercity passenger rail projects are unlikely to be financed simply by the private sector, and requires a public private partnership. The development of Ohio Hub will call for a substantial investment by the state of Ohio and the Federal Government. While it is unclear exactly what the size of the Federal government's contribution will be it is likely to be in the range of 50 to 80 percent of the total investment. The Ohio Hub financial analysis assumes that 80 percent of the capital cost would be paid for by the federal government, and that 20 percent will come from state/private sector match.

1.9 Institutional Arrangements for Project Implementation

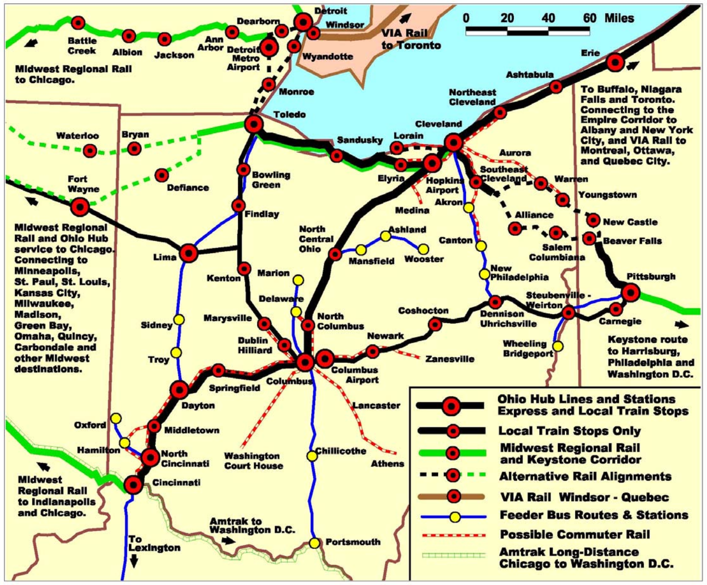
As the Ohio and Lake Erie Regional Rail - Ohio Hub Study progresses to more detailed planning and ultimately to securing funding for implementation of the Ohio Hub System, multi-state participation and cooperation becomes necessary for the system's success. With the progression of a series of activities, it is important to define the institutional arrangement that meets the needs of the Ohio Hub Study collective action while minimizing intrusion on the authorities, powers and immunities of each state.

Institutional arrangements, organizational structure, and agreements between participating entities (e.g., states) and the railroad will be needed for undertaking or overseeing project-related activities. Institutional arrangements range from less formal arrangements such as a Letter of Agreement to a more formal multi-state legislated compact arrangement. The level of arrangement selected will reflect the administrative needs of the states and the degree of complexity of the issues being dealt with.

An example of an existing passenger rail compact is the Interstate Rail Passenger Advisory Council (Interstate High-Speed Intercity Rail Passenger Network Compact). Its purpose is to explore the potential for high-speed rail within the Great Lakes region and to encourage a cooperative and coordinated regional approach for planning and development activities. It is the policy of the Compact member states "to cooperate and share jointly the administrative and financial responsibilities of preparing a feasibility study concerning the operation of such a (passenger rail) system connecting major cities in Ohio, Indiana, Michigan, Pennsylvania and Illinois."

The origin of this Interstate Rail Passenger Advisory Council is traced to January 30, 1979, when a bill was introduced in the Ohio legislature to create a high-speed rail compact with Ohio's neighboring states. That bill was signed into law on August 28, 1979, and neighboring states were contacted and urged to join the Compact. By 1981, Michigan, Pennsylvania, Illinois and Indiana had joined the Compact. In the early 1990's, New York and Missouri also became members of the Compact. The Council continues to provide an institutional framework in which state rail transportation officials may work together to advance the Ohio Hub intercity/interstate passenger rail project.

Preliminary System Plan



2. Engineering Assessment and Capital Cost Estimates

The Study Team conducted an Engineering Assessment in cooperation with Amtrak, the Ohio Rail Development Commission, and the Indiana, Michigan and New York Departments of Transportation. In addition, railroad representatives attended Study Team meetings and participated in field reviews. The Engineering Assessment provides an evaluation of the current condition of the railroad infrastructure and rights-of-way; identifies improvements needed to support the Modern (79-mph) and High-Speed (110-mph) passenger service scenarios; and provides capital cost estimates for route segment and alternative system configurations.

In addition to the Engineering Assessment, this Chapter identifies rolling stock (equipment) costs and land costs. Land costs have been presented as a placeholder for access to railroad rights-of-way.

The Engineering Assessment and its findings and recommendations are preliminary and have not been discussed in detail with the railroads. As discussed earlier, the Study is conceptual, the project is un-funded and formal negotiations with the railroads have not been initiated. Future Engineering Assessments will require considerably more discussion to ensure railroad concurrence. Final design concepts and recommended capital plans will depend on detailed operations analyses, design coordination and in-depth discussions with the freight railroads. As the project moves beyond the feasibility phase, railroad involvement and coordination will become increasingly important.

The Engineering Assessment was conducted at a *feasibility level* of detail and accuracy. Exhibit 2-1 highlights the levels of accuracy associated with typical phases of project development and engineering design. A low level of accuracy is associated with the evaluation of project feasibility; while the highest level of accuracy is achieved during final design and production of construction documents. The Ohio & Lake Erie Regional Rail – Ohio Hub Study is the first step in the project development process.

Exhibit 2-1: Engineering Project Development Phases and Levels of Accuracy

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

*Percent of *Final Design*. **Percent of actual costs to construct.
Table prepared by HNTB

2.1 Engineering Assessment Process

The first step in the Engineering Assessment was to divide each rail corridor into route segments. Route segments generally begin and end at railroad control points located in towns or cities. Each corridor was divided into four or five route segments. The route segments are identified on the corridor maps and are described in the following sections. Field inspections of the Ohio Hub railroad corridors and route segments were conducted in March, May, September and November of 2002. The railroad corridors included:

- Cleveland-Pittsburgh via Youngstown (NS and W&LE)
- Cleveland-Pittsburgh via Alliance (NS)
- Cleveland-Toledo-Detroit via Wyandotte (NS and CN)
- Cleveland-Toledo-Detroit via Detroit Airport (NS and CSX)
- Cleveland-Erie-Buffalo (CSX and CN)

The field inspection for the Cleveland-Columbus-Dayton-Cincinnati (3-C) corridor was conducted as part of an earlier Feasibility Study. This corridor was inspected in the summer of 2000 and the *Cleveland-Columbus-Cincinnati High-Speed Rail Study Final Report* was completed in July 2001.[3]

Inspections of additional "Incremental Corridor" route segments were conducted in November and December of 2005. The railroad corridors included:

- Columbus-Pittsburgh via Steubenville (former PRR Panhandle Alignment)
- Columbus-Fort Wayne via Dunkirk (CSX and Chicago Fort Wayne and Eastern Railroad-CFW&E, a wholly owned subsidiary of the Rail America Corporation)
- Columbus-Toledo via Dunkirk (CSX)

2.2 Cost Estimate Assumptions, Standards, and Definitions

A systematic engineering planning process was used to conduct an engineering assessment of the rail rights-of-way and to estimate the capital investment required for each route. The process used for the 2007 update was consistent with the earlier 2004 Ohio Hub and MWRRS plans. The initial step in this process was to segment each route and to assess the elements of the infrastructure of each route segment. The elements that were assessed included:

- Track work
- Stations, Terminals, and Maintenance Facilities
- Bridges/Under
- Bridges/Over

[3] The train schedule analysis for this corridor assumes segments previously identified as 90-mph could be upgraded to 110-mph, subject to curve speed limits that are automatically calculated by the software. The train schedules proposed here are considered reasonable for a 110-mph service, but are subject to further refinement when the engineering is updated.

- Highway Grade Crossings
- Train Control (Signals and Communications)

The engineering assessment of these elements was accomplished by conducting field views of each segment. A field view is a limited site verification without detailed surveys and consists of the sampling of critical sites along the track at crossings, bridges and stations. At each location, engineering notes are compiled and the physical track conditions are compared with the latest track charts and other information provided by the railroads. These field views were coordinated with the appropriate state and Amtrak.

Field observations were conducted at highway/railroad crossings, overpasses and parallel roadways. The inspections focused on the condition of the track and the ability to accommodate joint freight and passenger train operations. The railroad right-of-way was examined for its ability to accommodate additional tracks for added capacity. Where possible, other existing facilities were observed, including bridge conditions, vertical/horizontal clearances, passenger train facilities, railroad yards and terminal operations. Photographic records were made at many locations and are included in the descriptions below.

As route segments were examined in the field, general concepts were developed and assumptions were made regarding the capacity and operational improvements needed to accommodate future passenger trains. The primary objective was to conceptualize improvements that would improve fluidity and enhance the reliability of both passenger and freight rail operations.

The results of the field inspections were combined with data derived from railroad track charts to determine more precisely the recommended infrastructure improvements and to estimate the capital costs. The data was input into a track inventory system. This program generates a corridor track inventory and estimates the costs of upgrading for various train speed scenarios. The track inventory system stores information on track condition and track geometry such as curvature, gradient, and turnouts; information on structures such as bridges, crossings, fly-overs and stations, maximum operating speeds, and unit cost data for engineering improvements. The system generates track data files to identify quantities and to estimate costs. Cost estimates were prepared using the same unit costs developed for the Midwest Regional Rail Initiative (MWRRI). The *TRACKMAN*™ Train Inventory System is described in detail in the Appendices.

Track Work

During the field views, the condition of the track was noted and a determination made relative to the improvements required to accommodate a specific train technology. The limited field views involved walking short segments of the track at several locations. The purpose was to determine the existing track condition, assess its suitability to accommodate joint rail freight and passenger operations based on FRA regulations and track safety standards, and gather sufficient data to identify needed infrastructure improvements.

A key engineering assumption, adopted for this Study, involved the centerline offset between an existing high density freight track and a new FRA Class 6, 110-mph track. Both NS and CSX requested that new Class 6 high-speed passenger tracks be constructed at a minimum 25-foot centerline offset from the adjacent freight track. However, in order to accommodate possible future capacity expansion, the 25-foot offset was increased to a 28-foot centerline offset. The 28-foot offset would allow a future siding with 14-foot track centers to be constructed between the new 110-mph passenger track and the adjacent freight track. Based on the field reviews the costs associated with the 28-foot offset were estimated and included under the line item "High-Speed Rail (HSR) on New Roadbed and New Embankment." This line item includes new track and ties, track ballast, sub ballast and the earthwork required to build a four-foot-high embankment.

For the "incremental corridor" segments that were added in 2007, a dedicated track was provided at 28-foot offset from Columbus, OH to the junction with the east-west CSX mainline at Ridgeway, OH. Significant added capacity will be needed on this segment to accommodate the needs of the Honda assembly plant at Marysville, as well as to provide capacity for increased CSX intermodal operations into Parsons Yard in Columbus. Other segments of the "incremental corridors" are only lightly-used by freight trains, so it was assumed that the existing track would be upgraded to 110-mph for co-mingled operations. This ability to co-mingle 110-mph passenger service with light density freight operations is consistent with the assumption made in the MWRRS for the Fort Wayne to Chicago "Southern Alignment" segment, as well as for the MWRRS Joliet to St. Louis line.

Under the Modern Scenario, if new FRA Class 4 tracks were added for 79-mph train operations, then the standard 14-foot track centers were assumed for the cost estimates. Under the High-Speed Scenario, wherever the 28-foot centerline offset was not feasible due to inadequate right-of-way or other constraints, new track was added at the standard 14-foot centerline offset from the adjacent freight track, and the proposed passenger train speed was limited to 79-mph. The quantity of this track was included in the cost estimates under the line item "High-Speed Rail (HSR) on New Roadbed," which includes new track and ties, track ballast and sub ballast. The cost estimates also included upgrading the adjacent freight track or tracks with tie and ballast replacement under the line item "Timber and Surface w/ 33% Tie Replacement." In rural areas where a third track was assumed at a 28-foot centerline offset, costs for the extension of culverts were included. Costs for new or expanded bridges were also included as needed.

Realignment and Superelevation of Curves

Physical forces on the passengers, rolling stock and track serve to limit the speed at which a train can safely or comfortably operate through curves. The overall track standard defined for the MWRRS, which was also applied to the Ohio Hub, was to increase super-elevation to 4½ inches where possible. For lines with very light freight operations or for high-speed intermodal trains, additional increases in super-elevation might be possible, but in no case will superelevation exceed the value that balances freight speed at 60 mph or be greater than 6.0 inches. Where heavy freight operations (*e.g*., slow coal trains) exist, lower levels of super-elevation are used.

Passenger speed limits have been calculated based on a cant deficiency value or "unbalance" of six inches which has been approved by the FRA for passive-tilt equipment now operating in the Pacific Northwest corridor. This value has been demonstrated on new tilt type passenger

equipment, but exceeds that generally permitted by the FRA for passenger service using conventional non-tilting equipment or that has been permitted by the Class 1 freight railroads for passenger service operating on shared use track.

It is not envisioned that curves will be realigned due to the reconstruction cost and environmental considerations associated with this type of improvement, however, spirals may be adjusted to permit higher approach speeds. Both the increase in superelevation and cant deficiency will result in reconstruction of the existing track curve geometry, lengthening the curves (spiraled section) and possibly moving the track laterally a few feet toward the center of the arc. This is included in the capital cost where curve speeds are increased.

Bridges and Tunnels

A field view was conducted of a representative sampling of bridges along the routes. An estimate was made of the cost to upgrade or widen the bridges to accommodate high-speed rail operations. The cost to upgrade bridges along the routes was extrapolated from the estimated costs of the representative bridges. A complete inventory of bridges was developed for each route. For estimating the cost of new bridges or bridge replacements, conceptual engineering plans were used for a bridge to carry either single or double tracks over highways, streams, valleys, and rivers. Some bridges will require rehabilitation on the abutments and superstructure. This type of work includes pointing of stone abutment walls, painting of bridges, and replacement of bearings. Many of the major bridge cost estimates have been estimated only as placeholders which will be subject to more detailed engineering analysis in the future.

Train speeds are limited on some major through girder bridges and in tunnels. In the case of bridges, a moving train imposes impact loads on the underlying track and structure. The magnitude of the impact loads vary with the mass and speed of the train. Train speeds exceeding the original design criteria of the bridge may have detrimental effects, particularly with respect to fatigue limits of critical bridge members. A train entering a tunnel experiences a pressure gradient as it compresses the column of air within the tunnel. Modern tunnels are designed to accommodate this phenomenon with blast relief tubes. Speed limits are required for older tunnels that lack blast relief tubes.

Stations, Terminals, and Maintenance Facilities

The stations and terminals were inspected and the general condition noted. General recommendations for facility improvements were made to conform to the requirements of a given technology. Based on the selected technology, considerable improvements may be required for the platforms to be compatible with the technology. Additionally, substantial improvements in amenities within the stations are needed. The need for parking was also assessed.

Conceptually, vehicle servicing will be performed at corridor end-points or at other points where trains lay over at night. Specific locations for servicing facilities have not yet been finalized.

Highway/Railroad Grade Crossings

The treatment of grade crossings to accommodate 110-mph operations is a major challenge to planning a high-speed rail system. Highway/railroad crossing safety will play a critical role in future project development phases and a variety of devices will be considered to improve safety including median barriers, barrier gates, traffic channelization devices, wayside horns, fencing and the potential closure of crossings. The FRA requires full quadrant gates with median barriers as the minimum protection for 110-mph operations. Constant-warning time crossing protection is usually required to accommodate the large differential in speed between freight and passenger trains. The treatment and design of improved safety and warning devices will need further development to identify specifications and various approaches that may be advanced as part of an integrated program in Ohio.

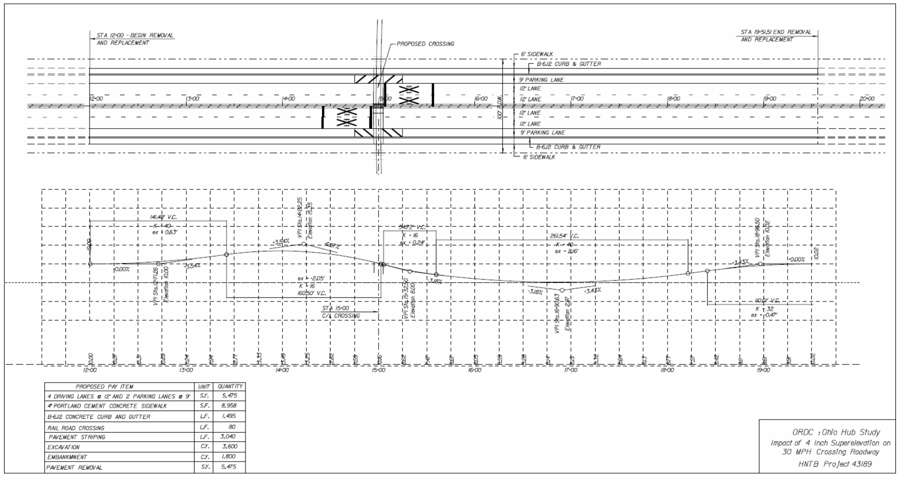
There are numerous grade crossings through downtown business areas and residential communities. For many of these, speed restrictions have been assumed, but there are others where high-speed operations are essential to the success of the Ohio Hub. Additionally in many rural areas, secondary roads parallel the railroad structure. Protection of crossings perpendicular to both the track structure and the parallel roadway minimizes opportunities for safe closure of the crossings. The treatment of these crossings may include installation of acceleration and deceleration lanes and/or installation of traffic signals on the secondary roadway. Other challenges that will require specific engineering solutions include humped crossings that do not provide acceptable sight distances for the train or highway vehicles.

For development of cost estimates, the treatment of a grade crossing is based on the average daily traffic through the crossing, proximity of parallel roadways, width of roadway, and presence of pedestrian crossings. The proposed treatments of the closure would potentially include: arresting barriers (a new technology in demonstration stages), and quad gates with median barriers. Highway crossing surfaces would be upgraded with pre-cast concrete panels.

Private crossings are numerous throughout the Midwest. The MWRRI Steering Committee has accepted the guideline to close five percent of private crossings per year, subject to public approval. It is assumed that a similar policy will be followed by the Ohio Hub. Where private crossings cannot be closed, electronic gated crossings or conventional flashers and gates are needed. Pedestrian and bicycle crossings will be eliminated where not integrated into an existing roadway grade crossing.

For rail operations above 79-mph, grade crossings will be protected by installation of arresting barriers, quad gates with median barriers, and/or extension of existing gates with additional counterweight. Arresting barriers will be used for grade crossings with high average daily traffic and where the installation of an arresting net is appropriate. A minimum of eighty feet is required between the gate and the arresting net.

Exhibit 2-2: Highway Regrading for Crossing Curve with Superelevation



Four-quad gates will be installed in areas where warranted by average daily traffic. Extended gate arms with counterweight and chain link fencing will be used in rural areas where average daily traffic is low. The gate arm of the existing flashers and gates will be extended to meet a 50-foot section of chain link fence to be constructed at each quad of the crossing.

In this study, speeds through towns crossing urban grid systems are generally limited to 60-mph, depending on the closeness of structures, the frequency of street crossings and traffic volumes crossing at local streets. Conventional warning gates were specified for speeds up to 79-mph. Even so, there is sometimes a desire to raise speeds through towns that may require in increase in some curve superelevations. If there is a station stop in the town, of course, a curve speed restriction can be accommodated without much impact on the train schedules. One factor that often limits speeds through towns are curve superelevations in urban grade crossings, which as shown in Exhibit 2-2 often cannot be increased with incurring major added expense. Because "humped" railroad crossings are no longer acceptable in new construction, street surfaces must be regraded to give a smooth crossing that aligns with the tilt angle of the tracks. Doing this can be very expensive in urban areas, but this treatment has been applied to some rural crossings.

Signals and Communications (Train Control)

State-of-the-art signals and communication systems are needed where train speeds are 79-mph or more. Train control and communication systems safely coordinate freight and passenger train operations to permit the joint use of one or more tracks. On heavily used lines, railroads install Centralized Train Control (CTC) to maximize track capacity; however, train speeds are limited to 79-mph. Under CTC usage, trains are dispatched from a central control location. Positive Train Control (PTC) is an advanced train control system and is used to enhance CTC system capabilities. PTC provides precise train-location information to an on-board computer and allows for train speeds above 79-mph. Several research and development efforts are currently evaluating advanced train control systems:

- The Michigan DOT and the FRA, along with Amtrak are advancing a $28 million project to implement an Incremental Train Control System (ITCS) in Michigan. The ITCS system is being tested on a 65-mile portion of the Chicago-Detroit High-Speed Rail Corridor between Kalamazoo and Grand Beach. This system uses existing railroad signals to obtain train status information. The system radios the data to each train where the computer informs the engineer of safe operating conditions. The computer will slow down or stop the train if unsafe operations are attempted.

- The Illinois DOT, the Association of American Railroads (AAR), Union Pacific and the FRA have tested a Positive Train Control Project (PTC) on a 123-mile segment of the Chicago-St. Louis High-Speed Rail Corridor. This PTC system would use commands radioed to each train from Union Pacific's central dispatch center.

  Despite some success in the tests of the system in these field trials, a significant amount of development effort is still required before a revenue-service ready PTC system is complete. In September 2006, the stakeholders agreed to move this research and development effort to the Transportation Technology Center in Pueblo, Colorado, which provides an ideal controlled environment for system refinement and testing. Lockheed Martin Corporation has agreed to provide in-kind development/ engineering services for

  about 3 years. Contingent upon funding availability, FRA will continue to provide program management support and system engineering services. This new program started in January 2007.[4]

This Study has included costs to upgrade the train control and signal systems. Under the 79-mph Modern Scenario, the capital costs include the installation of Centralized Train Control (CTC). Under the High-Speed Scenario, the signal improvements include the added costs for a PTC signal system. It was assumed that sidings would be needed to add capacity and accommodate passing trains. In single-track territory, a ten-mile-long passenger siding was assumed at a spacing of approximately fifty miles. Turnouts and turnout signals are included for sidings and spurs to local industry.

Fencing and Treatment of Bike Trails

Final determination of the need for fencing along the Ohio Hub right-of-way must be made during the Preliminary Engineering and Design stages for each corridor. Fencing is more likely to be advised for 110-mph operations than for 79-mph or 90-mph operations. It is also more likely to required in urban areas than rural areas, although situations will differ. Three types of fencing are needed for the Ohio Hub. Farm fencing would be used in rural areas. Chain link fencing, six feet high, could be used near crossings in rural areas and in residential and commercial areas. Decorative aluminum or steel fencing could be used in historic areas and in downtown business districts.

ORDC has not yet formally adopted a "trail policy" or trail design specifications regarding the development of a trail either within or adjacent to active high-speed tracks. However, across the United States, a number of dual use corridors that feature bike trails along with active rail lines are in service. The construction standards vary widely, particularly with respect to fencing, mode separation distance and common use of bridge structures. A *minimum* standard commonly accepted around the country is 30 feet from center of track to edge of trail.[5] In Newark, Delaware, a rail-trail has been built at that separation from Amtrak's high-speed northeast corridor tracks, although a greater separation is recommended where practicable.[6] The requirements for vertical and horizontal separation along with the need for fences and barriers for rail-trails will be examined as part of the preliminary engineering and project development process.

Feasibility-level cost estimates presented here for reconstruction of existing rail-trails assume new structures and grade generally within the existing right of way at nominal edge of trail to track centerline of 30 ft. The unit cost for bike trail replacement is based on typical rates for new highway construction at about $1.5 million per lane mile, which may be conservative for bike trail construction, which more typically ranges from $20,000 up to $500,000 per mile.[7]

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[4] See: http://www.fra.dot.gov/us/content/605
[5] See: http://www.fhwa.dot.gov/environment/rectrails/rwt/section5a.htm - fig56
[6] See: http://www.fhwa.dot.gov/environment/rectrails/rwt/section2c.htm and http://www.udel.edu/PR/UDaily/2004/biketrail072403.html
[7] See: http://www.nysphysicalactivity.org/site_beactiveenv/nybc/source_files/6_resources/costdata/states_costest.xls

2.3 Infrastructure Improvement Costs

The unit costs in the Ohio Hub Study are identical to those developed for the MWRRI. The MWRRI costs were derived from the 1997 Chicago/Milwaukee Rail Corridor Study and the 1993 Chicago to St. Louis High-Speed Rail Capital Cost Estimates, completed for the Wisconsin and Illinois Departments of Transportation by Envirodyne Engineers, Inc. in association with Pricewaterhouse. The unit costs were subsequently validated by the study of high-speed rail operations in the Chicago to St. Louis corridor, completed by DeLeuw Cather & Co. in association with Sverdrup Civil, Inc. for the Illinois Department of Transportation.

All the capital cost estimates in this report and in fact the entire study, is presented in 2002 dollars, which are the same units used in the earlier 2004 Ohio Hub report and in the MWRRS plan. However, some construction and materials costs have increased since the development of the original plan, so the Ohio Hub costs should be updated to current 2007 dollars soon as part of the project development process. ODOT has seen a 12 to 15 percent annual increase in construction costs in the last three or four years.

2.3.1 Infrastructure Improvement Categories and Unit Costs

The total estimated capital cost for the Ohio Hub System is a summation of the costs for all of the individual project components. Capital costs for infrastructure improvements fall into one of eight categories:

- Trackwork
- Passenger stations and support facilities, including a train service and inspection facility and train layover facilities
- Turnouts (switches)
- Bridges under –A road, river or another railroad goes underneath the track
- Bridges over – A road or another railroad goes over the track
- Roadway/railway crossings
- Signals
- Curves

Each category contains a set of infrastructure improvement elements. Each element, along with its unit cost is listed in Exhibit 2-3.

Exhibit 2-3: Engineering and Cost Estimate Assumptions and Definitions

Trackwork

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
1.1	HSR on Existing Roadbed	per mile	$993
1.2a	HSR on New Roadbed	per mile	$1,059
1.2b	HSR on New Roadbed & New Embankment	per mile	$1,492
1.2c	HSR on New Roadbed (Double Track)	per mile	$2,674
1.3	Timber & Surface w/ 33% Tie Replacement	per mile	$222
1.4	Timber & Surface w/ 66% Tie Replacement	per mile	$331
1.5	Relay Track w/ 136# CWR	per mile	$354
1.6	Freight Siding	per mile	$912
1.65	Passenger Siding	per mile	$1,376
1.71	Fencing, 4 ft Woven Wire (both sides)	per mile	$51
1.72	Fencing, 6 ft Chain Link (both side)	per mile	$153
1.73	Fencing, 10 ft Chain Link (both side)	per mile	$175
1.74	Decorative Fencing	per mile	$394

Stations

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
2.1	Full Service – New	each	$1,000
2.2	Full Service – Renovated	each	$500
2.3	Terminal – New	each	$2,000
2.4	Terminal – Renovated	each	$1,000
2.5	Layover Facility	lump sum	$5,544-6,536
2.6	Service and Inspection Facility	lump sum	$18,973

Turnouts

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
4.1	New #24 High-Speed Turnout	each	$450
4.2	New #20 Turnout Timber	each	$124
4.3	New #10 Turnout Timber	each	$69
4.4	New #20 Turnout Concrete	each	$249
4.5	New #10 Turnout Concrete	each	$118

Bridges-under

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
5.1	Four-Lane Urban Expressway	each	$4,835
5.2	Four-Lane Rural Expressway	each	$4,025
5.3	Two-Lane Highway	each	$3,054
5.4	Rail	each	$3,054
5.5	Minor River	each	$810
5.6	Major River	each	$8,098
5.71	Convert Open Deck Bridge To Ballast Deck (single track)	per LF	$4.7

5.72	Convert Open Deck Bridge To Ballast Deck (double track)	per LF	$9.4
5.73	Single Track on Flyover Structure	per LF	$6
5.8	Single Track on Approach Embankment w/Retaining Wall	per LF	$3

Bridges-over

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
6.1	Four-Lane Urban Expressway	each	$2,087
6.2	Four-Lane Rural Expressway	each	$2,929
6.3	Two-Lane Highway	each	$1,903
6.4	Rail	each	$6,110

Crossings

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
7.1	Private Closure	each	$83
7.2	Four Quadrant Gates w/Trapped Vehicle Detector	each	$492
7.3	Four Quadrant Gates	each	$288
7.31	Convert Dual Gates to Quad Gates	each	$150
7.41	Convert Flashers Only to Dual Gates	each	$50
7.4a	Conventional Gates Single Mainline Track	each	$166
7.4b	Conventional Gates Double Mainline Track	each	$205
7.5a	Single Gate with Median Barrier	each	$180
7.5b	Convert Single Gate to Extended Arm	each	$15
7.71	Pre-cast Panels without Roadway Improvements	each	$80
7.72	Pre-cast Panels with Roadway Improvements	each	$150
7.8	Michigan -Type Grade Crossing Surface	each	$15

Signals

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
8.1	Signals for Siding w/ High-Speed Turnout	each	$1,268
8.2	Install CTC System (single track)	per mile	$183
8.21	Install CTC System (double track)	per mile	$300
8.3	Install PTC System	per mile	$197
8.4	Electric Lock for Industry Turnout	per mile	$103
8.5	Signals for Crossover	per mile	$700
8.6	Signals for Turnout	per mile	$400

Curves

Item No.	Description	Unit	Unit Cost (Thousands of 2002$)
9.1	Elevate and Surface Curves	per mile	$58
9.2	Curvature Reduction	per mile	$393
9.3	Elastic Fasteners	per mile	$82

2.3.2 Contingencies

Contingencies for project development, design, engineering and construction have been added to the cost estimates. Contingencies were applied as a percentage of the base capital cost of each infrastructure element. The contingency costs include:

- Construction contingency 15%
- Design contingency 0%
- Design engineering 7%
- Program Management 3%
- Construction management and inspection 4%
- Owner's management – environmental, etc. 2%
- Insurance 0%

2.3.3 Placeholders

In addition to the cost categories, the capital costs include placeholders as conservative estimates for large and/or complex engineering projects. At the low end, these include costs for new railroad connections, interlockings and signal improvements; at the high end, these include new highway bridges, river crossings, rail over rail grade separations, along with major capacity improvements in the yards and terminal areas.

Placeholders provide lump sum budget approximations based on expert opinion rather than on an engineering estimate. Placeholders are used where detailed engineering requirements are not fully known. The following highlights some of the key placeholder costs that have been assumed in this analysis. These costs will require special attention during the project development phase and include:

- Connections for incorporating segments of the W&LE into the proposed Cleveland-Pittsburgh alignment.
- Connection track for incorporating the Freedom Secondary into the proposed Youngstown alignment.
- Costs for earthmoving and an Ohio Turnpike bridge for adding a third track to the Alliance line.
- Capacity improvements on the Cleveland to Berea segment, including a new movable drawbridge bridge over the Cuyahoga River in downtown Cleveland.
- On the Berea to Toledo line, new interlockings at the Huron and Vermillion river bridges; a flyover at Vickers and a new Maumee River bridge
- On the Toledo to Detroit line via either CN or CSX alignments, Airline Yard capacity enhancements, signal improvements and realignment of yard tracks.
- On the CN from Toledo to Detroit, mainline capacity improvements, River Rouge Yard improvements and a new lift bridge over the River Rouge.
- Between Cleveland and Buffalo, track improvements and capacity enhancements through the CSX Collinwood Yard, a flyover at Ashtabula and reconfiguration of tracks and signals at Erie.

- Miscellaneous improvements on the Niagara Falls to Buffalo segment.
- A new Ohio River bridge in Pittsburgh for passenger service to Columbus via the Panhandle.
- Bike trail replacement along the Panhandle from Walker's Mill to Weirton Jct. and in the Newark, OH area.
- For direct Columbus to Chicago service, flyovers at CP Mike in downtown Fort Wayne.

2.4 Infrastructure Improvement Costs by Corridor and Route Segment

The Engineering Assessment process yields an estimate of infrastructure costs for the passenger rail corridors. The following sections summarize the existing conditions and the proposed improvements, and provide a comparison of the costs for improving the lines for the Modern (79-mph) and High-Speed (110-mph) Scenarios. Detailed infrastructure costs are available in the Appendices.

2.5 Cleveland-Pittsburgh via Youngstown

The Cleveland-Pittsburgh via Youngstown corridor is approximately 139.8 miles in length. The corridor was inspected in March and May of 2002, was segmented as described in Exhibit 2-4 and is illustrated in Exhibit 2-5. Amtrak currently operates the daily *Three Rivers* (New York-Pittsburgh-Chicago) and the daily *Capitol Limited* (Washington D.C.-Pittsburgh-Chicago) over portions of this corridor.

Exhibit 2-4: Cleveland-Pittsburgh via Youngstown Route Segments

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speed (mph)	High-Speed Scenario Maximum Train Speed (mph)
1	Cleveland-Ravenna	NS/W&LE	35.1	79	79
2	Ravenna-Warren	NS	23.0	79	110
3	Warren-Youngstown	NS	18.4	79	110
4	Youngstown-New Castle	P&LE	16.0	79	110
5	New Castle-Pittsburgh	NS	47.3	79	79

Exhibit 2-5: Cleveland-Pittsburgh via Youngstown Route Segments

Segment 1: Cleveland-Ravenna

The Cleveland-Ravenna route segment is owned by Norfolk Southern. The heavily used route, part of the NS *Cleveland Line* is 35.1-miles long, is located in Cuyahoga and Portage Counties, and runs through or near the Cities of Cleveland, Garfield Heights, Maple Heights, Bedford, Walton Hills, Oakwood, Northfield, Macedonia, Hudson, Streetsboro and Ravenna. The route has five highway/railroad grade crossings. Amtrak's *Capitol Limited* operates over the line.

The existing mainline is double-track, welded rail and is in good condition. The maximum freight speeds are 50-mph over the FRA Class 4 tracks.

The proposed improvements for the Cleveland-Ravenna route create additional mainline capacity while upgrading the existing tracks. The Study assumes that freight and passenger trains would co-mingle on the same tracks over this segment. Due to the heavy volume of freight rail traffic, the complexity of operating through multiple connections, along with the constrained right-of-way, improving this line segment to FRA Class 6 for 110-mph was not feasible. The proposed improvements will allow a maximum passenger train speed of 79-mph.

This Study initially assumed that the alignment of the NS *Cleveland Line* would be used for the entire passenger route segment from Cleveland to Ravenna. However, the inspection of the corridor, southeast of Cleveland, identified the NS *Maple Heights Intermodal Yard* as a potential operational bottleneck. It was concluded that the adjacent Erie Lackawanna Railroad and Wheeling & Lake Erie (W&LE) Railroad rights-of-way offer an opportunity to bypass the NS

Intermodal facility. Therefore, the Study assumes that a passenger bypass alignment would be constructed over the Erie Railroad right-of-way beginning at CP Erie Crossing and would connect to the W&LE right-of-way near East 93rd Street. This routing follows the W&LE right-of-way, bypassing the *Maple Heights Intermodal Yard*, and rejoins the NS *Cleveland Line* in Bedford.

Beginning at the existing Amtrak station on the Cleveland lakefront, a new third track would be added between downtown (MP 122.97) and CP Erie Crossing (MP 116.9). The existing NS mainline is elevated for about three miles through Cleveland, with only one highway/railroad grade crossing in the first five miles southeast from the Lakefront. Four main tracks previously existed, and the right-of-way for the most part is still intact. At CP Erie Crossing, the alignment would connect to the old Erie Lackawanna Railroad tracks at grade and run south along the right-of-way for approximately 1.4 miles.

Near 93rd Street, the alignment connects to the Wheeling & Lake Erie Railway (W&LE) tracks via a new connection and continues south for approximately 4.6 miles along the W&LE to Bedford. At Bedford, the alignment would connect back to the NS right-of-way near NS MP 110 near West Glendale Street and would continue south toward Ravenna on the NS *Cleveland Line* to MP 88. A new third track would be constructed between CP Maple and Ravenna.

Photo 1: Looking east at CP 181 along CSX to Buffalo (left) and NS to Ravenna (right), just east of Cleveland Station

Photo 2: Looking east at the interlocking with Erie Lackawanna at NS MP 116.9, CP Erie Crossing. A new at-grade connection is proposed in the northeast quadrant to connect

Photo 3: Looking south along the NS *Cleveland Line* at MP 118.5

Photo 4: Looking north at Glendale Road, NS MP 110. NS tracks are on left, W&LE on right. A connection would be made in this area from the NS corridor to the W&LE tracks.

Photo 5: Looking south along the W&LE alignment, at Harvard Ave.

Photo 6: Looking south near Brown Street, NS MP 98 in Hudson

One new interlocking and three new connections will be required. An $18 million placeholder was provided for these costs. Detailed cost spreadsheets can be found in the Appendices.

The estimated capital cost for improving the Cleveland-Ravenna route segment for 79-mph freight and passenger operations is $214 million. The capital cost is the same for both the Modern and High-Speed Scenarios. The cost per mile is $6.1 million.

Photo 7: Looking south at Alexander Road, NS MP 107

Photo 8: Looking south from Libby Road overpass, NS MP 112.3, at *Maple Heights Intermodal Yard*

Exhibit 2-6 highlights the improvement costs by category. Trackwork and the reconstruction of highway bridges account for most of the capital cost of this segment.

Exhibit 2-6: Segment 1 – Cleveland-Ravenna Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$62,366	29.11%
Turnouts	$1,213	0.57%
Curves	$0	0.00%
Signals	$2,515	1.17%
Stations/Facilities	$2,000	0.93%
Bridge-Under	$126,255	58.93%
Bridge-Over	$0	0.00%
Crossings	$1,896	0.88%
Segment Total	$196,245	91.60%
Placeholder	$18,000	8.40%
TOTAL	**$214,245**	**100.00%**
COST/MILE (35.1 miles)	**$6,104**	

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Segment 2: Ravenna-Warren

The Ravenna-Warren route segment is owned by Norfolk Southern. The 23-mile long route follows the old Erie Lackawanna Railroad mainline, which was a 2-track high-speed mainline, but under Conrail ownership was downgraded and referred to as their Freedom Secondary, and located in Portage and Trumbull Counties, and passes through or near Ravenna, the Ravenna Arsenal, Windham, Braceville, Leavittsburg and the City of Warren.[8] Photo 9 shows a view of a tangent section of the Freedom Secondary near Ravenna.

Photo 9: Looking south along a tangent section of the Freedom Secondary alignment in Ravenna

The route is not currently used for either freight or passenger service, although the tracks are still in place. The route offers the opportunity to develop a high-speed passenger rail corridor with little or no freight train operations. The route would have 29 highway/railroad grade crossings.

The route segment begins west of the City of Ravenna at a new connection with the NS *Cleveland Line* at MP 88. The alignment follows the old Erie Lackawanna Railroad mainline, the ex-Conrail Freedom Secondary, from MP188 to MP 165, and runs just west of the City of Warren near Leavitt Road. The improvements for this segment involve the reconstruction of the *Freedom Secondary* track structure, the installation of new signals and grade crossing warning devices. The new line would accommodate either speed option and could be built to FRA Class 4, 79-mph track, or to FRA Class 6, 110-mph track. One new connection is needed and is identified as a placeholder for $5 million.

The total estimated cost to improve the 23-mile route segment for the Modern Scenario at 79-mph passenger train speeds is $68.3 million or about $3 million per mile (Exhibit 2-7). The total estimated cost to improve the line for the High-Speed Scenario or 110-mph is $81.4 million or about $3.5 million per mile.

[8]The western end of the former Erie Lackawanna line from Kent to Ravenna is operated by the Wheeling & Lake Erie Rwy (W&LE).

Exhibit 2-7: Segment 2 – Ravenna-Warren Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$43,115	63.08%	$43,115	52.95%	0.00%
Turnouts	$248	0.36%	$900	1.11%	262.90%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$4,209	6.16%	$8,740	10.73%	107.65%
Stations/Facilities	$0	0.00%	$0	0.00%	$0.0
Bridge-Under	$10,968	16.05%	$10,968	13.47%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$4,814	7.04%	$12,702	15.60%	163.86%
Segment Total	$63,354	92.69%	$76,425	93.86%	20.63%
Placeholders	$5,000	7.31%	$5,000	6.14%	0.00%
TOTAL	**$68,354**	**100.00%**	**$81,425**	**100.00%**	**19.12%**
Cost/Mile (23.0 Miles)	**$2,971**		**$3,540**		

Segment 3: Warren-Youngstown

Norfolk Southern owns the Warren-Youngstown route segment. The route follows the old Pennsylvania Railroad (PRR) corridor along the Mahoning River and is 18.4 miles long. The route is located in Trumbull and Mahoning Counties, and passes through, or near the City of Warren, Niles, McDonald, Girard and the City of Youngstown. The route is lightly used by freight trains and it is not currently used for Amtrak service. Under the High-Speed Scenario, the Study assumes that the route improvements would create a passenger rail corridor with a potential top speed of 110-mph. The route has seven highway/railroad grade crossings.

Beginning west of the City of Warren near Leavitt Road, the route segment follows the NS Pymatuning I. T. subdivision, (the old Erie Railroad) eastward from MP 49.5 to MP 54. A new connection at MP 54 would allow the line to turn southward toward Youngstown. The line continues south on the NS *Niles Secondary* subdivision (the old PRR) from MP 15.6 to MP 11.7, then following the NS *Lordstown Secondary* subdivision (the old PRR) from MP 10 to MP 0.

Improvements for the segment involve the construction of a single Class 4 track for the Modern Scenario, or a single Class 6 track for the High-Speed Scenario. Class 6 would allow passenger trains to operate at a maximum speed of 110-mph. The line segment has only a few grade crossings, which would need either to be eliminated or equipped with special safety devices and other highway warning devices. Photo 10 shows a view of the abandoned Erie right-of-way in Warren. Photo 11 shows a view of the PRR track north of Youngstown near the North Star steel mill.

Exhibit 2-8 highlights the improvement costs by category. The high-speed scenario is 10 percent more expensive. Trackwork and bridge construction account for a majority of the cost of improving this segment for either 79-mph or 110-mph train speeds. The total estimated cost to improve the 18.4-mile route segment for 79-mph passenger train speeds is $66.2 million or about $3.6 million per mile. The total estimated cost to improve the line for a 110-mph top speed is $72.4 million or about $3.9 million per mile.

Exhibit 2-8: Segment 3 – Warren-Youngstown Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$35,868	54.17%	$35,868	49.54%	0.00%
Turnouts	$248	0.37%	$900	1.24%	262.90%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$3,367	5.08%	$6,992	9.66%	107.66%
Stations/Facilities	$1,000	1.51%	$1,000	1.38%	0.00%
Bridge-Under	$12,588	19.01%	$12,588	17.39%	0.00%
Bridge-Over	$1,903	2.87%	$1,903	2.63%	0.00%
Crossings	$1,245	1.88%	$3,149	4.35%	152.93%
Segment Total	$56,219	84.90%	$62,400	86.19%	10.99%
Placeholders	$10,000	15.10%	$10,000	13.81%	0.00%
TOTAL	**$66,219**	**100.00%**	**$72,400**	**100.00%**	**9.33%**
Cost/Mile (18.4 Miles)	**$3,598**		**$3,934**		

Photo 10: In Warren at Austin Ave. looking west along abandoned Erie right-of-way. CSX is on left.

Photo 11: Old PRR railroad north of Youngstown near North Star Steel Mill, looking north

Segment 4: Youngstown-New Castle

The Study assumes that this 16-mile long route segment would be improved as a dedicated passenger rail corridor. The line would use the abandoned Pittsburgh and Lake Erie (P&LE) right-of-way. Under the High-Speed Scenario, the improvements involve the construction of a new Class 6 single track capable of 110-mph passenger train speeds.

In Ohio, the route is located in Mahoning County, and passes through, or near the City of Youngstown, Campbell, Struthers and Lowellville; in Pennsylvania, the line is located in Lawrence County, and runs through Edinburg and New Castle. The line would have 10 highway/railroad grade crossings. Amtrak currently operates the *Three Rivers* (New York-Pittsburgh-Chicago) on the CSX tracks, parallel to the P&LE right-of-way.

The new passenger line would be constructed on the abandoned P&LE right-of-way. Based on the field review it was determined that construction of a dedicated high-speed passenger track would be possible.[9] The P&LE right-of-way runs parallel to the CSX railroad corridor from Youngstown to the City of New Castle, and follows the north side of the Mahoning River. The line would have 10 highway/railroad grade crossings. In New Castle, the P&LE passenger alignment would connect to the NS *Youngstown Line* at CP 75. Photo 12 shows a view of the abandoned P&LE railroad right-of-way.

Photo 12: At the Pennsylvania/Ohio state line looking northwest along CSX (at right) and the abandoned P&LE right-of-way

Photo 13: River Road, NS MP 11

The total estimated cost to improve the 16-mile route segment for 79-mph passenger train speeds is $72.7 million or about $4.5 million per mile. The total estimated cost to improve the line for 110-mph operating speeds is $76.5 million or about $4.8 million per mile. Exhibit 2-9 identifies

[9] The estimate is for restoring a section of currently abandoned track, so curves on the new trackage could be constructed to the correct superelevation. There is no need for reworking or realigning any existing curves since this segment is all new construction.

the improvement costs by category and the percent increase in cost for the High-Speed Scenario. The high-speed turnouts and the PTC signal improvements account for most of the additional $3.8 million for the High-Speed Scenario.

Exhibit 2-9: Segment 4 – Youngstown-New Castle Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$32,087	44.11%	$32,087	41.92%	0.00%
Turnouts	$248	0.34%	$900	1.18%	262.90%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$2,928	4.03%	$6,080	7.94%	107.65%
Stations/Facilities	$0	0.00%	$0	0.00%	$0.00%
Bridge-Under	$25,428	34.96%	$25,428	33.22%	0.00%
Bridge-Over	$3,806	5.23%	$3,806	4.97%	0.00%
Crossings	$3,243	4.46%	$3,243	4.24%	0.00%
Segment Total	$67,740	93.13%	$71,544	93.47%	5.62%
Placeholders	$5,000	6.87%	$5,000	6.53%	0.00%
TOTAL	**$72,740**	**100.00%**	**$76,544**	**100.00%**	**5.23%**
Cost/Mile (16.0 Miles)	**$4,546**		**$4,784**		

Segment 5: New Castle-Pittsburgh

The 47.3-mile New Castle-Pittsburgh route segment is owned by Norfolk Southern. It would use a portion of the NS *Youngstown Line* and a portion of the NS *Fort Wayne Line.*

In Pennsylvania, the line is located in Lawrence, Beaver and Allegheny Counties. South of New Castle, the route runs along the west side of the Beaver River and passes through, or near Moravia, Wampum, West Mayfield, Geneva Hill, Mt. Washington, Steffens Hill, Pleasantview, Beaver Falls and New Brighton. The route crosses the Beaver River and runs along the north side of the Ohio River through Rochester, East Rochester, Freedom, Conway, Baden, Ambridge, Leetsdale, Edgeworth, Sewickley, Osborne, Haysville, Glenfield, Emsworth, Ben Avon, Avalon, Bellevue, and the City of Pittsburgh.

The route has six highway/railroad grade crossings. Amtrak's *Three Rivers* (New York-Pittsburgh-Chicago) operates over the entire route segment. Amtrak's *Capitol Limited* (Washington-Pittsburgh-Chicago) operates over the *Fort Wayne Line* between Rochester and Pittsburgh. Ohio Hub passenger trains would co-mingle with NS freight trains over this entire route segment. The maximum proposed passenger speed is 79-mph.

The route segment begins at the abandoned P&LE corridor where it would connect to the NS *Youngstown Line* in New Castle at MP 75. From here, the line continues south to CP Rochester MP 97.2. From Rochester, the alignment continues to Pittsburgh, following the NS *Fort Wayne Line* from CP Rochester to the existing Amtrak station in downtown Pittsburgh (MP 26 to MP

0). The route passes by NS's *Conway Yard*, which creates extensive switching movements and other freight rail activity.

On the north end, the NS *Youngstown Line* is a double track, Class 3 railroad. The Study recommends significant upgrades to the track structure, including two-thirds tie replacement and heavy resurfacing of both tracks. On the south end, the *NS Fort Wayne Line* is a Class 4, triple track main line in good condition (see Photo 13 above). This section of track is recommended for improvement with one-third tie replacement and heavy resurfacing on all three tracks. The capital cost for a train layover facility near the Pittsburgh station has been included in the cost estimates.

The total estimated cost to improve the 47.3-mile route segment to FRA Class 4, 79-mph standards is $40.3 million or $853 thousand per mile. Exhibit 2-10 highlights the improvement costs by category. A $5.5 million lump sum was added under station facilities to provide for the renovation of the Pittsburgh Amtrak Station. Trackwork and bridge construction accounts for most of the cost to improve this route segment.

Exhibit 2-10: Segment 5 – New Castle-Pittsburgh Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$31,075	77.01%
Turnouts	$496	1.23%
Curves	$0	0.00%
Signals	$0	0.00%
Stations/Facilities	$7,044	17.46%
Bridge-Under	$0	0.00%
Bridge-Over	$0	0.00%
Crossings	$1,738	4.31%
Segment Total	$40,353	100.00%
Placeholders	$0	0.00%
TOTAL	**$40,353**	**100.00%**
Cost/Mile (47.3) miles	**$853**	

2.5.1 Cleveland-Pittsburgh via Youngstown Capital Cost Summary

Exhibit 2-11 summarizes the total estimated costs for improving all five Cleveland-Pittsburgh via Youngstown route segments. The cost to improve the corridor under the Modern Scenario is $461.9 million or $3.29 million per mile. The cost to improve the corridor under the High-Speed Scenario is $484.9 million or $3.46 million per mile.

Exhibit 2-11: Cleveland-Pittsburgh via Youngstown Capital Cost Summary

Segment Number	Segment Name	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Cost (1000s)	Cost/ Mile	Cost (1000s)	Cost/ Mile
1	Cleveland-Ravenna	NS/W&LE	79-mph	35.1	$214,245	$6,103	$214,245	$6,103
2	Ravenna-Warren	NS	110-mph	23.0	$68,354	$2,971	$81,425	$3,540
3	Warren-Youngstown	NS	110-mph	18.4	$66,219	$3,598	$72,400	$3,934
4	Youngstown-New Castle	P&LE	110-mph	16.0	$72,740	$4,546	$76,544	$4,784
5	New Castle-Pittsburgh	NS	79-mph	47.3	$40,353	$853	$40,353	$853
TOTAL				**140.2**	**$461,912**	**$3,294**	**$484,968**	**$3,459**

Exhibit 2-11 (continued): Cleveland-Pittsburgh via Youngstown Corridor Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Corridor Cost	Cost (1000s)	% of Total Corridor Cost	
Trackwork	$204,512	44.28%	$204,512	42.17%	0.00%
Turnouts	$2,453	0.53%	$4,409	0.91%	79.74%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$13,019	2.82%	$24,327	5.02%	86.86%
Stations/Facilities	$10,044	2.17%	$10,044	2.07%	0.00%
Bridge-Under	$175,239	37.94%	$175,239	36.13%	0.00%
Bridge-Over	$5,709	1.24%	$5,709	1.18%	0.00%
Crossings	$12,936	2.80%	$22,728	4.69%	75.70%
Segment Total	$423,912	91.77%	$446,968	92.16%	5.44%
Placeholders	$38,000	8.23%	$38,000	7.84%	0.00%
TOTAL	**$461,912**	**100.00%**	**$484,968**	**100.00%**	**4.99%**

2.6 Cleveland-Pittsburgh via Alliance

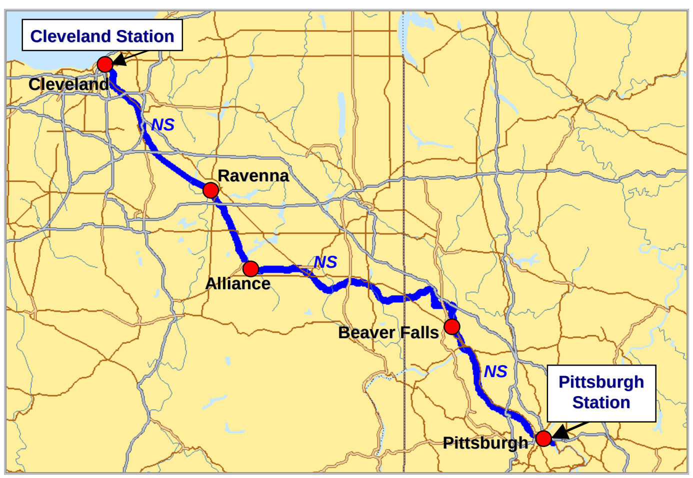
The Cleveland-Pittsburgh route via Alliance is 138.9 miles long making it only one mile shorter than the alternative Cleveland-Pittsburgh route via Youngstown. Both corridor alternatives follow the same route between Cleveland and Ravenna and between Rochester and Pittsburgh. The field inspection between Ravenna and Beaver Falls was conducted in November of 2002. The route was segmented as described in Exhibit 2-12 and is illustrated in Exhibit 2-13.

The entire corridor serves as the route for Amtrak's *Capitol Limited* (Washington-Pittsburgh-Chicago) and the *Three Rivers* (New York-Pittsburgh-Chicago) runs over a portion of this route west of Pittsburgh.

Exhibit 2-12: Cleveland-Pittsburgh via Alliance

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speed (mph)	High-Speed Scenario Maximum Train Speed (mph)
1	Cleveland-Ravenna	NS	37.1	79	79
2	Ravenna-Alliance	NS	18.8	79	79
3	Alliance-Beaver Falls	NS	52.9	79	79
4	Beaver Falls-Pittsburgh	NS	30.2	79	79

Exhibit 2-13: Cleveland-Pittsburgh via Alliance Route Segments



The field inspection of the Ravenna to Beaver Falls route segment revealed that it is not feasible to increase train speeds above 79-mph. Due to the rail alignment's sharp horizontal and vertical curves and its constrained right-of-way, improving this line to FRA Class 6 for 110-mph train speeds was not considered feasible. The right-of-way clearances required to add a third high-speed track at a 28-foot centerline offset were not available. However, the Study assumes that line capacity would be increased and that a third mainline track would be added at a standard 14-foot track center. The two existing mainline tracks would be rehabilitated. The Study also assumes that freight and passenger trains would co-mingle on the same tracks along the new triple tracked mainline. The following describes the route segments and the proposed improvements for 79-mph maximum passenger train speeds.

Segment 1: Cleveland-Ravenna

The Cleveland-Ravenna segment is nearly identical to Segment 1 for Cleveland-Pittsburgh via Youngstown. Extending south from NS MP 88 where the Youngstown corridor alternative would connect to the *Freedom Secondary*, this route segment continues to run along the NS *Cleveland Line* to MP 85.9 in Ravenna. The total length of the segment is 37.1 miles, two miles longer than the Cleveland-Ravenna route segment under the Youngstown alternative. Therefore, this cost includes an additional $3 million for the required trackwork. The description of the route and its required infrastructure improvements were discussed previously in Section 2.5, under Segment 1 of the Cleveland-Pittsburgh via Youngstown alternative.

The estimated capital cost for improving the 37.1-mile Cleveland-Ravenna route segment for 79-mph freight and passenger operations is $218 million. This cost is the same for both the Modern and High-Speed Scenarios. The cost per mile is $5.9 million. Exhibit 2-14 provides a breakdown of the improvements by cost category.

Exhibit 2-14: Segment 1 – Cleveland-Ravenna Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$65,763	30.22%
Turnouts	$1,213	0.56%
Curves	$0	0.00%
Signals	$2,515	1.16%
Stations/Facilities	$2,000	0.92%
Bridge-Under	$126,255	58.01%
Bridge-Over	$0	0.00%
Crossings	$1,896	0.87%
Segment Total	$199,642	91.73%
Placeholders	$18,000	8.27%
TOTAL	**$217,642**	**100.00%**
COST/MILE (37.1 Miles)	**$5,866**	

Segment 2: Ravenna to Alliance

The 18.8-mile Ravenna-Alliance route segment is owned by Norfolk Southern. The line is part of the busy NS *Cleveland Line.* It is located in Portage and Stark Counties, and passes through or near the City of Ravenna, New Milford, Atwater Station, Limaville, Bolton and the City of Alliance. The route would have 19 highway/railroad grade crossings. Amtrak runs the *Capitol Limited* over this route.

The NS *Cleveland Line* is a double-track, welded rail, heavily used mainline corridor. Current freight speeds of 50-mph indicate that it is a Class 4 mainline. The route follows the *Cleveland Line* from Ravenna at MP 85.9 to Alliance at MP 67.1. A proposed third track would add capacity over the entire route segment and would allow passenger and freight trains to co-mingle on the same tracks. The maximum passenger train speed would be 79-mph. The existing double-track mainline would be rehabilitated with new ties and track ballast, which accounts for 61 percent of the capital cost. The total estimated cost to improve the 18.4-mile route for 79-mph passenger train speeds is $73.1 million or about $3.9 million per mile. Exhibit 2-15 identifies the route segments capital requirements by cost category.

Exhibit 2-15: Segment 2 – Ravenna-Alliance Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$44,846	61.35%
Turnouts	$248	0.34%
Curves	$0	0.00%
Signals	$800	1.09%
Stations/Facilities	$500	0.68%
Bridge-Under	$23,808	32.57%
Bridge-Over	$0	0.00%
Crossings	$2,900	3.97%
Segment Total	$73,102	100.00%
Placeholders	$0	0.00%
TOTAL	**$73,102**	**100.00%**
Cost/Mile (18.8 Miles)	**$3,888**	

Segment 3: Alliance to Beaver Falls

The Alliance-Beaver Falls route segment is owned by Norfolk Southern. The 52.9-mile long route is part of the heavily used NS *Fort Wayne Line.*

Photo 14: Moff Road looking east, NS MP 76.4

Photo 15: Walnut Street looking west, NS MP 38.4

In Ohio, the line is located in Stark, Mahoning and Columbiana Counties, and it passes through, or near the City of Alliance, Sebring, Beloit, Salem, Leetonia, Columbiana, New Waterford, and East Palestine. In Pennsylvania, the line is located in Beaver County and passes through Enon Valley, New Galilee, Homewood, West Mayfield, Geneva Hill and Beaver Falls. The line has 38 highway/railroad grade crossings.

The segment begins at CP Alliance where the NS *Cleveland Line* (MP 67.1) connects to the NS *Fort Wayne Line* (MP 83.05). The *Fort Wayne Line* crosses the state line into Pennsylvania and runs to Beaver Falls at MP 30.2. The double-track, welded rail mainline has a 50-mph maximum authorized speed for freight. The line's horizontal and vertical curves restrict the ability to increase the design speed above 79-mph.

A proposed third track would add capacity over the entire route segment and would allow passenger and freight trains to co-mingle on the same tracks. The maximum passenger train speed would be 79-mph. The existing double-track mainline would be rehabilitated with new ties and track ballast. Some sections of track are situated in deep cuts in the rock and would require costly excavation for the construction of a third track. A placeholder value of $20 million was added to cover this cost and another $30 million was added for the reconstruction of an Ohio Turnpike bridge. The construction of the third track along with major bridge reconstruction accounts for almost 90 percent of the total cost. The total estimated cost to improve the 52.9-mile route segment to FRA Class 4, 79-mph standards is $288.4 million or $5.4 million per mile. Exhibit 2-16 provides a breakdown of the improvements by costs category.

Exhibit 2-16: Segment 3 – Alliance-Beaver Falls Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$120,488	41.78%
Turnouts	$496	0.17%
Curves	$0	0.00%
Signals	$1,600	0.55%
Stations/Facilities	$500	0.17%
Bridge-Under	$105,408	36.55%
Bridge-Over	$4,174	1.45%
Crossings	$5,750	1.99%
Segment Total	$238,416	82.66%
Placeholders	$50,000	17.34%
TOTAL	**$288,416**	**100.00%**
Cost/Mile (52.9 Miles)	**$5,452**	

Segment 4: Beaver Falls to Pittsburgh

The Norfolk Southern owned Beaver Falls-Pittsburgh 30.2-mile route segment is identical to the eastern portion of Segment 5 of the Cleveland-Pittsburgh via Youngstown route described above.

In Pennsylvania, the line is located in Beaver and Allegheny County. South of Beaver Falls, the route runs along the Ohio River through Rochester, East Rochester, Freedom, Conway, Baden, Ambridge, Leetsdale, Edgeworth, Sewickley, Osborne, Haysville, Glenfield, Emsworth, Ben Avon, Avalon, Bellevue, and the City of Pittsburgh. There are no highway/railroad crossings on this line segment.

Running south from Beaver Falls, the NS owned *Fort Wayne Line* continues to Pittsburgh along a Class 4, triple tracked mainline. In Pittsburgh, the line is four tracks. Ohio Hub passenger trains would co-mingle with NS freight trains over this entire route segment. The maximum proposed passenger speed is 79-mph. The Study recommends significant upgrades to the track structure, including two-thirds tie replacement and heavy resurfacing of both tracks. These upgrades account for 75 percent of the total segment cost. The capital cost for a train layover facility near the Pittsburgh station has been included in the cost estimates.

The total estimated cost to improve the 30.2 route miles for 79-mph operations is $30.5 million or about $1 million per mile. Exhibit 2-17 identifies the cost category improvements.

Exhibit 2-17: Segment 4 – Beaver Falls-Pittsburgh Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$22,985	75.30%
Turnouts	$496	1.62%
Curves	$0	0.00%
Signals	$0	0.00%
Stations/Facilities	$7,044	23.08%
Bridge-Under	$0	0.00%
Bridge-Over	$0	0.00%
Crossings	$0	0.00%
Segment Total	$30,525	100.00%
Placeholders	$0	0.00%
TOTAL	**$30,525**	**100.00%**
Cost/Mile (30.2 Miles)	**$1,010**	

2.6.1 Cleveland-Pittsburgh via Alliance Capital Cost Summary

Exhibit 2-18 summarizes the total estimated costs for improving all five Cleveland-Pittsburgh via Youngstown route segments. The cost to improve the corridor for 70-mph train speeds is $609.7 million or $3.3 million per mile.

Exhibit 2-18: Cleveland - Pittsburgh via Alliance Capital Cost Summary

Segment Number	Segment Name	Railroad	Maximum Design Speed	Miles	Modern Scenario	
					Cost (1000s)	Cost/Mile
1	Cleveland-Ravenna	NS	79-mph	37.10	$217,642	$5,866
2	Ravenna-Alliance	NS	79-mph	18.80	$73,102	$3,888
3	Alliance-Beaver Falls	NS	79-mph	52.90	$288,416	$5,452
4	Beaver Falls-Pittsburgh	NS	79-mph	30.20	$30,525	$1,010
TOTAL				**139.00**	**$609,684**	**$4,386**

Exhibit 2-18 (continued): Cleveland – Pittsburgh via Alliance Corridor Improvements by Cost Category

Cost Category	Cost (1000s)	% of Total Segment Cost
Trackwork	$254,081	41.67%
Turnouts	$2,453	0.40%
Curves	$0	0.00%
Signals	$4,915	0.81%
Stations/Facilities	$10,044	1.65%
Bridge-Under	$255,471	41.90%
Bridge-Over	$4,174	0.68%
Crossings	$10,546	1.73%
Segment Total	$541,684	88.85%
Placeholders	$68,000	11.15%
TOTAL	**$609,684**	**100.00%**

2.7 Cleveland-Toledo-Detroit via Wyandotte

The Cleveland-Toledo-Detroit via Wyandotte corridor is approximately 168.6-miles in length. The route segments are delineated in Exhibit 2-19 and are illustrated in Exhibit 2-20.

Exhibit 2-19: Cleveland-Detroit via Wyandotte Route Segments

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speeds (mph)
1	Cleveland-Berea	NS	12.3	79	79
2	Berea-Toledo	NS	95.8	110	110
3	Toledo-Vienna Junction	NS	9.9	79	79
4	Vienna Junction-West Detroit	NS / CN	45.3	79	110
5	West Detroit-Detroit Station	CN	5.3	60	60

Exhibit 2-20: Toledo-Detroit via Wyandotte

The Cleveland-Toledo route segment shares the alignment with the proposed MWRRS Cleveland-Toledo-Chicago High-Speed Rail Corridor. This Study has assumed that the capital improvements required between Cleveland and Toledo would be identical to those proposed under the MWRRS. Therefore, the scope of this Study did not duplicate the work and the field inspection for the corridor was limited to the route segments between Cleveland and Berea and between Toledo and Detroit. These segments were field inspected in March 2002.

Between Cleveland and Toledo, Amtrak's daily trains, the *Capitol Limited* (Washington-Pittsburgh-Chicago) and the *Lake Shore Limited* (New York/Boston-Albany-Chicago) currently operate over the corridor. Both of these Amtrak trains continue west of Toledo and do not serve the State of Michigan or connect to the City of Detroit. Before 1996, Amtrak operated the *Lake Cities* between Chicago, Detroit and Toledo. This service ran over the NS route through Wyandotte. Currently, the *Lake Cities* service terminates in Detroit and no longer serves Toledo.

Segment 1: Cleveland-Berea

Norfolk Southern owns the Cleveland-Berea route segment. This heavily used mainline segment is also known as the NS *Chicago Line* and is only 12.3-miles in length. The line is located in Cuyahoga County and passes through the Cities of Cleveland, Brooklyn, Brookpark and Berea, and runs adjacent to Cleveland Hopkins International Airport. Amtrak runs the *Capitol Limited* and the *Lake Shore Limited* over this corridor. The line has two highway/railroad crossings.

The route is an active and heavily congested freight corridor. A major Cleveland yard, *Rockport Yard*, is located off the *Chicago Line* at MP 190 and numerous industries, including the Ford Brookpark plant, are located on the line. In addition to the heavy rail traffic, another impediment is the moveable drawbridge at mouth of the Cuyahoga River just west of downtown Cleveland, which is less than one mile west of Cleveland's lakefront Amtrak Station.

As a result of the field inspection, it was determined that significant capacity improvements would be needed along the Cleveland-Berea track segment. The proposed improvements include upgrades to the existing tracks and the installation of a third track along with multiple sidings on the south and/or east side of the line. Sidings were used in lieu of a continuous fourth track because the constraints imposed by overhead highway bridges narrowed the available right-of-way to just three tracks in many locations.

Due to the high volume of freight traffic, a maximum speed of 79-mph is proposed. Passenger trains would co-mingle with freight trains along this route.

Placeholder costs for railroad capacity improvements at Brookpark near the Ford Plant and *Rockport Yard* were included in the cost estimates, as well as a new movable drawbridge bridge over the Cuyahoga River in downtown Cleveland. The Ford Plant and *Rockport Yard* improvements were estimated at $20 million, while the cost of the new bridge over the Cuyahoga River was estimated at $52 million. The estimated capital cost to improve the 12.3-mile Cleveland-Berea route segment for 79-mph co-mingled operations is about $124 million. The cost per mile for this segment is $10 million. Exhibit 2-21 identifies the costs by category.

Exhibit 2-21: Segment 1 – Cleveland-Berea Costs

Cost Category	Modern and High-Speed Scenario	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$32,842	26.53%
Turnouts	$4,454	3.60%
Curves	$0	0.00%
Signals	$12,080	9.76%
Stations/Facilities	$2,000	1.62%
Bridge-Under	$0	0.00%
Bridge-Over	$0	0.00%
Crossings	$400	0.32%
Segment Total	$51,776	41.83%
Placeholders	$72,000	58.17%
TOTAL	**$123,776**	**100.00%**
COST/MILE (12.3 Miles)	**$10,063**	

Segment 2: Berea-Toledo

The Berea-Toledo route segment continues to follow the Norfolk Southern owned *Chicago Line*. The 95.8-mile long route is located in Cuyahoga, Lorain, Erie, Ottawa and Wood Counties, and passes through, or near Olmsted Falls, North Ridgeville, Elyria, Amherst, Vermillion, Huron, Sandusky, Port Clinton, Lacarne, Oak Harbor, Rocky Ridge, Graytown, Elliston, Martin, Clay Center, Milbury, Northwood, Oregon and the City of Toledo. The line has 32 highway/railroad grade crossings. The NS *Chicago Line* is one of the most heavily used railroad corridors in the United States. It is currently a double-track, welded rail, Class 4 mainline.

From Berea to Toledo, a new dedicated high-speed Class 6 passenger track would allow 110-mph maximum passenger train speeds. The required 28-foot centerline offset would be accommodated; however, train speeds would be restricted in several locations. These restricted areas include junctions with major railroads and restrictions at bridge crossings, in addition to sections where there is not enough right-of-way to add a third track at a 28-foot centerline offset.

The causeway over Sandusky Bay and the bridges over the Huron and Vermillion rivers are major railroad structures that cannot be easily or inexpensively expanded to accommodate a third high-speed passenger track. In these sections, passenger trains will co-mingle with freight trains and will be restricted to Class 4, 79-mph speeds. New interlockings and signals will be needed at junctions between the freight tracks and the dedicated high-speed passenger track. A $3 million placeholder has been added for these connections; a $40 million placeholder has been provided for the construction of a rail/rail overpass at the NS/CSX Vickers at-grade crossing east of Toledo; and a $50 million placeholder is provided for the construction of a new Maumee River bridge. This bridge is needed for additional track capacity east of the Toledo Union Station.

The estimated capital cost to improve the 95.8-mile Berea-Toledo route segment for a dedicated 110-mph high-speed passenger operation is $337 million. The cost per mile for this segment is $4.3 million. The construction of the new high-speed track bed, trackwork and the new bridges account for more than 70 percent of the capital cost of this segment. Exhibit 2-22 highlights the capital requirements by cost category.

Exhibit 2-22: Segment 2 – Berea-Toledo Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$150,911	44.78%
Turnouts	$7,429	2.20%
Curves	$711	0.21%
Signals	$35,035	10.40%
Stations/Facilities	$2,000	0.59%
Bridge-Under	$19,068	5.66%
Bridge-Over	$19,948	5.92%
Crossings	$11,911	3.53%
Segment Total	$247,013	73.29%
Placeholder	$90,000	26.71%
TOTAL	**$337,013**	**100.00%**
COST/MILE (95.8 Miles)	**$3,518**	

Segment 3: Toledo-Vienna Junction

Norfolk Southern owns the 9.9-mile Toledo-Vienna Junction route segment. It includes portions of the NS *Cleveland Line* and the NS *Detroit Line*. In Ohio, the route is located in Wood County and runs through the City of Toledo; in Michigan, the line is located in rural Monroe County.
Amtrak's daily *Capitol Limited* (Washington-Pittsburgh-Chicago) and the daily *Lake Shore Limited* (New York/Boston-Albany-Chicago) operate over the *Cleveland Line*, but they do not run north on the *Detroit Line*. Amtrak no longer operates the extension of the *Lake Cities* (Chicago-Detroit) to Toledo. The Toledo-Vienna Junction route segment has 11 highway/railroad grade crossings.

A proposed third track would add capacity over the entire route segment and would allow passenger trains to operate at a maximum speed of 79-mph.

The route segment begins in Toledo at the Toledo Central Union Station. It runs west following the NS *Cleveland Line* and connects to the NS *Detroit Line* at MP 289.49. The existing double track mainline is in a narrow cut section with retaining walls along both sides. Proposed improvements involve adding track capacity by widening the cut and constructing a third mainline track between Toledo Union Station and the *Detroit Line*. The alignment connects to the *Detroit Line* at MP 57.7 and runs along the north side of the *Detroit Yard*. The MWRRS Chicago to Cleveland cost estimates include a Placeholder cost of $40 million for *Detroit* and *Airline Yard* capacity enhancements, signal improvements and realignment of yard tracks. The placeholder also includes costs for a new north lead from the *Cleveland Line* to the *Detroit Line*.

From *Detroit Yard* north through Swan Creek to Sylvania Avenue, the existing right-of-way appears constrained and a new high-speed track at 28-foot centerline offset is not feasible. Therefore, in order to add capacity, a third track on new roadbed with a 14-foot centerline offset

is recommended for this *Detroit Line* route segment. The passenger trains would co-mingle with freight trains at a maximum speed of 79-mph.

The line continues north on a new track and crosses through the CP Alexis interlocking at-grade. From Sylvania Avenue to Vienna Junction, a distance of about 6 miles, a separate, dedicated passenger track with 28-foot centerline offset is feasible. Train speeds could be increased to 110-mph; however, the cost estimates for this short track segment are based on 79-mph, Class 4 track.

The estimated cost to improve the 9.9-mile route between Toledo and Vienna Junction is $19.3 million or almost $2 million per mile. Exhibit 2-23 identifies the capital cost requirements by cost category.

Exhibit 2-23: Segment 3 – Toledo-Vienna Junction Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$12,563	65.10%
Turnouts	$0	0.00%
Curves	$0	0.00%
Signals	$0	0.00%
Stations/Facilities	$0	0.00%
Bridge-Under	$3,600	18.65%
Bridge-Over	$0	0.00%
Crossings	$3,135	16.25%
Segment Total	$19,298	100.00%
Placeholder	$0	0.00%
TOTAL	**$19,298**	**100.00%**
COST/MILE (9.9 Miles)	**$1,949**	

Segment 4: Vienna Junction-West Detroit

The Canadian National Railroad (CN) owns the Vienna Junction-West Detroit route segment. The 45.3-mile passenger line follows the CN alignment through Monroe and Wayne Counties. The line runs through, or near Monroe, Newport, Rockwood, Trenton, Wyandotte, Ecorse, River Rouge and the City of Detroit. The corridor is not currently used for passenger train service; however, in 1996, Amtrak discontinued the operation of an extension of the *Lake Cities* service from the NS *Detroit Line* from Detroit to Toledo. The line has 62 highway/railroad crossings.

Within this segment, the CN and NS *Detroit Line* rights-of-way adjoin each other, and the two lines run parallel. As part of the scope of work, this Study evaluated both the CN and NS route segments for use as a passenger rail alignment. As a result of this evaluation and for the purposes of this study, the Study Team used the CN trackage as the preferred alignment.

At Vienna Junction the passenger rail alignment shifts from the NS *Detroit Line* and connects to the CN at MP 4.92. The proposed improvement creates a dedicated, third track at a 28-foot centerline offset along the east side of the CN freight tracks. The alignment continues north to the *River Rouge Yard*. At *River Rouge Yard*, the passenger and freight trains will co-mingle over the same tracks. In order to accommodate heavy volumes of freight traffic, the proposed capacity enhancements include the reconfiguration of the tracks along with the construction of new tracks. A placeholder cost of $40 million is included for the River Rouge Yard improvements. A new lift bridge over the River Rouge is also included at a cost of $50 million.

The last 8.5 miles from River Rouge to Detroit is a heavily used industrial corridor with a high volume of freight traffic. The passenger trains would continue to co-mingle with freight trains through this segment and a placeholder for $20 million was assumed for capacity improvements. Track improvements and River Rouge capacity projects account for the majority of the costs for this segment. The total estimated cost to improve the 45.3-mile route for 79-mph passenger train speeds is $209 million or about $4.6 million per mile. The total estimated cost to improve the line for 110-mph operating speeds is $271.8 million or about $6 million per mile. Exhibit 2-24 identifies the cost for both the Modern and High-Speed Scenarios.

Exhibit 2-24: Segment 4 – Vienna Junction-West Detroit Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$75,563	36.14%	$85,096	31.31%	12.62%
Turnouts	$496	0.24%	$1,800	0.66%	262.90%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$8,286	3.96%	$17,206	6.33%	107.65%
Stations/Facilities	$1,000	0.48%	$1,000	0.37%	0.00%
Bridge-Under	$0	0.00%	$42,996	15.82%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$13,723	6.56%	$13,723	5.05%	0.00%
Segment Total	$99,068	47.39%	$161,821	59.53%	63.34%
Placeholder	$110,000	52.61%	$110,000	40.47%	0.00%
TOTAL	**$209,069**	**100.00%**	**$271,822**	**100.00%**	**30.02%**
COST/MILE (45.3 Miles)	**$4,615**		**$6,000**		

Segment 5: West Detroit-Detroit

The 5.3-mile West Detroit-Detroit route segment is part of a Conrail shared assets area. The Cleveland-Toledo-Detroit passenger rail corridor terminates at the proposed New Center station in Detroit. The route is common to the MWRRS Chicago-Detroit High-Speed Rail Corridor and is used by three existing Amtrak trains. Amtrak's *Wolverine*, the *Lake Cities* and the *Twilight Limited* operate daily between Chicago, Detroit and Pontiac.

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The proposed improvements would allow passenger trains to co-mingle with freight trains at a maximum speed of 60-mph. The capital cost estimates and infrastructure assessments were developed as part of the MWRRS and were taken from the Lansing-Detroit Study. The improvements include the rehabilitation of existing CN tracks from Vinewood to Woodward Avenue, new tracks and crossovers, and signal improvements. The $5.4 million capital cost for a train layover facility near the Detroit station has been included in the cost estimates.

Photo 16: At CN MP 4.8, Sterns Road, looking north toward Detroit. NS is on left, CN is on right

Photo 17: Looking north at CN MP 17.7, double track bridge over the River Raisin in Monroe

Photo 18: Looking north at CN MP 36.6, from West Road overpass

The total estimated cost to improve the 5.3-mile route segment for 60-mph train speeds is $21 million or $4 million per mile. Exhibit 2-25 identifies the capital improvements by cost category.

Exhibit 2-25: Segment 5 – West Detroit-Detroit Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$0	0.00%
Turnouts	$0	0.00%
Curves	$0	0.00%
Signals	$0	0.00%
Stations/Facilities	$6,044	28.31%
Bridge-Under	$0	0.00%
Bridge-Over	$0	0.00%
Crossings	$0	0.00%
Segment Total	$6,044	28.31%
Placeholder	$15,302	71.69%
TOTAL	**$21,346**	**100.00%**
COST/MILE (5.3 miles)	**$4,027**	

2.7.1 Cleveland-Toledo-Detroit via Wyandotte Capital Cost Summary

Exhibit 2-26 summarizes the total estimated costs for improving all five Cleveland-Toledo-Detroit via Wyandotte route segments. The cost to improve the corridor under the Modern Scenario is $710 million or $4.2 million per mile. The cost to improve the corridor under the High-Speed Scenario is $773 million or $4.6 million per mile.

Exhibit 2-26: Cleveland-Toledo-Detroit Capital Cost Summary

Segment Number	Segment Name	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost	Cost/ Mile	Capital Cost	Cost/ Mile
1	Cleveland-Berea	NS	79-mph	12.3	$123,776	$10,063	$123,776	$10,063
2	Berea-Toledo	NS	110-mph	95.8	$337,013	$3,518	$337,013	$3,518
SUB-TOTAL				**108.1**	**$460,789**	**$4,263**	**$460,789**	**$4,263**
3	Toledo-Vienna Jct.	NS	79-mph	9.9	$19,298	$1,949	$19,298	$1,949
4	Vienna Jct.-West Detroit	NS/CN	110-mph	45.3	$209,069	$4,615	$271,822	$6,000
5	West Detroit-Detroit	CR/Shared	60-mph	5.3	$21,346	$4,027	$21,346	$4,027
SUB-TOTAL				**60.5**	**$249,713**	**$4,127**	**$312,466**	**$5,165**
TOTAL				**168.6**	**$710,501**	**$4,214**	**$773,254**	**$4,586**

Exhibit 2-26 (continued): Cleveland-Toledo-Detroit via Wyandotte Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Corridor Cost	Cost (1000s)	% of Total Corridor Cost	
Trackwork	$271,879	38.27%	$281,412	36.39%	3.51%
Turnouts	$12,379	1.74%	$13,682	1.77%	10.53%
Curves	$711	0.10%	$711	0.09%	0.00%
Signals	$55,401	7.80%	$64,321	8.32%	16.10%
Stations/Facilities	$11,044	1.55%	$11,044	1.43%	0.00%
Bridge-Under	$22,668	3.19%	$65,664	8.49%	189.68%
Bridge-Over	$19,948	2.81%	$19,948	2.58%	0.00%
Crossings	$29,169	4.11%	$29,169	3.77%	0.00%
Segment Total	$423,199	59.56%	$485,951	62.85%	14.83%
Placeholder	$287,302	40.44%	$287,302	37.15%	0.00%
Total	**$710,501**	**100.00%**	**$773,254**	**100.00%**	**8.83%**

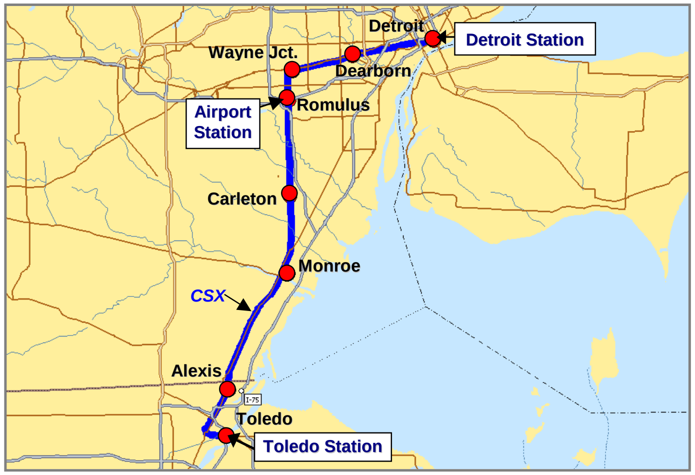
2.8 Cleveland-Toledo-Detroit via Detroit Metro Airport

The Cleveland-Toledo-Detroit via Detroit Metro Airport corridor is 176.2-miles in length and is approximately 7.6 miles longer than the alternative 168.5 mile Cleveland-Toledo-Detroit route via Wyandotte. Both corridors follow the same route between Cleveland and Toledo. The variation in the routes is found between Toledo and Detroit. This portion of the corridor was inspected in the field in March of 2002. The route was segmented as described in Exhibit 2-27 and is illustrated in Exhibit 2-28. Portions of the corridor serve Amtrak's daily *Capital Limited*, the *Lake Cities*, the *Three Rivers*, the *Wolverine* and the *Twilight Limited.*

Exhibit 2-27: Cleveland Detroit via Detroit Metro Airport

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speeds (mph)
1	Cleveland-Berea	NS	12.3	79	79
2	Berea-Toledo	NS	95.8	110	110
3	Toledo-Alexis	NS	7.3	60	60
4	Alexis-Wayne Junction	CSX	40.5	79	110
5	Wayne Junction-Detroit	NS	20.3	79	79

Exhibit 2-28: Cleveland-Detroit via Detroit Metro Airport



Segments 1 and 2: Cleveland-Berea and Berea-Toledo

The Cleveland-Berea and Berea-Toledo route segments are identical to Segments 1 and 2 of the Cleveland-Toledo-Detroit via the Wyandotte corridor. The description of the routes, the proposed infrastructure improvements and the estimated capital costs are described previously in Section 2.7.

Segment 3: Toledo-CP Alexis

Between Toledo and Alexis, this 7.3-mile route is identical to the Toledo-Vienna Junction route described above in the previous Section under Segment 3. The only difference between these two alternative route segments is that rather than heading northeast on the NS/CN, the Toledo-Alexis route connects the NS *Detroit Line* to the CSX line at CP Alexis, NS MP 51.

In order to make the connection between the two railroad rights-of-way, the proposed improvement for this route includes a new rail/rail grade separation. The proposed structure will grade separate the passenger rail alignment from the busy NS *Detroit Line*. The fly-over connects the passenger alignment on the east side of the NS *Detroit Line* to the track on the east side of the CSX mainline. The total estimated cost to improve the 7.3-mile route segment for 79-mph passenger train speeds is $30 million or about $4.1 million per mile. Exhibit 2-29 identifies segment cost categories.

Exhibit 2-29: Segment 3 – Toledo-Alexis Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$9,324	30.88%
Turnouts	$579	1.92%
Curves	$0	0.00%
Signals	$2,849	9.44%
Stations/Facilities	$0	0.00%
Bridge-Under	$14,600	48.36%
Bridge-Over	$0	0.00%
Crossings	$2,840	9.41%
Segment Total	$30,192	100.00%
Placeholder	$0	0.00%
TOTAL	**$30,192**	**100.00%**
COST/MILE (7.3 Miles)	**$4,135**	

Segment 4: Alexis-Wayne Junction

The CSX Railroad owns the Alexis-Wayne Junction route segment. The 40.5-mile route follows the CSX mainline through Monroe and Wayne Counties in Michigan. The route runs through, or near South Monroe, Monroe, Carleton, New Boston, Romulus and Wayne. It passes within one mile of the Detroit Metro Airport, and connects to the NS *Michigan Line* at Wayne Junction. The corridor is not currently used for passenger train service. There are 27 highway/railroad grade crossings.

The CSX double track mainline is 122-pound, welded rail. At the request of the Michigan Department of Transportation, two speed options were developed for this route segment: 79-mph; and 110-mph. The proposed improvements for 79-mph include two-thirds tie replacement and heavy resurfacing of both existing mainline tracks. The passenger and freight trains would co-mingle over the CSX entire route segment.

Under the 110-mph High-Speed Scenario, the passenger alignment would be constructed at a 28-foot centerline offset, and would separate the passenger and freight trains. The High-Speed Scenario is 76% more expensive than the Modern Scenario. The added cost is associated with the high-speed track, embankment, new signals and highway/railroad crossing safety improvements.

Photo 19: Looking north along CSX at Alexis Junction, CSX MP 57.7

Exhibit 2-30 highlights the costs for the Alexis-Wayne Junction segment for the three improvement options. The total estimated cost to improve the 40.5-mile route for 79-mph passenger train speeds is $68 million or about $1.7 million per mile. The total estimated cost to improve the line for 110-mph is $121.5 million or $3 million per mile.

Exhibit 2-30: Segment 4 – Alexis-Wayne Junction Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario from the Modern Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$49,919	73.16%	$77,566	63.84%	55.38%
Turnouts	$496	0.73%	$2,379	1.96%	379.64%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$12,150	17.81%	$16,899	13.91%	39.09%
Stations/Facilities	$500	0.73%	$500	0.41%	0.00%
Bridge-Under	$0	0.00%	$11,405	9.39%	-
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$5,165	7.57%	$12,760	10.50%	147.05%
Segment Total	$68,230	100.00%	$121,509	100.00%	78.09%
Placeholder	$0	0.00%	$0	0.00%	0.00%
TOTAL	**$68,230**	**100.00%**	**$121,509**	**100.00%**	**78.09%**
Cost/Mi (40.5 Miles)	**$1,685**		**$3,000**		

Segment 5: Wayne Junction-Detroit

The 20.3-mile Wayne Junction-Detroit route is part of the NS *Michigan Line* and is common to the Chicago-Detroit MWRRS High-Speed Rail Corridor; therefore, from CP Wayne east, Ohio Hub trains and MWRRS trains would share the tracks. Cleveland-Toledo-Detroit passenger trains would terminate at the proposed New Center station in Detroit. Amtrak's *Wolverine,* the *Lake Cities* and the *Twilight Limited* currently operate over the route between Chicago, Detroit and Pontiac. There are 11 highway/railroad grade crossings along the route.

Freight and passenger trains would co-mingle over this territory. The proposed improvements from Wayne Junction to West Detroit include two-thirds tie replacement and relay with 136-pound welded rail. Improvements from West Detroit to Beaubien include new track and rehabilitation of the CN tracks from Vinewood to Woodward Avenue, as well as new crossovers and signal improvements. The total estimated cost to improve the line for a top speed of 110-mph is $43.1 million or $2.1 million per mile. Exhibit 2-31 illustrates the costs for this route segment.

Exhibit 2-31: Segment 5 – Wayne Junction-Detroit Costs

Cost Category	Modern and High-Speed Scenarios	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$11,969	27.73%
Turnouts	$0	0.00%
Curves	$0	0.00%
Signals	$2,955	6.85%
Stations/Facilities	$8,536	19.77%
Bridge-Under	$3,054	7.07%
Bridge-Over	$0	0.00%
Crossings	$1,351	3.13%
Segment Total	$27,865	64.55%
Placeholder	$15,302	35.45%
TOTAL	**$43,167**	**100.00%**
COST/MILE (20.3 Miles)	**$2,126**	

2.8.1 Cleveland-Toledo-Detroit via Detroit Metro Airport Capital Cost Summary

Exhibit 2-32 summarizes the total estimated costs for improving all five Cleveland-Toledo-Detroit via Detroit Metro Airport route segments. The cost to improve the corridor under the Modern Scenario is $602 million or $3.4 million per mile. The cost to improve the corridor under the High-Speed Scenario is $655 million or $3.7 million per mile.

Exhibit 2-32: Cleveland-Toledo-Detroit via Detroit Metro Airport Capital Cost Summary

Segment Number	Route Segment	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost	Cost/ Mile	Capital Cost	Cost/ Mile
1	Cleveland-Berea	NS	79-mph	12.3	$123,776	$10,063	$123,776	$10,063
2	Berea-Toledo	NS	110-mph	95.8	$337,013	$3,518	$337,013	$3,518
SUB-TOTAL				**108.1**	**$460,789**	**$4,263**	**$460,789**	**$4,263**
3	Toledo-Alexis	NS	79-mph	7.3	$30,192	$4,135	$30,192	$4,135
4	Alexis-Wayne Junction	CSX	110-mph	40.5	$68,230	$1,685	$121,509	$3,000
5	Wayne Jct.-Detroit	NS	110-mph	20.3	$43,167	$2,126	$43,167	$2,126
SUB-TOTAL				**68.1**	**$141,589**	**$2,079**	**$194,868**	**$2,861**
TOTAL				**176.2**	**$602,378**	**$3,419**	**$655,657**	**$3,721**

Exhibit 2-32 (continued): Cleveland-Toledo-Detroit via Detroit Metro Airport Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario from the Modern Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$254,965	42.33%	$282,612	43.10%	10.84%
Turnouts	$12,958	2.15%	$14,841	2.26%	14.53%
Curves	$711	0.12%	$711	0.11%	0.00%
Signals	$65,069	10.80%	$69,818	10.65%	7.30%
Stations/Facilities	$13,036	2.16%	$13,036	1.99%	0.00%
Bridge-Under	$36,722	6.10%	$48,127	7.34%	31.06%
Bridge-Over	$19,948	3.31%	$19,948	3.04%	0.00%
Crossings	$21,667	3.60%	$29,262	4.46%	35.05%
Segment Total	$425,076	70.57%	$478,355	72.96%	12.53%
Placeholder	$177,302	29.43%	$177,302	27.04%	0.00%
TOTAL	**$602,378**	**100.00%**	**$655,657**	**100.00%**	**8.84%**

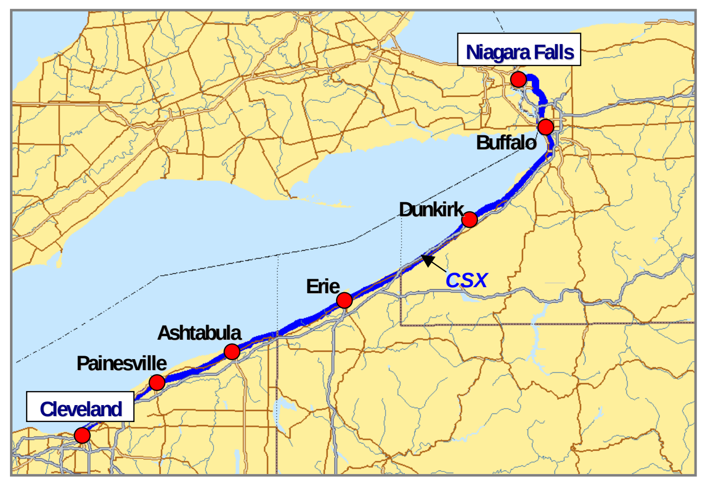
2.9 Cleveland-Buffalo-Niagara Falls-Toronto

The Cleveland-Buffalo-Toronto corridor is 289.8-miles in length. The distance between Cleveland and Niagara Falls is 206.8-miles; and the distance between Niagara Falls and Toronto is 83-miles. About 30 percent of the corridor length is in southern Ontario, Canada. However, the Study has focused on the portion of the route in the United States. The scope of work did not include a field review or an engineering assessment for the Canadian side of the corridor. The Cleveland-Niagara Falls corridor was inspected in September of 2002. The route was segmented as described in Exhibit 2-33 and is illustrated in Exhibit 2-34.

Exhibit 2-33: Cleveland-Buffalo-Niagara Falls-Toronto

Segment Number	Segment Name	Host Carrier	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speed (mph)
1	Cleveland-Erie	CSX	91.0	79	110
2	Erie-Buffalo	CSX	90.75	79	110
3	Buffalo-Niagara Falls	CSX	25.11	79	79
4	Niagara Falls-Toronto	CN	83.0	95	95

Exhibit 2-34: Cleveland - Niagara Falls



Two parallel railroads serve the Cleveland-Buffalo corridor; however, only the CSX route was examined. The scope of the Study included only the analysis of the CSX Chicago Line. While a cursory review of the parallel NS Buffalo-Conneaut-Euclid Line was conducted in the field, the engineering assessment and capital costs were not developed. The field review of the parallel NS line found that this route might offer advantages over the CSX route. As a result, the Study recommends that a full engineering assessment be conducted for the NS Buffalo-Conneaut-Euclid Line. This will allow for an alternative analysis of the two potential routes.

Amtrak currently operates the daily *Lake Shore Limited* (New York/Boston-Albany-Chicago) over the CSX *Chicago Line.* Amtrak's *Maple Leaf* is operated as part of the New York Empire service and runs daily between New York, Albany, Buffalo, Niagara Falls and Toronto.

Segment 1: Cleveland-Erie

The portion of the heavily used CSX *Chicago Line* between Cleveland and Erie is 91-miles long. In Ohio, the corridor is located in Cuyahoga, Lake and Ashtabula Counties and runs though the City of Cleveland, Euclid, Wickliffe, Willowick, East Lake, Willoughby, Mentor, Painsville, Perry, Madison, Beneva, Ashtabula, North Kingsville, and Conneaut. In Pennsylvania, the corridor is located in Erie County and passes through North Springfield, Lake City, Fairview, Vernodale and the City of Erie. The line runs adjacent to the southern boundary of the Erie International Airport and has 75 highway/railroad crossings. Amtrak operates the *Lake Shore Limited* over the line.

From the existing Cleveland Amtrak Station through the CSX *Collinwood Yard*, the passenger trains would co-mingle with CSX freight trains. Two existing mainline tracks and a long siding on the north side run east through the yard. A mainline fueling facility is located at the east end of the yard, near 200th Street. A new fourth track would add capacity and provide a bypass around the fueling facility. A $20 million placeholder was included for track improvements and capacity enhancements through the CSX *Collinwood Yard*.

Photo 24: Looking east along CSX tracks at *Collinwood Yard* from East 152nd Street overpass, CSX MP 174.1

Photo 25: Looking east along CSX tracks at 305th Street, CSX MP 166.78

Photo 26: Looking east along CSX at Rte 306, CSX MP 162

The new 79-mph track would continue through *Collinwood Yard* and end at MP 162. From here, the right-of-way widens and allows for the construction of a new high-speed track with a 28-foot centerline offset. The new track would allow for 110-mph passenger train speeds between MP 162 to the west end of the *Painesville Yard* at MP 156.

At MP 156, two existing mainline tracks and two sidings continue through the *Painesville Yard.* Several yard leads serve industries in the Painesville area. Through *Painesville Yard*, the passenger service would co-mingle with CSX freight at 79-mph. New interlockings and signals will be required at junctions where the passenger track connects to the mainline freight tracks for co-mingled operations.

Photo 27: Looking east along CSX at Newell Street, CSX MP 154.68

Photo 28: Looking east along CSX at Davis Road, CSX MP 146.1

East of Painesville, a dedicated passenger track with a 28-foot centerline offset would be constructed on the north side of the CSX corridor. The 110-mph passenger track would extend east to Ashtabula to MP 128.25.

In Ashtabula, the CSX Chicago Line crosses the NS Youngstown Line at grade at MP 127.9. A fly-over is proposed to grade separate the passenger track from the NS/CSX diamond. As it flies over the existing freight tracks, the passenger alignment would move from the north side to the south side of the NS Chicago Line. By switching from the north to the south side of the mainline, the passenger alignment will avoid a series of industrial spurs. A highway bridge, located approximately 1000-feet west of the diamond, will require some modifications to accommodate the vertical curve of the flyover. The new high-speed passenger track would continue east of Ashtabula to the west side of Erie at Paterno Junction at MP 90.7.

An $18 million placeholder was added for the NS/CSX flyover; $20 million was added for track and signal modifications; and $2 million was added for a new interlocking. The total estimated cost to improve the 91-mile route segment for 79-mph passenger train speeds is $269 million or about $2.9 million per mile (Exhibit 2-35). The total estimated cost to improve the line for 110-mph operating speeds is $346 million or about $3.8 million per mile. The 110-mph improvement costs are 28 percent more expensive than the improvements for 79-mph.

Exhibit 2-35: Segment 1 – Cleveland-Erie Capital Costs

Cost Category	Modern Scenario		High-Speed Scenario		%Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$171,887	63.92%	$171,184	49.54%	-0.41%
Turnouts	$3,887	1.45%	$6,495	1.88%	67.10%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$10,745	4.00%	$30,544	8.84%	184.26%
Stations/Facilities	$1,150	0.43%	$2,000	0.58%	73.91%
Bridge-Under	$12,000	4.46%	$48,441	14.02%	303.68%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$9,230	3.43%	$26,913	7.79%	191.58%
Segment Total	$208,899	77.69%	$285,577	82.64%	36.71%
Placeholder	$60,000	22.31%	$60,000	17.36%	0.00%
TOTAL	**$268,899**	**100.00%**	**$345,577**	**100.00%**	**28.52%**
COST/MILE (91 Miles)	**$2,954**		**$3,797**		

Photo 29: Looking west at CSX MP 127.9 near the NS Youngstown Line diamond

Segment 2: Erie-Buffalo

The Erie-Buffalo route segment continues to follow the CSX owned *Chicago Line*. It is 90.75 miles long. In Pennsylvania, the corridor is located in Erie County and passes through the City of Erie, Wesleyville and Harborcreek. In New York, the line is located in Chautauqua and Erie Counties and passes through the City of Erie, North East, Westfield, Dunkirk, Silver Creek, Irving, Angola, Wanakah, Locksley Park, Blasdell, Lackawanna and the City of Buffalo.

The route segment has 83 highway/railroad crossings. Amtrak operates the *Lake Shore Limited* over the line.

Approaching Erie from the west, the right-of-way becomes constricted and a third track at a 28-foot centerline offset is not feasible. At MP 90.7, the NS *Buffalo-Conneaut-Euclid Line* is adjacent to the CSX *Chicago Line*, and runs on the south side of the CSX mainline. The two railroads run parallel through the City of Erie from Paterno Junction (MP 90.7) to approximately MP 86, where the NS separates back onto its own corridor. Through Erie, the passenger trains would co-mingle with freight traffic at a 79-mph maximum speed from Paterno Junction through Erie and in the vicinity of the General Electric plant, from MP 90.7 to MP 83. The tracks and signals at MP 85 would need to be reconfigured.

Photo 30: Looking east along CSX at Whitney Road in Conneaut CSX MP 115.37

Photo 31: Paterno Junction, CSX MP 90.7 looking east along NS track connecting to CSX corridor

Photo 32: Erie Station, looking east

Photo 33: CSX CP 85 near East Avenue looking east

East of Erie, passenger train speeds would again increase to 110-mph from MP 83 to MP 75 near the City of Northeast. Constraints decrease the speed to 79-mph through the City of Northeast from MP 75 to MP 71.5.

East of the City of Northeast, the right-of-way widens to allow speeds of 110-mph from MP 71.5 to MP 58.2 in Westfield. At Westfield, constraints once again decrease the speed to 79-mph from MP 58.2 to MP 56.

Photo 34: CSX MP 84 at Franklin Ave., looking east. The tracks on the left are the GE plant testing tracks also used to connect to the CSX mainline.

Photo 35: At Northeast station looking east along CSX tracks, CSX MP 72

Photo 36: Looking east along CSX tracks at State St. in Ripley, CSX MP 65.3

Photo 37: Looking east along CSX from SR 394 overpass, CSX MP 57.54

East of Westfield, 110-mph train speeds are possible from MP 56 to MP 42.7 at Temple Road in Dunkirk. From Temple Road, the passenger trains would co-mingle with freight trains through Dunkirk to MP 37.

Photo 38: Looking east along CSX tracks at Middle Road crossing, CSX MP 39.27

Photo 39: Looking south over the Buffalo River Bridge

Beyond Dunkirk, the right-of-way widens to allow 110-mph operations from MP 37 to MP 16. From MP 16 to the Buffalo Exchange Street Station, the passenger trains would co-mingle with freight at a maximum speed of 79-mph. The diamond at MP 6, near Buffalo Exchange Street Station and would be reconfigured, but would restrict train speeds to 45-mph.

A $25 million placeholder was added for the reconfiguration of the signals at MP 85; $2 million was added for a new interlocking; and $500 thousand was added for the reconfiguration of the track at Exchange Street Station. The $5.5 million capital cost for a train layover facility near the Buffalo station has been included in the cost estimates. The total estimated cost to improve the 90.7-mile route for 79-mph passenger train speeds is $246 million or about $2.7 million per mile (Exhibit 2-36). The total estimated cost to improve the line for 110-mph is $367 million or about $4 million per mile. The additional cost of the High-Speed Scenario is attributed to trackwork, signals, bridge reconstruction and highway/railroad crossing safety improvements. The High-Speed Scenario is almost 50% more costly than the Modern Scenario.

Exhibit 2-36: Segment 2 – Erie-Buffalo Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$171,490	69.70%	$170,879	46.61%	-0.36%
Turnouts	$2,343	0.95%	$4,951	1.35%	111.31%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$6,721	2.73%	$26,471	7.22%	293.86%
Stations/Facilities	$6,544	2.66%	$6,544	1.78%	0.00%
Bridge-Under	$20,098	8.17%	$99,853	27.24%	396.83%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$11,360	4.62%	$30,416	8.30%	167.75%
Segment Total	$218,556	88.82%	$339,114	92.50%	55.16%
Placeholder	$27,500	11.18%	$27,500	7.50%	0.00%
TOTAL	**$246,056**	**100.00%**	**$366,613**	**100.00%**	**49.00%**
COST/MILE (90.75 Miles)	**$2,711**		**$4,040**		

Segment 3: Buffalo-Niagara Falls

The Buffalo-Niagara Falls route segment is owned by CSX. The 25.1-mile long route is located in Erie and Niagara Counties, and passes through or near the City of Buffalo, Kenmore, Tonawanda, North Tonawanda and the City of Niagara Falls. The line runs along the east and north sides of the Niagara Falls International Airport. The route segment has 10 highway/railroad crossings. Amtrak operates the *Maple Leaf* (Washington-New York-Albany-Buffalo-Niagara Falls-Toronto) over the line.

Photo 40: Looking west along CSX at Buffalo Exchange Street Station

Photo 41: Looking north at CSX track at Scajaquada Creek, CSX MP 4.2

Photo 42: Looking north along CSX track at Jagow Road, CSX MP 16.3

Photo 43: Looking east along CSX at the existing Amtrak Niagara Station

The existing CSX single-track line runs from the Buffalo Exchange Street Station to Niagara Falls. Passenger trains would co-mingle with freight traffic over the entire segment and would operate up to 79-mph. The proposed improvements include replacement of 50 percent of the ties and re-laying the track with 136-pound welded rail. All grade crossing surfaces would also be upgraded with pre-cast panels. One new interlocking is needed for a cost of $2 million. The total estimated cost to improve the 25.1-mile route for 79-mph train speeds is $30.4 million or $1.2 million per mile (Exhibit 2-37).

Exhibit 2-37: Segment 3 – Buffalo-Niagara Falls Costs

Cost Category	Modern and High-Speed Scenario	
	Cost (1000s)	% of Total Segment Cost
Trackwork	$25,517	83.90%
Turnouts	$248	0.82%
Curves	$0	0.00%
Signals	$800	2.63%
Stations/Facilities	$1,000	3.29%
Bridge-Under	$0	0.00%
Bridge-Over	$0	0.00%
Crossings	$850	2.79%
Segment Total	$28,415	93.42%
Placeholder	$2,000	6.58%
TOTAL	**$30,415**	**100.00%**
COST/MILE (25.11 Miles)	**$1,211**	

Photo 44: Looking west over Niagara River Bridge to Canada

Segment 4: Niagara Falls-Toronto

The Niagara Falls-Toronto route segment is owned by the Canadian National and is 83-miles long. Extending around the western end of Lake Ontario, the Niagara Falls-Toronto route segment continues to Toronto. An engineering assessment of this portion of the corridor was not included in the scope of the Ohio Hub Study; therefore, no field inspection of this segment was performed. A placeholder cost of $50 million was included in the estimates for miscellaneous improvements, in addition to costs for stations. It was assumed that the existing Amtrak and VIA Rail train schedules and train running times would be maintained over this portion of the corridor. As project planning and development moves forward, capacity and line improvements will need to be more fully evaluated. The total placeholder cost for improving this line is $58.544 million or about $705 thousand per mile.

2.9.1 Cleveland-Buffalo-Niagara Falls-Toronto Capital Cost Summary

Exhibit 2-38 summarizes the capital improvement costs by cost category for all five Cleveland-Buffalo-Niagara Falls-Toronto route segments.

Exhibit 2-38: Cleveland-Buffalo-Niagara Falls-Toronto Capital Cost Summary

Seg. No.	Route Segment	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost (1000s)	Cost/ Mile	Capital Cost (1000s)	Cost/ Mile
1	Cleveland-Erie	CSX	110-mph	91.0	$268,899	$2,954	$345,577	$3,797
2	Erie-Buffalo	CSX	110-mph	90.8	$246,056	$2,711	$366,613	$4,040
3	Buffalo-Niagara Falls	CSX	79-mph	25.1	$30,415	$1,212	$30,415	$1,212
SUB-TOTAL				**206.9**	**$529,243**	**$2,559**	**$723,632**	**$3,498**
4	Niagara Falls-Toronto	CN	95-mph	83.0	$58,544	$705	$58,544	$705
TOTAL				**289.9**	**$603,915**	**$2,083**	**$801,149**	**$2,763**

Exhibit 2-38 (continued): Cleveland-Buffalo-Niagara Falls-Toronto Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$368,895	61.08%	$367,580	45.88%	-0.36%
Turnouts	$6,478	1.07%	$11,694	1.46%	80.52%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$18,266	3.02%	$57,815	7.22%	216.52%
Stations/Facilities	$17,238	2.85%	$18,088	2.26%	4.93%
Bridge-Under	$32,098	5.31%	$148,294	18.51%	362.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$21,440	3.55%	$58,179	7.26%	171.36%
Segment Total	$464,415	76.90%	$661,650	82.59%	42.47%
Placeholder	$139,500	23.10%	$139,500	17.41%	0.00%
TOTAL	**$603,915**	**100.00%**	**$801,149**	**100.00%**	**32.66%**

2.10 Cleveland-Columbus-Cincinnati (3-C Corridor)

The Cleveland-Columbus-Cincinnati Corridor was segmented as illustrated in Exhibit 2-39, and is illustrated in Exhibit 2-40.

Exhibit 2-39: Cleveland-Columbus-Cincinnati

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speed (mph)	High-Speed Scenario Maximum Train Speed (mph)
1	Cleveland-Berea	NS	12.3	79	79
2	Berea-Columbus	CSX	121.0	79	110
3	Columbus-Sharonville	NS	108.0	79	110
4	Sharonville-Cincinnati	CSX	17.0	79	110

Exhibit 2-40: Cleveland-Columbus-Cincinnati

The scope of work for the Ohio Hub Study assumed that the findings from an earlier Cleveland-Columbus-Cincinnati (3-C) feasibility study would be incorporated into this analysis. The earlier study, conducted in 2000 with a final report issued in July 2001, describes the infrastructure improvements that were considered at that time. The capital improvements contemplated for the Ohio Hub Study incorporated the 3-C study findings with the exception of the 28-foot centerline offset for a high-speed 110 mph track. The 3-C corridor study did not incorporate this required offset and instead used a 14-foot centerline as the criteria for high-speed operations on NS and CSX rights-of-way.

For the purposes of this study, the original 3-C capital cost estimates were adjusted for a 90-mph train operation. The capital cost for 90-mph operation was adjusted downward for 79-mph; and was adjusted upward to account for the additional costs associated with a 28-foot offset for 110-mph operations. The cost for the 3-C 90-mph operation, along with the derived costs for 79-mph and 110-mph operations are illustrated in Section 2.4.1. Ultimately, it will be necessary to re-examine the 3-C corridor in order to more accurately identify the required capacity and infrastructure improvements, and to determine the financial impacts that the 28-foot centerline offset will have on the development of passenger rail service.

In order to estimate the capital costs for 79-mph and 110-mph operations, the Ohio Hub Study made two adjustments to the capital cost estimates for the 90-mph operation:

- Based on empirical evidence of the typical cost relationship between 79-mph and 110-mph operations in other corridors, it was estimated that the 3-C capital cost for the 79-mph Modern Scenario would be $723 million or about $2.8 million per mile.
- The original 3-C Study proposed adding new track capacity along 108 miles of the 258-mile corridor. The Ohio Hub Study suggests adding a new track along the entire length of the corridor, 158 miles of which would be high-speed with a centerline offset of 28-feet. For the High-Speed Scenario, this increased the estimated cost for 3-C infrastructure to $1.166 billion, or about $4.5 million per mile.
- Additionally, this study allows for sharing the cost of the Cleveland-Berea line segment with the Detroit service, which reduces the cost of the 3-C improvement. Capital cost sharing for the overlapping route segments is described in the next Section of the report.

2.10.1 Cleveland-Columbus-Cincinnati Capital Cost Summary

Exhibit 2-41 provides a breakdown of the 3-C corridor capital costs by cost category for each route segment for 90-mph speed improvements.

Exhibit 2-41: Cleveland-Columbus-Cincinnati
Capital Cost Summary
(Costs for Modern and High-Speed Scenarios Derived from 90-mph Engineering Assessment)

Seg. No.	Route Segment	Railroad	Max. Design Speed (mph)	Miles	Modern Scenario		90-mph Option		High-Speed Scenario	
					Capital Cost (1000s)	Cost/ Mile	Capital Cost (1000s)	Cost/ Mile	Capital Cost (1000s)	Cost/ Mile
1	Cleveland - Berea	NS	79	12.3	$123,776	$10,063	$123,776	$10,063	$123,776	$10,063
2	Berea - Cincinnati	NS/CSX	110	246.0	$599,109	$2,435	$632,136	$2,570	$1,042,712	$4,239
SUB-TOTAL				**258.3**	**$722,885**	**$2,799**	**$755,912**	**$2,915**	**$1,166,488**	**$4,516**

Exhibit 2-41 (continued): Cleveland-Columbus-Cincinnati
Corridor Improvements by Cost Category
90-mph Option Only
All Segments

Cost Category	Segment 1 Cleveland-Berea 12.3 miles		Segment 2 Berea-Columbus 121 miles		Segment 3 Columbus-Sharonville 108 miles		Segment 4 Sharonville-Cincinnati 17 miles		Corridor Cost 258.3 miles	
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Corridor Cost
Trackwork	$32,842	26.53%	$161,095	55.35%	$136,209	53.08%	$14,826	17.55%	$344,972	45.64%
Turnouts	$4,454	3.60%	$1,800	0.62%	$1,800	0.70%	$0	0.00%	$8,054	1.07%
Curves	$0	0.00%	$5,330	1.83%	$5,330	2.08%	$0	0.00%	$10,660	1.41%
Signals	$12,080	9.76%	$38,764	13.32%	$27,295	10.64%	$3,111	3.68%	$81,250	10.75%
Stations/Facilities	$2,000	1.62%	$8,544	2.94%	$4,000	1.56%	$7,544	8.93%	$22,088	2.92%
Bridge-Under	$0	0.00%	$10,476	3.60%	$21,700	8.46%	$55,409	65.60%	$87,585	11.59%
Bridge-Over	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%
Crossings	$400	0.32%	$65,049	22.35%	$60,278	23.49%	$576	0.68%	$126,303	16.71%
Segment Total	$51,776	41.83%	$291,058	100.00%	$256,612	100.00%	$81,466	96.45%	$680,912	90.08%
Placeholder	$72,000	58.17%	$0	0.00%	$0	0.00%	$3,000	3.55%	$75,000	9.92%
TOTAL	**$123,776**	**100%**	**$291,058**	**100%**	**$256,612**	**100%**	**$84,466**	**100%**	**$755,912**	**100%**
COST/MILE	**$10,063**		**$2,405**		**$2,376**		**$4,969**		**$2,926**	

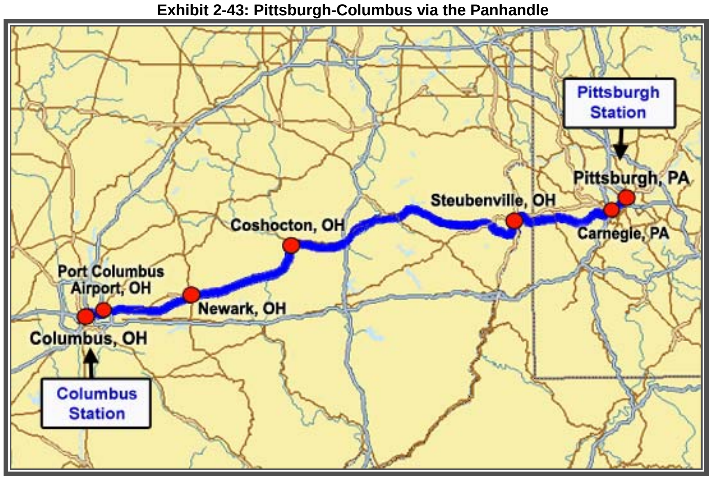
2.11 Pittsburgh to Columbus via the Panhandle

The Pittsburgh to Columbus corridor via the Panhandle is approximately 193.8-miles in length. The route segments are delineated in Exhibit 2-42 and are illustrated in Exhibit 2-43.

Exhibit 2-42: Pittsburgh-Columbus via the Panhandle Route Segments

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speeds (mph)
1	Pittsburgh to CP Esplen	NS	4.0	30	30
2	CP Esplen to Walker's Mill	POC	9.1	60	60
3	Walker's Mill to Mingo Jct	NS/ Abd'n	38.5	79	79
4	Mingo Jct to Newark	OCR	108.3	79	79 / 110
5	Newark to Columbus	OCR	33.9	79	110

Exhibit 2-43: Pittsburgh-Columbus via the Panhandle



Segment 1: Pittsburgh to CP Esplen

The proposed Pittsburgh to Columbus route originates at Pittsburgh's Penn Station, shown in Photos 45 and 46, which it would share with Amtrak long distance, Ohio Hub Cleveland-Pittsburgh, and any future Keystone corridor services that may be developed by the State of Pennsylania to link Harrisburg and points east. From Penn Station, the route would follow the NS Fort Wayne line west to the CP Penn interlocking, where trains would diverge to cross the Ohio Connecting Bridge from CP Isle to CP Esplen on the south side of the Ohio River. The distance from Penn Station to CP Esplen is about four miles. Exhibit 2-44 shows the costs for upgrading this segment, which consist primarily of placeholder costs for upgrading the capacity of the Ohio River bridge crossing.

Exhibit 2-44: Segment 1 – Pittsburgh to CP Esplen Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$0	0.00%	$0	0.00%	0.00%
Turnouts	$0	0.00%	$0	0.00%	0.00%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$0	0.00%	$0	0.00%	0.00%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$0	0.00%	$0	0.00%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$0	0.00%	$0	0.00%	0.00%
Segment Total	$0	0.00%	$0	0.00%	0.00%
Placeholders	$50,000	100.00%	$50,000	100.00%	0.00%
TOTAL	**$50,000**	**100.00%**	**$50,000**	**100.00%**	0.00%
Cost/Mile (4.0 Miles)	**$12,500**		**$12,500**		

Photo 45: Pittsburgh's Historic "Penn" Station

Photo 46: Pittsburgh Train Station Platform View

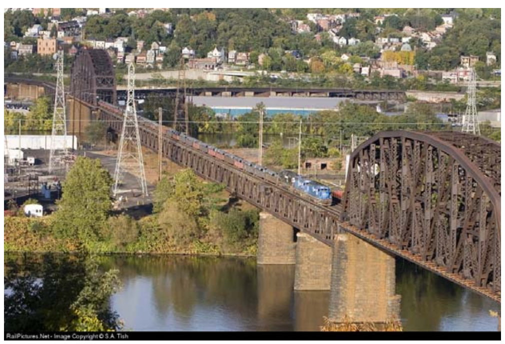


Photo 47: Ohio Connecting Bridge at Brunot Island. © Scott Tish, Used with Permission

Photo 47 shows Norfolk Southern's Mon Line OC Bridge. This two track bridge crosses the Ohio River at Brunot Island. In previous years, a west leg wye connection existed at CP Esplen on the south end of the bridge, allowing the Pennsylvania Railroad to access Scully Yard. This connection was removed, but could be restored as the right of way still exists.

There is a capacity concern, however, since existing freight train volumes on the bridge are reported to be about 50 per day and forecast to increase with additional coal trains serving a new power plant at Shelocta. The Mon Line segment from the double-tracked OC Bridge upstream to the single-tracked Port Perry bridge has become part of NS's double-stack route, which bypasses clearance restrictions on the NS main line through Pittsburgh Penn Station. If a new bridge is needed, it would impose a significant capital cost as the distance between the north and south shorelines is approximately 3500 ft and the waterway is navigable, requiring long spans and

sufficient elevation or a movable span to allow barge traffic. An alternative to the new bridge may be to fund clearance and capacity improvements on the NS main line through Penn Station, or on an alternative route via Kiski Junction. In order to provide reliable passenger service between Columbus and Pittsburgh, a $50 million placeholder has been included in the cost estimate for a new Ohio River bridge.

Segment 2: CP Esplen to Walker's Mill

The engineering inspection covered multiple possible routes or combinations of routes in the Pittsburgh terminal area, including the historic Pennsylvania Railroad (PRR) Panhandle (former Conrail Pittsburgh to Columbus main line), Pittsburgh and Ohio Central Railroad (PRR Weirton Secondary Track and Pittsburgh Industrial Railroad) and Wheeling and Lake Erie (WE) alternatives.

A key observation is that the original PRR Panhandle bridge across the Ohio River has been utilized as part of Pittsburgh's Light Rail system; farther west, the abandoned rail alignment has been converted into a bus rapid transit system (BRT) from Carnegie to the Ohio River. As the BRT system represents a multi-hundred million dollar investment with a typical design life in excess of fifty years, this study has identified an alternative route from Pittsburgh to Carnegie, anticipating that the BRT system will remain in service. Fortunately, the existing Pittsburgh and Ohio Central Railroad right of way via Scully yard could be available for high speed rail use, subject to agreement with the railroad.

The Pittsburgh and Ohio Central Railroad is a subsidiary of the Ohio Central Railroad, headquartered in Coshocton, OH. In a brief meeting on November 8, 2005, the railroad management expressed some interest in using the railroad track and right of way for future high speed passenger service, recognizing that such service would bring infrastructure improvements and benefits to the railroad. Exhibit 2-45 shows the cost of recommended improvements to this segment, which include:

Esplen POC MP 5.3 to Carnegie POC MP 11.8

- Install CTC signaling
- Install CWT grade crossing warning systems
- Upgrade track to Class 3, no new tracks required

Carnegie POC MP 11.8 / PRR MP 8.4 to Walker's Mill PRR MP 11.0

- Install CTC signaling
- Install CWT grade crossing warning systems
- Build/Upgrade class 4 passing siding
- Upgrade track to class 4

Exhibit 2-45: Segment 2 – CP Esplen to Walker's Mill Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$4,737	53.77%	$4,737	53.28%	0.00%
Turnouts	$248	2.81%	$248	2.79%	0.00%
Curves	$141	1.60%	$141	1.59%	0.00%
Signals	$2,314	26.27%	$2,314	26.03%	0.00%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$0	0.00%	$0	0.00%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$1,370	15.55%	$1,450	16.31%	5.84%
Segment Total	$8,810	100.00%	$8,890	100.00%	0.91%
Placeholders	$0	0.00%	$0	0.00%	0.00%
TOTAL	**$8,810**	**100.00%**	**$8,890**	**100.00%**	0.91%
Cost/Mile (9.1 Miles)	**$968**	-	**$977**		

Photo 48: POC Railroad, Duff's Junction east of Scully Yard looking East

The Pittsburgh and Ohio Central Railroad (POC) owns the former Pennsylvania Industrial Railroad and PRR Weirton Secondary track between Esplen and Carnegie. The alignment generally follows Chartiers Creek to Carnegie. As shown in Photos 48 and 49, the tracks were observed as continuous welded rail of heavy section on good ties and ballast. The tracks split with the south branch curving to Esplen. A double track alignment exists between Esplen and

Duff's Junction and is currently in use allowing traffic to operate from Scully Yard to the CSXT/NS (former B&O/Conrail) tracks on the south side of the Ohio and Monongahela River.

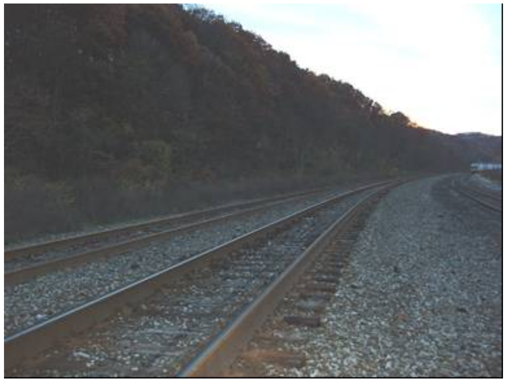


Photo 49: POC Railroad double track south (railroad west) of Duff's Junction

Photo 50: POC Railroad (former PRR Panhandle) at Carnegie, with adjacent PAT busway

As shown in Photo 50, the Port Authority Transit (PAT) busway runs adjacent to the railroad through Carnegie on the north side of the track. A pedestrian crossing with flashers is provided to allow access from West Main St. in Carnegie. The railroad crosses the busway at grade just east of the station.

Photo 51: POC at Boyd Street in Carnegie, PA

As shown in Photo 51, the tracks were observed as continuous welded rail of heavy section (136 lb rolled in 1994) on good ties and ballast. The PAT busway commuter parking lies just north of the track. Sufficient space exists to construct a second track on the north side, allowing passenger or freight trains to pass. Photo 52 shows the POC Railroad (ex-PRR Panhandle line) between Carnegie and Walker's Mill. This siding could be extended between Carnegie and Walker's Mill. Photo 53 shows the Western extent of the POC Railroad at Walkers Mill POC MP 14.4. The former PRR grade included two tracks.

Photo 52: POC between Carnegie and Walker's Mill

Photo 53: West end of POC track Walker's Mill MP 14.4

Photos 54 through 58 show the alternative (rejected) route segments consisting of the original route of the Pennsylvania Railroad Panhandle Division into downtown Pittsburgh. Part of this route has been converted into the Pittsburgh Port Authority West Busway from Downtown Pittsburgh to Carnegie Station. The Port Authority has constructed a Bus Rapid Transit system on the original Panhandle grade between the Ohio River and Carnegie. As can be seen in Photo 54, this property is no longer available for high speed passenger rail service, as the busway has been constructed on the centerline of a nominal 100 ft alignment.

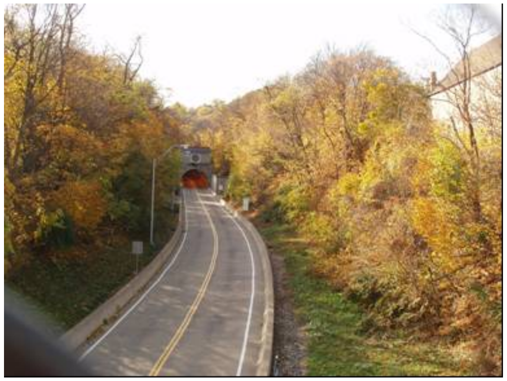


Photo 54: PAT West Busway, Corliss Tunnel portal at PRR MP 4.7

Photo 55: PAT West Busway, Sheridan Station east of the Corliss Tunnel

As shown in Photo 55, typical busway passenger stations are constructed with a two lane configuration allowing express buses to pass while local buses are stopping. Pedestrian platforms and pedestrian access walkways occupy the right of way to provide access to the street and community. Photo 56 shows that the busway facilities employ virtually the entire original right of way, making construction of a new high speed rail system there very difficult requiring significant changes to the existing BRT system.

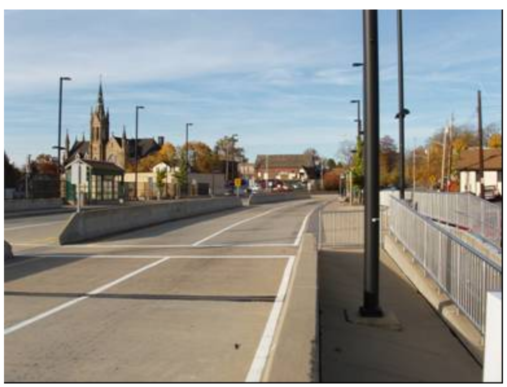


Photo 56: PAT West Busway, Crafton Station at PRR MP 6.0

Photo 57: PAT West Busway, Carnegie Station at PRR MP 8.6

Photo 58: PAT West Busway, Carnegie Station at PRR MP 8.6

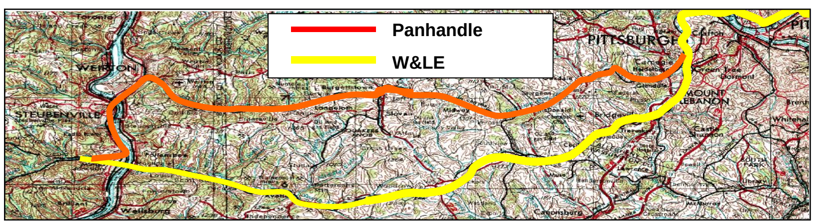
Photos 57 and 58 show the Pittsburgh Port Authority West Busway (former Panhandle Division of the Pennsylvania Railroad) West Busway terminal station at Carnegie PRR MP 8.6. This station is the westernmost station on the West Busway system. As shown in Photo 58, signaled pedestrian access is provided across the track. Photos 50 and 58 are the same, showing that the route evaluation via either Scully or the Busway has reached the same point west of Pittsburgh.

Segment 3: Walker's Mill to Mingo Jct

As shown in Exhibit 2-46, two rail routes are potentially available for linking Mingo Jct/ Weirton and Carnegie: the abandoned Panhandle alignment and the W&LE (former PWV):

- In 1999, Conrail donated a 29 mile long segment of the Panhandle Division of the PRR to Allegheny County, Washington County and the West Virginia Railroad Authority. This acquisition led to the creation of the Panhandle Trail between Walker's Mill in Collier Township, PA and Weirton, WV. A multi-purpose recreational trail has been constructed on the former railroad grade from Walker's Mill to McDonald in PA and from the Colliers to Harmon Creek in WV. The link from McDonald to the WV state line is reported to be under construction or in the planning stage.
- In contrast, the W&LE route still serves as an active freight line. As such, using this route may offer some advantages over trying to reactivate the abandoned Panhandle alignment. The W&LE line was built later than the Panhandle and tends to follow the ridgelines, whereas the Panhandle was built in the Charter's Creek river valley. As such, the Panhandle employs more moderate grades than the W&LE, but W&LE appears to have a somewhat straighter alignment that may permit somewhat higher speeds. The bridge structures along the Panhandle are more substantial, employing earthen embankments and massive stoneworks, compared to the long elevated steel trestles and aged, deckplate girder structures that were seen on the W&LE.

Exhibit 2-46: Mingo Jct-Carnegie Route Alternatives



Both the abandoned Panhandle and the alternative W&LE route were inspected. However, at the direction of ORDC, the Panhandle route served as the basis for developing the capital cost and operational analysis for this study. It is recommended that the W&LE alternative be evaluated in a future phase of work.

Assessing the legal issues associated with restoration of rail service on the Panhandle is not within the scope of this study. However, for the purpose of identifying capital cost, it is anticipated that the resultant infrastructure will be of dual use, providing for both recreational and passenger rail service, so the capital cost estimate provides for replacement of the existing recreational trail.

Typical curves on the Panhandle alignment through western Pennsylvania and the West Virginia Panhandle range from one to seven degrees and occur at less than one mile intervals. The

alignment curvature will serve to limit the speed of passenger service, even with tilting equipment, to less than 79 mph in many places. Due to the cost and impact beyond the railroad right of way, we have avoided increasing the superelevation in curves at grade crossings. However, in several cases, particularly in undeveloped areas, we have shown a superelevation increase through some grade crossings to maintain speed on a given track segment. In such cases, the capital cost estimate reflects an additional cost.

Between Pittsburgh and Mingo Jct over the Panhandle alignment, passenger service speeds on this route will be restricted to a maximum of 79-mph due to geometric constraints. Possible speeds over the W&LE alignment between these points have not been evaluated.

In summary, the route that was evaluated from Pittsburgh, PA to Mingo Jct, OH includes the following rail segments defined from east to west:

- From Pittsburgh Penn Station, the NS Fort Wayne Line to the OC Bridge to CP Esplen.
- Pittsburgh and Ohio Central Railroad (POC) from Norfolk Southern's Ohio River "Mon Line" bridge to Carnegie via Esplen POC MP 5.3, Duff's Jct. POC MP 8.2, Scully Yard POC MP 8.7, Lewis Run Junction (Char) POC MP 9.8, and Carnegie POC MP 11.8 and PRR approximate MP 8.4
- Pittsburgh and Ohio Central Railroad from Carnegie POC MP 11.8 and PRR approximate MP 8.4 to Walkers Mill POC MP 14.4 and PRR approximate MP 11.0 on the former PRR Panhandle Div
- Walkers Mill PRR approximate MP 11.0 to MacDonald PRR approximate MP 18.2 on the Panhandle Div, now the Panhandle Trail
- MacDonald PRR approximate MP 18.2 to Colliers PRR approximate MP 35.6 on the Panhandle Div, now the Panhandle Trail (under construction)
- Colliers PRR approximate MP 35.6 to Weirton Junction PRR approximate MP 40.0, now the Panhandle Trail
- Norfolk Southern Weirton Subdivision from Weirton Junction PRR approximate MP 40.0 to the interchange point with the Ohio Central Railroad (Columbus and Ohio River Railroad Company Main Line) at PRR MP 49.5 via Steubenville and Mingo Junction.

Much of the PRR Panhandle railroad corridor is owned by either state or county governments. Traffic is relatively light on those sections that still have track. For development of engineering cost estimates, it is assumed that passenger and freight service will share a common track and that track configuration and superelevation will be optimized to provide the maximum passenger speeds consistent with safe shared operations. Exhibit 2-47 shows the cost of recommended improvements to this segment, which include:

Walker's Mill PRR MP 11.0 to Weirton Junction PRR MP 40.0

- Install CTC signaling
- Install CWT grade crossing warning systems
- Build class 4 mainline track
- Build class 4 passing siding

- Build multipurpose trail system on 25 ft segregation within ROW limits

Weirton Junction PRR MP 40.0 to OCR Interchange PRR MP 49.5

- Install CTC signaling
- Install CWT grade crossing warning systems
- Upgrade track to Class 3, no new tracks required
- Rehabilitate the Weirton Ohio River Bridge for passenger service at maximum permissible track speed.

Exhibit 2-47: Segment 3 – Walker's Mill to Mingo Jct Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$57,993	47.01%	$57,993	46.89%	0.00%
Turnouts	$248	0.20%	$248	0.20%	0.00%
Curves	$960	0.78%	$960	0.78%	0.00%
Signals	$10,823	8.77%	$10,823	8.75%	0.00%
Stations/Facilities	$1,000	0.81%	$1,000	0.81%	0.00%
Bridge-Under	$0	0.00%	$0	0.00%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$3,846	3.12%	$4,166	3.37%	8.32%
Segment Total	$74,869	60.69%	$75,189	60.79%	0.43%
Placeholders	$48,500	39.31%	$48,500	39.21%	0.00%
TOTAL	**$123,369**	**100.00%**	**$123,689**	**100.00%**	0.26%
Cost/Mile (38.5 Miles)	**$3,204**		**$3,213**		

The main costs for the Walker's Mill to Mingo Jct segment are $58.0 million for replacing the abandoned track, $43.5 million for replacing 29 miles of bike trail, $5.0 million for upgrades and repairs to the Ohio River bridge at Weirton, and $15.0 million for crossings and signals. The slight increase in costs for the high-speed scenario in Exhibit 2-47 relate to additional grade crossing improvements that were assumed for improving the road conditions, not directly affecting train speed through the area.

Photos 59 through 66 cover the Panhandle alignment from Walker's Mill to Mingo Jct which was the basis of the cost estimate for this report. Photos 67 through 77 cover the W&LE alternative, including the area where a connection track would be needed to link the two lines at Bridgeville, PA.

Photo 59: Beginning of Panhandle Trail at Walker's Mill

Photo 59 shows the trail that has been constructed on the old Pennsylvania Railroad grade. A high speed rail system would displace the trail, so as to employ the compacted grade and structures. The trail could then be reconstructed parallel to the rail line, within the right of way by employing more abrupt vertical curvature and gradients. Photo 60 shows the Panhandle Trail masonry and concrete bridge over Chartiers Creek. Photo 61 shows an upstream view of the same structure. This substantial structure can be reused with little or no modification for the high speed rail system. An adjacent pedestrian structure must be constructed for a trail application to provide sufficient separation between modes.

Photo 60: Panhandle Bridge over Chartier's Creek – Downstream View

Photo 61: Panhandle Bridge over Chartier's Creek – Upstream View

Photo 62: Trail at Oakdale, View east along the double track grade, now serving as a multi-purpose trail.

Photo 63: Trail at Oakdale, View west. Sufficient space exists to construct a single track, fencing and an adjacent trail.

Photo 64: Trail at MacDonald. PRR MP 18.2 at Route 980 McDonald St.

Photo 64 shows the trail at MacDonald. PRR constructed multiple tracks on this segment. The westbound ruling grade of 1% is several miles west of this point. The facilities included three or more tracks between McDonald and Weirton.

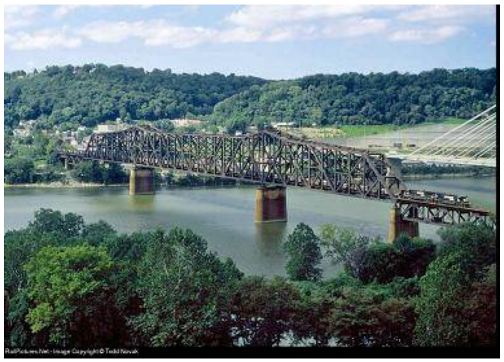


Photo 65: PRR Panhandle Bridge at Weirton. © Todd Novak, Used with Permission

Photo 65 shows the large Ohio River bridge on the former PRR Panhandle line from Weirton to Mingo Jct. To access a steel mill, Norfolk Southern still operates the Weirton Sub from Collier PRR MP 35.6 through Weirton Junction, Steubenville, and Mingo Junction to the east portal of Gould Tunnel. The track through Steubenville is heavy weight continuous welded rail suitable for heavy taconite service. Freight speeds are slow as numerous grade crossings exist at close spacing. Multiple tracks existed in the past, however much of the distance is now operated as a single track railroad with multiple track sidings at Weirton Junction and west of Mingo Junction.

Photo 66: NS/OHCR Interchange Track East of Gould Tunnel

As shown in Photo 66, the Ohio Central interchanges with NS at PRR MP 48, between the Gould Tunnel and Mingo Junction. A two mile, two track siding east of the east portal of the Gould Tunnel is used for interchange between the Ohio Central and Norfolk Southern. The main track lies on the south and employs a heavy weight continuous welded rail section that is very worn. Ties are fairly old and the ballast section is good. This is a low speed class 1 or class 2 track. Compromise joints are depicted in the photo where the rail weight transitions. The equipment stored on the north siding has not moved in some time.

As shown in Exhibit 2-46, the Wheeling and Lake Erie Railway (W&LE) operates freight service on a route that generally parallels the Panhandle line to offer an alternative route between Mingo Jct and Pittsburgh. Photos 67 through 77 document this option, although capital costs were not developed in this study. While the W&LE does not offer a direct route into downtown Pittsburgh, connections could be made between the Ohio Central Railroad and W&LE at sites west of Mingo Junction, OH and at Bridgeville, PA, respectively, to complete a route from the Gould Tunnel to the NS Mon Line OC bridge. The W&LE and Ohio Central rights of way parallel one another from Mingo Junction to Bowerston, Ohio. From Jewett to Bowerston, a distance of 9 miles, the W&LE tracks have been taken up and W&LE operates over the Ohio Central, so the necessary track connection between OC and the W&LE is already in place in Bowerston.

Photo 67: Lewis Run Junction at POC MP 9.8, PCY line coming in from right

Photo 67 shows the Pittsburgh and Ohio Central Railroad Lewis Run Junction (Char) POC MP 9.8. The former Pennsylvania Railroad Weirton Secondary track and Pittsburgh Chartiers and Youghiogheny Railway (PCY) meet at this point, just west of Scully Yard. The PCY was reorganized as the Pittsburgh Industrial Railroad in 1993 and was later taken over by the Pittsburgh and Ohio Central Railroad in 2001. This track is in service between Lewis Run Junction and Bridgeville via East Carnegie and Junction No. 1.

Photo 68: W&LE and PCY Parallel east of Green Tree Road

Photos 68 and 69 show that the Wheeling and Lake Erie Railway (W&LE) and Pittsburgh and Ohio Central Railroad (PCY) lines parallel between Bower Hill and South Carnegie. The Wheeling and Lake Erie occupies the high line. It is possible to construct a connecting track at this point east of Green Tree Rd. The approximately 40 ft elevation difference may result in a steep grade which can be suitable for passenger service.

Photo 69: View east on Green Tree Road showing parallel W&LE and PCY Tracks

Photo 70: W&LE and PCY Crossing, View East

Photos 70 and 71 show how the Wheeling and Lake Erie and Pittsburgh and Ohio Central Railroad (PCY) cross in a grade separation at Bower Hill near Bridgeville, PA. The Wheeling and Lake Erie occupies the high line and PCY the lower track at grade.

Photo 71: W&LE and PCY Crossing, View West

Photo 72: W&LE Bridge at Vienna, PA

Photo 72 shows a ballasted deck plate girder bridge on a two-track abutment. The bridge decks and abutments would require some maintenance to be suitable for high speed passenger service. Photo 73 shows the Wheeling and Lake Erie Railway track at Vienna, PA. The track consists of 132 lb jointed rail rolled in 1958. The rail is in poor shape with significant flattening in low rail on curves. Wheel flanges are running on the joint bars. Ballast shoulders are minimal. The current W&LE timetable speeds are presumed to be relatively low, given the conditions. The line is not signaled, although it may have been signaled in the past.

Photo 73: W&LE Track at Vienna, PA

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Technical Memorandum & Business Plan

Photo 74: W&LE Bridge at Mingo Jct.

Photos 74 and 75 show the Wheeling and Lake Erie Railway bridge over the Ohio River east of Mingo Junction. The through truss and deck truss spans are currently in freight service.

Photo 75: W&LE Bridge at Mingo Jct.

Photo 76: W&LE and Panhandle Parallel west of Mingo Jct.

Photo 76 shows that the Wheeling and Lake Erie Railway runs parallel to and within several hundred feet of the Pittsburgh and Ohio Central (former PRR Panhandle Division) west of Mingo Junction. Between PRR MP 46.0 – 49.0 it would be possible to construct a connecting track across farmland to employ the W&LE for service between Mingo Jct and Pittsburgh.

Segment 4: Mingo Jct to Newark

The proposed route follows the historic Pennsylvania Railroad Panhandle line. The eastern segment of the Panhandle Line is owned by Ohio Rail Development Commission and leased to the Ohio Central Railroad subsidiary, Columbus and Ohio River Railroad Company. The lease covers the Panhandle from PRR MP 49.5 (east of the Gould Tunnel) to PRR MP 157.8 in Newark, OH. Train traffic is relatively light. The W&LE shares a short 9-mile segment of the line from Jewett to Bowerston. It is anticipated that passenger and freight service will share a common track and that the track configuration and superelevation will be optimized to provide the maximum permissible passenger service speeds consistent with safe passenger and freight operations.

Light freight traffic exists on a single track line between the Gould Tunnel and Newark. While the right of way is wide enough to permit the construction of a dedicated high speed track, it is believed to be more cost effective to rebuild the existing single track and commingle with the freight service. Accommodation must be made for Panhandle Trail segments which are under construction or planned for construction on the right of way. Exhibit 2-48 shows the cost of recommended improvements to this segment:

Gould Tunnel PRR MP 49.5 to Newcomerstown PRR MP 108

- Install CTC and PTC signaling
- Install CWT grade crossing warning systems

- Upgrade main track to Class 4 east of MP 94.5; Class 5 west of MP 94.5
- Construct new ten mile siding
- Rehabilitate Gould Tunnel

Newcomerstown PRR MP 108 to Newark PRR MP 157.8

- Install CTC and PTC signaling
- Install CWT grade crossing warning systems
- Upgrade track to Class 6
- Construct new ten mile siding
- Rehabilitate Tuscarawas River Bridge MP108.3
- Rehabilitate Muskingum River Bridge MP126.9
- Build multipurpose trail system on 25 ft segregation within ROW limits from Hanover to Newark

The main costs are $68.8 million for track upgrades, $83.1 million for signals and crossings including $12 million for regrading highway approaches to permit higher curve superelevation, $15 million for bridge and tunnel upgrades and $16.5 million for relocating 11 miles of the bike trail.

Exhibit 2-48: Segment 4 – Mingo Jct to Newark Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$66,095	39.99%	$68,813	35.35%	4.11%
Turnouts	$496	0.30%	$1,148	0.59%	131.45%
Curves	$1,811	1.10%	$1,811	0.93%	0.00%
Signals	$28,403	17.19%	$40,873	20.99%	43.90%
Stations/Facilities	$2,000	1.21%	$2,000	1.03%	0.00%
Bridge-Under	$0	0.00%	$6,314	3.24%	-
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$22,971	13.90%	$30,221	15.52%	31.56%
Segment Total	$121,776	73.68%	$151,180	77.66%	24.15%
Placeholders	$43,500	26.32%	$43,500	22.34%	0.00%
TOTAL	**$165,276**	**100.00%**	**$194,680**	**100.00%**	17.79%
Cost/Mile (108.3 Miles)	**$1,526**		**$1,798**		

This study has limited the speeds to 60-mph in the Gould Tunnel and 60-79 mph on the major steel through girder bridges crossing the Ohio, Tuscarawas and Muskingum Rivers, which currently operate only at FRA class 1 or class 2 track speeds. These assumptions could prove conservative in later analysis.

Photos 77 through 94 depict current conditions and proposed improvements along the route.

Photo 77: East Portal, Gould Tunnel

Photo 77 shows the Ohio Central Railroad (Columbus and Ohio River Railroad Company Main Line) Gould Tunnel East Portal at PRR MP 50.0. A single track is provided through the tunnel. The east portal evidences some distress due to water intrusion and freeze thaw cycles. Water runs down the face of the tunnel and cracks are evident. Water pools at track level at the east portal. While visibility is poor within the tunnel, some support structure is visible toward the center. The tunnel has limited height and width clearance (16 ft 9 in high by 11 ft wide), but should be should be sufficient for commercial high speed rail equipment. Significant improvements will be required to both the track and tunnel structure for passenger service. As the tunnel does not appear to have blast relief (and offers limited side and roof clearance) train speeds are likely to be restricted to approximately 60 mph. The current OHCR track speed through the tunnel is 10 mph according to the track chart. The rail is jointed with a heavy section, typically 140 lbs, rolled in the late 1950s. Ties are presumed to be in relatively poor condition as drainage is non-existent. The track in this area will require extensive reconstruction for reliable passenger rail service.

From Gould Tunnel, the inspection team proceeded west to Newcomerstown and did not inspect the track between the tunnel at PRR MP 50.0 and PRR MP 107. According to the OHCR track chart, the rail is generally a heavyweight (132-140 lb section and ranges in age from 25 to 50 years. Much of this route is continuous welded rail, but recent maintenance activities are not evident on the track charts. Curves of 1 to 3 degrees through rugged terrain will serve to limit the track speed to approximately 70-80 mph. No signals exist on this route. A number of the grade crossings include active warning systems. In the past, the route included double track throughout with frequent sidings and spurs serving local industry. The second track has been removed throughout most of the route, leaving the roadbed to serve as a maintenance access roadway.

Photo 78: Chestnut St, Newcomerstown, OH, view East

Photo 78 shows the Ohio Central Railroad at Chestnut St in Newcomerstown, OH PRR MP 107.9. The rail is continuous welded 140 lb rolled between 1953 and 1961. This lightly trafficked crossing employs a timber crossing surface. Drainage at the crossing is poor. Previously, the route employed two tracks. No signaling exists. Current freight speed is depicted as 25 mph on the track chart. Photos 79 and 80 show the crossing at South College St in Newcomerstown, OH. PRR MP 108.0. Rail and ballast conditions are good. Tie conditions are fair, with evidence of dry rot. A second track existed on the south side. This crossing includes gates and flashers. Concrete panels provide a smooth crossing surface.

Photo 79: South College St, Newcomerstown, OH, view West

Photo 80: South College St, Newcomerstown, OH, view East

Photo 81 shows the Tuscarawas Bridge near Newcomerstown, OH PRR MP 108.3. Because of its inaccessible location this bridge was not inspected, but conditions seen on the Muskingum River bridge farther west were assumed to be typical for all the major bridges along the line.

Error!

Photo 81: Tuscarawas River Bridge, Newcomerstown, OH PRR MP 108.3

Photo 82: Farm Road west of Newcomerstown, OH PRR MP 110.3 - View East

Photo 82 shows a farm road crossing west of Newcomerstown, OH. The rail is jointed 133-lb rolled between 1949 and 1953. Surface defects are evident and the head is flattened. This lightly trafficked crossing employs a timber crossing surface. Drainage at the crossing is poor resulting in degraded ballast and tie conditions. Previously, the route employed two tracks. No signaling exists. Current freight speed is depicted as 25 mph on the track chart. Photo 83 shows a long cut east of Morgan Run, OH. Drainage appears to have been well maintained in this cut, resulting in good track conditions. The rail is jointed with a good ballast section.

Photo 83: Long Cut east of Morgan Run, OH

Photos 84 through 87 show the Muskingum River Bridge at PRR MP 126.9 -- a three span, steel through truss bridge built in 1913. The bridge originally provided for two tracks, but has been reduced to a single track operation. The speed limit is depicted as 40 mph on the OHCR track chart. However, the bridge ties are in poor condition with evidence of dry rot and missing spikes. The top flange of the deck girder is missing rivet heads and has rusted. Other steel components exhibit some level of corrosion.

Photo 84: Muskingum River Bridge

Photo 85: Muskingum River Bridge

Photos 86 and 87: Muskingum River Bridge

Photos 88 and 89: Grade Crossing at Adam's Mill

Photo 90: Black Run SR-586 crossing. PRR MP 145.0 – View West

Photos 88 and 89 show a grade crossing at Adams Mill, PRR MP 132.1, with a passive “Buckeye” crossing warning sign. The heavy CWR rail section provides a reasonable track modulus on poorly drained and fouled ballast with poor tie conditions. This would need to be corrected for high speed passenger service.

Photo 90 shows the Black Run SR-586 crossing. The crossing surface has been improved recently using concrete, steel edged panels. The gates and bungalow are new. An industry spur and siding exist just west of the crossing. The 2.5 mile siding is relatively close to the main line, possibly at 12 to 13 ft centers. Rail is 132 lb CWR rolled in 1979 in good condition. Ties and ballast are in good condition as well. The track chart indicates that the maximum speed is 40 mph corresponding to class 3 track conditions.

Photo 91: Seven Hill Road Overpass showing Bike Trail adjacent to Track

Photo 91 looks down into a cut at PRR MP 150 view west from Seven Hill Rd overpass. The Panhandle Trail has been constructed adjacent to the railroad on the north side from Hanover to Newark, a distance of approximately 11 miles. Photo 92 shows the Ohio Central Railroad at approximate PRR MP 152. The rail is 132 lb CWR rolled in 1979. Rail, ties and ballast are in good condition and the track chart indicates a speed of 40 mph. The Panhandle Trail immediately adjacent to the track is 10 ft wide, separated from the track by a 4 ft high cyclone fence located 8 ft from the track centerline.

Photo 92: Bike Trail adjacent to Track near PRR MP 152

Photo 93: Bike Trail at Morris St. in Newark, PRR MP 157.3 – View East

Photos 93 and 94 show the Morris St. grade crossing in Newark, where the bike trail to Hanover begins. The crossing includes gates at Morris St. The roadway to the parking facility serving the trail does not have an active warning system. For high speed passenger service, the trail will have to be relocated to a minimum of 25 ft from rail centerline to the edge of the trail. In Newark, the trail is located very close to the railroad tracks. It is not certain that sufficient right of way exists to reconstruct the trail at a 25 ft setback. However, the alignment through Newark includes several abrupt back to back curves and a station stop in Newark that also serve to limit speeds through the town.

Photo 94: Morris St. in Newark, PRR MP 157.3 – View West

Segment 5: Newark to Columbus

The Newark to Columbus (C&N) segment is generally single track CWR, stretching from Newark C&N MP 104.1 to Grant C&N MP 136. Because the former B&O line to Zanesville joins the Panhandle in Newark, this segment has heavier freight traffic than the east end of the Panhandle. When the Ohio Rail Development Commission gained title to the eastern end of the Panhandle, it also acquired ConRail's 50% share in the Newark to Columbus segment. More recently, the Ohio Central bought the remaining 50% share from CSX as a part of its purchase of the Newark-Zanesville line.[10]

Formerly this segment was double tracked with sidings that gave the appearance of a four-tracked mainline. The track chart indicates that most of the rail is CWR 120 to 140 lb, rolled between 1956 and 1980. Curves are modest, ranging from 30 minute to 1 degree. Speeds west of Newark are depicted at 49 mph. From Port Columbus C&N MP 130.0 to Grant C&N MP 136.7 just east of downtown Columbus**,** the line still has two main tracks and sidings. At Grant C&N MP 136.7, the C&N and NS connection to the northern corridor meet. Just west lies the Civic Center underpass and CP138 where the Buckeye Line diverges. This is the historic site of the Columbus Union Station. Exhibit 2-49 shows the cost of recommended improvements to this segment, which include:

- Install CTC and PTC signaling
- Install CWT grade crossing warning systems
- Build Class 3 yard bypass track at Newark
- Upgrade track to Class 6
- Build ten mile passing siding
- Construct trench under the NS and CSX to grade separate the junction at Grant

The main costs are $27.5 million for track upgrades, $31.4 million for crossings and signals including $6 million for for regrading highway approaches for higher curve superelevation, and $45 million for the grade separation under I-670 at Grant. The cost of this grade separation may possibly be avoided depending on what strategy is adopted for dealing with rail freight capacity needs in the Columbus terminal.

[10] See: http://a257.g.akamaitech.net/7/257/2422/06jun20041800/edocket.access.gpo.gov/2004/04-27743.htm

Exhibit 2-49: Segment 5 – Newark to Columbus Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$26,373	27.92%	$27,592	24.87%	4.62%
Turnouts	$496	0.53%	$1,148	1.03%	131.45%
Curves	$136	0.14%	$136	0.12%	0.00%
Signals	$10,472	11.09%	$17,150	15.46%	63.77%
Stations/Facilities	$1,000	1.06%	$1,000	0.90%	0.00%
Bridge-Under	$0	0.00%	$4,677	4.22%	-
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$4,986	5.28%	$8,254	7.44%	65.54%
Segment Total	$43,463	46.01%	$59,957	54.04%	37.95%
Placeholders	$51,000	53.99%	$51,000	45.96%	0.00%
TOTAL	**$94,463**	**100.00%**	**$110,957**	**100.00%**	17.46%
Cost/Mile (33.9 Miles)	**$2,787**		**$3,273**		

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Photo 95: Newark, OH, C&N Subdivision MP 104.6 – View West

Photo 95 shows the small yard of the Ohio Central Railroad in Newark, OH. This view was taken just east of the junction witb the PRR Panhandle line. (PRR MP 157.8= C&N MP 104.1). This yard spans approximately one mile and includes multiple tracks. It should be possible to reconstruct the yard to include equivalent storage capacity along with an added main line track on the existing bridge structures. Rail and ties are in poor condition with extensive rail wear. Photo 96 shows the C&N subdivision at Cleveland Ave in Columbus, OH heading west towards Grant, where three OHCR tracks merge to one and continue curving to the south.

Photo 96: Columbus, OH, C&N MP 136.1 – Cleveland Ave Overpass – View West

Photo 97: Columbus, OH at Grant – View West, from North Side of I-670 Overpass

Photo 97 shows the C&N Subdivision and NS Mainline passing under I-670 from the north side. The proposed track configuration would connect the Buckeye Line to the C&N Subdivision without crossing the NS mainline at grade. The close proximity of Cleveland Ave and I-670 overpasses prevents construction of any flyover to clear the NS mainline at Grant. It may be possible to construct a trench under the NS mainline to carry Panhandle trains under the NS. Trenching would be a costly endeavor, as the lines would cross at a high skew underneath the I-670 overpass. Photo 98 shows the C&N line curving to the right through the underpass, while the NS main track that leads to the 3-C corridor curves to the left. The track in the foreground is an industrial spur.

Photo 98: Columbus, OH at Grant – View East, from South Side of I-670 Overpass

Photo 99: Columbus, OH at Grant – View West, from South Side of I-670 Overpass

Photo 99 shows NS and CSX west of the I-670 overpass heading under the Civic Center towards CP-138. The track in the foreground is an industrial spur. The trench would pass under the tracks and rise to surface between the CSX Columbus Line track and the adjacent roadway. Photo 100 shows the NS Cincinnati Line at CP-138 under High St. An alternative strategy was suggested to stub end a Pittsburgh track and platform in the empty bays on the southeast side of the tracks. This option would not require the costly trench, but would not permit through service to Cincinnati. The Buckeye line diverges from under the underpasses off the left side of the photo.

Photo 100: Columbus, OH at CP-138 – View East under High Street

Photo 101: Columbus, OH, Buckeye Line West of CP-138 – View East from Front Street to High Street

Photos 101 and 102 shows the envisioned site for a new Columbus Multi-Modal Transportation Terminal that could be constructed on the Buckeye Line west of CP-138, between High St. and Front St. to serve all Columbus passenger routes. Sufficient space exists for two tracks from CP138 to CP Hocking. An adjacent local street has consumed land that would be needed to provide any additional tracks. Extensive rail infrastructure must be constructed further west to provide a flyover connection between the Buckeye Line and both the NS Cincinnati Line and CSX Scottslawn Subdivision.

Photo 102: Columbus, OH, Buckeye Line West of CP-138 – View West from High Street towards Front Street

2.11.1 Pittsburgh-Columbus via Panhandle Capital Cost Summary

Exhibit 2-50 summarizes the total estimated costs for improving all five Cleveland-Columbus via Panhandle segments. The cost to improve the corridor under the Modern Scenario is $441.92 million or $2.28 million per mile. The cost to improve the corridor under the High-Speed Scenario is $488.22 million or $2.52 million per mile.

Exhibit 2-50: Pittsburgh-Columbus via Panhandle Capital Cost Summary

Segment Number	Route Segment	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost	Cost/ Mile	Capital Cost	Cost/ Mile
1	Pittsburgh to CP Esplen	NS	30-mph	4	$50,000	$12,500	$50,000	$12,500
2	CP Esplen to Walker's Mill	POC	60-mph	9.1	$8,810	$968	$8,890	$977
3	Walker's Mill to Mingo Jct	NS/ Abd'n	79-mph	38.5	$123,369	$3,204	$123,689	$3,213
4	Mingo Jct to Newark	OCR	110-mph	108.3	$165,276	$1,526	$194,680	$1,798
5	Newark to Columbus	OCR	110-mph	33.9	$94,463	$2,787	$110,957	$3,273
TOTAL				**193.8**	**$441,918**	**$2,280**	**$488,216**	**$2,519**

Exhibit 2-50 (continued): Pittsburgh-Columbus via Panhandle Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario from the Modern Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$155,198	35.12%	$159,135	32.60%	2.54%
Turnouts	$1,488	0.34%	$2,792	0.57%	87.63%
Curves	$3,048	0.69%	$3,048	0.62%	0.00%
Signals	$52,012	11.77%	$71,160	14.58%	36.81%
Stations/Facilities	$4,000	0.91%	$4,000	0.82%	0.00%
Bridge-Under	$0	0.00%	$10,991	2.25%	-
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$33,173	7.51%	$44,091	9.03%	32.91%
Segment Total	$248,918	56.33%	$295,217	60.47%	18.60%
Placeholder	$193,000	43.67%	$193,000	39.53%	0.00%
TOTAL	**$441,918**	**100.00%**	**$488,216**	**100.00%**	**10.48%**

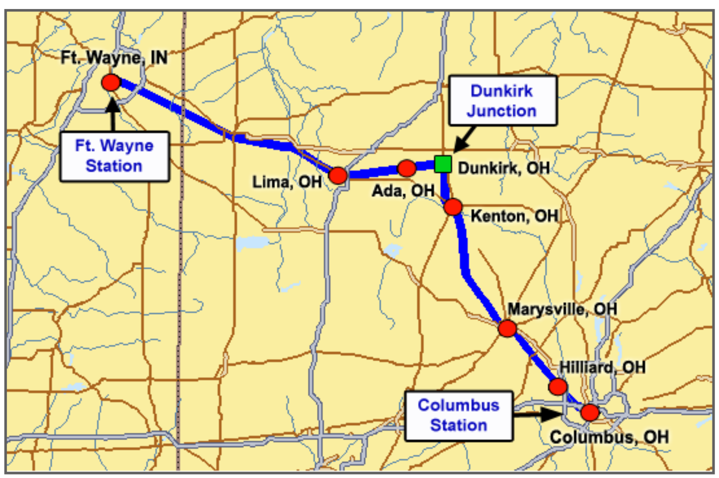
2.12 Columbus to Fort Wayne via Dunkirk

The Columbus to Fort Wayne corridor via Dunkirk is approximately 193.8-miles in length. Due to time and budget constraints and the expansive territory covered in this report, track segments were inspected selectively to develop a general understanding of the existing conditions and make recommendations for operating speeds and capital improvements. The route segments are delineated in Exhibit 2-51 and are illustrated in Exhibit 2-52.

Exhibit 2-51: Columbus-Fort Wayne via Dunkirk Route Segments

Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speeds (mph)
1	Columbus to CP Mounds	CSXT	7.0	79	79
2	CP Mounds to Dunkirk	CSXT	65.2	79	110
3	Dunkirk to Fort Wayne	CSXT (CFE)	82.9	79	110

Exhibit 2-52: Columbus-Fort Wayne via Dunkirk



Segment 1: Columbus to CP Mounds

The original Columbus Union Station site has been redeveloped as the Columbus Convention Center. Therefore, a new station site in downtown Columbus has been proposed on the Buckeye line between High St. and Front St., just west of CP 138 in downtown Columbus -- the same as the preferred "Site A" that was identified by the December 1994, Columbus Multimodal Transportation Terminal Feasibility Study. To be feasible from a rail operations point of view, the design for a passenger rail station in downtown Columbus must respect:

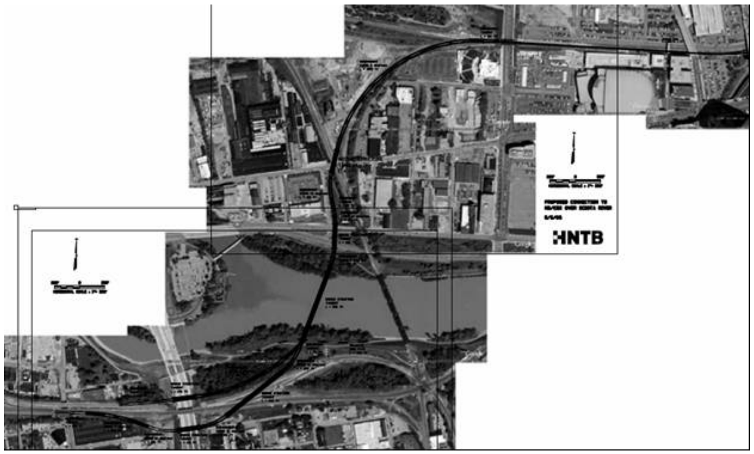
- The geometric constraints for constructing rail station facilities in an urban area
- The pattern and intensity of freight rail operations through the area.
    - o A busy east-west NS rail corridor passes through CP-138 to Scioto Jct. and connects the NS northern corridor on the east to Buckeye yard and the Dayton line on the west. CSX trains also use this line through downtown Columbus to connect Galion to Parsons Yard and to the Scottslawn Subdivision.
    - o A busy north-south CSX rail line passes just west of the proposed station site and must be crossed to reach any of the western connecting passenger lines.
- The ability to connect both the 3-C and Panhandle corridors on the east, and to the 3-C and Fort Wayne/Toledo corridors on the west.

The Ohio Hub plan recognizes the challenges associated with adding passenger services through a busy rail terminal with intensive freight operations:

- The proposed station site west of CP-138 is clear of the NS Dayton line and would permit through freight train operation towards Dayton while passenger trains are "in the clear" in separate passenger station tracks, that are off the main line.
- West of the station, a proposed double tracking of the former Conrail Western Branch from CP Scioto to CP Mounds (now part of the CSX Scottslawn Subdivision) as also suggested by the November 2001 Central Ohio Regional Rail Study Final Report, would:
    - o Move some NS trains from the Buckeye line to an alternative rail corridor that has fewer highway grade crossings;
    - o Compensate NS for the loss of capacity on the Buckeye line;
    - o Add capacity for increased CSX intermodal and carload freight movements from Parsons Yard to the CSX east-west mainline at Ridgeway;
    - o Add capacity for passenger service from Columbus to Chicago and Detroit.
- An elevated flyover structure, shown in Exhibit 2-53 has been proposed to connect the Buckeye line to the Western Branch. This structure would be used by 3-C trains to access the NS Dayton District[11], as well as by Columbus-Chicago and Columbus-Detroit passenger trains to reach the CSX Scottslawn Subdivision.

[11] The "Dayton District" is just another name for the NS Columbus-Cincinnati line. See: http://en.wikipedia.org/wiki/Dayton_District

Exhibit 2-53: Columbus Flyover to Connect Buckeye Line to the Dayton/Scottslawn Subdivions



The proposed flyover would grade separate passenger operations from the CSX line, but has rather steep grades as well as 12-degree curves. This structure would be suitable for passenger train operations at a restricted speed. The geometry of the proposed structure may not support effective freight train operations. This report suggests a possible means for introducing passenger rail to downtown Columbus while accomodating existing freight operating patterns. However, an integrated strategy for rationalizing freight and passenger operations through Columbus may result in a greater benefit at a lower cost. Further engineering work would be required to develop an grade separation alternative that could be used by both freight and passenger trains. Exhibit 2-54 shows the cost of proposed improvements to this segment, which include:

- Construct a new flyover connection from the Buckeye Line to the Dayton and Scottslawn Subdivisions
- Upgrade CTC signaling
- Install CWT grade crossing warning systems
- Add a Class 4 double track at 14-foot center to support 79-mph operations from CP Scioto to CP Mounds

The main costs are $10.44 million for double tracking CP Scioto to CP Mounds, $4.13 for crossings and signals, and $55.0 million for the flyover structure to connect the Buckeye line to the Scottslawn Subdivision.

Exhibit 2-54: Segment 1 – Columbus to CP Mounds Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$15,090	20.23%	$15,090	20.23%	0.00%
Turnouts	$372	0.50%	$372	0.50%	0.00%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$3,506	4.70%	$3,506	4.70%	0.00%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$0	0.00%	$0	0.00%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$620	0.83%	$620	0.83%	0.00%
Segment Total	$19,588	26.26%	$19,588	26.26%	0.00%
Placeholders	$55,000	73.74%	$55,000	73.74%	0.00%
TOTAL	**$74,588**	**100.00%**	**$74,588**	**100.00%**	0.00%
Cost/Mile (7.0 Miles)	**$10,655**		**$10,655**		

Photo 103 shows the crossing of the CSX and Buckeye lines at CP Hocking. Passenger trains from Columbus to Chicago and Detroit could use the Buckeye Line via Marble Cliffs from CP Hocking to CP Mounds, but this wouldn't work for 3-C Cincinnati trains. Instead of crossing at CP Hocking, the proposed flyover solution provides full a grade-separation with CSX and works for all corridors, including the 3-C. It is not practical to grade-separate the CSX crossing at CP Hocking, shown in Photo 101, because the I-670 highway bridge passes directly overhead.

Photo 103: CP Hocking view west along the Buckeye Line. The double-tracked CSXT line to Marion passes through the girder bridge on the right.

Segment 2: CP Mounds to Dunkirk

The CSXT alignment from Columbus north through Marysville, Ridgeway, and Kenton, called the Scottslawn Secondary, is generally single track CWR with sidings. Except at interlocked crossings with other railroads the route is not signaled, so speeds are limited to 50 mph. The line is generally tangent except when passing through Marysville, Raymonds and Kenton. North from Ridgeway, the next major junction is at Dunkirk where the Scottslawn line crosses the ex-PRR Fort Wayne line into Chicago. From Ridgeway to Columbus, the route acts as a branch from CSX's Cleveland-Indianapolis mainline, and serves the Honda assembly plant at Marysville. Since the Scottslawn Secondary forms a key part of CSX's route from Columbus to St. Louis, the Columbus to Ridgeway line sees heavy freight traffic. North of Ridgeway, the Scottslawn line is reduced to mostly local traffic, since CSX rerouted most Toledo freight via its parallel line through Lima. Exhibit 2-55 shows recommended improvements, including:

- From CP Mounds to Ridgeway, construct a new a dedicated Class 6 passenger track on 28-foot separation, where practicable, with crossovers at 15 mile intervals.
- Grade separate the CSX rail crossing at Ridgeway
- Install CTC and PTC signaling
- Install CWT and four quadrant gate grade crossing warning systems
- Upgrade the existing track to Class 6 for comingled running north of Ridgeway
- Install chain link fencing through populated areas including: Columbus to Hilliard, Marysville, West Mansfield, and Kenton

The main costs are $93.9 million for dedicated track from CP Mounds to Ridgeway and for upgrading the existing single track north of Ridgeway to Dunkirk, $63.5 million for crossings and signals, and $40 million for the flyover of the CSX line at Ridgeway.

Exhibit 2-55: Segment 2 – CP Mounds to Dunkirk Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$93,943	46.27%	$93,943	41.07%	0.00%
Turnouts	$620	0.31%	$1,924	0.84%	210.32%
Curves	$1,610	0.79%	$1,610	0.70%	0.00%
Signals	$18,304	9.01%	$31,148	13.62%	70.17%
Stations/Facilities	$1,000	0.49%	$1,000	0.44%	0.00%
Bridge-Under	$22,588	11.12%	$22,588	9.87%	0.00%
Bridge-Over	$4,174	2.06%	$4,174	1.82%	0.00%
Crossings	$20,801	10.24%	$32,354	14.14%	55.54%
Segment Total	$163,040	80.30%	$188,742	82.51%	15.76%
Placeholders	$40,000	19.70%	$40,000	17.49%	0.00%
TOTAL	**$203,040**	**100.00%**	**$228,742**	**100.00%**	12.66%
Cost/Mile (65.2Miles)	**$3,114**	-	**$3,508**		

Photo 104: CSX Scottslawn Subdivision, Delaware Ave at Marysville – View South

Photos 104 and 105 show the Scottslawn Subdivision at the Delaware Avenue crossing in Marysville, OH. It can be seen that there is enough room through the town to add another track, but probably not on a 28' center. An investigation of the applicable Toledo and Ohio Central railway valuation maps indicates that the existing single track railroad has been constructed in the center of a nominal 66 ft right of way. Therefore, adding new track on a 28' center would require widening the right-of-way.

Photo 105: CSX Scottslawn Subdivision, Delaware Ave at Marysville – View North

Photo 106: CSX Scottslawn Subdivision, Main Street at Marysville – View North

Photos 106 and 107 were taken a little farther north. Photo 104 taken at Main Street shows a siding that leads to an industrial spur, the same spur seen from Maple Street with a railcar on it.

Photo 107: CSX Scottslawn Subdivision, Maple Street at Marysville – View South

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Photo 108: CSX Mainline at Ridgeway – View East towards Marion

Photos 108 through 110 show the junction of the Scottslawn Subdivision with the CSX mainline at Ridgeway, where a grade separation is proposed. It can be seen that there are no physical obstacles to grade-separating the lines at Ridgeway although provision must be made to tie the three connection tracks back in, after the lines have returned to grade level.

Photo 109: CSX Scottslawn Subdivision at Ridgeway – View South towards Columbus

Photo 110: CSX Scottslawn Subdivision at Ridgeway – View North towards Toledo

Photos 111 and 112 show the crossing of the Scottlawn Subdivision with the Fort Wayne line at Dunkirk, OH. Currently no connection exists between the lines at this point, but a new connection in the southwest quadrant would be required here to enable to through passenger service from Columbus to Chicago via Fort Wayne. No grade separation is proposed here, but an OWLS crossing would be proposed here to eliminate the speed restriction for Toledo-bound passenger trains continuing farther north along the Scottslawn line.

Photo 111: CSX Scottslawn Subdivision crossing CFE Ft. Wayne line at Dunkirk – View West towards Ft. Wayne

Photo 112: CSX Scottslawn Subdivision crossing CFE Ft. Wayne line at Dunkirk – View North towards Toledo

The CSX Scottslawn line crosses the CSX Fort Wayne Line (now Chicago, Ft Wayne & Eastern) at Dunkirk, CSXT MP 61.2. View north along the CSXT. Photo 113 shows a portion of the property and local roadway that must be crossed in order to build the proposed southwest quadrant connection.

Photo 113: CSX Scottslawn Subdivision crossing CFE Ft. Wayne line at Dunkirk – View South towards Columbus across Southwest Quadrant

Photo 114: CSX Scottslawn Subdivision crossing CFE Ft. Wayne line at Dunkirk – Southwest Quadrant location of proposed Connection Track

Photo 114 shows that the proposed connection track in the southwest quadrant would cross an adjacent homeowner's property and a roadway. Photo 115 shows the view southeast along the Scottslawn line. Constructing a connection track in the southwest quadrant will require some modifications to the end of siding and roadway crossing. The CSX tracks are on a 2 degree 40 minute curve. Track condition is good with 131 lb continuous welded rail on timber ties with good ballast condition. The diamond itself is in fair shape, reflecting heavy traffic and limited maintenance. The diamond is signaled on all sides to prevent collisions from crossing traffic.

Photo 115: CSX Scottslawn Subdivision crossing CFE Ft. Wayne line at Dunkirk – View South towards Columbus

Segment 3: Dunkirk to Fort Wayne

The Dunkirk to Fort Wayne segment follows the historic Pennsylvania Railroad "Fort Wayne" alignment which at one time served as the PRR's primary east-west Chicago main line. In the past it had been a double track railroad, although the second track has been removed. Under Conrail ownership the line was downgraded in favor of NYC's parallel route to the north and parts of it had even been taken completely out of service. However, with the Conrail breakup, ownership of this line passed to CSXT. In August 2004, CSXT leased the line to the Chicago, Fort Wayne and Eastern Railroad, a RailAmerica short line. The line is no longer signaled, although some of the historic signal masts still remain in place. Local signals are provided to protect interlocking junctions at crossing diamonds. Exhibit 2-56 shows the cost of recommended improvements to this segment, which include:

- Install CTC and PTC signaling
- Install CWT and four quadrant gate grade crossing warning systems
- Upgrade the existing track to Class 6 for comingled operation with light density freight.
- Construct a 10 mile passenger siding on the existing roadbed to allow freight and passenger trains to pass
- Install chain link fencing through populated areas including: Ada, Lima, Elida, Delphos, Van Wert, Convoy, Monroeville, Maples, Adams, and Fort Wayne
- Construct a new flyover grade-separated crossing over the NS main line in Fort Wayne

The main costs are $73.6 million for upgrading the track, $83.4 million for crossings and signals, and $20 million for the flyover of the NS line at Mike interlocking in Fort Wayne.

Exhibit 2-56: Segment 3 – Dunkirk to Fort Wayne Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$72,075	48.58%	$73,650	38.48%	2.19%
Turnouts	$1,020	0.69%	$2,324	1.21%	127.84%
Curves	$228	0.15%	$228	0.12%	0.00%
Signals	$26,398	17.79%	$42,729	22.33%	61.86%
Stations/Facilities	$1,000	0.67%	$1,000	0.52%	0.00%
Bridge-Under	$0	0.00%	$10,756	5.62%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$27,658	18.64%	$40,694	21.26%	47.13%
Segment Total	$128,378	86.52%	$171,382	89.55%	33.50%
Placeholders	$20,000	13.48%	$20,000	10.45%	0.00%
TOTAL	**$148,378**	**100.00%**	**$191,382**	**100.00%**	28.98%
Cost/Mile (82.9 Miles)	**$1,790**	-	**$2,309**		

Photo 116: Fort Wayne Line at Dunkirk, just west of the diamond at MP 236.3 - View west

Photo 116 shows that the track condition just west of Dunkirk is fair with 136 to 140 lb jointed rail, rolled in 1956. Tie and ballast conditions are fair although the surface is poor indicating that train speeds on this route are slow. A little farther west at MP 236.6, Photo 117 shows that tie and ballast conditions are poor at the Township Road grade crossing with no drainage. The surface is poor indicating that train speeds on this route are slow. The second main track on the south side has been removed. We may be observing some encroachment on the right-of-way.

Photo 117: Fort Wayne Line at Dunkirk, Township Road at MP 236.6 - View east

Photo 118: Fort Wayne Line at Dola, MP 238 - View east

Photo 118 shows good track condition with 140 lb jointed rail, rolled in 1978. Tie and ballast conditions are good. However, the surface is poor indicating that train speeds are slow. Photo 119 shows the track condition is fair with 132 lb continuous welded rail, rolled in 1975. Ballast condition is fair with poor drainage. The ties are rotted. The surface is poor indicating that train speeds on this route are slow. The track on the north has been removed. It appears that the track removal varied to keep existing industry services. This would make it a bit difficult to construct a high speed alignment at 28 ft centers since freight sidings are on both sides of the track.

Photo 119: Fort Wayne Line at Peterson Rd, east of Ada at MP 242.6 - View east

Photo 120: Fort Wayne Line at Peterson Rd, east of Ada at MP 242.6 - Close up of Rotted Tie Conditions

Photo 121: Fort Wayne Line at Ada historic passenger station MP 245.5 - View east

Photo 122: Fort Wayne Line at Ada historic passenger station MP 245.5 - View east – Another view of the track in front of the station

Photo 122 shows the track condition in Ada is poor with 132 lb continuous welded rail, rolled in 1979. Ballast condition is poor with very poor drainage. The ties are rotted. The surface is poor indicating that train speeds on this route are slow. The track on the north has been removed. The right-of-way is very narrow at this point with frequent grade crossings and close proximity of adjacent structures. Speeds are assumed to be restricted to 60-mph through the town.

Photo 123: Fort Wayne Line at Ada historic passenger station MP 245.5 - View west

Photo 124: Fort Wayne Line at Lima crossing CSX/NS MP 260.3 - View east

Photos 124 and 125 show the Wayne Line at the CSX/NS crossing and Lima train station, at MP 260.3. The track is 132 lb jointed rail, rolled in 1953. Ballast condition is poor with little drainage. The surface is rough indicating that train speeds on this route are slow. The track on the north has been removed. The right-of-way is very narrow at this point.

Photo 125: Fort Wayne Line at Lima crossing CSX/NS MP 260.3 - View west

Photo 126: Fort Wayne Line east of Delphos MP 274 - View west

Photos 126 and 127 show the Ft Wayne line in the vicinity of Delphos. The rail is 132 lb continuous welded. Surface and ballast conditions are good, but the ties are rotted. A siding with light weight rail exists on the south side. The track on the north side has been removed.

Photo 127: Fort Wayne Line east of Delphos MP 274 - View east

Photo 128: Fort Wayne Line at Delphos MP 274.4 - View west

Photo 128 shows the Fort Wayne Line at Delphos, viewing west at the bridge over Flat Fork Creek, and the industry siding on south and South Main St. The main track on the north side has been removed. Rail is 132 lb continuous welded, but drainage is poor and ties are rotted. Photo 129 shows the Fort Wayne west of Delphos. The rail here is 136 lb continuous welded. Surface is fair, but the ties are rotted and the ballast is fouled. A siding with light weight rail exists on the south side. Sufficient space exists to restore a main line track at 14 to 18 ft centers on the north side, allowing grain trains to work at Central Soya on the existing main track and siding.

Photo 129: Fort Wayne Line west of Delphos MP 275 - View east

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Photo 130: Fort Wayne Line west of Delphos MP 275 - View west

Photo 130 shows an industry track connecting to the siding at Delphos. Photo 131 was taken at Middlepoint, farther west, where the Pure Line Food company on the north side lacks a rail spur. This was probably taken out when the main line track on the north side was removed. Surface and ballast conditions are poor, due to inadequate drainage.

Photo 131: Fort Wayne Line, Mason St grade crossing MP 280.3 in Middlepoint - View east

Photo 132: Fort Wayne Line, Mason St grade crossing MP 280.3 in Middlepoint – Close up

Photo 132 shows the Mason St grade crossing MP 280.3 in Middlepoint. The rail is 136 lb jointed rolled in the 1950s. The grade crossing is timber and very rough. All such crossing surfaces must be replaced under the high speed rail program. Photo 133 shows the Fort Wayne line entering Van Wert. The track on the north side has been removed. The right-of-way is very narrow at this point. Sufficient space exists here to restore the original two track configuration, but not at 28 ft centers. Van Wert includes numerous grade crossings, many of which should be closed for high speed passenger operations. A 60-mph speed restriction is anticipated here.

Photo 133: Fort Wayne Line at Van Wert MP 287.0 – View west

Photo 134: Fort Wayne Line at Van Wert MP 287.0 – View east

Photo 134 shows that the double track on the north side has been removed through Van Wert. The right-of-way is very narrow at this point. The rail is a heavy weight section, continuous welded, with insulated joints at the crossing starts. Flashers or flashers and gates are installed at all the crossings in town. Photo 135 shows the through girder bridge over Town Creek. Close access for inspection was not possible. The bridge provides sufficient width for multiple tracks.

Photo 135: Fort Wayne Line, Town Creek bridge at Van Wert MP 287.6

Photo 136: Fort Wayne Line, Diamond Crossing at Van Wert MP 287.7 – View west

Photo 136 shows the diamond crossing in Van Wert. This crossing is a remnant of the former NYC Northern Branch from Carlisle (between Dayton and Cincinnati) to Michigan. Farther south, the Greenville-Ansonia segment of that line is operated by R J Corman; practically all the rest of the line has been abandoned. A short segment of the NYC branch was kept to serve local industries in Van Wert. A connection in the northeast quadrant, shown diverging from the left in Photo 137, provides access to this branch. The track here is jointed heavy weight rail. Ballast and tie conditions are fair to good. It is suggested to eliminate this diamond and replace it with an electrically-locked hand throw switch for serving local industries on the south side of Van Wert.

Photo 137: Fort Wayne Line, Diamond Crossing at Van Wert MP 287.7 – View east

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Photo 138: Fort Wayne Line, Convoy MP 294.7 – View west

Photo 138 and 139 show the Fort Wayne Line at Convoy. The rail on both tracks is heavy weight and jointed. Surface and ballast conditions are fair to good. The mainline track on the north side has been removed. The track on the south side is a siding constructed to serve the grain silo. This siding rejoins the main several thousand feet to the west. The crossing at Convoy has a timber surface. Good drainage has not been maintained.

Photo 139: Fort Wayne Line, Convoy MP 294.7 – View east

Photo 140: Fort Wayne Line, Washington St in Monroeville MP 304.3 – View west

Photos 140 and 141 show the Washington St grade crossing in Monroeville. The rail is heavy weight and jointed. Surface and ballast conditions are fair to good. The second main track on the north side has been removed. A siding lies on the south side to serve the grain elevator. The crossing surface is timber and asphalt. Flashers provide warning of a train approach.

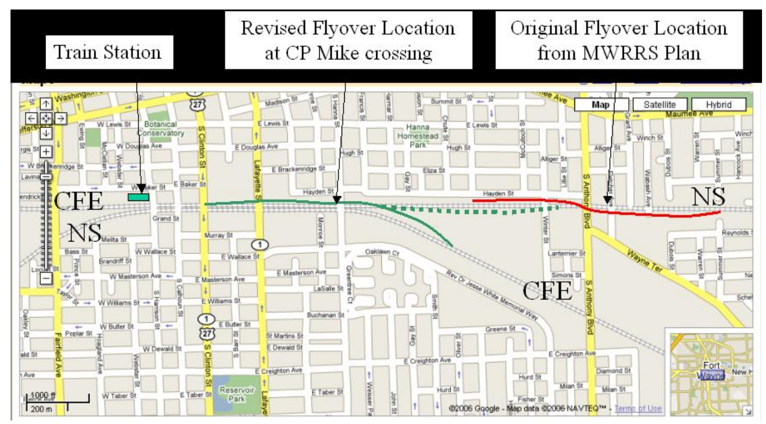
Photo 141: Fort Wayne Line, Washington St in Monroeville MP 304.3 – View east

The physical inspection of the Fort Wayne line terminated at Monroeville due to time limits. However, the Fort Wayne Line continues northwest to Fort Wayne, generally as a non signaled, single track railroad, as the north track had been removed in the past. At CP Adams MP 314.5, the Decatur secondary track joins the Fort Wayne line so from Adams west, the two main tracks remain in place. The two main tracks continue through Piqua Yard to CP Mike, passing to the south side of a modern intermodal yard.

At CP Mike at MP 319.2, the Norfolk Southern former Wabash and Nickel Plate mainlines cross the ex-PRR Fort Wayne line at grade. Exhibit 2-57 is a map of downtown Fort Wayne, Indiana that shows the CP Mike area, just east of the former Amtrak station, where the ex-PRR Fort Wayne line crosses the Nickel Plate (now NS) mainline at grade.

As shown in Exhibit 2-57, the original MWRRS plan anticipated a need to grade separate rail crossings of the Nickel Plate (now NS) mainline but placed the flyover structure east of CP Mike along the NS corridor. However, a flyover in that location would not be accessible to Columbus trains heading down the ex-PRR main line (now CFE) towards Lima. To be accessible to both routes, the MWRRS flyover structure must be shifted farther west, as shown in Exhibit 2-57, or else two separate structures built. This Ohio Hub plan conservatively includes a placeholder for the cost of a separate flyover at CP Mike; the MWRRS engineering plan for the grade separation of rail lines at Fort Wayne should be revisited for an opportunity to reduce the cost, in light of the new requirement for adding Chicago-Lima-Columbus service.

Exhibit 2-57 – Need for a Revised Plan for Flyovers in Downtown Fort Wayne, IN



2.12.1 Columbus to Fort Wayne – Capital Cost Summary

Exhibit 2-58 summarizes the total estimated costs for improving all three Columbus to Fort Wayne segments. The cost to improve the corridor under the Modern Scenario is $426.0 million or $2.7 million per mile. The cost to improve the corridor under the High-Speed Scenario is $494.7 million or $3.2 million per mile.

Exhibit 2-58: Columbus to Fort Wayne
Capital Cost Summary

Segment Number	Route Segment	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost	Cost/ Mile	Capital Cost	Cost/ Mile
1	Columbus to CP Mounds	CSXT	79-mph	7	$74,588	$10,655	$74,588	$10,655
2	CP Mounds to Dunkirk	CSXT	110-mph	65.2	$203,040	$3,114	$228,742	$3,508
3	Dunkirk to Fort Wayne	CSXT (CFE)	110-mph	82.9	$148,378	$1,790	$191,382	$2,309
TOTAL				**155.1**	**$426,006**	**$2,747**	**$494,712**	**$3,190**

Exhibit 2-58 (continued): Columbus to Fort Wayne
Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario from the Modern Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$181,108	42.51%	$182,683	36.93%	0.87%
Turnouts	$2,012	0.47%	$4,620	0.93%	129.62%
Curves	$1,838	0.43%	$1,838	0.37%	0.00%
Signals	$48,208	11.32%	$77,383	15.64%	60.52%
Stations/Facilities	$2,000	0.47%	$2,000	0.40%	0.00%
Bridge-Under	$22,588	5.30%	$33,344	6.74%	47.62%
Bridge-Over	$4,174	0.98%	$4,174	0.84%	-
Crossings	$49,079	11.52%	$73,668	14.89%	50.10%
Segment Total	$311,006	73.01%	$379,712	76.75%	22.09%
Placeholder	$115,000	26.99%	$115,000	23.25%	0.00%
TOTAL	**$426,006**	**100.00%**	**$494,712**	**100.00%**	**16.13%**

2.13 Dunkirk to Toledo

The Dunkirk to Toledo corridor is approximately 63.1-miles in length. The Columbus to Dunkirk segment is shared by both Columbus to Toledo and Columbus to Fort Wayne routes. A description of the Columbus to Dunkirk segment is found in the previous section.

At Dunkirk, instead of turning towards Fort Wayne, the Toledo line continues north on the former CSXT Scottslawn Secondary to Toledo. (This segment was renamed the CSXT Toledo Branch Subdivision, extending from MP 4.0 at Stanley to MP 82.3 where it joins the CSXT Scottslawn Secondary Subdivision.) At Stanley CTT MP 19.5, the route joins the former Toledo Terminal Railroad (now operated by CSXT as the Toledo Terminal Subdivision) until joining the Norfolk Southern mainline to Chicago at Vickers CTT MP 21.5 / NS MP 285.4 to head west across the Maumee River and reach the existing Amtrak Toledo terminal. These route segments are delineated in Exhibit 2-59 and are illustrated in Exhibit 2-60.

Exhibit 2-59: Dunkirk to Toledo Route Segments

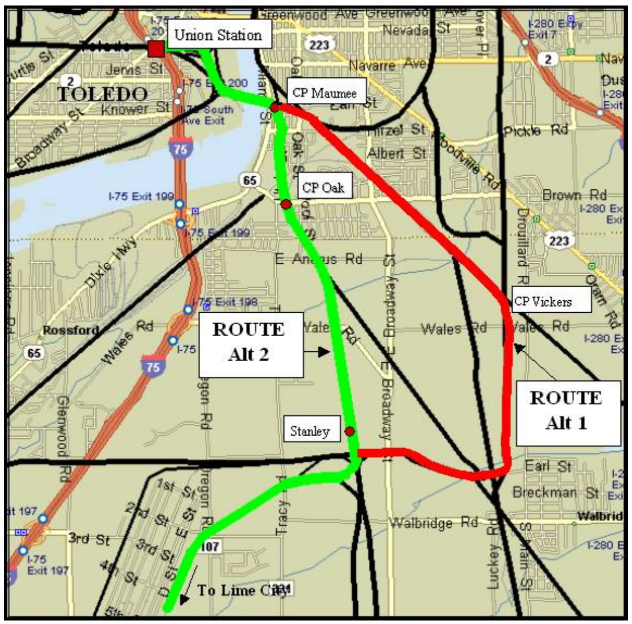
Segment Number	Segment Name	Railroad	Length (miles)	Modern Scenario Maximum Train Speeds (mph)	High-Speed Scenario Maximum Train Speeds (mph)
1	Dunkirk to CP Stanley	CSXT	57.2	79	110
2	CP Stanley to Vickers	CSXT	2.4	45	45
3	Vickers to Toledo	NS	3.5	60	60

Exhibit 2-60: Dunkirk to Toledo

Two route options, shown in Exhibit 2-61 exist from CP Stanley to the Toledo Union Station.

- **Route option 1** which was used as the basis for this report, would entail co-mingling with freight traffic on the Toledo Terminal railroad, joining the MWRRS corridor at Vickers and following the MWRRS alignment from the southeast into Toledo Union Station. The need for Columbus access would then enter into planning for the proposed passenger flyover at Vickers interlocking.
- **Route option 2** which was not evaluated would use the Miami Cut branch, that joins the NS mainline just east of the Maumee River. It would enter the NS corridor from the south side of the tracks. To get to the Toledo Union Station, any passenger train entering at that point would have to cross over both of the NS mainline tracks stopping all freight operations in both directions to make this crossover move.

Exhibit 2-61: Alternative Routes from CP Stanley into Toledo Union Station



However, it should be noted that additional options may exist for accessing a Toledo passenger station which go beyond the scope of this report.

- For example, as shown in Photo #167 an overhead rail bridge already exists at the junction of the Miami Cut branch with the NS mainline. It is possible that passenger trains using Route Option 2 might use this bridge to cross over the NS freight tracks, then turn west across the Maumee River on the proposed new passenger rail bridge, that would be several hundred feet north of the existing Maumee River railroad crossing.
- A second option may be to relocate the station platforms to the south side rather than the north side of the NS mainline tracks. Then the MWRRS dedicated track from Delta could be constructed on the south side rather than on the north side of the NS freight tracks. Shifting the passenger platforms to the south side of the freight tracks might make sense, since both the Fort Wayne and Columbus rail accesses naturally approach the station from the south. If Columbus trains used the Olive Branch, they would then only need to use one track to cross the existing Maumee River bridge and would not need to cross over both freight tracks, as they now need to do in order to access station platforms on the north side. Building the dedicated track on the south rather than on the north side would also appear to resolve the problem of getting through Airline Yard, although it may make passenger access to the CN's Detroit line more difficult.
- It should be noted that the proposed highway/rail grade separation project at Wales Road will make the design of the proposed Vickers rail flyover more complicated, especially if a requirement to connect to a Columbus passenger service were also added.

While the MWRRS recommendation to construct a dedicated passenger track on the north side of the NS freight line makes sense in the context of the current MWRRS plan, when Ohio Hub lines to Detroit and Columbus are added, additional operational and engineering considerations enter the picture. This report has developed a plan for connecting these additional Ohio Hub corridors into Toledo Union Station without changing the base MWRRS or previous Ohio Hub engineering assumptions. However, it is recommended that all access route alternatives be retained, and further explored in detail in order to develop a fully integrated and optimized plan to address all facility needs for both envisioned Ohio Hub and MWRRS rail passenger services.

Segment 1: Dunkirk to CP Stanley

The Scottslawn Sub track (now CSXT Toledo Branch Subdivision from CP Stanley at MP 4.0 to CP-82 south of Kenton) crosses the CSXT Fort Wayne Line at Dunkirk MP 61.2. CSXT reports that the Toledo Branch Subdivision is a single track with sidings and is not signaled with speeds limited to 50 mph. According to the 1993 Conrail track charts, the line is generally tangent between Dunkirk and Toledo except at Hancock and Findlay, allowing unrestricted speeds. TMACOG has determined that the Toledo Branch carries four trains per day in the Toledo area. This level of traffic is less than the line carried under Conrail operation, since CSX also has a parallel (ex-C&O) line from Toledo down to Columbus. North of Ridgeway, the planning assumption is that the existing single main track will be upgraded to FRA Class 6 to support comingled operation of passenger service with light-density freight. Exhibit 2-62 shows the cost of recommended improvements to this segment, which include:

- Install CTC and PTC signaling
- Install CWT and four quadrant gate grade crossing warning systems
- Upgrade the existing track to Class 6
- Construct one ten mile Class 6 passing siding to support freight and passenger service
- Install chain link fencing through populated areas including: Findley, Bowling Green and Perrysburg
- Construct a flyover to grade separate passenger service from the CSXT mainline at Galatea, and a second flyover to grade separate the NS mainline at Mortimer.

The main costs are $38.7 million for track, $60.8 million for signals and crossings, and $40 million for the flyovers at Galatea and Mortimer.

Exhibit 2-62: Segment 1 – Dunkirk to CP Stanley Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$37,283	30.06%	$38,670	25.72%	3.72%
Turnouts	$248	0.20%	$900	0.60%	262.90%
Curves	$1,662	1.34%	$1,662	1.11%	0.00%
Signals	$14,863	11.98%	$26,131	17.38%	75.81%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$2,430	1.96%	$6,171	4.10%	153.95%
Bridge-Over	$2,087	1.68%	$2,087	1.39%	0.00%
Crossings	$25,451	20.52%	$34,718	23.09%	36.41%
Segment Total	$84,024	67.75%	$110,340	73.39%	31.32%
Placeholders	$40,000	32.25%	$40,000	26.61%	0.00%
TOTAL	**$124,024**	**100.00%**	**$150,340**	**100.00%**	21.22%
Cost/Mile (57.2 Miles)	**$2,168**		**$2,628**		

Photo 142: CSX Toledo Branch, Sandusky Street at Findlay, OH – View South

Photo 142 shows a view of good track conditions on this line at Findlay, Ohio. Photo 143 shows the crossing of the low-density NS branch line at Findlay, OH. Since passenger train speeds will be limited by nearby curves within an urbanized area and the train station may be located nearby, the speed restriction imposed by the diamond crossing has minimal impact.

Photo 143: NS Lima Branch crossing at Findlay, OH – View North

Photo 144: NS Mainline Crossing at Mortimer, OH – View East

Photo 144 shows the crossing of the high-density NS mainline a little farther north at Mortimer. This view looks east along the NS mainline, showing the CSX line crossing. It is recommended to grade-separate this crossing to eliminate conflicts between passenger and NS freight trains. Photos 145 and 146 show views north and south along the CSX Toledo branch at Mortimer, showing no significant physical impediments to grade separating this crossing. In Photo 146, County Road 216 crosses the CSX line about 500 feet south of the NS diamond at Mortimer.

Photo 145: NS Mainline Crossing at Mortimer, OH – View North

Photo 146: NS Mainline Crossing at Mortimer, OH – View South

Photos 147 through 149 show the crossing of the Toledo branch with the CSX (former B&O) double tracked mainline at Galatea. There do not appear to be any serious physical impediments to grade separating this crossing.

Photo 147: CSX Mainline Crossing at Galatea, OH – View South along Toledo Branch

Photo 148: CSX Mainline Crossing at Galatea, OH – View West along CSX Mainline

Photo 149: CSX Mainline Crossing at Galatea, OH – View North along Toledo Branch

Photo 150: CSX Toledo Branch, Bowling Green, OH – View North

Photo 150 shows a view of good track conditions on the Toledo Branch in Bowling Green, OH. Photo 151 shows the CSXT Toledo Branch Subdivision at the Tracy Rd grade crossing, west of CP Stanley. Two tracks converge to a single track just to the west at the signal mast in the distance.

Photo 151: CSX Toledo Branch, Tracy Road Crossing – View West

Photo 152: CSX Toledo Branch, Tracy Road Crossing – View East

Photo 152 shows the view east at the Tracy Road crossing. The north track continues east to join the Toledo Terminal tracks at CP Stanley. The south track loops southeast to join the Miami Cut Branch also at Stanley. Under the assumed Route Alternative 1 in Exhibit 2-61, passenger service would operate on the north track to connect to the CSX Toledo Terminal railroad. Under Route Alternative 2, the south track would be used. Photo 153 shows a close up of the CSXT Toledo Branch Subdivision at the Tracy Rd grade crossing, west of CP Stanley. The north track is 127 lb continuous welded rail on timber ties and hard rock ballast. The 1940 rail is worn with flat spots and engine burns visible. Ties and ballast are in fair to good condition. Drainage has been maintained, evidence that the line sees relatively frequent use.

Photo 153: CSX Toledo Branch, Tracy Road Crossing – Close up of Track

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Segment 2: CP Stanley to Vickers

This route segment follows the CSXT Toledo Terminal railroad from CP Stanley to a junction with the NS Chicago mainline at Vickers. It is shown as Route Alternative 1 in Exhibit 2-61.
Freight traffic is very heavy on the Toledo Terminal Subdivision. According to recent timetables, maximum permissible freight speeds are generally 30 mph. Co-mingling of freight and passenger service will be required. Because of slow freight train speeds in the terminal area, maximum superelevation in the mainline track will be limited to 4 inches. As this is a very congested area, track improvements on the freight railroad owned property are assumed to be subject to general use by all traffic, subject to maintaining dispatching priority for passenger trains. It is not practical to have wide disparities in speeds between passenger and freight traffic in the congested terminal area. Exhibit 2-63 shows the cost of recommended improvements to this segment, which include:

- Upgrade existing CTC signaling for new track segments
- Install CWT gate grade crossing warning systems
- Construct Class 3 third track to support freight and passenger service for a design speed of 40-mph through the terminal area
- Construct a connection to the NS mainline new third track at Vickers
- Construct modifications to interlockings at Stanley, Waldbridge and Vickers

The main costs are $20.0 million for the added cost to the Vickers flyover structure to accommodate Columbus connectivity, and $6.0 million for the costs of modifications to the interlockings at Stanley, Walbridge and Vickers.

Exhibit 2-63: Segment 2 - CP Stanley to Vickers Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$2,909	9.04%	$2,909	8.95%	0.00%
Turnouts	$124	0.39%	$124	0.38%	0.00%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$1,223	3.80%	$1,223	3.76%	0.00%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$810	2.52%	$810	2.49%	0.00%
Bridge-Over	$0	0.00%	$0	0.00%	0.00%
Crossings	$1,130	3.51%	$1,450	4.46%	28.32%
Segment Total	$6,196	19.24%	$6,516	20.04%	5.16%
Placeholders	$26,000	80.76%	$26,000	79.96%	0.00%
TOTAL	**$32,196**	**100.00%**	**$32,516**	**100.00%**	0.99%
Cost/Mile (2.4 Miles)	**$13,415**	-	**$13,548**		

Photo 154: CSX Toledo Terminal, MP 19.0 – View East

Photo 154 shows the CSXT Toledo Terminal Subdivision at MP 19.0. The signal in the distance is the junction of the Toledo Branch Subdivision. Photo 155 and 156 show the Toledo Terminal at Broadway Road crossing between Stanley and Walbridge. Both main tracks are heavy weight continuous welded rail on good ties and ballast. The southernmost track is lighter weight and jointed and serves as a siding or industry track. Sufficient room exists for a third main track and crossovers to be added on the north side. TMACOG data indicates that the Terminal Railroad volumes are 30 trains per day at this point.

Photo 155: CSX Toledo Terminal, Broadway Road Crossing – View East

Photo 156: CSX Toledo Terminal, Broadway Road Crossing – View West

Broadway roadway crossing in Photo 156 is asphalt with gates and flashers. Freight speed is slow at 10-30 mph. Photo 157 shows that the north track of the Toledo Terminal railroad has 141 lb continuous welded rail on good ties and ballast.

Photo 157: CSX Toledo Terminal, Broadway Road Crossing – Close up of Track

Photo 158: CSX Toledo Terminal CTT MP 20.8, Walbridge Interlocking

Photo 158 shows the CSXT Toledo Terminal Subdivision at Walbridge CTT MP 20.8. This is a complicated interlocking with multiple turnouts and crossing tracks. The construction of additional capacity by adding a third track on the north side through this junction is necessary to achieve reliable passenger service. Photos 159 and 160 give additional views of the junction at Walbridge.

Photo 159: CSX Walbridge Junction CTT MP 20.8 – View East

Photo 160: CSX Walbridge Junction CTT MP 20.8 – View West

Photos 161 and 162 shows the CSXT Toledo Terminal at the Wales Rd crossing. Sufficient room exists between the power lines and the existing track to add a track from Walbridge to Vickers. The City plans to relocate and grade separate Wales and Drouillard Roads. Photo 161 looks north to the Vickers crossing at CTT MP 21.9 / Norfolk Southern MP 285.4, while Photo 162 looks south towards Walbridge. Photo 163 shows the track at the Wales Road crossing. Both main tracks are 136-lb continuous welded rail on good ties and ballast.

Photo 161: CSX Toledo Terminal, Wales Road Crossing CTT MP 21.7 – View North

Photo 162: CSX Toledo Terminal, Wales Road Crossing CTT MP 21.7 – View South

Photo 163: CSX Toledo Terminal, Wales Road Crossing CTT MP 21.7 – Close up of Track

Segment 3: Vickers to Toledo

Freight traffic is very heavy on the Norfolk Southern Cleveland-Chicago mainline. Vickers is a very busy crossing with trains in sight almost all the time. The existing maximum freight speed between Vickers and the Maumee River Bridge is 30 mph Both the MWRRI and Ohio Hub studies have proposed a flyover at Vickers. A Norfolk Southern freight and passenger flyover would allow the Columbus-Toledo passenger service to connect in the southwest quadrant with a new track on the west side of the CSXT Toledo Terminal Railroad, underneath the flyover, to tie into the north side of the Norfolk Southern Cleveland-Chicago mainline. Since the new track on the north side will serve the passenger trains almost exclusively, superelevation may be set to serve the passenger requirements. Exhibit 2-64 shows the cost of recommended improvements to this segment, which include:

- Upgrade existing CTC signaling for new track segments
- Install CWT gate grade crossing warning systems
- Construct Class 4 third track to support passenger service under MWRRI and Ohio Hub plans for a design speed of 60-mph
- Construct Vickers flyover to support passenger service under MWRRI and Ohio Hub plans
- Construct new Maumee River movable bridge to support passenger service under MWRRI and Ohio Hub plans

The main costs are $4.2 million for track, and $16.8 million for modifying highway overpasses and underpasses for the third track between Vickers and Toledo. The cost of the proposed new Maumee River bridge has already been reflected as part of the previous MWRRS plan.

Exhibit 2-64: Segment 3 - Vickers to Toledo Costs

Cost Category	Modern Scenario		High-Speed Scenario		% Change in Cost for the High-Speed Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$4,242	19.00%	$4,242	19.00%	0.00%
Turnouts	$0	0.00%	$0	0.00%	0.00%
Curves	$0	0.00%	$0	0.00%	0.00%
Signals	$1,153	5.16%	$1,153	5.16%	0.00%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$9,162	41.04%	$9,162	41.04%	0.00%
Bridge-Over	$7,612	34.10%	$7,612	34.10%	0.00%
Crossings	$155	0.69%	$155	0.69%	0.00%
Segment Total	$22,324	100.00%	$22,324	100.00%	0.00%
Placeholders	$0	0.00%	$0	0.00%	0.00%
TOTAL	**$22,324**	**100.00%**	**$22,324**	**100.00%**	0.00%
Cost/Mile (3.5Miles)	**$6,378**	-	**$6,378**		

Photo 164: CSX – NS Junction at Vickers – View across Southwest Quadrant, West towards Toledo

Photo 164 shows the crossing with the Norfolk Southern Cleveland-Chicago Mainline at Vickers, viewing west toward Toledo. Space exists on either side for additional tracks. Space also exists to construct a variety of alternative flyover structures. Photo 165 views east along the NS mainline, toward the Oakdale Yard turnout and the Stanley Secondary track, at the CP 286 crossovers. Sufficient space appears to exist on the north side to construct a third track at 14 ft centers. This track would connect to a new Maumee River bridge that would go directly into the Toledo passenger station platforms.

Photo 165: Norfolk Southern Cleveland-Chicago Mainline at CP 286 - View east

Photo 166: Norfolk Southern Cleveland-Chicago Mainline at CP 286 - View west

Photo 166 views west at the CP 286 crossovers. Photo 167 at the Miami Cut junction shows that sufficient space exists on the north side of the mainline to install a third track under the bridge at 14 ft centers. West of this point, the new passenger track must diverge to the north to access a new rail bridge over the Maumee River. This bridge must be far enough downriver so as not to interfere with operation of the existing railroad swing bridge over the Maumee.

Photo 167: Olive Secondary Track Bridge over the NS Cleveland-Chicago Mainline MP 287.5 – View east

Photo 168: Miami Cut branch diverging from the NS Cleveland-Chicago Mainline MP 287.5 – View east

If the Miami Cut branch, shown diverting on the right in Photo 168 were used by Toledo-Columbus passenger trains, the Olive Secondary overhead bridge might be used to grade separate the crossing of passenger trains to a new bridge or to reconnect to the NS mainline on the north side. Photos 169 and 170 show the Norfolk Southern Maumee River bridge. This two track bridge includes a swing span through truss on the east side of the river and multiple through truss spans to the west. The bridge is heavily used, requiring that a new high speed passenger rail service must consider constructing a new movable bridge across the river.

Photo 169: NS Maumee River Bridge, MP 287.6 – View West

Photo 170: NS Maumee River Bridge, MP 287.6 – View East

Photo 170 shows the Norfolk Southern Maumee River Crossing from the east. Space exists on the north side of the bridge to add a new swing span or bascule bridge, several hundred feet downriver from the existing bridge, for passenger service. Constructing the bridge on the north side would also allow relatively unobstructed access to the Amtrak station on the west side of the river. A bridge at the existing Norfolk Southern track level could serve both Cleveland and Columbus traffic from the Norfolk Southern Mainline alignment. An alternative higher level bridge could possibly serve Columbus traffic coming from the Olive Secondary and Cleveland traffic on the Norfolk Southern Mainline. These detailed track configuration options could be evaluated in more comprehensive studies. A new bridge would also require a new grade separation with, or rerouting of Miami Street which parallels the Maumee River on the east bank.

However, the Norfolk Southern often stops for a crew change at this point obstructing one of the two tracks on the bridge. If the crew change were relocated somewhere else in the Toledo terminal, this would improve bridge capacity and may eliminate the need for building a second Maumee River bridge.

2.13.1 Dunkirk to Toledo Capital Cost Summary

Exhibit 2-65 summarizes the total estimated costs for improving all three Dunkirk to Toledo segments. The final segment, from Vickers to Toledo, is shared with the MWRRS. The cost to improve the corridor under the Modern Scenario is $178.5 million or $2.8 million per mile. The cost to improve the corridor under the High-Speed Scenario is $205.1 million or $3.2 million per mile.

Exhibit 2-65: Dunkirk to Toledo Capital Cost Summary

Segment Number	Route Segment	Railroad	Maximum Design Speed	Miles	Modern Scenario		High-Speed Scenario	
					Capital Cost	Cost/ Mile	Capital Cost	Cost/ Mile
1	Dunkirk to CP Stanley	CSXT	110	57.2	$124,024	$2,168	$150,340	$2,628
2	CP Stanley to Vickers	CSXT	45	2.4	$32,196	$13,415	$32,516	$13,548
3	Vickers to Toledo	NS	60	3.5	$22,324	$6,378	$22,324	$6,378
TOTAL				**63.1**	**$178,544**	**$2,830**	**$205,180**	**$3,252**

Exhibit 2-65 (continued): Dunkirk to Toledo via Detroit Metro Airport Capital Improvements by Cost Category

Cost Category	Modern Scenario		High-Speed Scenario		% Increase in Cost for the High-Speed Scenario from the Modern Scenario
	Cost (1000s)	% of Total Segment Cost	Cost (1000s)	% of Total Segment Cost	
Trackwork	$44,434	24.89%	$45,821	22.33%	3.12%
Turnouts	$372	0.21%	$1,024	0.50%	175.27%
Curves	$1,662	0.93%	$1,662	0.81%	0.00%
Signals	$17,239	9.66%	$28,507	13.89%	65.36%
Stations/Facilities	$0	0.00%	$0	0.00%	0.00%
Bridge-Under	$12,402	6.95%	$16,143	7.87%	30.16%
Bridge-Over	$9,699	5.43%	$9,699	4.73%	-
Crossings	$26,736	14.97%	$36,323	17.70%	35.86%
Segment Total	$112,544	63.03%	$139,180	67.83%	23.67%
Placeholder	$66,000	36.97%	$66,000	32.17%	0.00%
TOTAL	**$178,544**	**100.00%**	**$205,180**	**100.00%**	**14.92%**

2.14 Capital Costs for Trainsets

The 2007 business plan update raised the demand forecast for some corridors, resulting in a recommendation to standardize the fleet using larger 300-seat trains costing $17.9 million each, the same trains as would be employed by the MWRRS. This purchase price was based on a 30 percent discount for a large volume purchase, while fleet standardization would provide additional opportunities for cycling equipment between both Ohio Hub and MWRRS routes.

In the 2007 study as discussed in Chapter 3, train operations were jointly optimized between the Ohio Hub and MWRRS. 33 trains would be needed for the three MWRRS corridors (Cincinnati, Cleveland and Detroit); after this, only 14 more trains would be needed add the four Ohio Hub corridors. (This assumes pooling equipment with MWRRS and a reduction of Toledo-Cleveland service to 10 daily round trips instead of the originally assumed 16.) Since these would be 300-seat trains, the fleet cost for the original Ohio Hub system is $250.6 million. Adding the three incremental corridors would require 11 more trains, bringing the total capital requirement to $447.5 million. For a 79-mph service using smaller 200-seats trains, the cost would be $350 million.

2.15 Costs for Access to Railroad Rights-Of-Way

Since its inception, Amtrak has had the statutory right to operate passenger trains over freight railroad tracks and rights-of-way. When using freight tracks, Amtrak is required to pay only avoidable costs for track maintenance along with some out-of-pocket costs for dispatching.
However, these payments do not cover all of the freight railroads' incremental costs associated with dispatching Amtrak's passenger trains. Railroad costs increase due to delays caused by Amtrak's tightly scheduled trains. Track capacity constraints and bottlenecks create unreliable conditions where train delays often become unavoidable. While federal regulations give passenger trains dispatch priority, railroad dispatchers often encounter congestion where it becomes difficult to control traffic and adhere to Amtrak's timetables. In some cases, Amtrak will offer the railroads a payment to provide on-time passenger train performance. On heavily used line segments, however, these incentive payments only partially compensate a railroad for the costs of increased delay, and some railroads simply refuse to accept incentive payments. On lightly used lines, the economic rationale for making these payments is questionable since passenger trains cause very little delay on such tracks.

Amtrak's payments do not include an access fee for the use of a railroad's tracks or its rights-of-way. Amtrak's federal statutory right-of-access has never required such a payment, and therefore, Amtrak avoids paying a fee or "rent" for occupying space on privately held land and facilities.

While Ohio Hub partner States may choose a different course, the final determination of what Ohio passenger rail interests will pay host freight railroads for use of their tracks and rights-of-way will ultimately be accomplished through negotiations. A placeholder fee is included in this report as a shadow cost for what future negotiations might yield.

The Ohio Hub Study assumes that a cost for access would be included as part of the up-front capital expense, and would be used to purchase the rights to use the underlying railroad rights-of-way for the passenger service. It is assumed that railroads would receive this compensation in cases where the construction of a dedicated high-speed passenger track is on their property. If new track cannot be constructed within the existing railroad rights-of-way, then this cost would fund the possible acquisition of adjacent property.

The outright purchase of the land is not the only method whereby railroads could receive compensation for access to railroad rights-of-way. Commuter rail development provides examples of various types of payments for access rights. Some of these projects involved the purchase of the railroad rights-of-way while others provide up-front capital improvements in return for access to a railroad's tracks. The actual methods of payment remain to be determined during negotiations, and may depend on the importance of the track to the freight railroad as well as the level of capital to be invested by the passenger rail authority.

One possible area of concern is the freight railroads' ability to retain operating control over their rights-of-way. Whenever transit systems have paid full price to acquire a freight rail line, as on some commuter rail projects, the transit agencies have assumed operating control over the property. The Ohio Hub Study assumes that the freight railroads would remain the primary user over the Ohio Hub railroad corridors and that they would retain control over these rights-of-way. The railroad would have the right to use the increased capacity provided by the passenger system for its high-speed freight services.

For budgetary purposes, the Ohio Hub Study assumes an "over the fence" methodology for appraising the maximum value of railroad rights-of-way. To estimate land costs, four land uses alongside each corridor were identified:

- *Rural* (i.e., farmland),
- *Suburban fringe* (i.e., areas in transition from farmland to new suburban development),
- *Suburban* (i.e., low-to-medium density residential and commercial/retail area), and
- *Urban* (i.e., high density residential, commercial, and industrial areas)

The value of a 50-foot wide right-of-way was established for each land use and the total land cost of the railroad corridor was estimated. The land value was increased by a factor of 1.2 to account for the advantage of a previously assembled corridor. The land cost on the Panhandle line is much lower than the other corridors because major sections are already owned by state agencies: 29 miles of bike trail from Walker's Mill to end of the track near Weirton Jct, and the 108-mile section from Mingo Jct to Newark that is owned by ORDC.

Exhibit 2-66 develops a land cost for each of the four original Ohio Hub corridors, with alternatives for the Cleveland-Detroit and Cleveland-Pittsburgh rail corridors; plus three "incremental" corridors added in 2007. For the original four-corridor system, costs for access to the railroad rights-of-way were estimated at approximately $230 to $233 million, depending which route alternatives are selected. Incremental corridors add another $87 million to this total, so the land costs for a fully built-out system would come to approximately $320 million.

Exhibit 2-66: Costs for Right-Of-Way
(Thousands of 2002$)

Corridor	Distance (miles)	Total	Cost/ Mile
Cleveland-Pittsburgh via Youngstown	140	$47,352	$338
Cleveland-Pittsburgh via Alliance	139	$47,012	$338
Cleveland-Detroit via Wyandotte	169	$55,624	$329
Cleveland-Detroit via Detroit Airport	176	$57,930	$329
Cleveland-Niagara Falls	207	$57,172	$276
Cleveland-Columbus-Cincinnati	258	$70,754	$274
Pittsburgh-Columbus via Panhandle	190	$13,922	$ 73
Columbus-Ft. Wayne via Dunkirk	155	$52,548	$338
Dunkirk-Toledo	63	$20,769	$329

2.16 Costs for Infrastructure, Equipment, and Right-Of-Way

Exhibit 2-67 develops the capital cost for the fully built out Ohio Hub system, based on the 2007 plan assumptions. Rather than sharing or allocating costs for line segments between the MWRRS and Ohio Hub, the 2007 plan update conservatively assumes that Ohio Hub will fund the full capital cost for the Cleveland to Toledo segment. The cost of Wayne Junction to Detroit is assumed to be funded by Michigan as part of MWRRS. The cost of the Cleveland to Berea segment is paid for by the 3-C corridor. The capital costs summary reflects the "Preferred Alternative" option 1 which reflects the Detroit Airport plus Youngstown alternative. Capital costs for the Wyandotte and Alliance alternatives were reported in the previous sections.

Exhibit 2-67: Total Capital Costs: Ohio Incremental Corridors System
(Thousands of 2002$)

System Configuration	Modern Scenario	High-Speed Scenario
Cleveland-Pittsburgh via Youngstown	$461,912	$484,968
Cleveland-Detroit via Detroit Airport	$540,490	$593,769
Cleveland-Niagara Falls	$603,915	$801,149
Cleveland-Columbus-Cincinnati	$660,977	$1,104,600
Pittsburgh-Columbus via Panhandle	$441,918	$488,216
Columbus-Ft. Wayne via Dunkirk	$426,006	$494,712
Dunkirk-Toledo	$178,544	$205,180
INFRASTRUCTURE SUB-TOTAL	**$3,313,762**	**$3,975,360**
Land	$320,447	$320,447
Maintenance Base	$18,973	$18,973
Train Fleet	$350,000	$447,500
GRAND TOTAL	**$4,003,182**	**$4,762,280**

2.17 Capital Cost Observations

For the purposes of advancing the financial and economic analysis, the 2004 study selected Option 1 – the Cleveland-Detroit via Detroit Metro Airport and the Cleveland-Pittsburgh via Youngstown routing, shared with MWRRS –as the most beneficial alternative. Adding the three incremental corridors onto this four-route system, as shown above in Exhibit 2-77, the overall capital cost projection would be $4.0 billion for a 79-mph system, or $4.9 billion for a 110-mph system. This includes the costs for the required rail infrastructure upgrades, land purchases and equipment purchase, and includes the full cost of the shared MWRRS line segments.

It is again important to mention here that this study does not formally recommend the advancement of specific route alternatives. Ultimately, the state DOT's will determine the level of analysis needed to make a final route decision; however, if federal funds are used, relevant National Environmental Policy Act (NEPA) procedures must be followed to obtain a federal "Record of Decision." Possible next steps in the project development process are described in Chapter 12. Other Capital Cost Observations include:

- The costs for the installation of Positive Train Control and improved grade crossing warning systems account for the majority of the additional costs of the High-Speed Scenario. The costs for building new 110-mph Class 6 track are not that much more than 79-mph track, although high-speed track does cost more to maintain when it is in operation.
- The cost differential for upgrading the 3C Cleveland-Columbus-Cincinnati route from 79-mph to 110-mph is significant because of the large number of highway/railroad grade crossings over this route. For most routes, the difference in cost between the Modern and High-Speed Scenarios is generally small and is due to the assumption that additional tracks would be added under both speed scenarios. In most cases, a 79-mph track was added for additional capacity along the routes evaluated under the Modern Scenario.
- The Cleveland-Detroit via Detroit Metro Airport alignment has the advantage of serving both the Detroit Metro Airport as well as the populous suburbs west of Detroit including Dearborn, MI. This alternative routing also has a lower capital investment, since it shares the Wayne Junction to Detroit route segment with MWRRS. Using the CSX avoids the higher costs associated with the expense for bypassing the River Rouge Yard and for accommodating heavy industrial switching activities on the Wyandotte alternative route over the CN railroad.
- Adding a third track to the Alliance line requires a larger capital investment for bridges and earthwork. The alternative route via Youngstown makes use of the abandoned or lightly used railroad rights-of-way, reusing existing bridges and avoiding the need for extensive grading. The geometric alignment of the Youngstown route is superior, allowing for up to 125-mph speeds over some stretches compared to a maximum 79-mph speed limit on the alternative route through Alliance. While the Youngstown alignment serves a larger population base, implementing the Alliance routing may still be less costly if it were possible to avoid triple-tracking the entire route.

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- The incremental corridors, except for a short segment of the CSX Scottslawn subdivision from Columbus to Ridgeway, mostly assume co-mingling with existing freight at 110-mph; whereas the original four Ohio corridors were built alongside freight mainlines and mostly relied on construction of new dedicated track. However, the costs for adding the incremental corridors include significant placeholder costs for capacity mitigation in the congested endpoint terminal areas, as well as for bike trail relocation along some segments.

The Ohio Hub shares approximately 128.4 route miles with the MWRRS system. The total cost of upgrading this shared track to Class 6, 110-mph track is estimated at $504 million. Of this $504 million, $233 million may be allocated to the MWRRS on a train frequency-basis; the balance of this cost, or $271 million, would be absorbed by the Ohio Hub System. The 2007 business plan update however, assumed that the Ohio Hub bears the full capital cost for its corridors, and these full costs are the ones reflected in the updated Cost/Benefit analysis.

2.18 State Cost Shares

For developing a state breakdown of the capital costs of proposed High Speed rail investments, a summary table has been developed that shows the three eastern MWRRS routes along with seven Ohio Hub corridors. Exhibit 2-68 details the capital cost by state for the fully built out Ohio Hub plus the eastern MWRRS system, based on 2007 plan assumptions. Exhibit 2-68 assumes that Ohio Hub will cover the cost of Cleveland to Toledo, so the capital cost of the MWRRS Cleveland line has been cut back to Toledo to eliminate the double-counting.

Exhibit 2-68: Infrastructure Capital Costs by State: Ohio Incremental Corridors + Eastern MWRRS System (Thousands of 2002$)

MWRRS CORRIDORS	Federal	Michigan	Indiana	Ohio	Pennsyl	New York	Canada	TOTAL
Michigan Lines	$453,500	$401,313	$22,665					$877,478
Chicago-Cincinnati[1]	$101,250		$354,400	$153,067				$608,717
Chicago-Toledo[2]	$101,250		$291,800	$316,077				$709,128
SUB-TOTAL MWRRS	$656,000	$401,313	$668,865	$469,144				$2,195,322
OHIO HUB CORRIDORS								
3-C[3]				$1,166,488				$1,166,488
Pittsburgh (Youngstown)				$406,342	$78,625			$484,967
Detroit (Metro Airport)[4]		$121,509		$367,205				$488,714
Niagara Falls [5,6]				$269,550	$164,014	$309,041	$58,544	$801,149
Panhandle				$305,637	$182,579			$488,216
Columbus-Ft Wayne[7]			$63,156	$431,555				$494,711
Dunkirk-Toledo				$205,180				$205,180
SUB-TOTAL OHIO HUB			$63,156	$3,151,957	$425,218	$309,041	$58,544	$4,129,425
STATE GRAND TOTALS	$656,000	$401,313	$732,021	$3,621,102	$425,218	$309,041	$58,544	$6,324,747

1- MWRRS assumed Ohio's share 50% of Cincinnati-Indianapolis segment. Nothing for Indianapolis-Louisville.
2- MWRRS Assumed a mileage-based proration on cost of Fort Wayne-Toledo segment
3- This 3-C cost includes 100% of the cost of Cleveland-Berea, which is later shared by the Detroit and MWRRS lines
4- Excludes costs for Wayne Jct-Detroit that have already been charged to MWRRS, but includes Toledo-Berea costs
5- Ohio Share 78% of Cleveland-Erie segment, based on 71 out of 91 miles
6- Pennsylvania Share 24% of Erie-Buffalo segment, based on 22 out of 91 miles
7- Indiana Share 33% of Fort Wayne-Dunkirk segment, based on 27 out of 83 miles

For the three eastern MWRRS routes, Exhibit 2-68 uses the cost allocations that were earlier developed in Section 12.8 of the MWRRS report. A significant share (29.9%) of the total investment requirement has been designated a Federal responsibility in the MWRRS report. This reflects the route mileage of the South-of-the-Lake corridor which, east of Grand Crossing, carries interstate passengers almost exclusively. Recognizing the critical role of the Chicago terminal for the success of the entire MWRRS plan and the significant interstate component of overall MWRRS ridership, development of Chicago access has been agreed by the MWRRS Steering Committee as a primary responsibility of the Federal government.

The total infrastructure cost of the Ohio Hub system is $4.13 billion. The costs for land, trains, and a maintenance base add 19%, bringing this total up to the $4.91 billion that is shown in Exhibit 2-67.

Ohio's share of infrastructure cost would be $3.15 billion, or 76% of the total Ohio Hub. The only corridors that Ohio can develop on its own would be the 3-C, Columbus to Toledo, and perhaps a portion of the Panhandle line from Newark into Columbus. All the other Ohio Hub corridors require the cooperation of other states, which accounts for the other 24% of the total Ohio Hub cost.

Ohio's share of the total investment for rail infrastructure would be $3.15 billion for Ohio Hub segments, and $0.47 billion for the MWRRS segments, coming to a total of $3.62 billion. Adding the 19% additive for land, trains and a maintenance base would bring Ohio's total cost to $4.31 billion. However, it is not anticipated that Ohio would have to cover all these capital costs out of its own budget, but that some level of Federal grant assistance would also be available.

It must be noted that all the costs in this report are expressed in $2002, and some costs may have risen significantly due to increased prices for input factors steel and concrete. These costs need to be brought up to a current year basis in a future phase of work.

3. Operating Strategies, Station Locations and Fleet Requirements

This section describes the key assumptions used to develop the passenger rail service scenarios and operating plans; it identifies potential station locations and it provides an assessment of equipment technologies and fleet requirements. The analytical framework uses the *TRACKMAN*™, *LOCOMOTION* ™ and *COMPASS*™ software programs (components of the *RightTrack*™ software system) in an interactive analysis to calculate train travel times, build corridor train schedules, and recommend train technology and rail system operating strategies. These results are used in Chapter 6 to identify the system operating costs. The Appendices provide additional detail on the *RightTrack*™ system.

3.1 Service and Operating Assumptions

One of the primary objectives of the study was to assess alternative service and speed improvements for the Ohio Hub corridors. Initially, three speed options were considered, 79-mph, 90-mph and 110-mph. However, based on preliminary study findings, the 90-mph speed option did not significantly improve ridership, revenue or travel time above the 79-mph improvements. Therefore, the 90-mph option was eliminated from further analysis, and the study focused primarily on the 79-mph Modern Scenario and the 110-mph High-Speed Scenario.

Corridor train timetables were developed for both the Modern and High-Speed Scenarios. The Alliance Corridor was evaluated only for 79-mph service. Based on the preliminary demand estimates for each of the potential station locations (discussed next) an optimal number of train frequencies were determined. The High-Speed Scenario, with its larger ridership, may be able to support higher train frequencies; however, in order to advance a fair comparison of the speed scenarios, both operating plans used the same number of daily train frequencies. The 79-mph scenario used smaller trains than the 110-mph in order to balance the capacity need.

In the 2004 analysis, proposed daily train service frequencies for the initial four corridors were:

- Cleveland-Toledo-Detroit Corridor (both alternatives) 8 daily round trips
- Cleveland-Pittsburgh Corridor (both alternatives) 8 daily round trips
- Cleveland-Erie-Buffalo-Niagara Falls-Toronto Corridor 5 daily round trips
- Cleveland-Columbus-Dayton-Cincinnati Corridor 8 daily round trips

In 2007, three additional "Incremental" corridors were added to the system:

- Pittsburgh-Columbus via Panhandle 4 daily RT / 8 RT west of Newark
- Columbus-Detroit via Toledo 8 daily round trips
- Columbus-Chicago via Fort Wayne 8 daily round trips

The 2007 analysis also adjusted train frequencies on shared segments, as shown in Exhibit 1-2 to rationalize Ohio Hub with MWRRS operations. A total of 10 daily round trips were needed from Fort Wayne to Cleveland and from Toledo to Detroit; and 14 daily round trips were needed from Fort Wayne to Chicago to handle forecast 2025 traffic volumes.

The assumptions used in developing the operating plans for both speed scenarios included:

- Two-minute station dwell times
- An equal number of express and local trains operating on each corridor
- One heavy-maintenance facility in Cleveland or a shared facility with the MWRRS, which is proposed for Waterford/Pontiac, Michigan
- Minimum 30-minute terminal station train turn-around times
- Train layover and train turn facilities along with light service and inspection facilities provided in Detroit, Cincinnati, Pittsburgh, Toronto, Buffalo and Columbus. Addition of the incremental corridors adds only the need for a layover facility at Newark, OH since not all the train frequencies on the Panhandle would go all the way through to Pittsburgh. Alternatively the four extra trains may be terminated at Zanesville instead of Newark if it were decided to develop a service extension to Zanesville.
- Connectivity between the rail stations and the airports

3.1.1 Corridor-Specific Operating Assumptions

Due to the unique characteristics and travel demand on each corridor, train schedules, as shown in the Appendix, were developed for the High-Speed Scenarios. These schedules suggest that some routes could be paired to develop direct run-through services, while other routes would utilize coordinated timed transfers. It must be understood that the schedules developed in the Appendix do not represent the only possible pairing of routes. Alternative pairing of the routes could also have been developed that would develop different sets of run-through services. Whenever a timed transfer is indicated, it would usually be possible to swap the trainsets to go to alternative destinations.[12] Rather than mixing and matching the train destinations, for minimizing passenger confusion, we assumed fixed route pairings so all the interconnections work the same way for every train every day.

Cleveland-Pittsburgh Corridor

- Express trains operate non-stop between Cleveland and Pittsburgh.
- All trains operate the full length of the corridor.
- As described in Chapter 2 - Engineering Assessment, a field review concluded that 110-mph service via the Alliance Alternative route was not feasible due to the vertical and horizontal curves on the alignment, space limitations of the right-of-way, and the heavy volume of Norfolk Southern freight rail traffic on the line. Therefore, the study did not advance a 110-mph rail High-Speed Scenario for the Alliance Alternative, but rather focused solely on the 79-mph Modern Scenario for this alignment.

[12] For example, the schedules assume that 3-C trains would run through from Cleveland to Cincinnati, and that Columbus-Pittsburgh Panhandle trains would be paired with Columbus-Chicago trains to produce a Pittsburgh-Columbus-Chicago run-through service. The schedules feature timed transfers in both directions so, for example, a rider from Newark, OH could make an across-the-platform transfer at Columbus to a connecting 3-C train. However,an alternative schedule design at Columbus could have swapped the trains, so trains from Pittsburgh via the Panhandle would head west to Cincinnati while the connecting train from Cleveland via the 3-C could continue on to Fort Wayne and Chicago.

- In the schedules developed for the Incremental Corridors network, the Cleveland-Pittsburgh line was paired with the MWRRS Cleveland line, resulting in some trains running all the way through to Chicago.

Cleveland-Detroit Corridor

- Express trains include stops at either one or both Cleveland and Detroit airports, depending on the time of day.
- All trains operate the full length of the corridor.
- More frequent service is provided in the morning and evening peak periods to accommodate commuter demand to and from the Detroit and Cleveland airports.
- Train timetables were designed to serve the heavier demand to and from the airports.
- In the schedules developed for the Incremental Corridors network, the Toledo-Detroit line was paired with the Toledo-Columbus line, resulting in a Columbus to Detroit run through service. These Detroit-Columbus trains have a timed cross-platform transfer in Toledo for connecting to both Fort Wayne and Cleveland.

Cleveland-Buffalo-Toronto Corridor

- Express service includes intermediate stops at Erie, Buffalo and Niagara Falls.
- Four trains per day operate in each direction the full length of the corridor, while the fifth train terminates in Buffalo.
- Thirty minutes were added for customs and immigration inspection at the US-Canada border
- Service between Niagara Falls, Ontario and Toronto reflects the current VIA Rail and Amtrak running times and service patterns. Following discussions with Canada's VIA Rail regarding service over the Niagara Falls-Toronto route segment, it was assumed that train speeds would not be increased and the existing train timetables would be used. As part of VIA Rail's "Fast" project, some service upgrades have been proposed between Hamilton and Toronto. However, future project development phases will need to fully engage VIA Rail and the Canadian National in an evaluation of potential capacity and infrastructure improvements between Niagara Falls, Hamilton and Toronto.
- In the schedules developed for the Incremental Corridors network, the Cleveland-Toronto line was paired with the 3-C corridor, resulting in a Cincinnati to Toronto run through service.

Cleveland-Columbus-Cincinnati Corridor

- Express service includes intermediate stops at Columbus and Dayton.
- All trains have a suburban stop at Cleveland Hopkins International Airport.
- Seven daily trains operate in each direction over the full length of the corridor, while the eighth train terminates in Columbus.

- In the schedules developed for the Incremental Corridors network, the Cleveland-Toronto line was paired with the 3-C corridor, resulting in a Cincinnati to Toronto run through service.

Columbus-Pittsburgh Corridor

- Express service includes intermediate stops at Steubenville, Newark and at Port Columbus airport.
- Four daily round trips operate the full length of the corridor; four other frequencies operate only from Columbus to Newark, which may optionally be extended to Zanesville.
- In the schedules developed for the Incremental Corridors network, the Columbus-Pittsburgh line was paired with the Chicago-Columbus line, resulting in some trains running all the way through to Chicago. Alternative schedule pairings at Columbus could provide single-seat service from Pittsburgh through to Cincinnati or Detroit.

Columbus-Fort Wayne-Chicago Corridor

- Columbus-Fort Wayne service runs through to Chicago using the MWRRS corridor
- Express trains stop at Marysville, Kenton[13], Lima, Fort Wayne and Gary.
- Most trains operate the full length of the corridor, a few mid-day frequencies utilize a cross-platform transfer to MWRRS trains at Fort Wayne.
- In the schedules developed for the Incremental Corridors network, this line was paired with the Columbus-Pittsburgh Panhandle route, resulting in some trains running all the way through from Chicago to Pittsburgh.

Columbus-Toledo-Detroit Corridor

- Columbus-Toledo service runs through to Detroit using the Toledo-Detroit segment that was a part of the original Ohio Hub evaluation
- Express trains stop at Marysville, Kenton, Findlay, and Bowling Green on their way to Detroit.
- Peak hour trains operate the full length of the corridor, some mid-day frequencies may utilize a cross-platform transfer to Cleveland-Detroit trains at Toledo.

3.2 Potential Station Locations

Based on an assessment of the prospective rail demand, the study identified the general locations for potential stations along all of the Ohio Hub corridors. On the average, station spacing on a high-speed rail system should be limited to one stop every 30-60 miles. More station stops will increase travel times, decrease average train speeds and cause the service to be less competitive.

[13] Kenton is a county seat and the biggest nearby town. In preliminary schedule development we have assumed that all trains will stop there, but this can be revised in future phases of planning.

It should be noted that, consistent with the assumptions made in earlier Ohio Hub studies and in the MWRRS, the capital costs assumes that stations will be developed jointly between the rail system and the communities they serve. The rail capital costs for stations include only the facilities that are required for rail operations, primarily the cost of platforms. It is assumed that the stations themselves will be provided by the local communities, and that their investment will be supported by joint commercial development, shared transit use or other funding sources.

Passenger rail stations would be located in downtown centers, in suburban areas near interstate highways and adjacent to the Detroit and Cleveland international airports. The primary means of accessing stations would be by automobile, public transit, or by walking. Stations would have automobile drop-off areas and long-term parking lots. Most stations would be served by taxis, regional transit, feeder bus and shuttle bus operators. Downtown stations would be within walking distance to major trip generators and employment and activity centers.

The identification of specific station locations is beyond the scope of this study and sites will be selected in future project development phases. Local governments, business interests and citizens groups would be involved in the station location planning and design process.

Thirty-two potential Ohio Hub rail stations were identified as part of the original 2004 route system. An additional twelve stations were added by the Incremental Corridors in 2007. These stations are in various phases of planning and development. In a few instances, the local governments have made commitments to their existing Amtrak stations and this study assumes that Ohio Hub trains will continue to stop at these facilities. Other communities, without Amtrak service, have not conducted station location planning efforts simply because there has not been a need. Potential station stops and locations are identified in Exhibit 3-1.

Exhibit 3-1: Potential Station Locations
Cleveland-Pittsburgh Alternative Routes

Youngstown Route Potential Station Locations	Alliance Route Potential Station Locations	Potential Station Location
Cleveland, Ohio	Cleveland, Ohio	Existing lakefront Amtrak station location. Proposed North Coast Transportation Center.
Southeast Cleveland	Southeast Cleveland	Potential alternative locations in Hudson or Macedonia. Station location study needed.
Warren, Ohio	--	Potential alternative sites in downtown. Station location study needed.
--	Alliance, Ohio	Potential station locations in downtown. Station location study needed.
Youngstown, Ohio	--	Potential station locations in downtown. Station location study needed.
--	Salem/Columbiana, Ohio	Station location study needed.
North Pittsburgh, Pennsylvania	--	Potential alternative station locations in New Castle. Station location study needed.
--	North Pittsburgh, Pennsylvania	Potential alternative station locations in Beaver Falls, New Brighton or Rochester. Station location study needed.
Pittsburgh, Pennsylvania	Pittsburgh, Pennsylvania	Existing Amtrak station site in downtown Pittsburgh.

Cleveland-Toledo-Detroit Alternative Routes

Wyandotte Route Potential Station Locations	Detroit Metro Airport Route Potential Station Locations	Potential Station Location
Cleveland, Ohio	Cleveland, Ohio	Existing lakefront Amtrak station location. Proposed North Coast Transportation Center.
Cleveland Airport, Ohio	Cleveland Airport, Ohio	Adjacent to Cleveland Hopkins Airport Terminal. Station location study and airport planning needed.
Elyria, Ohio	Elyria, Ohio	New downtown location at the locally owned New York Central Station.
Sandusky, Ohio	Sandusky, Ohio	Existing Amtrak station location.
Toledo, Ohio	Toledo, Ohio	Existing Toledo Central Union Terminal.
Monroe, Michigan	--	City identified site on CSX, station location study needed.
--	Monroe, Michigan	Monroe, Michigan / Station site proposed at 1107 W. Seventh Street by Monroe County Planning Commission
Wyandotte, Michigan	--	Station location study needed.
--	Detroit Airport, Michigan	Possible site near south entrance of airport at Eureka Road or an alternative site near the north entrance of airport at Merriman Road. Shuttle bus connection required. Station location study needed.
--	Dearborn, Michigan	Existing Amtrak station site.
Detroit, Michigan	Detroit, Michigan	Existing Amtrak station site at Detroit New Center Station.

Cleveland-Erie-Buffalo-Niagara Falls-Toronto

Proposed Stations	Potential Station Locations
Cleveland, Ohio	Existing lakefront Amtrak station location. Proposed North Coast Transportation Center.
Northeast Cleveland, Ohio	Potential alternative locations in Euclid, Mentor or Painesville. Station location study needed.
Ashtabula, Ohio	Station location study needed.
Erie, Pennsylvania	Existing Amtrak station location in downtown.
Dunkirk, New York	Station location study needed.
Buffalo, New York	Potential station in downtown. Alternative station location site at Railroad Wye (see text).
Niagara Fall, New York	Existing Amtrak station or new station location study needed.
Niagara Falls, Ontario	Existing VIA Rail and Amtrak station location.
Hamilton, Ontario	Existing VIA Rail and Amtrak station location.
Oakville, Ontario	Existing VIA Rail and Amtrak station location.
Toronto, Ontario	Existing VIA Rail and Amtrak station location.

Cleveland-Columbus-Dayton-Cincinnati

Proposed Stations	Potential Station Locations
Cleveland, Ohio	Existing lakefront Amtrak station location. Proposed North Coast Transportation Center.
Cleveland Airport, Ohio	Adjacent to Cleveland Hopkins Airport terminal building. Station location and airport planning needed.
Galion, Ohio	Preliminary station sites identified, additional study needed.
North Columbus, Ohio	Preliminary station sites identified, additional study needed.
Columbus, Ohio	Proposed station location between High and Front Streets
West Columbus, Ohio	Not a part of the original 3-C study, but recently proposed in order to support development in the New Rome area. Additional study needed.
Springfield, Ohio	Preliminary station locations identified, additional study needed.
Dayton, Ohio	Preliminary station sites identified, additional study needed.
Middletown, Ohio	Station location study needed.
North Cincinnati, Ohio	Station location study needed.
Cincinnati, Ohio	Station location study underway by City of Cincinnati. Alternative downtown locations under evaluation.

Pittsburgh-Newark-Columbus

Proposed Stations	Potential Station Locations
Pittsburgh, Pennsylvania	Existing Amtrak station site in downtown Pittsburgh.
Carnegie, PA	If the Panhandle alignment is selected, at Carnegie West Busway stop on Mansfield Boulevard and West Main Street; if W&LE is chosen, then near the Bell Avenue West Busway stop near Bell Avenue and Arch Street.
Steubenville, OH	If the Panhandle alignment is selected, in downtown Steubenville; if W&LE is chosen, the station would have to be in the Mingo Junction area, just east or west of the Coen Tunnel; perhaps at Cool Spring Road about 4 miles south of downtown Steubenville. A more detailed station location study is needed.
Coshocton, OH	Station location study needed.
Newark, OH	Trains from both Zanesville and Pittsburgh could potentially stop at the historic PRR station at 25 East Walnut Street.
Port Columbus Airport	Adjacent to Port Columbus Airport. A shuttle bus or airport people mover may be needed to link to airport terminal. Station location study and airport planning needed.
Columbus, Ohio	Proposed station location between High and Front Streets

Columbus-Fort Wayne through to Chicago

Proposed Stations	Potential Station Locations
Columbus, Ohio	Proposed station location between High and Front Streets
Northwest Columbus, Ohio	Potential suburban stop in Hilliard or Dublin, location study needed.
Marysville, Ohio	Station location study needed.
Kenton, Ohio	Station location study needed.
Ada, Ohio	Possible local service stop for Ohio Northern University, additional study needed.
Lima, Ohio	Existing former Amtrak station site in downtown Lima.
Fort Wayne, Indiana	Existing former Amtrak station site in downtown Fort Wayne.

Columbus-Toledo through to Detroit

Proposed Stations	Potential Station Locations
Columbus, Ohio	Proposed station location between High and Front Streets
Northwest Columbus, Ohio	Potential suburban stop in Hilliard or Dublin, location study needed.
Marysville, Ohio	Station location study needed.
Kenton, Ohio	Station location study needed.
Findlay, Ohio	Station location study needed.
Bowling Green, Ohio	Station location study needed.
Toledo, Ohio	Existing Toledo Central Union Terminal.

Cleveland Stations

The Cleveland metropolitan area would have one downtown station and three potential suburban stops.

- It is assumed that the downtown Cleveland station would be the hub of the Ohio and Lake Erie Regional Rail system. The stations would be served by trains from all four Ohio Hub corridors, along with the MWRRS Chicago-Cleveland corridor. This study assumes that the downtown Cleveland station would be located on the lakefront near the existing Amtrak station. The station layout, track and platform configuration should provide enough capacity for train operational flexibility and will need to accommodate easy passenger transfers between corridor services. Four tracks with two center platforms would offer the greatest operational flexibility for Ohio Hub train operations. The Greater Cleveland Regional Transit Authority's 1998 Intermodal Hub Study evaluated alternative sites for Cleveland's lakefront North Coast Transportation Center, and the recommended site is assumed for this study. A Northeast Ohio Commuter Rail Feasibility Study also recommended this site. However, a commuter rail operation serving the Cleveland area will create additional demands for space at the Cleveland terminal. Station design and operations will need to be studied in greater detail in future project development phases.

- A suburban station at the Cleveland Hopkins Airport would be served by three lines: Ohio Hub trains to Detroit, Ohio Hub trains to Columbus and Cincinnati and MWRRS trains to Chicago. The rail station should be located immediately adjacent to the airport terminal. An elevated pedestrian bridge could provide a direct connection between the rail station and the terminal.
- A suburban station in northeast Cleveland, on the line to Buffalo, could be located in either the Euclid, Painesville or the Mentor areas
- A suburban station in southeast Cleveland on the line to Pittsburgh could be located in the Macedonia or Hudson areas

Columbus Stations

The Columbus metropolitan area would have one downtown station and up to four suburban stops. The "Incremental" corridors would add direct rail routes to Pittsburgh, Toledo, Chicago, and possibly to Indianapolis. A downtown station would be served by trains from as many as six directions, so Columbus would become a second major hub in the Ohio rail system.

- This study assumes that the downtown Columbus station would be located between High and Front Streets. There is an alternative station site slightly farther west along the Buckeye line in the approximate vicinity of the CP Hocking rail junction. Any station location along the Buckeye Line between High Street and Neil Avenue may require reconfiguring and/or reconstructing the Convention Center roadway and pedestrian overpasses. Finally, a rail station directly under the Civic Center as planned in the early 1980's High Speed rail studies may also be a possibility, but because of the tight space restrictions east of CP-138, a passenger station there would probably be feasible only if all daytime freight trains were rerouted out of the downtown area.
- A suburban station at the Port Columbus Airport would probably be located at the south side of the airport terminal and need to be linked to the main terminal by a shuttle bus connection. If all four western rail connections were built, there will be a directional imbalance of trains from the west that will need to terminate in Columbus. There would be up to 32 trains a day coming from the west but only 16 trains going east. Grandview Yard near downtown on the Buckeye line was previously identified by ORDC and local planners as a possible place to do HSR staging and perhaps trainset maintenance. However, in the context of incremental corridors development, a second possibility may be to run trains through to the airport instead of terminating trains in downtown Columbus. If a train maintenance and turnaround facility were built at the airport instead of at Grandview, all trains originating from Columbus might in fact start out from there, rather than from downtown Columbus. Further study is needed to determine the best location for a Columbus-area train maintenance base and to take the appropriate steps that are needed for site preservation.
- A suburban stop in North Columbus has always been envisioned by the 3-C plan. Additional stations at west Columbus on the 3-C line in the New Rome area, as well as in northwest Columbus on the Toledo line at Hilliard or Dublin, have been proposed by this

study. It is important to note that the suburban stations need to be included in the express as well as local train stopping in order for these stations to be effective. If not enough trains stop at the suburban stations, then passengers will have more of an incentive to drive their cars downtown rather than to use the suburban stops. Suburban stops also need to be reasonably accessible to major interstate highways.

Toledo Station

- With addition of a direct rail link from Toledo to Columbus, the Toledo station would become a third major hub on the Ohio Hub system. It would support through rail services and cross-platform transfers not only east-west from Cleveland to Chicago on the MWRRS corridor; but also Ohio Hub services from Detroit to both Cleveland and Columbus. In the future, development of an Indiana rail service from Detroit through Toledo, to Fort Wayne, Indianapolis and Louisville has also been suggested.
- With all these possibilities, it is important that the Toledo station be located so all these passenger services can be developed, as well as to minimize conflicts with freight operations. It has been noted in Chapter 2 that shifting the platform tracks to the south side of the freight tracks may reduce conflicts with freight trains, but it is also noted that the current Toledo station is located a considerable distance from the Toledo CBD. A downtown site near that of the former PRR station might offer better joint development opportunities, but rail access would be more difficult than at the existing site. It is suggested that both alternatives may be considered in future station location studies.

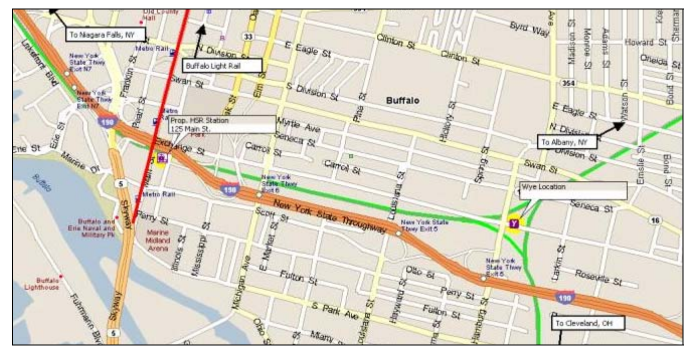
Buffalo Station

The City of Buffalo is actively pursuing the development of a new Intermodal Transportation Center next to Amtrak's current Exchange Street Station. The Exchange Street Station is located in Buffalo's central business district (CBD) near the existing light rail transit system.

From a rail operations point of view, the Exchange Street location is not ideally situated on CSX's Chicago-Albany mainline, which passes about one mile east of the Buffalo CBD, but is instead located on the branch line to Niagara Falls, as shown in Exhibit 3-2. This causes operational problems for long distance trains such as Amtrak's *Lake Shore Limited.* The *Lake Shore* cannot serve the Exchange Street station without backing into or out of the station. Moreover, all future long distance passenger trains, operating between New York, Boston, Albany, Cleveland and Chicago would be required to make this time consuming back-up move to serve the Exchange Street station. Amtrak generally discourages station operations that involve back up moves, unless they occur at a terminal station. The Exchange Street station location would *not* cause train operational problems either for the Cleveland-Buffalo-Niagara Falls-Toronto service or for the existing Amtrak service over the Toronto-Niagara Falls-Buffalo-Albany-New York route.

An alternative to using the Exchange Street station in downtown Buffalo would be to locate a new station inside the railroad wye, where the three intercity rail corridors converge. All future regional and long distance passenger rail services will pass through the wye including trains that run between Cleveland-Buffalo-Niagara Falls; Albany-Buffalo-Niagara Falls; and Albany-Buffalo-Cleveland. This may become more important in the future as a means of improving connectivity to Empire Service if it is desired to through-route any Ohio Hub trains with Empire Corridor services in the future. In this case however, it would be valuable to extend the Buffalo light rail system to connect with the new station site. The railroad wye is located approximately one mile from the downtown as illustrated in Exhibit 3-2.

Exhibit 3-2: Site of Buffalo, NY Station at Exchange Street and the Wye Site



Niagara Falls Station

Niagara Falls, New York has proposed to relocate that city's passenger rail station to the old "Customs House" site at the US/Canada border. Currently, the Amtrak station is located in a former rail freight warehouse, three miles from the central business district on an inconsequential, industrial side street, remote from the commercial area or any public transit line. US Customs and Immigration would also relocate to the new station complex. Bringing these functions into one station complex would eliminate the need for trains to make a second stop for border clearance.

Train delays of an hour or more at the border are not rare. Moreover, delays are unpredictable and frequently cause late departures. Moving the Customs/Immigration functions into a new facility is not expected to change procedures. On-board inspection while the train is underway, rather than when stopped at the border, is needed to reduce the delays substantially. Unfortunately, the Department of Homeland Security has given no commitment to making such a change since they prefer to operate out of fixed facilities. Accordingly, border delays are likely to continue. An alternative for pre-clearing rail passengers headed into the US by establishing fixed facilities at the Toronto and Hamilton train stations are more fully discussed in Chapter 4.

3.3 Train Technology Assumptions

Key elements of the operating plan have significant implications for the procurement of rolling stock. The operating plan has been developed to accommodate the requirement for fast, frequent and reliable service with minimal delays for station stops or equipment servicing. The most important characteristic of the operating plan is the overall train travel time. Travel times are directly dependent upon train technology because differences in design can improve train performance by increasing rates of acceleration and braking, increasing operating speed and permitting higher speeds through curves.

The development of a North American passenger rail industry will benefit from many years of advanced rail technology development in Europe and Asia. This technology is available for North American applications and could be used to upgrade equipment fleets throughout the country. Over the past few years, domestic high-speed rail has become a reality with the introduction of Amtrak's Acela technology in the Northeast Corridor and the new Spanish Talgo trainsets currently in operation in the Pacific Northwest. Amtrak, the FRA and Bombardier have worked together to develop an Advanced Turbine Locomotive, the JetTrain. This gas turbine technology is capable of speeds up to 150-mph and does not require the expensive electrification of the corridor infrastructure. Several electrified very high-speed intercity rail systems operate at even higher speeds throughout the world.

One factor that determines transit time is a passenger car's "tilt" or "non-tilt" design. Tilting equipment is especially advantageous for increasing train speed on existing tracks. Onboard hydraulic systems (*active tilt*) or car suspension designs (*passive tilt*) lower the centrifugal forces felt inside cars. This allows trains to operate at higher speeds through curves, reducing transit time. Applications include Talgo's pendular passive tilting system, which allows commercial speeds of up to 125-mph, and the Acela/JetTrain design with an active tilting system and commercial speeds of 150-mph. Talgo has recently developed a new integrated tilting trainset, the Talgo-XXI, which includes the locomotives and passenger cars.

Another factor to consider when determining the suitability of train technology used in the Ohio Hub System is compliance with Federal Railroad Administration (FRA) safety requirements. The FRA has what is called *Tier 1* safety requirements that pertain to all passenger trains operating up to a maximum speed of 125-mph. More stringent *Tier 2* requirements are applied to passenger trains operating in excess of 125-mph, up to 150-mph. Given these determinants several passenger locomotives and car technologies have been evaluated including self-propelled Diesel Multiple Units (DMU), similar to the Adtranz IC3 Flexliner. DMUs are self-propelled trainsets where the locomotive diesel power engine is integrated into the passenger cars. Exhibit 3-3 illustrates the various train technologies that are available. All technologies are non-electric, powered either by diesel engines or by gas turbines. Integrated trainsets, which do not allow coupling or uncoupling individual cars (except in the repair shop) are listed separately from locomotives that can operate with a variety of passenger car types.

Exhibit 3-3: Available Technologies:
Trainsets

	Maximum Operating Speed	Steerable Bogie	Tilting	Status	Tier 1 Compliance
Bombardier DMU Voyager	125-mph	No	Yes	In Service (UK)	No
Bombardier DMU Flexliner	110-mph	No	No	In Service (DK)	No
Bombardier/Siemens DMU ICE TD	125-mph	No	Yes	In Service (Germany)	No
Siemens American Cities Express	110-mph	Yes	Yes	Under Development	Under Development
Talgo XXI	125-mph	Yes	Yes	Testing	Testing

Locomotives

	Maximum Operating Speed	Steerable Bogie	Tilting	Status	Tier 1 Compliance
Bombardier Advanced Turbine Locomotive	150-mph	No	No	Testing	Yes
General Electric P42	110-mph	No	No	In Service (US)	Yes
General Motors F59	110-mph	No	No	In Service (US)	Yes
General Motors/Siemens DE30AC	100-mph	No	No	In Service (US)	Under Development
Siemens Rh2016	90-mph	No	No	Testing	Yes

Passenger Cars for Locomotives

	Maximum Operating Speed	Steerable Bogie	Tilting	Status	Tier 1 Compliance
Amtrak Horizon Type Cars	110-mph	No	No	In Service (US)	Yes
Bombardier Acela Express	150-mph	No	Yes	In Service (US)	Yes
Bombardier Push Pull Coach	79-mph	No	No	In Service (US)	Yes
Siemens American Cities Express Cars	110-mph	Yes	Yes	Under Development	Under Development
Talgo TPU	125-mph	Yes	Yes	In Service (US)	Yes

The MWRRS has compared three different train technologies and determined that any of the three – IC Flexliner DMU, JetTrain, Talgo – could perform within the required operational parameters. A life cycle cost analysis verified that two of the three technologies could operate within the cost parameters of the initial MWRRI business plan. It was therefore determined that the MWRRI operating and financial plans should adopt the conservative posture of the higher-cost technology of the two that met the financial criteria, specifically - the Talgo passive tilt technology.

The Talgo XXI, "generic train" was also assumed for the Ohio Hub Study. Because this technology is slightly slower than the DMU on most corridors, the ridership and revenue forecasts are also more conservative than if the better performing DMU had been selected. Selecting a generic, Talgo-type train for the Ohio Hub operating and financial plans does not suggest that Talgo would be selected for the Ohio Hub operation. Rather, this selection increases the flexibility for choosing a technology, because multiple manufacturers and technologies will be able to meet the broader performance parameters provided by this conservative approach.

3.3.1 Train Consist Assumption

The Talgo XXI was assumed as the "generic" train technology for both the High-Speed and the Modern Scenarios.

- A six-car Talgo XXI train, with its smaller, articulated cars would provide total seating capacity of 194, plus four wheelchair positions. Each train would have four coaches with 36 seats per car, plus two handicapped-accessible coaches with 25 seats and two wheelchair positions. These trains were assumed to cost $14.0 million each, consistent with a 30% discount that was assumed for a volume-purchase of the trainsets.
- An eight-car Talgo XXI train with seven regular coaches with 36 seats per car, and two handicapped accessible coaches with 25 seats, would provide a capacity of 302-seats. These trains cost $17.9 million each, based on the same volume-purchase assumption.

The 2004 Ohio Hub study assumed a mixture of 194-seat and 302-seat trains on different corridors. However, because of the higher connecting ridership developed by the Incremental corridors and adjustments made to some of the ridership forecasts in this business plan update:

- For the 110-mph High Speed scenarios, this study recommends deployment of large 302-seat trains on all the Ohio Hub corridors, the same trains that were recommended by the MWRRS study.
- For the 79-mph "Modern" scenarios since train frequency was held constant, smaller 194-seat trains were assumed instead to reflect the lower forecast ridership for this slower service. This smaller train may also be used during ramp-up and for a stand-alone 3-C operation, until traffic levels rise enough to require the larrger 302-seat train.

3.3.2 Other General Rolling Stock Service and Operational Requirements

The following general assumptions have been made regarding the operating requirements of the rolling stock:

- Train consists 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 consist 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 train may include a bistro area where food service can be provided during times when they are not passing through the train with the trolley cart.[14]
- On-board space is required for stowage of small but significant quantities of mail and express packages.
- 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.

[14] Amtrak recently introduced food cart service on some of its trains. See: http://www.unitedrail.org/2007/03/26/this-week-at-amtrak-2007-03-23/ The article states that, "Most short distance Empire Corridor trains are without food service; rolling food carts have been tested and performed well financially, allegedly nearly breaking even. It's interesting to note that a rolling food cart up and down the aisles of coaches, which requires one employee to man, does better than one employee offering food service from a standing position behind a counter. This seems to be a question that needs further investigation." However, the finding that food trolley cart service does better financially than a bistro car is consistent with the experience of rail operators in Europe and elsewhere.

- 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.

3.4 Operating Plans and Train Performance

A Train Performance Calculator was used to determine train running times for each corridor. The program used route and train performance characteristics to estimate running times and levels of service for both the Modern and High Speed Scenarios. The TEMS *LOCOMOTION*™ Train Performance Calculator is described in the Appendices. To guarantee a high level of reliability in "on-time" performance, extra time, referred to as *recovery time*, was incorporated into each operating plan. Recovery time is a cushion in the schedule to allow for minor delays en route due to freight traffic congestion along the line, mechanical difficulties, weather factors, temporary speed restrictions or other operating difficulties. Because differences in freight traffic levels vary by segment, recovery time percentages are not assumed to be uniform. For corridors with a higher level of freight congestion, more recovery time was allowed. As shown in Exhibit 3-4, most of the recovery time allotments varied between five and eight percent. The exception is the Pittsburgh corridor via Alliance, where high levels of existing freight rail traffic resulted in a higher (ten percent) recovery time.

Exhibit 3-4: Summary of Recovery Time

Corridor	Segment Description	% Recovery Time
Cleveland-Detroit (Wyandotte Alternative)	Cleveland-Toledo	8%
	Toledo-Detroit	7%
Cleveland-Detroit (Detroit Metro Airport Alternative)	Cleveland-Toledo	8%
	Toledo-Wayne	7%
	Wayne-Detroit	5%
Cleveland-Pittsburgh (Youngstown Alternative)	Entire Segment	5%
Cleveland-Pittsburgh (Alliance Alternative)	Entire Segment	10%
Cleveland-Buffalo-Toronto	Cleveland-Niagara Falls, ON	8%
	Niagara Falls, ON-Toronto	VIA Rail Timetable
Cleveland-Columbus-Cincinnati	Entire Segment	8%
Pittsburgh-Columbus via Panhandle	Entire Segment	7%
Columbus-Fort Wayne	Entire Segment	7%
Columbus-Toledo	Entire Segment	7%

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Exhibit 3-5 summarizes travel times for the Modern and High-Speed Scenarios and provides a comparison with existing travel time for bus and rail. Rail offers significant travel time improvements in all corridors when compared with existing or historical rail and bus services. For example the 1950's PRR schedule for Pittsburgh-Columbus was 4 hours, but Greyhound bus now offers a 3:25 timing. The proposed 79-mph rail schedule would be identical to PRR's, whereas the improved 110-mph schedule could be 45 minutes faster. The rail schedule would need to be faster in order to compete with express bus service on I-70 or with auto. More travel time improvements occur over longer corridors, such as Cleveland-Toronto and Cleveland-Cincinnati. Average train speeds (57-mph and 73-mph respectively) in the High Speed scenario would be competitive with automobile speeds. In general, Modern scenario schedules are not time competitive with auto. It should be noted that auto travel times do not include delays due to traffic congestion. By including these delays, the Ohio Hub revenue and ridership projection could be significantly increased.

Exhibit 3-5: Local and Express Train Travel Times
Modern and High-Speed Scenarios
Comparison to Existing Rail or Bus Services

Corridor	Existing Rail or Bus Service	Modern Scenario		High-Speed Scenario		Travel Time Savings *	
		Local	Express	Local	Express	Local	Express
Cleveland-Detroit (Detroit Airport)	No Service	3:10	2:46	2:47	2:23	0:23	0:23
Cleveland-Buffalo-Toronto	8:30	5:35	5:21	5:20	4:53	0:15	0:28
Cleveland-Pittsburgh (Youngstown)	4:30	2:36	2:15	2:24	2:02	0:12	0:13
Cleveland-Columbus-Cincinnati[1]	5:15	4:27	4:07	3:49	3:28	0:38	0:39
Pittsburgh-Columbus	3:25	4:00	3:50	3:15	3:05	0:45	0:45
Columbus-Ft Wayne	No Service	2:40	2:30	2:10	2:00	0:30	0:30
Columbus-Toledo	3:15	2:50	2:40	2:25	2:10	0:30	0:30

Notes:
*Savings from the High-Speed Scenario versus the Modern Scenario.
1. Existing Service includes all public transportation (Amtrak, bus thruway service and a combination of both) available in the study area.
2. The Alliance Alternative under the High-Speed Scenario was determined infeasible based on field inspection of the alignment.
3. Cleveland-Columbus-Cincinnati corridor with the Modern Scenario was estimated using the *Cleveland-Columbus-Cincinnati High-Speed Rail Study*.

Based on the corridor operating plans, Exhibit 3-6 summarizes travel times between major city-pairs and shows the average operating speed for trains under the High-Speed Scenario (110-mph). Note that travel times varied based on the scheduled layover time for making connections at the Cleveland station.

Exhibit 3-6: Travel Time Summary for Major City Pairs
High-Speed Scenario

City-Pair	Rail Distance (miles)	Base System Travel Time *	Increm Corr Travel Time *	Base System Avg Train Speed (mph)
Detroit-Pittsburgh	314	5:13	Same	60
Detroit-Columbus	310	4:28	3:10	69
Detroit-Cincinnati	432	6:18	5:20	69
Detroit-Buffalo	356	5:07	Same	70
Detroit-Toronto	464	7:33	Same	61
Pittsburgh-Columbus	275	4:20	3:05	63
Pittsburgh-Cincinnati	398	6:19	5:15	63
Pittsburgh-Buffalo	322	4:41	Same	69
Pittsburgh-Toronto	430	7:30	Same	57
Columbus-Buffalo	317	4:21	Same	73
Columbus-Toronto	425	7:10	Same	59
Cincinnati-Buffalo	440	6:08	Same	72
Cincinnati –Toronto	548	8:57	Same	61

Note: Travel time varies based on layover time at Cleveland Station.

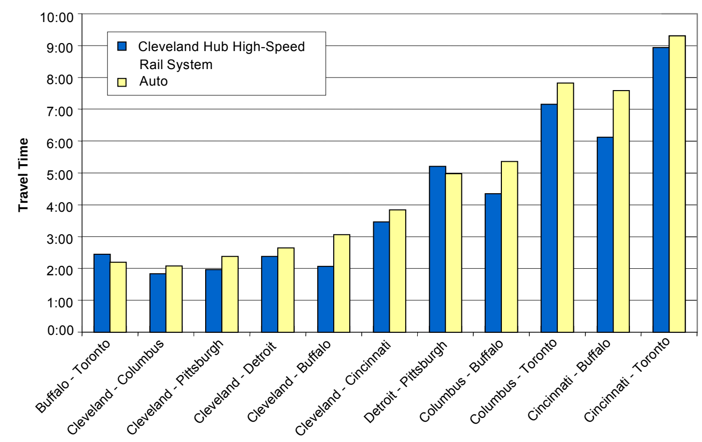
Exhibits 3-7 and 3-8 show comparative travel times between auto and the proposed Ohio Hub train schedules. The rail travel times between Detroit and Pittsburgh, and Buffalo and Toronto were slightly higher than the Auto travel time. The Ohio Turnpike offers a more direct and shorter auto route than the rail line because it bypasses downtown Cleveland. The savings in travel time also decreased by a few minutes on Niagara Falls-Toronto compared to Cleveland-Buffalo because of the delays at the border. This schedule includes an allowance of thirty-minutes for customs and immigration inspections at the border and it assumes that the Canadian portion of the corridor would maintain the existing Amtrak and VIA Rail train speeds as defined by the existing timetable. Detailed operating schedules for all corridors are provided for the High-Speed Scenario in the Appendices.

Exhibit 3-7: Rail and Auto Travel Time Comparison for the Selected City-Pairs

City Pair	Rail Distance (miles)	Auto Distance (miles)	Rail Travel Time	Auto Travel Time (Includes 15-minute Refueling/ Rest Area Break per 200 miles)
Cleveland-Detroit	175	169	2:23	2:39
Cleveland-Pittsburgh	144	139	2:02	2:23
Cleveland-Columbus	135	143	1:50	2:05
Cleveland-Cincinnati	258	249	3:28	3:51
Cleveland-Buffalo	182	193	2:04	3:04
Buffalo-Toronto[4]	105	104	2:27	2:12
Detroit-Pittsburgh	314	292	5:13	4:59
Columbus-Buffalo	317	330	4:21	5:22
Columbus-Toronto[4]	425	433	7:10	7:50
Cincinnati-Buffalo	440	441	6:08	7:36
Cincinnati-Toronto[4]	548	545	8:57	9:19

Note:
1. Source of auto distance and travel time estimates is the American Automobile Association Trip Tik database.
2. Above city-pairs were selected based on the similarity of route between proposed rail route and auto travel route.
3. Rail Times based on 110-mph high-speed service
4. Includes an allowance of 30 minutes for border crossing

Exhibit 3-8: Comparative Travel Time Summary



3.5 Operating Plans and Fleet Size Requirements

The number of train sets required for day-to-day Ohio Hub operations must be large enough to cover all assignments in the operating plan with sufficient spares for maintenance, yet without excess equipment sitting idle. Two different approaches can be used for estimating the required fleet size:

- The first approach is highly detailed, since it requires construction of detailed train schedules and then development of an equipment cycling plan to cover all the schedules. This detailed cycling approach was used in the previous 2004 Ohio Hub study, and can even be constructed to factor in equipment maintenance requirements, as was done in the previous MWRRS study.
- The second approach is less detailed and uses reasonable average train mileage factors based on a parametric approach, but must still adequately reflect the operating characteristics of the system being modeled. A parametric approach is better suited to "mix and match" studies that must quickly deal with a large number of alternative network configurations. In this case a reasonable estimate of the overall fleet requirement can still be developed without requiring the construction of detailed train schedules.

For example, it is known that rail networks that have longer routes tend to have better equipment utilization, since trains spend a greater proportion of their time running rather than laying over between assignments. As well, larger networks and/or higher train frequencies improve equipment utilization, because there are more opportunities to match inbound arrivals with outbound departures to schedule equipment turns on reasonably tight connections.

- Scheduling connections that are too tight results in an adverse reliability impact as late train arrivals propagate through the network.
- On the other hand, if connections are scheduled too loosely or the train frequencies are not high enough to allow scheduling of efficient connections, there will be a cost penalty to be paid in the form of reduced equipment utilization.

In the earlier 2004 Ohio Hub studies based on the original four corridors, a detailed cycling approach was employed to develop two potential fleet size options: a corridor-based train operation and a Cleveland run-through train operation.

- Under a corridor-based operation, the required fleet size would be slightly larger than a Cleveland run-through operation. Corridor-based operations would concentrate train utilization to a single corridor with most trains terminating, and then reversing direction at the Cleveland station. This requires passengers to transfer across the platform to board another corridor train. Under this scenario, six trains would be needed for each corridor for a total fleet size of 24 trains. One spare train would be assigned to each line, adding four trains, for a total fleet size of 28 units. Under this option, spares account for 14 percent of the fleet.
- Under a Cleveland run-through operation, schedules would be developed to link two corridors, allowing trains to continue through Cleveland. This reduces the need for

passengers to transfer at Cleveland and improves equipment utilization efficiencies. The aggressive scheduling of trains will require a slightly smaller fleet of only 19 trains. With four spare trains, the total fleet requirement would be 23 trains. Cleveland run-through operations will eliminate the need for some time-consuming passenger layovers, which will result in improved corridor-to-corridor travel time, and ridership and revenues. The train timetables provided in the Appendices assume a limited number of Cleveland run-through schedules. Rolling stock costs are discussed in Chapter 2.

With more aggressive timetables, it should be possible to operate the Ohio Hub service with a smaller fleet of trains. Additionally, given an aggressive maintenance policy, a 14 percent reserve may be overly conservative. Talgo claims over 98 percent availability of its trains in service in the Pacific Northwest corridor. The MWRRS assumes that 10 percent of the trains in the fleet are reserved as spares.

As shown in Exhibit 3-9, the Cleveland-Columbus-Cincinnati corridor generates the greatest number of train-miles, with almost 1.3 million annually. The short Cleveland-Pittsburgh corridor generates the fewest train miles. Depending on the selection of route alternatives, the entire Ohio Hub Regional Rail System would generate from 3.7 to 3.8 million train-miles every year. This compares with the MWRRS plan, which would operate 13.8 million train miles every year.

Total train miles reflect an operation equivalent to 312 days per year, which includes five weekday schedules plus a half-day service on Saturday (largely morning) and a half-day service on Sunday (largely evening).[15]

[15] This implies that daily weekday ridership can also be estimated by dividing the annual total by 312. Each weekend day gets about ½ the ridership of a normal weekday total and train frequencies are correspondingly thinned.

Exhibit 3-9: Ohio Hub Annual Train Miles and Fleet Size Requirements

Corridors	Miles	Frequency			Total Annual Train-Miles*			Number of Trainsets		
		Lvl 1	Lvl 2	Lvl 3	Lvl 1	Lvl 2	Lvl 3	Lvl 1	Lvl 2	Lvl 3
Level 1: Three Eastern MWWRS Corridors										
Michigan [1]	305	Mult Rts	Mult Rts	Mult Rts	2.8 Mill	2.8 Mill	2.8 Mill	16	14	14
Cleveland [2]	354	8	10	12	1.7 Mill	1.5 Mill	1.8 Mill	10	8	9
Cincinnati	310	6	6	6	1.2 Mill	1.2 Mill	1.2 Mill	7	6	6
Level 2: Ohio Base Corridors										
Cleveland-Detroit (Metro Airport)	175		10	10		1.1 Mill	1.1 Mill		6	6
Cleveland-Pittsburgh (Youngstown)	140		8	8		0.7 Mill	0.7 Mill		3	3
Cleveland-Buffalo-Toronto	290		5	5		0.6 Mill	0.6 Mill		3	3
Cleveland-Columbus-Cincinnati	258		8	8		1.4 Mill	1.4 Mill		7	7
Level 3: Ohio Incremental Corridors										
Pittsburgh-Columbus	201			4 / 8 to NWK			0.6 Mill			3
Columbus-Ft Wayne	160			8			0.8 Mill			4
Columbus-Toledo	113			8			0.5 Mill			3
TOTAL	-				5.7 Mill	9.3 Mill	11.5 Mill	33	47	58

* Based on 312 equivalent-days of operation per year. Train-miles in Exhibit 3-9 are not additive, due to inclusion of the route alternatives in the table.

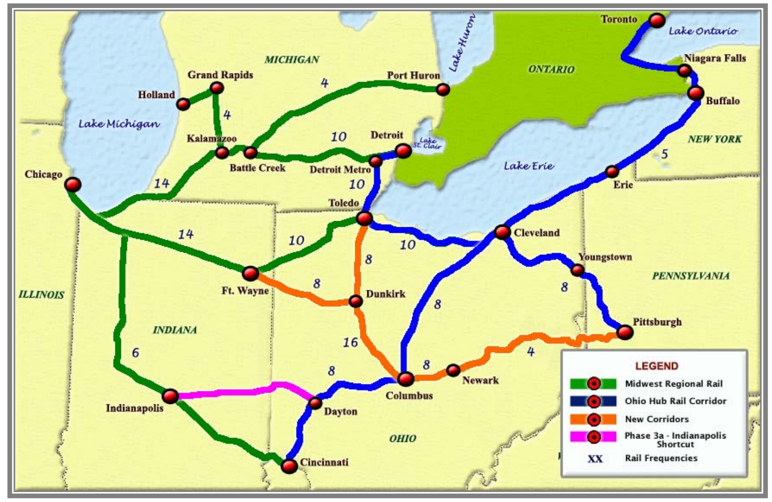
1- Michigan consists of three lines to Pontiac, Port Huron and Holland
2- MWRRS Includes Toledo-Cleveland mileage only in Level 1; in Levels 2 and 3, these miles roll up to the Ohio Hub. MWRRS Cleveland Train-Miles decrease in Level 2 because Ohio Hub assumes responsibility for the Toledo-Cleveland mile. They increase again in Level 3 because of the added Chicago to Fort Wayne train frequencies.

Another way to analyze the efficiency of fleet utilization is to compare the annual miles per train. Under the detailed cycling plan that was developed in the 2004 Ohio Hub study, utilization of equipment on the Ohio Hub turned out to be somewhat less efficient than it was for the MWRRS. MWRRS trains are expected to average approximately 250,000 miles per year. Using the less aggressive, but more operationally conservative schedules provided in the Appendices, Ohio Hub trains are expected to average only 165,000 miles per year, resulting a higher reserve ratio. The utilization that was developed for Ohio Hub reflects the shorter length of the Ohio Hub routes as compared to the MWRRS routes, as well as the fact that there are fewer opportunities for pairing connections in Cleveland as opposed to Chicago.

For the 2007 business plan update, equipment fleet requirements were revisited under a slightly different set of assumptions than those employed in the original 2004 Ohio Hub plan. With the

shift to use 300-seat trainsets in the Ohio Hub system, trainsets could be cycled between MWRRS and Ohio Hub routes. This provides an opportunity for significant improvements in equipment utilization. In addition, the development of the basic Ohio Hub ridership scenarios has always assumed MWRRS connectivity.

Exhibit 3-10: "Three Layer" Assumption for Fleet Size Development in 2007 Update



Therefore, a new fleet sizing analysis was developed for the incremental corridors under the following assumptions:

- It was assumed that the MWRRS corridors that utilize the South-of-the-Lake improvement, shown as "green" in Exhibit 3-10, would be built first. The equipment fleet requirement for operating these four corridors on a stand-alone basis would be 33 trains operating 5.7 million train-miles[16], assuming an average utilization of 175,000 miles per train. This is considered reasonable given the length of these routes and the frequency of train service that would be provided over them.
- Next it was assumed that the four original Ohio Hub corridors shown in "blue," would be added to the eastern MWRRS system. The incremental fleet required to add these corridors would be 14 trains, for a total fleet of 47 trains operating 9.3 million train-

[16] These four routes would generate 41% of the train miles of the overall MWRRS system.

miles[17], assuming a slight improvement in equipment utilization to 200,000 miles per train – still not as good as what was projected for the original MWRRS system.

- Finally, adding the incremental corridors shown in "orange," would require an additional 11 trains, for a total fleet of 58 trains operating 11.5 million train-miles[18], holding utilization constant at approximately 200,000 miles per train.

It is interesting to contrast the original Ohio Hub fleet requirements of 19 trains from the earlier 2004 study, that assumed that Ohio Hub operates on a stand-alone basis; with the reduced fleet requirement of 14 trains if the Ohio Hub routes are added as an increment on top of the MWRRS service using a standardized train set. This reduction reflects not only improved opportunities for cycling equipment for tighter connections at layover points, but also a reduced reserve fleet requirement and a lower percentage of the equipment fleet tied up the maintenance shop at any point in time.

However, it should also be noted that since the train size was increased from 196-seats to 302-seats, the 2007 business plan update employs larger more expensive trains, even though it needs fewer of them. As compared to the 2004 study, it should be stated that the new fleet sizing methodology is based on a more aggressive equipment utilization scenario (200,000 annual miles per train) and that it assumes that the MWRRS and the Ohio Hub jointly cycle a shared fleet.

In summary, the overall fleet requirement assumed for the 2007 business plan update is:

- Fourteen (14) 300-seat trains for the original four Ohio Hub routes, and
- Eleven (11) additional 300-seat trains for the incremental corridor services, including the added run through services from Columbus to Detroit, and from Columbus to Chicago.

[17] The addition of the Ohio Hub routes to the MWRRS routes in this study, assumes some rationalization of overlapping train frequencies on the Toledo to Cleveland segment. Accordingly, the increase in train-miles operated from Level I to Level II is slightly less than the 3.8 million train miles that were estimated for a stand-alone Ohio Hub system in the 2004 study.

[18] This increment from Level II to Level III includes the additional train-miles and train-sets that would be needed to support service from Columbus all the way into Chicago.

4. Travel Demand and Forecasting

This section describes the major steps taken to develop the travel demand model for the Ohio Hub System. The demand model predicts public responses in the Ohio and Lake Erie region to various rail service characteristics including train frequency, travel time, train and station amenities, and fares.

The creation of the travel demand model for the Ohio Hub Study required the delineation of the study area and definition of a zone system; collection of data including stated preference survey data, socioeconomic data and origin-destination data; and development of transportation networks for the competing intercity modes of travel (auto, air, bus, and rail). Additionally, a feeder bus network was defined to extend the reach of the rail network.

4.1 The Zone System

The first step in the development of the travel demand model was establishing a zone system that would reflect both the Ohio Hub Stand-Alone and the MWRRS travel market areas. The only difference between the Stand-Alone and the MWRRS scenarios was in the transportation network characteristics, not in the zone system. The same zone system was used in all analyses.

The zone system provides a reasonable representation of the market area where travel would occur between origins and destinations. Most zones represent county-level census information; however, where it is important to identify more refined trip origins and destinations, some counties are split into two or more zones. The travel demand model forecasts the total number of trip origins and destinations by each zone.

The Ohio Hub Zones were developed based on three components: the MWRRS Phase 4B zone system, the approved rail alignments, feeder bus services and the proposed station stops. In addition, the study included airport-specific zones based on the twenty-five major airports within the study area. The airports are identified in the Appendices. By creating interconnectivity between the region's airports and passenger rail stations, the airports serve as trip generators within the travel demand model.

Two hundred fifty-six zones were identified for the Ohio Hub Study. Exhibit 4-1 illustrates the study area's internal zone system. A much larger area that encompasses the study's external zone system is illustrated in Exhibit 4-2. The external zone system generates trips with origins and/or destinations that are *outside* the immediate service area of the Ohio Hub. As part of the national passenger rail network, the Ohio Hub interconnects with other regional passenger rail corridors. To the west, the Ohio Hub connects with the MWRRS, which generates external trips that contribute to the Ohio Hub network. To the east, existing Amtrak service connects to the Ohio Hub – the *Empire, Keystone* and VIA Rail corridors. Therefore, the external zone system includes areas that are northeast, east and southeast of the Ohio Hub. These external zones include New York City, Philadelphia, Harrisburg, Washington, D.C., Albany, Montreal, Quebec City and others.

Exhibit 4-1: Study Area's Internal Zone System

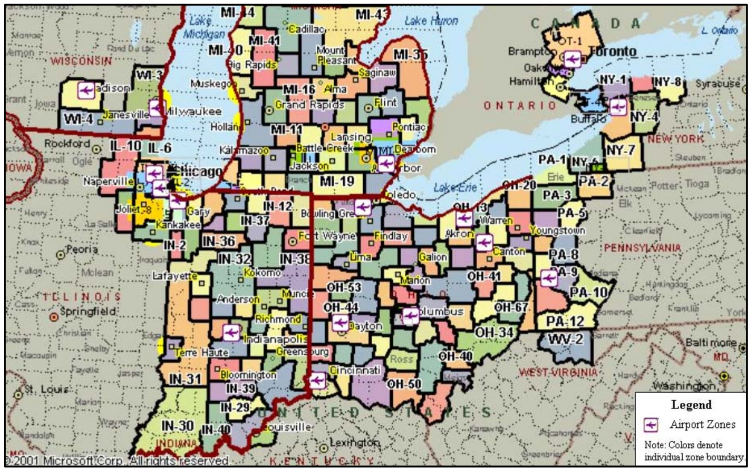
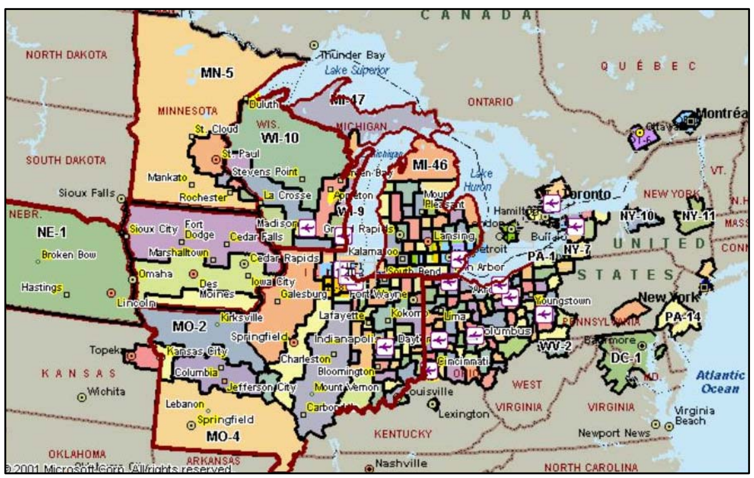
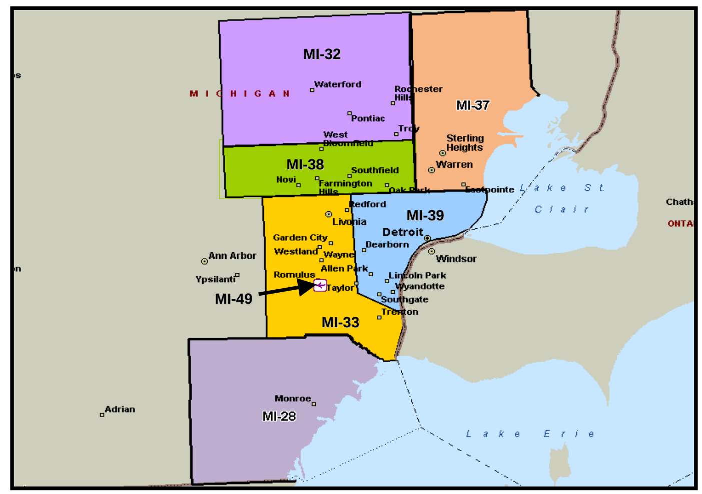


Exhibit 4-2: Study Area Internal and External Zones



Zones in Michigan are based on the MWRRS zone system. Exhibit 4-3 identifies zones in southeastern Michigan that were used in the trip-purpose break down on the Toledo-Detroit route segment discussed in Chapter 5. However, the full set of Michigan zones were used in predicting ridership in all scenarios, including Ohio Hub Stand-Alone scenarios. The only difference is in the quality of rail connectivity provided. In the base case that includes the MWRRI System, rail and auto access was provided across a wide area of southern Michigan. In the Ohio Hub Stand-alone Scenario, the network connection only included existing Amtrak service and traffic was largely generated from the six zones of southeast Michigan that are shown in Exhibit 4-3.

Exhibit 4-3: The Predominant Michigan Zones Used in the Toledo-Detroit Segment and Stand-alone Analysis



In Ohio, the zone system is based almost entirely on the MWRRS zone system, with some changes where zones were disaggregated to a county level. Examining potential markets served by Ohio Hub rail stations required the inclusion of the zones in western New York, Pennsylvania, and southeastern Ontario, Canada. A detailed zone description is provided in the Appendices.

4.2 Stated Preference Survey

Stated preference surveys provide critical insight into travel markets and travel behavior. Stated preference surveys were conducted in the corridors connecting Cleveland to Buffalo, Detroit, Pittsburgh and in Columbus and Cincinnati. Additionally, the Ohio Hub Study relies heavily on regional market research data from similar surveys conducted for the Midwest Regional Rail Initiative (MWRRI). A full description of previously conducted market research is available in the *Midwest Regional Rail Initiative Project Notebook*.

The purpose of conducting the surveys was to collect specific attitudinal data by interviewing travelers within the Ohio and Lake Erie Region. The travelers were asked to identify how they value travel times and frequencies associated with particular modes of transportation. These values were then combined with previously collected MWRRI data and incorporated into the calibration process for the travel demand model. The calibration process adapts the model to the specific characteristics of the travel market within the Ohio and Lake Erie Region.

4.2.1 Survey Methodology

Travel options in a stated preference survey enable respondents to consider the trade-offs among desirable travel attributes, such as time, comfort, cost, speed and accessibility without regard to travel mode. Trade-offs included a range of service options that were presented in such a way as to induce the individuals to respond realistically without specifying a mode of travel. More specifically, stated preference surveys ask travelers to choose between a changing travel cost and another value, such as travel time or service frequency. The choice the traveler makes demonstrates his or her preference between cost, time or other travel aspects of the rail mode.

The stated preference surveys for this study were conducted using a quota group sampling approach. The information collected from the respondents in a specific quota sampling category was then expanded to the overall quota sample population based on known socioeconomic and traveling characteristics. Quota surveys, which are now widely used in commercial, political and industrial surveying, have the advantage of being relatively inexpensive to implement while providing expanded coverage and more statistically significant results than random sample surveys.

With input from the ORDC, the study team developed surveys for each travel mode. Each survey collected information on origin and destination, trip purposes, demographics, values of time (VOT) and values of service frequency (VOF). A minimum sample from each travel market segment (by mode and trip purpose) was required to ensure statistical confidence. Using the Central Limit Theorem[19], it was determined that a minimum sample size of 20 to 40 participants ensures the statistical validity to each quota sample. For this study's stated preference surveys, the desired quota target was set at 80-100 interviews, with an established minimum quota of 30 interviews per trip purpose/travel mode. The Appendices contain a sample survey form.

[19] The Central Limit Theorem states that the sampling distribution of the mean of any distribution with mean μ and variance σ2 approaches a normal distribution with mean μ and variance σ^2/N as N the sample size increases. Spiegel, M.R., Theory and Problems of Probability and Statistics, NY McGraw Hill, pp. 112-113, 1992

4.2.2 Survey Implementation

Stated preference surveys were conducted at various locations within the study region in a manner designed to reach a broad sample of the potential users of an intercity passenger rail system. Approximately 1,320 surveys were completed. The surveys were conducted between January and April of 2002, using handout, mail-out and interview techniques. The surveys captured data from a broad mix of business travelers, tourists and resident leisure travelers.

Air mode surveys were conducted at five major airports in the region – Buffalo Niagara International Airport, Cleveland Hopkins International Airport, Port Columbus International Airport, Detroit Metro Wayne County Airport and Pittsburgh International Airport. The surveys targeted passengers traveling among cities served by the proposed Ohio Hub System. Airports were not modeled individually, but rather the surveys were used to calibrate a single set of mode-specific model parameters, by trip purpose and length, that were applied throughout the entire study region.[20]

Most auto mode surveys were conducted at the Interstate 71 rest areas north of Columbus and northeast of Cincinnati; at the rest area on Interstate 90 in Angola, New York and at the rest area on Highway 2 near Vermilion, Ohio. Additionally, auto surveys at the Columbus (Ohio) State House and Ohio Turnpike Commission were conducted.

Rail mode surveys were conducted onboard Amtrak's *Three Rivers* trains operating between Toledo and Pittsburgh[21], and the *Maple Leaf* trains operating between Buffalo and Niagara Falls.

The study team was unsuccessful in obtaining permission to conduct surveys onboard Greyhound buses. Accordingly, the bus survey form that is included in the Appendix could not be used. After discussion with the ORDC, it was agreed that the study would use the results of the survey of bus travelers previously conducted for the MWRRI. Exhibit 4-4 describes this study's survey sites, type of survey and the number of responses to each.

[20] Average gasoline fuel costs were raised to $2.25 in the latest Ohio Hub forecasts. However, this fuel price increase didn't affect the validity of the surveys that were collected earlier, because the surveys primarilty focused on identifying customers Value of Time tradeoffs in a manner that is independent of fuel price or mode.

[21] These Amtrak surveys that were conducted in the middle-of-the-night on a long-distance train produced some results that were ultimately deemed not representative of the travel behavior that would be seen in a short-distance daytime corridor service. These behavioral parameters were ultimately replaced along with the base-line travel demand forecast for a daytime corridor service, setting aside some of the ticket lift data on existing long-distance train service. This resulted in boosting the demand forecast for the Detroit, Niagara Falls and Pittsburgh corridors and making the forecasts for these corridor more consistent with forecasts elsewhere.

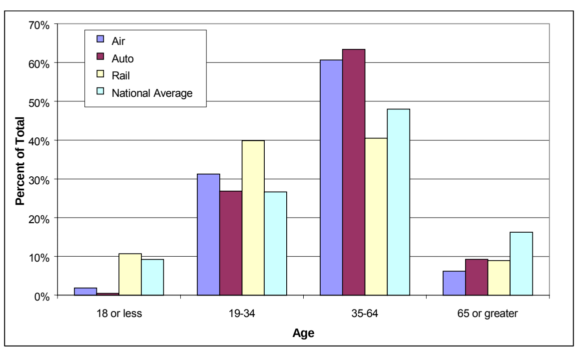
Exhibit 4-4: Stated Preference Survey Locations and Number of Responses

Survey Sites/Type of Survey	Mode	Trip Purpose	Number of Responses
Buffalo Airport	Air	All Purposes	109
Cleveland Airport	Air	All Purposes	51
Columbus Airport	Air	All Purposes	242
Pittsburgh Airport	Air	All Purposes	21
Detroit Metro Airport	Air	All Purposes	12
Amtrak: Toledo to Pittsburgh	Rail	All Purposes	91
Amtrak: Harrisburg to Pittsburgh	Rail	All Purposes	79
Amtrak: Buffalo to Niagara Falls	Rail	All Purposes	86
Columbus State House	Auto	All Purposes	46
Highway 2 – Vermilion, OH	Auto	All Purposes	118
Interstate 71 Rest Area North of Columbus	Auto	All Purposes	122
Interstate 71 Rest Area Northeast of Cincinnati	Auto	All Purposes	165
Interstate 90 (NY State Thruway) – Angola Rest Area	Auto	All Purposes	107
Ohio Turnpike Commission	Auto	All Purposes	68
		Total Responses	***1317***

4.2.3 Survey Demographic Characteristics

Distinct demographic characteristics exist for all travelers who participated in the survey. For example, air passengers generally have the highest income and rail passengers are slightly younger than the travelers on other modes are. A comparison of age distributions (Exhibit 4-5) shows that the age distribution for air and auto travelers peaks between the ages of 35 and 64, while the rail age distribution peaks between the ages of 19 and 24. The peak household income distribution (Exhibit 4-6) for auto and rail travelers is between $30,000 and $59,999. On the other hand, the air traveler category peaks at the $100,000 or greater level.

Exhibit 4-5: Age Distribution of Survey Respondents



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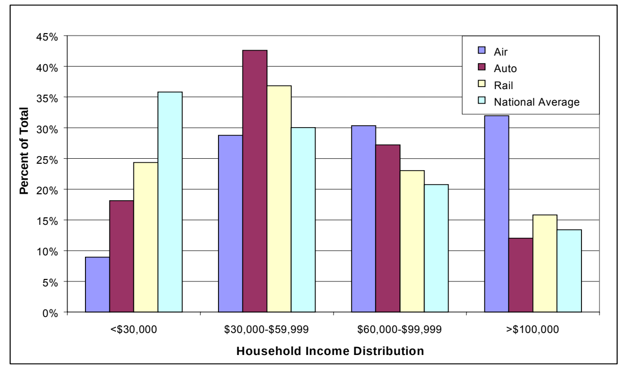
Technical Memorandum & Business Plan

Exhibit 4-6 Income Distribution of Survey Respondents



4.2.4 Comparison with Other Studies

As shown in Exhibits 4-7 and 4-8, survey responses were collected for various modes and trip purposes. Survey findings were differentiated between *Business* travelers and *Other* travelers for air, auto and rail modes. These two exhibits provide comparison tables of this study's survey results to four similar studies, which are presented in year 2000 constant dollars.

Values obtained from the survey data are consistent and comparable across all modes with those obtained from similar studies previously conducted in the region. For example, the findings in the Boston-Portland (*i.e., Restoration of the Portland-Boston Commuter Rail Service Study*, completed by TEMS in 1997), values of time and frequency closely resemble the findings in this Study, with few exceptions.

Air and rail values of time are slightly higher in the Ohio Hub Study area than in other related MWRRS corridors. This may be attributable to a lower level of discount airline operations in the Ohio and Lake Erie Region and a higher population density than that of the MWRRS region (Exhibit 4-9). However, the higher air values do not change the relative ranking-across-modes within each study and, in general, there is a strong consistency in the results. For example, air business travelers consistently respond with the highest values of time, while auto and rail travelers respond with lower values. The overall character of the model's results remains the same since relative values between modes rather than absolute values are the more influential factors affecting a model.

Exhibit 4-7: Comparison of Value of Time with Other Studies ($/hour in 2000$)

Modes	Trip Purpose	Ohio Hub [1]	Wisconsin SRP [2]	MWRRI [3]	Illinois[4]	Boston[5]	Portland-Boston[6]
Air	Business	79	70	59	66	85	70
	Other	31	45	30	42	47	27
Auto	Business	26	21	24	36	33	31
	Other	19	17	18	21	23	18
Bus	Business	16*	20	16	20	24	20
	Other	11*	13	11	11	18	17
Rail	Business	33	20	27	30	24	31
	Other	16	15	20	21	18	17

[1] The Ohio and Lake Erie Regional Rail – Ohio Hub Study (2004)
[2] Wisconsin State Rail Plan 2020 Corridors Feasibility Study (2001)
[3] Midwest Regional Rail Initiative Business Plan (1997)
[4] Illinois Rail Market Analysis (1996)
[5] MBTA North Station-South Station Rail Link Project (1996)
[6] Restoration of Portland-Boston Passenger Rail Service (1994)
***** MWRRS Value used for Ohio Hub

Exhibit 4-8: Comparison of Value of Frequency with Other Studies ($/hour in 2000$)

Modes	Trip Purpose	Ohio Hub[1]	Wisconsin SRP[2]	MWRRI[3]	Illinois[4]	Boston[5]	Boston-Portland[6]
Air	Business	40	44	30	44	45	48
	Other	28	32	20	31	36	17
Bus	Business	13*	11	13	13	24	15
	Other	11*	9	11	9	22	12
Rail	Business	22	14	14	14	37	19
	Other	13	10	10	10	37	13

[1] The Ohio & Lake Erie Regional Rail – Ohio Hub Study (2004)
[2] Wisconsin State Rail Plan 2020 Corridors Feasibility Study (2001)
[3] Midwest Regional Rail Initiative Business Plan (1997)
[4] Illinois Rail Market Analysis (1996)
[5] MBTA North Station-South Station Rail Link Project (1996)
[6] Restoration of Boston-Portland Passenger Rail Service (1994)
***** MWRRS Value used for Ohio Hub

4.3 Socioeconomic Data

Socioeconomic data in the COMPASS™ demand model was upgraded with the most recent data, as well as the latest economic forecasts, for the 2007 Business Plan update. This update was performed in conjunction with the Ohio Hub Economic Impact study, to ensure the consistency of modeling assumptions and results. The update produced minor adjustments to a few of the previous model assumptions but did not result in any radical revisions.

Forecasting travel demand between the model's zones required base year estimates and forecasts of three socioeconomic variables – population, employment and household income – for each of the Ohio Hub model zones. To allow for assessment of the financial and operational feasibility of the system over its full life-cycle of 30 years, socioeconomic variables were forecasted through 2040.

For the U.S. zones, base-year estimates were developed using county-level and census-tract level data from the U.S. Census Bureau (Bureau of Economic Analysis, U.S. Department of Commerce)[22]. For Canadian zones, base year data were estimated by using census division-level and CMA-level [23] data from 2001 Census of Canada database (Statistics Canada) [24]. For the U.S. zones future year forecasts were obtained by applying the Woods & Poole, Inc[25] county-level growth rates to the base-year levels for all three variables, with projections beyond 2025 based on 2001-2025 trend lines. For Canadian zones the socio-economic forecasts were based on the projections from multiple official Canadian sources and historic trends as well [26].
Exhibit 4-9 summarizes the upgraded base-year and forecast-year socioeconomic data for the primary Ohio Hub System study area. This area includes the zones of the internal zone system that are directly connected to Ohio Hub rail stations. Here we have zones located in four American states – Ohio, Michigan, New York and Pennsylvania and in the Canadian Ontario province. It is important to note that a large portion of southern Michigan is included into the primary study area of the Ohio Hub system. These zones are connected to the Ohio Hub System through Michigan's feeder bus network and the MWRRS Chicago-Detroit rail corridor [27]. Exhibits 4-10, 4-11 and 4-12 illustrate the forecasts by State/Province for three key socioeconomic variables – population, employment and average household income- within the Ohio Hub Study area.

The population and employment charts highlight the similarity in growth rates for zones in Ohio and Michigan. The western portions of New York and Pennsylvania show relatively slower growth rates, while the Toronto area of Ontario province shows higher growth rates. Income growth rates for zones in the U.S. are similar (ranging between 1.1-1.2 per cent a year), while the corresponding annual growth rates in an analyzed part of Ontario province is only slightly less.

[22] See: http://factfinder.census.gov/
[23] CMA – Census Metropolitan Area.
[24] See: http://ceps.statcan.ca/english/census01/home/Index.cfm
[25] Woods & Poole, Inc. is an independent, widely respected firm that specializes in long-term economic and demographic projections. Its clients include public and private institutions from a number of different industries, e.g., the Wisconsin Department of Transportation, AOL/Time Warner, Coca-Cola, McKinsey & Co. and PricewaterhouseCoopers.
[26] See: Ontario Ministry of Finance (http://www.fin.gov.on.ca/english/), Institut de la Statistigue du Quebec (http://www.stat.gouv.qc.ca/default_an.htm).
[27] Socioeconomic data for all zones – both internal and external, - is given in Appendices.

Exhibit 4-9: Summary of Base and Projected Socioeconomic Data
Population

	Base and Forecast Years					Ave. Annual Growth Rate 2000 - 2040
	2000	2010	2020	2030	2040	
Michigan*	9,268,738	9,701,935	10,139,648	10,557,361	11,015,075	0.43%
New York*	2,277,124	2,296,983	2,317,964	2,338,945	2,359,926	0.09%
Ohio	11,353,140	11,786,791	12,226,077	12,665,362	13,104,648	0.36%
Ontario*	5,994,251	7,085,854	8,140,028	9,194,201	10,248,375	1.35%
Pennsylvania*	3,086,940	3,105,535	3,125,652	3,145,768	3,165,885	0.06%
Total	31,980,193	33,977,098	35,949,368	37,921,638	39,893,908	0.55%

Exhibit 4-9 (continued):
Employment

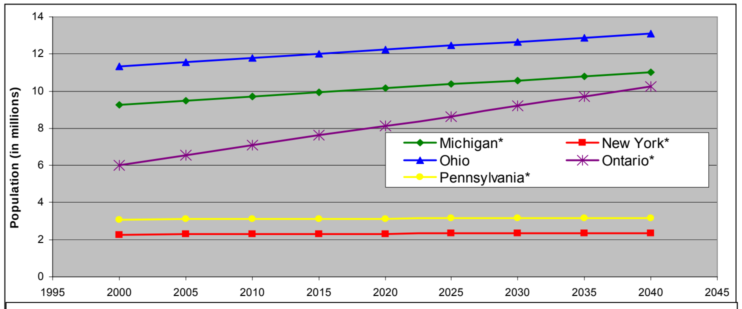
	Base and Forecast Years					Ave. Annual Growth Rate 2000 - 2040
	2000	2010	2020	2030	2040	
Michigan*	4,343,209	4,801,005	5,246,394	5,694,791	6,142,857	0.87%
New York*	1,051,811	1,111,730	1,176,628	1,241,527	1,306,426	0.54%
Ohio	5,402,175	5,982,655	6,512,379	7,049,889	7,586,542	0.85%
Ontario*	3,041,005	3,756,640	4,481,080	5,205,521	5,929,961	1.68%
Pennsylvania*	1,396,742	1,507,126	1,619,934	1,732,742	1,845,551	0.70%
Total	18,320,266	17,159,156	19,036,416	20,924,470	22,811,337	1.01%

Exhibit 4-9 (continued):
Average Household Income (in 2005 $)

	Base and Forecast Years					Ave. Annual Growth Rate 2000 - 2040
	2000	2010	2020	2030	2040	
Michigan*	$70,421	$80,228	$89,939	$99,667	$109,426	1.11%
New York*	$59,981	$68,297	$77,021	$85,545	$94,076	1.13%
Ohio	$62,350	$71,678	$80,862	$89,990	$99,045	1.16%
Ontario*	$66,092	$72,947	$79,906	$86,911	$93,864	0.88%
Pennsylvania*	$57,228	$66,206	$75,621	$84,749	$93,839	1.24%
Average	$64,634	$73,579	$82,463	$91,231	$99,909	1.09%

Note: Asterisk (*) mark indicates the states with base and forecast year socioeconomic data that are smaller than state/province totals.

Exhibit 4-10: Population Growth Forecasts



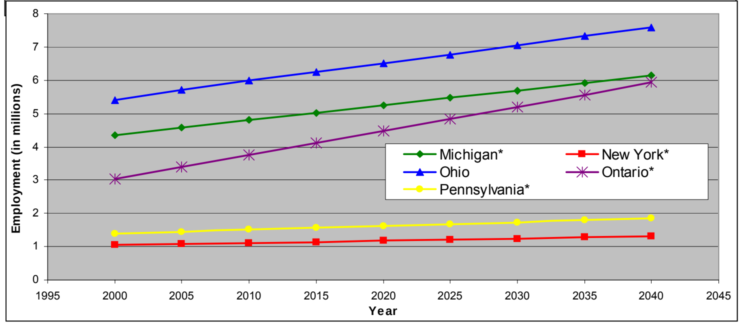
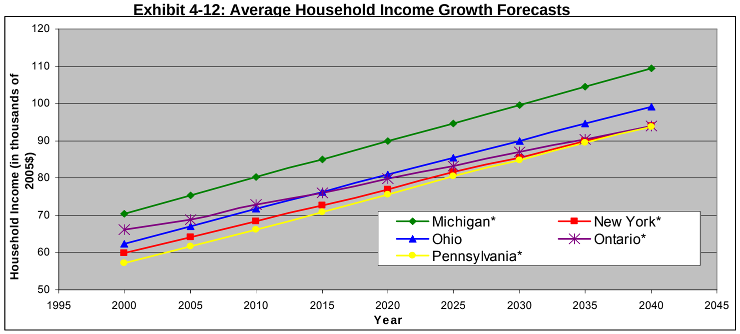


Exhibit 4-12: Average Household Income Growth Forecasts



Note: Asterisks indicate the states with base- and forecast-year socioeconomic data smaller than state/province totals.

4.4 Origin-Destination Data

The multi-modal intercity travel analyses developed from the *COMPASS*™ model required the collection of origin-destination (O-D) data describing annual passenger trips between zone pairs. For each O-D zone pair, the annual passenger trips were broken down by transportation mode (auto, air, rail and bus) and by trip purpose (*Business* and *Other*, where *Other* travel includes leisure and commuter trips). The *COMPASS*™ model is described in the Appendices.

Because the goal of the study was to evaluate intercity travel, the O-D data collected for the model reflected travel between zones (*i.e.*, between counties, neighboring states and major urban areas). Local traveling characteristics (short distance trips) were not included in the analysis in order to maintain accuracy in forecasting intercity trip making. The study team's experience with survey data gathered for MWRRI project provided a template upon which to base the data requirements for this study.

MWRRI data was used in conjunction with new Ohio Hub data to provide the overall 2000 O-D data requirements. The additional MWRRI sources included various private and public agencies' databases for trips within the nine-state Midwest system. Where data were not available, traffic volumes were simulated based on known travel behavior between pairs of zones with similar characteristics (*e.g.*, distance, population and available modes). The process used generalized cost pathskims for the respective modes and was based on the networks built for the model to determine zone-pair accessibility to the system and to allocate missing trips. A *pathskim* is the simulated travel cost between any pair of zones for a particular mode and a particular trip purpose. High impedance values are introduced within the pathskims to prohibit the allocation of trips to regions outside the external zone system or exceeding a designated, generalized cost difference between the respective modes of travel.

Additional sources, assumptions and methodologies used to develop the base Ohio Hub travel market data for each mode of travel are described below.

4.4.1 Air Mode

Origin-destination data for five major commercial airports in the study area was provided by the Federal Aviation Administration's (FAA) *10% Ticket Sample* (1999), which represented the latest-available data at the time this analysis was performed. The air passenger growth rates between 1996 and 1999 were then used to inflate the 1999 FAA *10% Sample* air trips to a 2000 base-year sample.

Only commercial air traffic is considered in this study. The data contains the number of existing (1999) air passenger trips for each respective O-D airport combination within the Ohio Hub Study zone system. Additionally, data were obtained that give the number of enplanements, or passenger trips, between airports in the study area and neighboring external zones. Connecting passenger trips, as well as trips to or from destinations beyond these boundaries, were excluded from the database as they do not reflect candidates for diversion to high-speed rail.

A trip purpose split analysis was performed on each respective O-D combination based on the collected survey data and by extrapolating the results of the surveys to similar routes. Finally, the

airport-to-airport data were distributed to the respective catchment zones based on generalized cost and socioeconomic characteristics to yield the final, zonal, O-D trip matrix by trip purpose.

4.4.2 Auto Mode

Auto trip data were derived from various state forecasting models. Where state forecasting models were lacking, models were applied to areas of similar socioeconomic and trip-making characteristics. Survey results were used to break down the trips produced by the individual state models by trip purpose (*i.e.*, *Business* and *Other*).

4.4.3 Rail Mode

For the 2004 Ohio Hub business plan, Amtrak provided a complete year 2000 station-to-station ridership matrix encompassing the entire study area. This matrix included O-D data culled from Amtrak's Cleveland-Pittsburgh (*Three Rivers*), Cleveland-Buffalo (*Lake Shore Limited*) and Buffalo-Niagara Falls (*Maple Leaf*) trains, from VIA Rail, and from Amtrak service data already provided in the MWRRI operating plan. It should be noted that the Amtrak data did not reflect any information for the 3-C corridor, so the base-line forecast for that corridor was model-derived, based on a benchmark comparison to other areas of similar socioeconomic and trip-making characteristics.

The Amtrak rail trip matrix was distributed on a zonal level based on a generalized cost distribution model and survey results. For the purpose of the study model, a *Business* and *Other* (leisure) trip purpose share was sought; therefore, surveys along the routes within the study area and previous trip purpose shares for the respective zones were used to allocate the total Amtrak passenger trips to obtain the complete trip purpose matrices.

Although the Amtrak station-to-station database contained a First and Coach Class classification, only total ridership characteristics were used. Rail surveys from previous studies have revealed that the First and Coach Class ridership did not provide sufficient definition to warrant a relationship between fare class and trip purpose. Both First Class and Coach Class have *Business* and *Other* travelers.

The 2007 Ohio Hub business plan update was conducted in conjunction with the Ohio Hub Economic Impact study. By comparing the rail trip generation rates to zonal socioeconomics in calibration of the economic models, as well as by benchmarking the performance of the rail corridors to each other, it became apparent that certain of the original Ohio Hub routes had been underforecasted in the 2004 Business Plan. In particular, the three corridors that had been underforecasted were the ones where Amtrak ticket lift data had been used in preparation of the forecast. It became apparent that Amtrak data used to initialize the Pittsburgh, Detroit and Buffalo corridors was reflective of demand for a long-distance train service in the middle of night. By benchmark comparison to other examples of daytime corridor services, we determined that the Amtrak base line data that we had been using bore little relation to the level of demand that would exist for a daytime Ohio Hub corridor service.

Therefore, for the 2007 Ohio Hub business plan update, the Amtrak long-distance train data was set aside and base line rail trips for all Ohio corridors were recalibrated on a consistent basis, using MWRRS benchmark comparisons that had already been developed. This reinitialization, along with upgrades to the the socioeconomic statistics that were described earlier, made the forecast for these three corridors more consistent not only with the earlier 3-C forecast, but also consistent with regard to the earlier MWRRS and new Incremental Corridors forecasts. The recalibration resulted in only a minor change to the 3-C forecast which had already been estimated based on benchmark comparisons. Howvever, the process raised the 2004 110-mph forecasts that had earlier been developed for the Ohio Hub Pittsburgh, Detroit and Buffalo corridors and for the east end of the MWRRS Chicago-Cleveland line.

4.4.4 Bus Mode

The study team developed an O-D database for intercity bus service using data provided by Greyhound Lines, Inc., which operates a variety of routes throughout the study area. Where Greyhound was not the intercity bus operator, trips were simulated based on socioeconomic characteristics and generalized costs.

A trip purpose breakdown was performed based on an analysis of survey results from a previous study. As in the other modes, the data obtained were station-to-station trips and needed to be transformed to a zone-to-zone descriptor. These trips were then distributed to their respective zones based on the generalized cost distribution obtained from the surveys and previous bus trip characteristic analyses.

4.4.5 Base Origin-Destination Data Summary

An external zone system was used to allocate all other trips going to areas outside the study area. As expected, auto is the most dominant mode; however, air service begins to take over some markets as the distance between city-pairs increases. The rail/bus market shares remain small for most city-pairs.

4.5 The Networks

Networks for the base and forecast years were developed for the four previously discussed modes of travel (air, auto, bus and rail).

Each network link was developed using schedule and fare information (for the air, bus and rail links) and for highway driving and access times (for highway connections to air, bus, and rail, as well as full auto trips). Fares and auto costs for each network link were also distinguished by trip purpose; for example, business trip costs are typically higher than leisure trip costs. Key attributes allocated to individual links by mode are shown in Exhibit 4-13; detailed networks for each mode are shown in the Appendices.

Exhibit 4-13: Key Components of Typical Networks

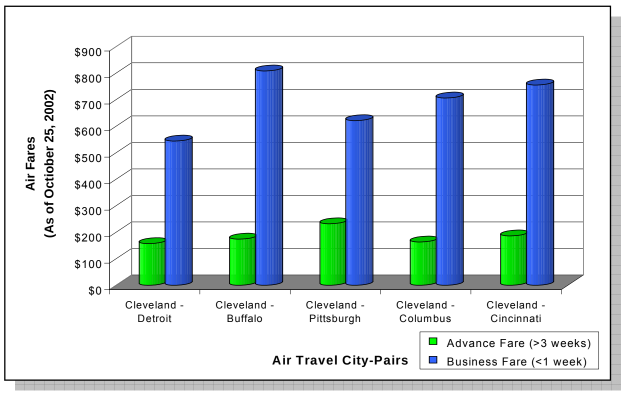
Attributes	Public Modes	Auto
Time	In-vehicle Time Access/Egress Times Number of Interchanges Connection Wait Times	Travel Time
Cost	Fare Access/Egress Costs	Operating Cost Tolls Parking (All divided by occupancy)
Reliability	On-time Performance	
Schedule	Frequency of Service Convenience of Times	

The auto network was developed to reflect the major highway segments within the study area. The Internal Revenue Service (IRS) Standard Mileage Rate was used to develop the auto network. The values provided by the IRS consist of an average cost of 32.5 cents per mile for *Business* and 10 cents per mile for *Other* travelers. The *Business* figure reflects the IRS estimate of the full cost of operating a vehicle because a business is required to pay the full cost for the use of an auto. *Other* costs are set at a marginal cost, which reflects how most social travelers perceive what their car costs to operate.

Air network attributes contain a range of variables that includes time and distances between airports, fares, on-time performance measures and connection times. Travel times and frequencies are derived from the Official Airline Guide (OAG). For travel time, the study team obtained the non-stop, shortest-path distance between airports. Airline fare information was provided by the official Internet websites of major airlines serving airports in the study area. This was cross-referenced with the Federal Aviation Administration's (FAA) revenue yields and average fares information obtained from the *Domestic Airlines Fares Consumer Report (Fourth Quarter 2000)* database. On-time performance measures were obtained from the FAA Delay and On-Time Statistics databases accessed from their website.

Exhibit 4-14 summarizes the average airfares of selected major city-pairs. Since most city-pairs in this study are relatively short-distance trips, travelers' airfares were found to be higher for business fares at 1-week advance booking ranging between $544 and $808, compared with 3-week advanced purchase fares ranging between $157 and $232. Thus, an alternative mode of transportation with a more reasonable cost than air would be an attractive option for many travelers in the region.

Exhibit 4-14: Average Air Fares for the Selected City-Pairs (in 2000$)



Bus network attribute data, such as fares, were obtained from official Internet websites (*e.g.*, Greyhound), while routes and schedules were obtained directly from Russell's *Official National Motor Coach Guide (2000)*. Fares were cross-referenced with fares obtained directly from Greyhound on selected routes within the study area. The rail network was developed from Amtrak schedules (year 2000) that provided travel times and distances for the routes within the proposed Ohio Hub Network. Fare-by-mile information was obtained directly from Amtrak ridership and revenue databases (year 2000) and was applied to the corridors based on their respective average fare by mile.

4.5.1 Feeder Bus Networks

In addition to the four network modes of travel, this study also considered the development of a feeder bus network for the rail system. The feeder bus network connects smaller communities, colleges and university towns to intercity passenger rail stations in the large urban centers. The feeder bus network will expand the service area and geographic reach of the Ohio Hub. Bus stations would include automobile passenger drop-off areas and small park-and-ride lots. Ideally, bus stations would be located in the center of a community, but must also be easily accessible to the regional highway system.

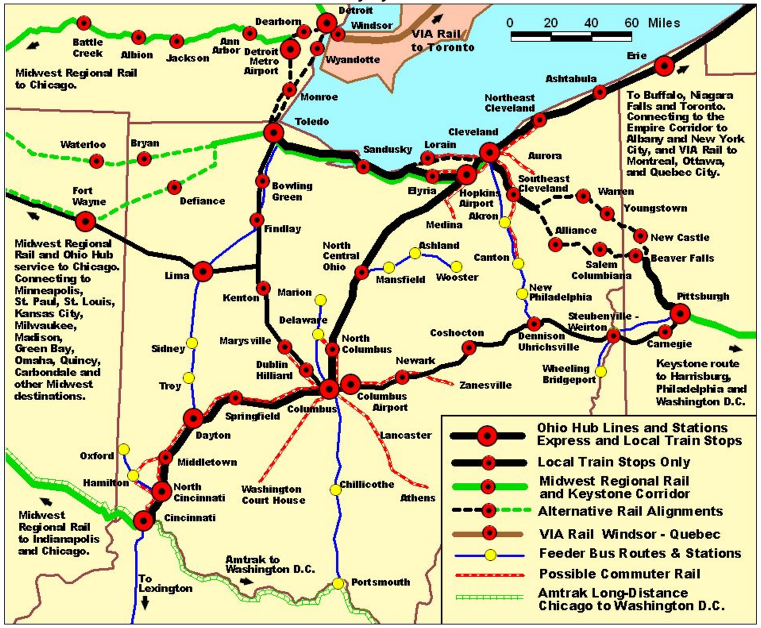
To be effective in diverting travelers from automobiles, rail feeder bus routes should be about 60 to 90 miles in length. An accepted guideline in the transportation industry suggests that feeder buses should operate over major roads and highways and should serve communities with a population of at least 20,000. The bus trip from the rail station to the last stop on the bus route should take no longer than 90 minutes. Each route would be served by at least one bus per day.

The feeder bus network for Michigan was identical to that proposed for the MWRRS. In Ohio, the feeder bus routes that have the greatest potential to contribute ridership to the Ohio Hub System shown in Exhibit 4-15 include:

- New Philadelphia-Canton-Akron-Cleveland
- Wooster-Ashland-Mansfield-Galion
- Wheeling/Steubenville-Pittsburgh
- Zanesville-Newark-Columbus
- Athens-Lancaster-Columbus
- Portsmouth-Chillicothe-Columbus
- Oxford-Hamilton-North Cincinnati
- Toledo-Findlay-Lima-Sidney-Troy-Dayton

For the incremental corridors assessment, the Newark-Columbus, Steubenville-Pittsburgh, and Lima-Fort Wayne feeder buses were replaced by rail services. Other feeder bus services were unchanged.

Exhibit 4-15: Ohio Hub Preliminary System Plan and Feeder Bus Routes



5. Ridership and Revenue Forecasts

The Ohio and Lake Erie Regional Rail Study evaluates different levels of rail service, including train frequency, train speed (or travel time), and assesses the ridership and revenue synergies from interconnecting the Ohio Hub to other existing and planned regional rail service.

The 2004 study developed eleven different system-wide ridership and revenue forecasts. The first eight alternatives evaluated two different speed options (79-mph vs. 110-mph) in four combinations of alternative Detroit and Pittsburgh routes. These eight forecasts assumed MWRRS connectivity, but three additional "stand-alone" scenarios, including a 79-mph "Start Up" scenario, were also developed that assumed little or no ridership benefits or operating synergies from interconnecting rail services. These results are summarized in Chapter 1.

The 2007 "Incremental Corridors" business plan update added three additional "Incremental" corridors onto the network that performed the best in the 2004 study, the Youngstown/Detroit Airport option. The three added routes are:

- Pittsburgh to Columbus via the former PRR Panhandle line
- Columbus to Chicago via Fort Wayne
- Columbus to Detroit via Toledo

In addition, a parametric analysis was performed to assess the ridership impacts of different options for connecting Columbus to Indianapolis. The results of this parametric analysis are reported in the Appendix.

New forecasts were developed for all the corridors at both 79-mph and 110-mph. In addition, the original forecasts for both Ohio Hub and connecting MWRRS corridors were upgraded to reflect updated demographics; improved estimates of "base line" rail trips in the Cleveland to Detroit, Buffalo, and Pittsburgh corridors to replace the Amtrak long-distance train data; and to quantify connecting ridership network impacts. In addition, because of the significant overlap between Ohio Hub and the MWRRS Chicago to Cleveland line, the MWRRS and Ohio Hub operations were jointly optimized along this this corridor to ensure provision of appropriate train frequencies to produce reasonable load factors on each route segment.

In addition, a change was made to eliminate the overlap that existed in the 2004 report between the MWRRS Cleveland line and the Ohio Hub Detroit corridor. In the 2007 analysis, the Cleveland to Toledo segment has been treated solely as a part of the Ohio Hub, so Ohio Hub is now solely responsible for all revenues and costs related to this segment. This change in definition eliminates the need for revenue or cost allocation, since all costs and revenues for this segment now accumulate to the Detroit-Cleveland Ohio Hub segment. Essentially, the MWRRS Cleveland corridor has been trimmed back to Toledo. By eliminating the need for cost and revenue allocations along this corridor, this change simplifies the financial reporting structure, since each link is now uniquely defined as a part of one and only one route for financial reporting purposes.

A second change in the corridor definition relates to the proposed Cleveland-Buffalo-Toronto service. In the 2007 update, the Toronto corridor has been trimmed back to Niagara Falls and the Canadian portion is treated as VIA Rail connectivity.[28] Buffalo corridor results reflect only revenues and costs attributable to the U.S. portion of the operation. The ridership forecasts continue to reflect connecting ridership on to Toronto, but the revenues reflect only the earnings between Cleveland and Niagara Falls, since VIA Rail would earn its own share of the revenues north of the border. In spite of this reporting change, because of the replacement of the Amtrak long-distance train data as described in Section 4.4.3, the ridership and revenue forecast for this corridor actually increased as a result of the 2007 update.

Because of these structural changes in the route definitions and the replacement of the long-distance train data, the 2007 results are not always directly comparable to the earlier 2004 result – in general the results for the Ohio Hub Detroit, Buffalo and Pittsburgh corridors were all found to be very conservative, and the forecasts for these corridors were boosted as a result of the 2007 update.

Because of these definitional changes to eliminate reliance on allocations, as well as the fine-tuning of both the train operations and demand forecast that were performed in the 2007 study, the new results are not directly comparable to the earlier ones. But because of recalibration of base trips for the Ohio Hub Cleveland-Detroit, Cleveland-Buffalo and Cleveland-Pittsburgh lines, the financial results for 110-mph service have in general been improved. The financial results for the 3-C and MWRRS corridors at 110-mph are very close to what they were in the previous studies.

For the 2007 update, a new "Three Layers" route reporting structure has been devised which assumes that the MWRRS routes would be implemented first, then adds the original four Ohio Hub routes, and finally the three Incremental corridors that were the focus of the 2007 update. This reporting structure does not imply that the corridors must actually be built in this sequence; it was simply developed to provide a means of identifying and reporting the connecting revenue impact of Ohio Hub on the MWRRS; and of the Incremental Corridors on both the base Ohio Hub corridors as well as on the MWRRS.

Because the Fort Wayne to Chicago segment of the MWRRS Cleveland line was not treated as a part of the Ohio Hub but remained an MWRRS corridor in the 2007 update, this structre was needed in order to develop a complete assessment of the the effect on MWRRS of adding the Columbus to Fort Wayne segment. The MWRRS revenues that result from Ohio Hub connectivity can be derived by subtracting the result of base Layer 1 (MWRRS routes only) from the results of the Layers 2 and 3 analyses (MWRRS plus Base Ohio Hub plus Incremental Corridors.) As well, the impact of the Incremental Corridors connecting revenue on both the base Ohio Hub and MWRRS networks can be seen by subtracting the result of Layer 3 from Layer 2.

[28] The Ohio Hub 2004 plan makes it clear that any track upgrades in Canada are assumed to be developed in cooperation with the Canadian government and not be funded by the Ohio Hub capital funds. In addition, the rail service is planned to be operated jointly with VIA Rail Canada so any revenues or costs incurred north of the border will accrue to VIA Rail.

Exhibit 5-1 shows the updated ridership forecasts that have been developed for the fully built-out Ohio Hub system, including the three new incremental corridors. The forecasts are all based on the Preferred Option 1 configuration: Youngtown and Detroit Airport route options with MWRRS connectivity, at both 79-mph and 110-mph, along with the three incremental corridors. A more detailed table that also shows revenues and costs for each route and for each of the 3-Layers will be found in Chapter 7.

Exhibit 5-1: 2025 Forecast Ohio Hub System Ridership

Ridership in Millions	**Ridership**		
assuming connecting MWRRS 110-mph service	79-mph	110-mph	% Change
Cleveland-Cincinnati	1.60	2.56	60%
Cleveland-Detroit	1.52	2.23	47%
Cleveland-Niagara Falls	0.59	0.91	54%
Cleveland-Pittsburgh	0.60	0.86	44%
Subtotal OHIO Base	4.30	6.56	52%
Pittsburgh-Columbus	0.62	0.92	49%
Columbus-Ft Wayne	0.79	1.12	41%
Columbus-Toledo	0.53	0.75	41%
Subtotal OHIO Incremental	1.94	2.78	44%
TOTAL OHIO HUB	6.24	9.34	50%

5.1.1 Station Volumes

For the fully built-out Ohio system with incremental corridors, the ridership forecasts show significant numbers of trip origins and destinations at the terminal stations at the end of the lines.[29] As shown in Exhibit 5-2, the Cincinnati, Columbus and Cleveland stations all generate more than 1,000,000 annual riders (originated + terminated.) Both downtown Detroit and suburban Dearborn stations generate over 400,000 riders. With a northerly Ohio Hub service extension to Pontiac, the combined boarding/alighting counts for the Detroit area stations would easily exceed 1,000,000 annual riders. At present, a Cleveland hub would be larger, but Columbus is growing at a faster rate, so a Columbus hub would almost equal Cleveland's hub by 2025. Possible addition of the Northeast Ohio Commuter Rail System in Cleveland, and development of commuter rail from Columbus to Newark and Zanesville can be expected to further boost these totals.

Pittsburgh ridership would be substantial with two-thirds of a million annual riders. Moreover, major intermediate stations such as Toledo and Dayton also showed heavy station volumes generating almost 800,000 riders each. Fort Wayne is already a very strong intermediate station in the MWRRS base generating 729,000 riders in 2025 of which about ¾ would be headed into Chicago; but with addition of Ohio Hub connectivity Fort Wayne ridership would double, and with incremental corridors, Fort Wayne's ridership would triple.

[29] The station volume consists of the annual number of passengers boarding and alighting at each station. If passengers enter the system at a bus feeder station, they are not considered to be boarding and alighting at the rail station, but rather at the bus feeder station.

The original 3-C corridor plan provided a suburban stop only in North Columbus, assumed to be in the vicinity of Worthington, Ohio. When the incremental corridors from Columbus to Chicago, Toledo and Pittsburgh were added, a northwestern suburban stop in Hilliard or Dublin as well as an eastern suburban stop at Port Columbus Airport became possible. As well, a suburban West Columbus stop, not part of the original 3-C planning effort, has been suggested.

When riders face a choice between a downtown station or several possible suburban stops, their choice of which stop to use is highly influenced by their direction of travel, as well as the specific frequencies and train schedules that are available at the specific suburban stop. Riders will not automatically choose the stop that is closest to their home, rather, they are likely to drive to a stop that is on the line they are traveling on. The use of suburban stops is also very sensitive to train frequency. Because of the complexity of this choice, we have not in this study attempted to separate downtown versus suburban ridership between the downtown Columbus and various suburban stations. However, since all the Columbus zones are connected into the rail system the overall Columbus ridership forecast is accurate. It is only a question of how ridership will distribute among the various stops.

Exhibit 5-2 does not include forecasts for small stations such as Ada, Kenton, or Uhrichsville. In general the ridership gained by stopping in such small towns may be offset by losses between the endpoints, because of the added time added to the schedule. A few local train stops in small places may be provided for the convenience of local residents, but this is not expected to have any material impact on the ridership or revenue forecast that has been developed for the Ohio Hub system.

Exhibit 5-2 updates the station forecasts for the preferred Option 1 as well as for the expanded system with the Incremental Corridors added. It should also be noted that the ridership forecast at individual stations was affected by the replacement of the Amtrak long-distance train data. Because the existing long distance Amtrak service operates only at night, Ohio stations at the smaller intermediate stops are only lightly used and some of them are skipped altogether. As compared to Exhibit 6-11 from the earlier Ohio Hub 2004 report, as a rule the projected ridership at the smaller intermediate stations has been increased substantially from the earlier forecasts. As a result of the 2007 update, the ridership projections at all the stations has now been made much more consistent with the observed demographics of each zone that were the earlier 2004 forecasts.

Exhibit 5-2: 2025 - Projected Station Volumes – High Speed Scenario – 2007 Update

Major Station	Station Volumes (annual Passengers)	
	Option 1	Incremental Corridor
Cleveland Hub	1,104,325	1,155,743
Cleveland-Detroit		
Cleveland Airport, OH	40,429	42,601
Elyria, OH	212,717	219,573
Sandusky, OH	142,398	148,736
Toledo, OH	638,972	786,186
Monroe, MI	74,600	92,853
Detroit Airport, MI	37,849	49,094
Dearborn, MI	392,505	462,911
Detroit, MI	367,237	423,360
Cleveland-Pittsburgh		
S.E. Cleveland, OH	63,976	65,575
Warren, OH	110,628	113,970
Youngstown, OH	77,973	81,218
North Pittsburgh, PA	136,094	145,183
Pittsburgh, PA	504,010	666,670
Cleveland-Buffalo/Toronto Corridor		
N.E. Cleveland, OH	150,740	154,435
Ashtabula, OH	31,836	32,603
Erie, PA	182,206	189,108
Dunkirk, NY	4,150	4,162
Buffalo, NY	211,745	218,702
Niagara Falls, NY	52,706	54,108
Niagara Falls, ON	34,143	34,871
Oakville, ON	14,380	14,627
Toronto, ON	311,358	317,071
Cleveland-Columbus/Cincinnati Corridor		
Cleveland Airport, OH	113,210	117,568
Gallion, OH	79,596	94,012
North Columbus, OH	296,728	465,874
Columbus, OH	641,341	1,110,486
Springfield, OH	51,207	69,995
Dayton, OH	639,978	787,616
Middletown, OH	63,437	74,791
North Cincinnati, OH	70,206	82,016
Cincinnati, OH	913,388	1,074,616
Columbus-Ft.Wayne-Toledo		
Marysville/Kenton, OH	-	302,907
Lima, OH	-	327,548
Ft Wayne, IN	1,267,634	1,810,754
Findlay, OH	-	205,146
Pittsburgh-Columbus		
Steubenville, OH	-	147,454
Coshocton, OH	-	46,138
Newark, OH	-	445,574

5.1.2 Trip Purpose Breakdown

Ridership forecasts were broken down by two trip purposes: *Business*, which accounts for employer-reimbursed travel and *Other*, which includes resident leisure and social travelers and tourists. As expected, the dominant trip purpose for all corridors was found to be *Other*, which accounts for approximately 58 to 70 percent of the total rail trips.[30]

5.1.3 Trip Distribution by Trip Characteristics

The demand forecasting model estimates total rail ridership by forecasting natural growth, induced demand and diverted trips. *Natural growth* trip estimation reflects changes in socioeconomic factors that contribute to changes in total travel demand in the corridor. *Socioeconomic factors* include population, employment and income used in this Study. *Induced demand* reflects the travel demand changes due to a modification in a transportation mode, which accommodates new trip-making characteristics that would not exist under present conditions. Induced demand is based on the improvements in accessibility offered by the rail mode within the total transportation system. *Diverted trips* illustrate the mode-to-mode shifts that result when an improved alternative is added to the network and influences travelers' choice of travel mode. For example, a new intercity rail option will divert trips from auto and air.

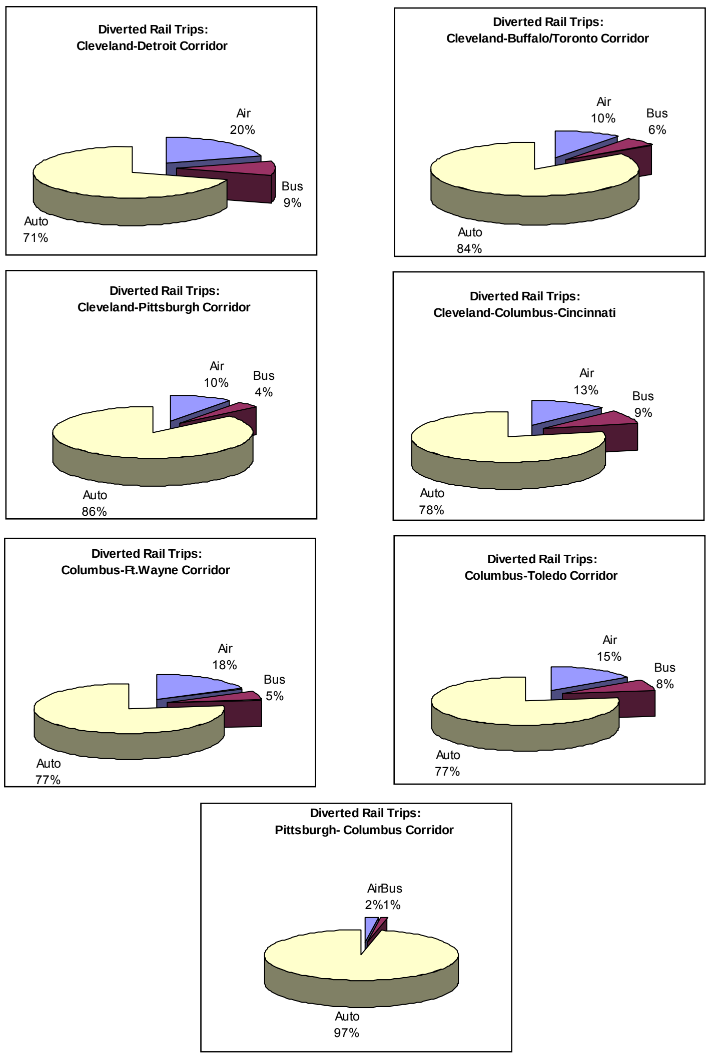
Exhibit 5-3 shows the trip diversion to rail by mode for forecast year 2025. Trip diversion percentages are illustrated for each of the four Ohio Hub corridors. Between 70 and 85 percent of the Ohio Hub's diverted trips are expected to come from the auto mode. Induced demand accounts for less than 10% of forecasted traffic.

As shown in Exhibit 5-3, the analysis of trip distribution shows similar patterns among most corridors. Most trips were diverted from the auto mode. The corridors ranged from 71 percent diverted from auto between Cleveland and Detroit, to 86 percent between Cleveland and Pittsburgh, which is typical to that seen in previous studies. Interestingly, the bus and air data showed that these modes were either very weak in the Pittsburgh to Columbus corridor, or else offered minimal direct service; 97% of the diversion for the Panhandle corridor would come from the auto mode.

Diverted trips from bus and air varied depending upon the existing market shares of the modes in each corridor. The Cleveland-Detroit corridor had the highest number of diverted trips (20 percent) from air since it has a relatively larger air market than any other corridor. The highest number of diverted bus trips (9 percent) was found in the Cleveland-Columbus-Dayton-Cincinnati corridor where a bus service is currently available. Induced demand was generally less than 10 percent.

[30] The 2004 study also reported a further breakdown of commuter travel as a share of originally-forecasted *Other* trips on the Detroit to Toledo segment. For the Detroit Metro option, it found a 24%-33%-43% breaddown between Other, Commuter and Business trips; for the Wyandotte option, the breakdown was 49%-20%-31%. The 2004 study did not forecast commuter ridership at the MPO zone level but rather used the regional zone system that had been established for the Ohio Hub. The forecast was only for commuter travel that could be captured by an intercity rail system at typical intercity fare levels, and did not forecast the ridership that could be obtained by a dedicated commuter rail system.

Exhibit 5-3: Diverted Trips by Corridor in 2025



5.1.4 Modal Split

The demand forecasting model also provides data on the market shares by mode, or *modal split*. As shown in Exhibit 5-4 the automobile remains the dominant mode, accounting for more than 96 percent of all trips within the study area during the 2025 forecast year. The modal share for rail is forecast as around 1.8 percent of the total travel demand in the Cleveland-Detroit corridor. This is only slightly higher than the air market share, and may be considered conservative in view of the short length of the corridor. Rail market shares for the rest of the corridors are expected to make up between 1% to 5% of total demand, depending largely on the quality and circuity of the competing highway network. The modal share for bus ranged from 0.2 percent to 0.6 percent of total demand. With the addition of the incremental corridors, the role of rail in the corridors served by the Ohio Hub system would become roughly comparable to that of air transport. Less than one-half of one percent of all corridor trips would be made by bus.

Exhibit 5-4: 2025 - Modal Market Share of Total Travel Demand by Mode - High Speed Scenario

Corridors	Air	Bus	Auto	Rail
Cleveland-Detroit	1.35%	0.57%	96.28%	1.80%
Cleveland-Buffalo-Toronto	0.38%	0.11%	98.66%	0.85%
Cleveland-Pittsburgh	0.59%	0.15%	97.89%	1.37%
Cleveland-Columbus-Cincinnati	0.80%	0.39%	96.86%	1.95%
Columbus-Pittsburgh	0.07%	0.01%	96.91%	3.01%
Columbus-Ft.Wayne	1.86%	0.52%	92.54%	5.08%
Columbus-Toledo	1.49%	0.59%	93.81%	4.11%
Ohio Hub System	**1.44%**	**0.43%**	**96.31%**	**1.82%**

5.1.5 Fares by Corridor

Exhibit 5-5 shows the upgraded ridership and total revenue forecasts that were developed for the fully built-out Ohio Hub system, including three MWRRS lines as well as the three new incremental corridors[31]. This exhibit also gives passenger-mile statistics and summarizes the fare assumptions, in terms of average revenue yields, that were assumed for both 110-mph and 79-mph forecasts. It can be seen that the average revenue yields for 110-mph service range from about 22¢ to nearly 40¢ per passenger mile. The 3-C and Buffalo lines optimized with very high yields for 110-mph service.

[31] These updated forecasts are all based on the Preferred Option 1 configuration: Youngtown and Detroit Airport route options with MWRRS connectivity, at both 79-mph and 110-mph.

Average fares for 110-mph service were the same as used in previous studies, and were the result of individual corridor fare optimizations that were performed in those prior studies. However, because each corridor has different characteristics, different fares were used in each corridor. The MWRRS Michigan corridors have the lowest fares; while the 3-C and Niagara Falls lines have the highest fares:

- The MWRRS fare optimization showed that the Michigan lines were capable of supporting higher fares; however, in the MWRRS analysis these fares were held to a moderate level as a result of an earlier policy decision by Michigan DOT.
- For 110-mph service, the 3-C fare optimizes at a high level indicating an exceptionally strong revenue potential for this corridor. This reflects a lack of effective air competition because the distances from Columbus to both Cleveland and Cincinnati are too short to support economical air service; but to remain attractive for business travel, speeds must be high enough to produce auto-competitive trip times. The unusually high revenue yields that were optimized for 110-mph service in the 3-C corridor cannot be sustained for a 79-mph service, and as already explained by Exhibit 5-18, the 79-mph forecast correspondingly shows a strong revenue reduction.
- Fares on Cleveland-Niagara Falls line were set higher than the revenue optimizing level in the previous study, but were retained for this analysis. These fares were due in part to a policy decision to suppress demand, to limit the number of passenger trains proposed to be added to the busy CSX Cleveland-Buffalo rail line. Once again, these high revenue yields that were forecast for a 110-mph service cannot be sustained for a 79-mph service.
- Fares for the 110-mph incremental corridors were optimized at about 25-27¢ per passenger mile[32], in the same approximate range as MWRRS fares.

Exhibit 5-5: 2025 Forecast MWRRS East and Ohio Hub with Incremental Corridors

Ridership, Passenger-Mile and Revenue all in Millions; MWRRS always 110-mph	79-mph OHIO HUB				110-mph OHIO HUB			
	Ridership	Pass-Miles	Revenue	Yield	Ridership	Pass-Miles	Revenue	Yield
Chicago-Michigan 110-mph	3.87	606.43	$136	$0.22	3.87	614.22	$136	$0.22
Chicago-FTW-Toledo 110-mph	2.11	324.98	$87	$0.27	2.39	371.95	$99	$0.27
Chicago-Cincinnati 110-mph	1.36	200.65	$59	$0.29	1.39	204.74	$60	$0.29
TOTAL MWRRS East Corridors	**7.34**	**1132.05**	**$282**	**$0.25**	**7.66**	**1190.90**	**$295**	**$0.25**
Cleveland-Cincinnati	1.60	167.53	$40	$0.24	2.56	267.34	$100	$0.38
Cleveland-Detroit	1.52	136.88	$28	$0.21	2.23	199.98	$51	$0.25
Cleveland-Niagara Falls	0.59	75.73	$18	$0.23	0.91	116.47	$45	$0.39
Cleveland-Pittsburgh	0.60	64.31	$17	$0.26	0.86	92.94	$30	$0.32
Subtotal OHIO Base	***4.30***	***444.45***	***$103***	***$0.23***	***6.56***	***676.73***	***$226***	***$0.33***
Pittsburgh-Columbus	0.62	62.11	$14	$0.22	0.92	90.86	$25	$0.27
Columbus-Ft Wayne	0.79	93.54	$20	$0.22	1.12	142.20	$36	$0.25
Columbus-Toledo	0.53	62.36	$14	$0.22	0.75	94.80	$24	$0.25
Subtotal OHIO Incremental	***1.94***	***218.01***	***$48***	***$0.22***	***2.78***	***327.85***	***$85***	***$0.26***
TOTAL OHIO HUB	**6.24**	**662.46**	**150.59**	**$0.23**	**9.34**	**1004.58**	**311.20**	**$0.31**

[32] The measure of "Passenger fare per train mile" is very closely related to revenue yield. If Passenger fare revenues are used then the Revenue per passenger mile calculation will develop a precise measure of revenue yield. If as in Exhibit 5-18, total revenues are used in the yield calculation, then the result will also include an ancillary revenues component that typically improves the average revenue yield by 10-15%. While Passenger fare per train mile is more appropriate for revenue yield optimization, the calculation based on Total Revenues may be more appropriate for comparison to a measure of Total Cost per passenger mile.

Fares for 79-mph service were consistently set in the range of 21-26¢ per passenger mile. These 79-mph fare assumptions were lowered from the earlier Ohio Hub study that had maintained higher revenue yields and modal biases on the basis of connecting to a 110-mph high speed service. Although ridership interconnectivity between Ohio Hub and MWRRS is significant, MWRRS connecting trips by no means comprise the majority of forecast Ohio Hub riders. Therefore, for the 2007 business plan it was considered prudent to adopt a more conservative posture by reducing both the revenue yields and modal biases for the updated 79-mph demand forecast.

By comparison to the earlier 2004 Ohio Hub study, the result is that the 110-mph forecasts for the Detroit, Buffalo and Pittsburgh corridors were raised, while the 79-mph forecast for the 3-C corridor was lowered in line with current assessment of the viability of the 79-mph service option. The result of these adjustments is that all four of the original corridors are now performing on a much more consistent basis with each another, as well as compared to the three new incremental corridors that were recently added.

Overall, the forecast ridership of a 110-mph system is about 50% more than that of a 79-mph system, while revenues double. However, the distribution of ridership and revenue impacts is not uniform, with both the Niagara Falls and 3-C corridors reflecting a higher sensitivity to operating speed. This reflects the strength of business travel in these markets, but also the presence of competitive alternatives that would cause a sharp revenue reduction for a 79-mph servic. This stems not only from the ridership reduction, but even more from the inability of a 79-mph service to sustain the high revenue yields that were optimized for a 110-mph service on these corridors.

Exhibit 5-6 highlights the relationship between the 79-mph versus 110-mph revenue forecasts, as compared to the level of capital investment proposed for each corridor. In this exhibit, it can be seen that the corridors reflecting the most dramatic revenue improvement for 110-mph service are the same ones that would require the greatest additions of dedicated track. To introduce even 79-mph passenger service on heavily used freight lines requires a significant investment in both line capacity and grade crossing improvements; once this is done as a rule, raising the speed adds only marginally to the cost, but substantially improves the attractiveness of the rail service. This ensures its ability to sustain a fare level that is high enough so the corridor can cover its own day-to-day operating cost, and produce an operating surplus.

Exhibit 5-6: 79-mph vs 110-mph Capital Cost vs Revenue Comparison

Capital Costs in $2002 Millions	**Capital Cost**			**Revenue**
	79-mph	110-mph	% Change	% Change
Cleveland-Cincinnati	$722	$1,166	61%	152%
Cleveland-Detroit	$602	$656	9%	78%
Cleveland-Niagara Falls	$603	$801	33%	155%
Cleveland-Pittsburgh	$462	$485	5%	78%
Pittsburgh-Columbus	$442	$488	10%	78%
Columbus-Ft Wayne	$426	$495	16%	78%
Columbus-Toledo	$179	$205	15%	78%

6. Operating Costs

This chapter describes the various costs associated with operating the Ohio Hub passenger rail system. Operating costs are categorized as variable or fixed. 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 drive the operating costs higher or lower. Fixed costs are generally predetermined, but may be influenced by external factors, such as the volume of freight traffic or may include a relatively small component of activity-driven costs. Some fixed costs, such as station operations, increase as line segments open but not in direct proportion to train miles. As a rule, costs identified as fixed should remain stable across a broad range of service intensities.

When analyzing variable and fixed costs, it becomes clear that the larger a system becomes, the more efficiently it tends to operate. This phenomenon is called "economies of scale." For example, as a rail system operates additional train miles, its fixed costs remain stable, so the average cost per train mile operated will decrease. This chapter demonstrates that economies of scale create cost saving synergies that have a positive effect on the Ohio Hub System's financial performance.

The costing approach originally developed for the Midwest Regional Rail System (MWRRS) was adapted for use in this study. Following the MWRRS methodology, eleven specific cost areas were identified. As shown in Exhibit 6-1 train miles impact the variable cost of equipment maintenance, energy and fuel, and train and onboard service crews. Passenger miles drive insurance liability costs. Ridership influences marketing, sales and station costs. Fixed costs include administrative costs, track and right-of-way maintenance costs, and feeder bus costs.

Exhibit 6-1: Categories and Primary Cost Drivers

Drivers		Cost Categories
Train Miles	→	Equipment Maintenance Energy and Fuel Train and Engine Crews OBS Crews Operator Profit
Passenger Miles	→	Insurance Liability
Ridership and Revenue	→	Sales and Marketing Station Costs[33]
Fixed Cost	→	Service Administration Track and ROW Maintenance Feeder Bus

[33] Station costs are affected only slightly by ridership, therefore this cost can be considered fixed for practical purposes.

Operating costs were developed for the Ohio Hub 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 Ohio Hub is implemented, actual costs will be subject to negotiation between the passenger rail authority and the contract rail operator(s).
- Freight railroads will maintain the track and right-of-way, but ultimately, the actual cost of track maintenance will be resolved through negotiations with the railroads.
- Maintenance of train equipment will be contracted out to the equipment supplier.
- Operating expenses for train operations, crews, management and supervision were developed through a bottoms-up staffing approach.
- A detailed Business Plan for providing a Ohio Hub express parcel and delivery service was not developed, but based on the results from a MWRRS analysis, the net contribution of express parcel service was estimated as 5 percent of passenger revenues in the High-Speed Scenarios.
- Train operating practices follow existing work rules for crew staffing and hours of service.
- Following US General Accounting Office (GAO) requirements, this analysis was conducted using real dollar terms without considering inflation. Inflation is treated in the Net Present Value calculations by using a real interest rate for discounting future cash flows.

Those scenarios having MWRRS connectivity show considerably better financial performance. This analysis makes a strong case for cost and revenue synergies that occur when a passenger service is developed as an integrated *network* of high-speed lines rather than as individual, isolated corridors:

- The Ohio Hub study evaluates both *High-Speed* (110-mph) and *Modern* (79-mph) scenarios. The 2004 study also evaluated a 79-mph *Start-up*[34] scenario. Additionally in the 2004 study, the *High-Speed* and *Modern* scenarios were evaluated both as *Stand-alone* systems and *with MWRRS connectivity*. The *Start-up* scenario was evaluated only as a stand-alone system. Four combinations of route alternatives were evaluated for the *High-Speed* and *Modern* scenarios with MWRRS connectivity, to determine which set of routes performed best. Each scenario had a different costing basis, which reflected its train speeds and appropriate economies of scale. While some MWRRS costs were adjusted downward to reflect the lower cost of operating the smaller 200-seat trains assumed by the 2004 Ohio Hub business plan, other costs were adjusted upwards to reflect a lack of economies of scale in a Ohio Hub Start-up System.

[34] High-Speed Scenarios include passenger train speeds to 110-mph, while Modern Scenarios limit speeds to their current 79-mph. Both the High-Speed and Modern scenarios increase frequency of train service to eight round-trips per day on each corridor except for Buffalo/Toronto, which has only five round-trips. The 79-mph Start-up scenario has two daily round-trips on each corridor.

- The updated 2007 study builds on the "preferred option" that was identified by the 2004 study: Option 1 – Detroit Airport + Youngstown, adding the three "incremental" corridors. As well, a new Implementation plan, as described in Chapter 7, was developed that adds the "incremental" corridors into the Ohio network. The financial performance of the network was projected on a year-by-year basis and revised Cost Benefit ratios have been calculated.

The costing model used for the "Incremental Corridors" evaluation follows the same basic framework as the original 2004 work. However, some adjustments to specific cost items have been incorporated as a result of the 2007 business plan update.

6.1 Ohio Hub Business Plan – Fixed Costs

6.1.1 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. The rates for all of these activities will ultimately be 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, it is important to recognize that the Ohio Hub Study is a feasibility-level analysis and that as the project moves forward, additional study and discussions with the railroads will be needed to further refine these cost estimates. Both capital and operating costs will be estimated. All costs are developed in 2002 constant dollars based on projected 2025 freight traffic levels.

When fully implemented, the Ohio Hub would provide the Ohio and Lake Erie region an increase in the maximum authorized speed as well as the frequency of train service. In order to accommodate the passenger trains on some heavily used corridors, the Ohio Hub assumes a substantial increase in capacity. Once constructed, these railroad improvements will need to be maintained to FRA standards required for reliable and safe operations.

The costing basis assumed in this report is that of *incremental* or *avoidable* costs. 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.

The following is a list of cost components that are included within the Track and Right-of-Way category:

- **Track Maintenance Costs.** Incremental 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.* The specific assumptions employed for this Study are discussed in the following pages. However, Zeta-Tech's costs are conceptual and are still 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. Based on the MWRRS study, a reimbursement rate of 39.5¢ per train mile was assessed in both the Modern and High-Speed Scenarios to cover these freight railroad costs. This 39.5¢ rate is about half the level of Amtrak's current costs, reflecting the economy of scale inherent in a large regional passenger rail network. However, there is no reason to assume any economies of scale in a small "Start-up" operation having only two round-trips per day, so Amtrak's full cost of 79¢ per train mile was assumed in that scenario. These costs are included as part of Track and Right-of-Way Maintenance costs in the calculation of operating results.
- **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 to the freight railroad of the infrastructure improvements made by the Ohio Hub as well as track maintenance payments. The Ohio Hub Financial Analysis assumes that right-of-way access will be purchased "up front" as a capital expense, rather than on an ongoing basis as an operating expense. A capital expense placeholder for right-of-way access has been calculated based on underlying land values, and is included in the total capital cost estimate in Chapter 2 of this report.

Similar concerns exist in the case of incentive payments for on-time performance. The infrastructure improvements to freight corridors called for in this study should provide enough capacity to allow superior on-time performance for both freight and passenger operations. The need for additional incentive payments will be unclear until performance data is obtained from actual post-implementation passenger rail operations.

Route-specific track maintenance costs were developed by subdividing each line into short segments. Wherever train speed, tonnage or number of tracks changed, a new line segment was created. Freight tonnage data was supplied by ORDC based on railroad tonnage maps and other available information. Annual growth rates of 2-5 percent were applied to project future year 2025 freight tonnages. Track configuration data was based on railroad track charts as well as the proposed capital upgrade plan described in Chapter 2.

The difference in cost required to maintain a higher class of track for passenger train operations is called the "maintenance increment." For 90-mph Class 5 and 110-mph Class 6 segments, Zeta-Tech's cost per track mile coefficients were used to calculate the freight maintenance increment depending on the level of freight tonnage. On top of this, a flat rate of $1.56 per train mile as used in the Zeta-Tech report, was added to reflect the direct cost of added passenger tonnage.

The Zeta-Tech report also used $1.56 as the cost-per-mile for passenger operation on 79-mph Class 4 segments. This cost that 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." Track maintenance costs have two main components:

- *Operating costs* cover expenses needed to keep existing assets in service and include 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. Therefore, capital maintenance costs are gradually introduced using a table of ramp-up factors provided by Zeta-Tech (Exhibit 6-2). A normalized capital maintenance level is not reached until 20 years after completion of the Ohio Hub rail upgrade program.

Exhibit 6-2: Capital Cost Adjustments Following Upgrade of a Rail Line

Year	% of Capital Maintenance	Year	% of Capital Maintenance
0	0%	11	50%
1	0%	12	50%
2	0%	13	50%
3	0%	14	50%
4	20%	15	75%
5	20%	16	75%
6	20%	17	75%
7	35%	18	75%
8	35%	19	75%
9	35%	20	100%
10	50%		

In the Ohio Hub Business Plan, only the operating component of track maintenance cost is treated as a direct operating expense. Capital maintenance costs are incorporated into the Ohio Hub Financial Plan and can be repaid using direct grants or from surplus operating cash flow. The latter option has been assumed in this study. Accordingly maintenance capital expenses only reduce the net cash flow generated from operations, and do not affect the operating ratio calculations. The annual amount of this capital cost is shown in the Cash Flow Analysis for the Ohio Hub System. The Capital Track maintenance line shown in the Benefit Cost analysis is based on the Net Present Value of the total capital track maintenance cost over the lifetime of the project – the NPV that appears in the Benefit Cost analysis is not the same as the annual sum, which can be calculated by applying the factors shown in Exhibit 6-2.

Segment-specific Assumptions

Infrastructure and capital planning for 110-mph operation, particularly in the Cleveland-Columbus-Cincinnati corridor is highly conceptual and is still subject to field verification and additional discussion with the freight railroads. The current capital plan may be regarded as conservative, pending completion of a detailed line capacity analysis for each track segment. A detailed line capacity simulation is especially needed for the suggested commingled line segments, as shown in Exhibit 6-3.

In developing maintenance costs, dedicated passenger tracks were assumed where 110-mph passenger service operates alongside high-density freight lines, as well as on lower-speed urban sections (i.e., Berea-Cleveland and Ivorydale Junction-Cincinnati) that were costed as 79-mph dedicated tracks. Given the level of freight traffic congestion that currently exists in these urban areas, reliable passenger service cannot be provided without augmenting capacity. Freight railroads could also use these tracks for their own trains, but they must be able to ensure priority dispatching for passenger access to the downtown Cincinnati and Cleveland terminals. For the 3-C line, the exact placement of dedicated track segments has yet to be defined. Some assumptions, as detailed in Exhibit 6-3, had to be made regarding the need for shared vs. dedicated usage in order to complete the cost calculations.

Exhibit 6-3: Track Maintenance Segment Costing Assumptions

Line Segment	Maintenance Costing Basis	Assumed Speed
Toledo-Detroit, either route	Commingled	110-mph
Cleveland-Pittsburgh via Alliance	Commingled	79-mph
Buffalo-Toronto via Niagara Falls	Commingled	79-mph
Galion-Dayton via Columbus	Commingled	110-mph
Toledo-Berea	Dedicated	110-mph
Berea-Cleveland	Dedicated	79-mph
Cleveland-Buffalo	Dedicated	110-mph
Galion-Berea	Dedicated	110-mph
Dayton-Ivorydale Jct	Dedicated	110-mph
Ivorydale Jct-Cincinnati	Dedicated	79-mph
Ravenna-New Castle via Youngstown	Dedicated	110-mph
Pittsburgh-Steubenville via Panhandle	Commingled	79-mph
Steubenville -Columbus via Panhandle	Commingled	110-mph
Columbus-Fort Wayne	Commingled	110-mph
Dunkirk-Toledo	Commingled	110-mph

Costing a track as dedicated infrastructure does not mean that freight trains will be prohibited from using it. Rather, it suggests that passenger trains as the primary user will pay the entire cost of maintaining the track and is a conservative assumption, since current costing ignores any possibility of freight or commuter train use. Sharing the cost of dedicated facilities with other trains up to the capacity of the facility would reduce the cost to the passenger operation since fixed costs could be shared with other traffic[35]. The added line capacity provided by the Ohio Hub may be especially attractive for additional intermodal trains that cannot be effectively accommodated within the capacity of existing rail facilities. Possible fees for using Ohio Hub dedicated tracks and cost-sharing opportunities will be subject to negotiation with the freight railroads and local transit agencies.

Dedicated segments were costed assuming Ohio Hub pays the full Zeta-Tech mileage cost of maintaining a single track plus $1.56 per passenger train mile. The Zeta-Tech methodology does not specifically address the costing of dedicated tracks, but implies that this additional $1.56 per passenger train mile should always be added to the track mile cost. Therefore, the $1.56 additive has been included as a conservative assumption, which more than covers the cost for occasionally using adjacent freight tracks (at a reduced speed) for meeting other passenger trains.

For calculation of operating costs in the Modern Scenario, since 79-mph operations do not require improving track conditions beyond FRA Class 4, there is no need to upgrade the FRA track class. Accordingly, a flat rate of $1.56 per train mile[36] was used on all lines for costing both the 79-mph Modern and Start-up Scenarios.

The Buffalo-Toronto segment was also costed at $1.56 per train mile since the current Business Plan assumed no speed improvements between Niagara Falls and Buffalo, or in Canada. From Cleveland to Buffalo, the need to maintain a high-speed dedicated track[37] for only five round-trips per day results in a very high cost. However, averaging that dedicated track cost across the entire length of the corridor results in a quite reasonable $5.20 per train mile, which is a level of cost that can be supported by the projected revenues of the route.

For passenger service on 79-mph segments of the Cleveland-Pittsburgh route, dedicated tracks are not needed except for capacity reasons[38]. While a detailed line capacity study was not funded as part of the current planning phase, given the high level of freight traffic the capital cost conservatively assumed (pending the outcome of a simulation analysis) that a third track would have to be provided from Cleveland to Beaver Falls, a distance of 108.8 miles, in both the High-Speed and Modern Scenarios[39]. The proposed added track would be constructed to FRA Class 4 standards and could operate on a commingled basis. Cleveland-Pittsburgh track maintenance on the Alliance line was costed at the $1.56 per passenger train mile standard rate with no increment

[35] TEMS estimates the incremental cost for freight use of Class 6 dedicated track may work out to approximately 20¢ per car mile, which is in the same range of cost that freight railroads typically pay each other for trackage rights. Any payment beyond this would contribute towards covering fixed costs. Since freight access will probably be priced on a car mile rather than train mile basis, due to the large size of modern trains only a few freight trains may be needed to significantly reduce the Cleveland Hub's share of cost on dedicated lines. Freight capacity sharing may be particularly important for the economics of adding a third track to the CSX Cleveland-Buffalo line, since passenger trains would consume only a small fraction of the new track's available capacity.
[36] $1.56 per train mile is slightly more than Amtrak is currently paying to U.S. freight railroads for track maintenance costs.
[37] Attempting to commingle passenger and freight on the existing CSX freight tracks would be even *more* expensive, since *two* tracks would have to be upgraded to Class 6 and maintained under heavy freight traffic. The most economical solution may be to upgrade the lightly used NS corridor instead. Doing this might avoid the cost of constructing new, dedicated track and require only a *single* existing NS track to be improved to Class 6 standards.
[38] Based purely on track maintenance cost savings, high-speed trains should be separated from heavy freight tonnage operations beyond about 20-50 MGT per track. For conventional speeds, line capacity considerations mainly determine the investment need.
[39] Instead of triple-tracking Cleveland to Beaver Falls, a better strategy for freight may be to instead upgrade the W&LE Orrville-Bellevue line. Orrville to Oak Harbor is a distance of only 98 miles compared to the current 108.8 mile Cleveland to Beaver Falls triple-tracking plan, and may have the additional benefit of avoiding the need to triple track from Cleveland to Toledo as well. This reroute would put Pittsburgh-Chicago through freight trains on a shorter, more direct line that would bypass the Cleveland urban area.

needed for maintaining a higher track standard. On the Youngstown alignment, only the middle portion from Ravenna to New Castle operates on dedicated high-speed track yielding an overall cost of $2.28 per train mile.

The Cleveland-Cincinnati or 3-C Corridor has an operating cost of $5.11 per train mile, due to a high proportion of 110-mph trains running, along with this corridor's heavy reliance on dedicated lines. The Galion-Dayton segment of the 3-C corridor was costed as a single track, 110-mph shared line with 20 percent double track for passing sidings. The Ohio Hub pays the incremental cost for maintaining a higher track class under projected 2025 freight traffic volumes. Commingling with freight from Galion to Columbus slightly reduces the cost, but freight tonnage is higher from Columbus to Dayton, therefore making little difference to the level of operating costs whether the existing freight track is shared there or not. However, a shared track from Columbus to Dayton would reduce the capital cost.

The Cleveland-Detroit corridor assumes a 110-mph dedicated track from Cleveland to Toledo shared with MWRRS passenger trains. In MWRRS connectivity scenarios, Cleveland to Toledo train mile costs are very reasonable since the cost can be divided over eight Ohio Hub plus eight MWRRS round trips. This calculation produces an operating cost of $3.53 per train mile for the Ohio Hub Stand-alone System or $2.36, if half of Cleveland-Toledo cost can be assigned to the MWRRS.

Costs for track maintenance on the three incremental corridors were all set at a comparable level to what had been earlier developed for the Chicago to Fort Wayne portion of the MWRRS corridor, about $3.79 per train-mile. This compares to $2.09 per train-mile that was assumed for 79-mph comingled operations and reflects a reasonable increment for maintaining Class 6 tracks on a lightly-used freight line.

Exhibit 6-4 shows the operating expense per train mile (excluding capital maintenance) for each of the four Ohio Hub corridors. It should be noted that compared to the $5.25 per train mile assumed in an earlier analysis of the Ohio Hub, these revised track maintenance costs compare quite favorably and have even been reduced from earlier figures. Exhibit 6-5 shows overall operating and capital costs for each corridor by year.

Exhibit 6-4: Track Operating Maintenance Cost per Train Mile ($2002)

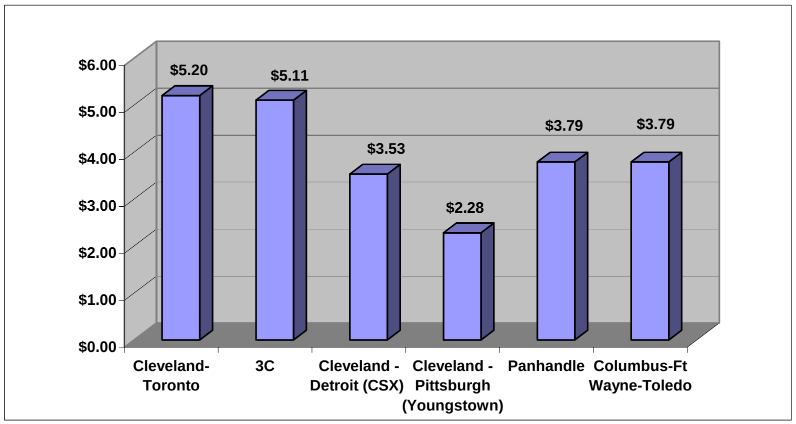


Exhibit 6-5: Ohio Hub Track Maintenance Cost by Year (in thousands of 2002 $)

Corridors: High-Speed Shared with Midwest Scenario	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cleveland-Detroit via Airport															
Track & RoW Maint	$0	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139
Capital MofW	$0	$0	$0	$0	$217	$365	$473	$893	$1,027	$1,109	$1,458	$1,593	$1,674	$1,884	$1,884
Cleveland-Pittsburgh via Youngstown															
Track & RoW Maint	$0	$0	$0	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593
Capital MofW	$0	$0	$0	$0	$84	$141	$182	$344	$396	$427	$561	$613	$644	$725	$725
Cleveland-Niagara Falls															
Track & RoW Maint	$0	$0	$0	$0	$0	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358
Capital MofW	$0	$0	$0	$0	$0	$296	$384	$724	$834	$900	$1,183	$1,292	$1,358	$1,529	$1,529
Cleveland-Columbus-Cincinnati															
Track & RoW Maint	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581
Capital MofW	$0	$0	$0	$0	$345	$580	$753	$1,420	$1,634	$1,763	$2,318	$2,533	$2,662	$2,996	$2,996
Pittsburgh-Columbus via Panhandle															
Track & RoW Maint	$0	$0	$0	$0	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256
Capital MofW	$0	$0	$0	$0	$118	$199	$258	$487	$560	$604	$795	$868	$913	$1,027	$1,027
Columbus-Fort Wayne-Toledo															
Track & RoW Maint	$0	$0	$3,027	$3,027	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165
Capital MofW	$0	$0	$0	$0	$271	$455	$591	$1,114	$1,282	$1,384	$1,819	$1,988	$2,089	$2,351	$2,351

Exhibit 6-5 (continued): Ohio Hub Track Maintenance Cost by Year (in thousands of 2002 $)

Corridors: High-Speed Shared with Midwest Scenario	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cleveland-Detroit via Airport																
Track & RoW Maint	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139	$4,139
Capital MofW	$2,116	$2,340	$2,476	$2,826	$2,826	$3,058	$3,282	$3,418	$3,768	$3,768	$3,768	$3,768	$3,768	$3,768	$3,768	$3,768
Cleveland-Pittsburgh via Youngstown																
Track & RoW Maint	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593	$1,593
Capital MofW	$815	$901	$953	$1,088	$1,088	$1,177	$1,264	$1,316	$1,451	$1,451	$1,451	$1,451	$1,451	$1,451	$1,451	$1,451
Cleveland-Niagara Falls																
Track & RoW Maint	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358	$3,358
Capital MofW	$1,717	$1,899	$2,009	$2,293	$2,293	$2,481	$2,663	$2,773	$3,058	$3,058	$3,058	$3,058	$3,058	$3,058	$3,058	$3,058
Cleveland-Columbus-Cincinnati																
Track & RoW Maint	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581	$6,581
Capital MofW	$3,365	$3,722	$3,937	$4,494	$4,494	$4,863	$5,220	$5,435	$5,992	$5,992	$5,992	$5,992	$5,992	$5,992	$5,992	$5,992
Pittsburgh-Columbus via Panhandle																
Track & RoW Maint	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256
Capital MofW	$1,153	$1,276	$1,350	$1,541	$1,541	$1,667	$1,789	$1,863	$2,054	$2,054	$2,054	$2,054	$2,054	$2,054	$2,054	$2,054
Columbus-Fort Wayne-Toledo																
Track & RoW Maint	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165	$5,165
Capital MofW	$2,641	$2,921	$3,090	$3,527	$3,527	$3,816	$4,096	$4,266	$4,703	$4,703	$4,703	$4,703	$4,703	$4,703	$4,703	$4,703

Station Operations

For the Ohio Hub, 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. In producing the station operations figures, station costs were scaled to station size. For example, larger end-terminal stations have additional staffing requirements due to high passenger volumes while smaller stations with less volume have minimal staffing needs.

All stations were assumed open for two shifts. Five additional staff positions would be added to each currently staffed Amtrak station and eight positions at each new location. Unstaffed stations operate at a cost of $68,808 per year; the incremental cost for stations currently staffed by Amtrak is $330,620, and new, staffed stations would cost $561,468 per year to operate[40]. The $68,808 cost shown for unstaffed stations covers the cost of utilities, ticket machines, cleaning and basic facility maintenance, which is also included in the staffed station cost. The cost of additional personnel, including benefits, is approximately $52,000 per person, per year.

The 2004 plan evaluated station costs were for three distinct scenarios: 110-mph High-Speed, 79-mph Modern and 79-mph Start-up, Exhibit 6-7 shows a Station Staffing Summary by Scenario, Exhibit 6-8 provides Station Expenses by Scenario. Costs for the High-Speed and Modern Scenarios were further evaluated based on shared versus non-shared operations with MWRRS. Exhibit 6-6 details the station-staffing assumptions used for the High-Speed Stand-alone, Modern Stand-alone and High-Speed Shared with MWRRS Scenarios.

- In the Modern Scenario, 12 of 32 Ohio Hub stations are staffed. Of these, Amtrak staffs 10 stations today, and the Ohio Hub System would add two new locations. The resulting cost levels are shown in Exhibit 6-8 and 6-9. For the implementation period 2010 through 2013, these costs were ramped-up based on the line segments scheduled to begin operation each year.
- In the High-Speed Scenario, the Study's demand forecast predicts substantial air-connect traffic at the station at Cleveland Airport. For this reason, the High-Speed Scenario Business Plan assumes a staffed station at the airport, while the two other suburban Cleveland stations remain unstaffed. With a conventional 79-mph service, air-connect travel is not expected to develop to any significant degree. Therefore, the Cleveland Airport station was not staffed under the Modern Scenario. This is the only difference in station costs between the Modern and High-Speed Scenarios.

[40] The original cost in 1996 dollars for unstaffed locations was $40,000 per year; for stations currently staffed by Amtrak $268,300, and new staffed stations $469,600 per year. In addition to this, the operating cost of ticket machines was $20,000 per year for each station in 1996 dollars. Applying a 1996-2002 inflation factor to these costs yields the 2002 dollar values that are cited here.

Exhibit 6-6: Station Staffing Detail by Scenario

Stations	110-mph Operations - Ohio Hub Layers 2 + 3 *			
	Standard-Unstaffed	Standard-Staffed	Stand Alone Unstaffed	Stand Alone Staffed
Elyria		0		
Sandusky	0			
Toledo Amtrak		0		
Monroe			1	
Detroit Airport			1	
Dearborn		0		
Detroit Amtrak (New Center)		0		
Cleveland		0		
Cleveland Airport		0		
Galion			1	
North Columbus			1	
Columbus				1
Dayton				1
Middletown			1	
North Cincinnati		1		
Cincinnati		0		
S.E. Cleveland			1	
Warren	1			
Youngstown	1			
North Pittsburgh			1	
Pittsburgh		1		
N.E. Cleveland	1			
Ashtabula	1			
Erie	1			
Dunkirk	1			
Buffalo Exchange		1		
Niagara Falls NY	1			
Niagara Falls ONT	1			
St. Catherines	1			
Hamilton (Aldershot)	1		Exclude CDN Stations	
Oakville	1			
Toronto		1		
Carnegie			1	
Steubenville			1	
Coshocton			1	
Newark				1
Port Columbus Airport			1	
Marysville			1	
Lima (towards Ft Wayne)				1
Findlay (towards Toledo)			1	
TOTAL	11	4	13	4

* Layer 1 stations included as part of MWRRS have a "Zero" next to them

Exhibit 6-7: Station Staffing Summary by Scenario

Stations	110-mph Operations - Ohio Hub Layers 2 + 3 *				Total
	Standard-Unstaffed	Standard-Staffed	Stand Alone - Unstaffed	Stand Alone - Staffed	
Cost/Station	$68,808	$330,620	$68,808	$561,468	
Detroit	0	0	2	0	2
3-C	0	1	3	2	6
Pittsburgh	2	1	2	0	5
Buffalo/Toronto	5	1	0	0	6
Panhandle	0	0	4	1	5
Cols-Ftw/Toledo	0	0	2	1	3
Total Stations	7	3	13	4	27

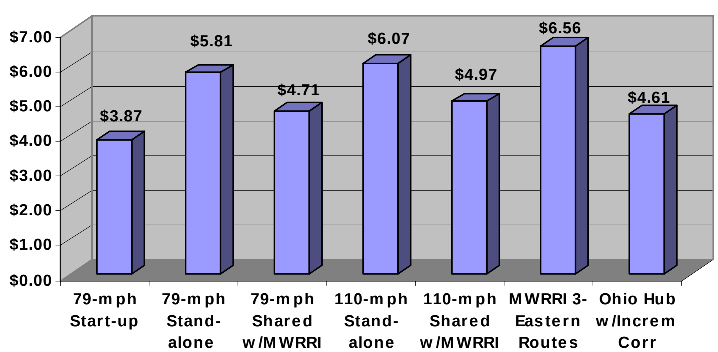
Exhibit 6-8: Station Expenses by Scenario
($2002 in thousands)

Stations	110-mph Operations - Ohio Hub Layers 2 + 3 *				Total
	Standard-Unstaffed	Standard-Staffed	Stand Alone - Unstaffed	Stand Alone - Staffed	
Detroit	$0	$0	$137,616	$0	$137,616
3-C	$0	$330,620	$206,424	$1,122,936	$1,659,980
Pittsburgh	$137,616	$330,620	$137,616	$0	$605,852
Buffalo/Toronto	$344,040	$330,620	$0	$0	$674,660
Panhandle	$0	$0	$275,232	$561,468	$836,700
Cols-Ftw/Toledo	$0	$0	$137,616	$561,468	$699,084
Subtotal Ohio Hub	*$481,656*	*$991,860*	*$894,504*	*$2,245,872*	***$4,613,892***
Chicago-Toledo					$2,051,494
Chicago-Cincinnati		- - - From MWRRS Report - - -			$1,509,614
Michigan Lines					$2,996,563
Subtotal MWRRS Eastern Lines					***$6,557,672***
Total					***$11,171,564***

The 2004 plan allocated the cost of shared MWRRS Detroit, Cincinnati and stations between Toledo and Cleveland 50/50 between the MWRRS and the Ohio Hub. Since five routes would use the downtown Cleveland station – four Ohio Hub routes plus the MWRRS – the Study assumed that the Ohio Hub System would retain 4/5 or 80 percent of the cost of the main Cleveland station. Once the allocation was calculated for the High-Speed Shared with MWRRS Scenario, the same percentage reduction was applied to the Modern Shared Scenario, as well (Exhibit 6-9). A detailed station staffing plan was not developed for the Start-up Scenario, but these is probably an opportunity for savings due to the lighter passenger volumes and less frequent train service. Savings could take the form either of staffing reductions, reduced station hours or fewer staffed stations. The Study assumed that station costs for the Start-up Scenario would be 2/3 that of the Modern Scenario.

The 2007 plan did not allocate any MWRRS station costs, but rather showed the cost of these stations as part of Layer 1 (the three Eastern MWRRS routes, $6.56 Million total.) After this, Ohio Hub stations were added on an incremental basis ($4.61 Million) Because the 2007 Ohio Hub station costs did not include any allocation of MWRRS costs, the incremental cost for adding the Ohio Hub routes was actually lower than estimated in the earlier 2004 Ohio Hub plan.

Exhibit 6-9: Annual Total Station Cost[40] (Millions of 2002$)



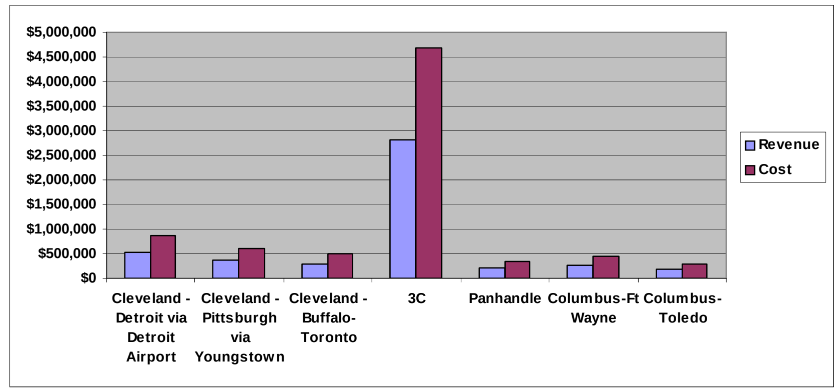
6.1.2 Feeder Bus Cost

A detailed feeder bus operating plan was not developed for the Ohio Hub; therefore, based on the MWRRI Study, an average cost of $10 per bus rider was assumed. Since the average bus revenue was only $6 per rider, operation of the buses shows a direct operating loss. However, if connecting rail revenue is included, then operation of the feeder buses becomes profitable to the Ohio Hub System. The 3-C Corridor makes the greatest use of feeder buses due to the wide distribution of nearby medium-sized cities, especially on the north end of the corridor, that are

[40] Station costs are modeled as fixed and in constant 2002 dollars. Accordingly, these costs remain constant for all forecast years after the system has been fully implemented.

not located directly on the proposed rail route through central Ohio. Exhibit 6-10 gives the 2025 feeder bus costs and revenues by corridor as used in development of the 2007 Ohio Hub Business Plan.

Exhibit 6-10: 2025 Feeder Bus Revenues and Costs (2002$)



6.1.3 Service Administration

For developing costs, a potential management organization for the Ohio Hub System was developed as a stand-alone structure, with no other responsibility than the operation of the Ohio Hub.[41,42] A detailed organization chart is included in the Appendix. The Ohio Hub System itself would retain only a small management staff for delivery audit, quality assurance and contract administration. TEMS added a 20 percent contingency, at Amtrak's request. Administrative costs are ramped up over a two-year implementation period, reflecting 70 percent of costs in Year 1, 80 percent of costs in Year 2, and 100 percent in Year 3. Exhibit 6-11 summarizes the overall costs of the management organization that was developed in the 2004 plan.

[41] Responsibilities would include liaison work with other rail and commuter lines, marketing, accounting, finance and interface activities with the States of Ohio, Michigan, Pennsylvania, New York and the Canadian Province of Ontario. Also included would be all operating department supervision as well as senior management, human resources, and police and security.
[42] Providers of equipment maintenance, on-board food service and express parcel service would have their own management structures; their administrative costs are included within those areas. As well, call center expenses are treated separately and described as Sales and Marketing costs.

Exhibit 6-11: 2004 Study - Ohio Hub Administrative Costs

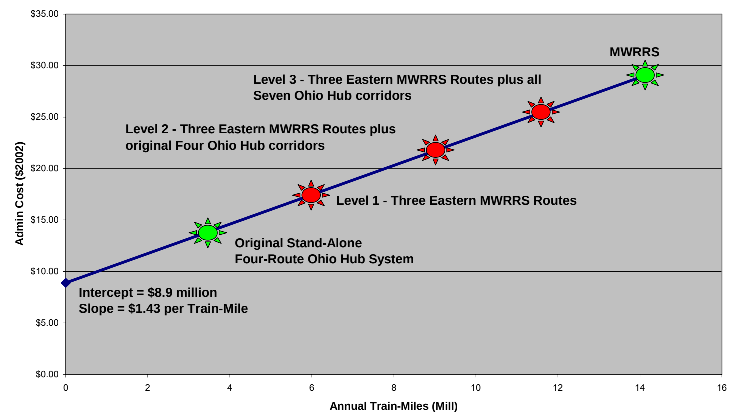
	Cleveland Hub Independent Operator			*Merged w/MWRRS Organization*		
	Top Mgmt	**Staff**	**Total**	**Top Mgmt**	**Staff**	**Total**
General Admin	$2,065,224	$2,244,888	$4,310,112	$516,306	$2,244,888	$2,761,194
Operations	$1,025,448	$2,648,206	$3,673,654	$256,362	$2,648,206	$2,904,568
Engineering/Mtce	$699,215	$1,568,341	$2,267,556	$174,804	$1,568,341	$1,743,145
Staff Expense	$3,789,887	$6,461,435	$10,251,322	$947,472	$6,461,435	$7,408,907
Office Lease	*50% of MWRRS-->*		$4,035,875	*25% of MWRRS-->*		$2,017,938
TOTAL			**$14,287,197**			**$9,426,844**

Administration costs were modeled differently in the 2004 study versus the 2007 update. The 2004 study developed two scenarios: shared with MWRRS, versus Ohio Hub stand-alone:

- For a shared operation, Ohio Hub would have to pay only for additional functional staff positions added to the MWRRS organization to support the added Ohio Hub train miles. In addition, the costing assumed that MWRRS top management (shown in light pink in the organization chart in the Appendix) would receive an additional 25 percent in pay, but that the top management organization would not have to be duplicated.
- In the standalone scenario, Ohio Hub would have to pay the full salaries of both the top management as well as the functional management staff (shown in dark blue.)
- The Start-up Scenario was costed at 50 percent of the level needed to support the fully built-out High-Speed or Modern Scenarios.

The challenge for the 2007 update was the fact that the networks to be compared were of different sizes and had different intensity of train operations. Therefore, an understanding of how administrative costs vary as a function of train miles was needed. A cost model was built by comparing the size of administrative organizations that had been previously developed by both the MWRRS and Ohio Hub. A larger network would require a greater number of management staff positions, but top management costs would be only slightly higher. *Based on this comparison, a fixed cost of $8.9 million plus $1.43 per train-mile was estimated for modeling administrative costs*. Use of this variable cost function allows administrative cost to be accurately estimated for different network configurations, without having to develop a detailed organization chart for each one.

Exhibit 6-12: 2007 Update - Ohio Hub Administrative Costs



6.1.4 Sales and Marketing

The primary expenses represented in this category consist of a $2,293,538 per year fixed advertising cost [43], plus fixed and variable call center expenses. 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. Assuming some flexibility for assigning personnel to accommodate peaks in volume and a 20 percent staffing contingency, variable costs come to 57¢ per rider plus a fixed supervisory cost of $458,716 per year.

A simplified ticketing methodology for unreserved service should result in a substantial cost savings. While there are advantages to variable pricing based upon yield management principles, the Ohio Hub does not call for that level of sophistication in its early stages. Simplicity in fares and services will limit talk time and heighten the use of voice recognition, menu-driven or Internet-based systems.

The MWRRS Shared Scenario assumes a shared call center between the MWRRS and the Ohio Hub; therefore, the supervisory cost of $458,716 per year can be eliminated. The Ohio Hub advertising budget remains the same under both the Shared and Stand-alone Scenarios – but it should be pointed out that any advertising expenditure will be much more *effective* for the larger combined system. The Start-up Scenario cuts the advertising budget in half to just $1,146,769, but needs to support the $458,716 call center supervision cost for a total of $1,605,485.

Credit card commissions were modeled as 1.8 percent of revenue and travel agency commissions as 1 percent of revenue.

[43] In 1996 dollars, these costs were originally $2 million per year advertising, $400,000 in call center supervision. They have been inflated to $2,293,538 and $458,716 respectively, in 2002 dollars.

6.2 Ohio Hub Business Plan – Variable Costs

6.2.1 Insurance Costs

Liability costs were estimated at 1.1¢ per passenger-mile, the same rate per passenger mile as national Amtrak operations. Federal Employees Liability Act (FELA) costs are not included here but are applied as an overhead to labor costs. Forecast passenger miles by route are shown in Exhibit 5-6.

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. A recent General Accounting Office (GAO) review[44] has concluded that this $200 million liability cap applies to commuter railroads as well as to Amtrak. If the GAO's interpretation is correct, the liability cap may also apply to potential Ohio Hub franchisees. If this liability limitation were in fact available to potential Ohio Hub franchisees, it would be much easier for any operator to obtain insurance that could fully indemnify a freight railroad at a reasonable price. It is recommended that the ORDC seek qualified legal advice on this matter.

6.2.2 Operator Profit

Institutional arrangements would identify the responsibilities of the states in deciding Ohio Hub policy and broad service delivery issues. These arrangements would also outline the responsibilities for management oversight of the rail operator, including periodic review of operating performance and contractor performance.

- A policy board would follow all the normal procedures of a governmental entity by allocating funds for the greatest public benefit, allowing public participation in all decision-making and by making complete and detailed financial disclosures.
- A rail service provider would operate in a commercial environment as a strictly private sector, for-profit, business enterprise. The service provider would make its decisions on a commercial basis and would be allowed to protect the confidentiality of its proprietary business data.

It is essential to the future of the Ohio Hub System to separate the policy board's requirement for service and funding oversight from the operator's business requirements to be profitable. As pointed out by the Amtrak Reform Council in 1997, the current Amtrak structure, by combining governmental and non-governmental functions in a single entity, does not do this. Amtrak might serve as an operator of the system, but authority and control over the allocation of capital dollars should be vested in the states and the FRA, rather than the operator.

[44] See: http://www.gao.gov/highlights/d04240high.pdf

The Ohio Hub Business Plan assumes that the operator takes a 10 percent mark-up on directly-controlled costs, including insurance, stations, sales and marketing, administration, train crew, and energy and fuel. All other costs related to track maintenance, on-board service, equipment maintenance and express parcel service are out-sourced and are assumed to include their own profit margins. Alternatively, an equivalent amount could be allocated as a percentage of revenue. Gross operator profit is allocated to the operator as a performance incentive.

6.2.3 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.

For consistency with the MWRRS business planning process, the Ohio Hub has chosen to adopt the MWRRS' higher cost assumption of $9.87 per train mile (for a 300-seat train) that was recently agreed to by the MWRRI Steering Committee. Before this figure can be used for the Ohio Hub, however, it must be adjusted to reflect the smaller 200-seat train that will be used by the Ohio Hub System. Data provided by equipment manufacturers at the original MWRRI 1999 equipment symposium was used to calculate these adjustments, using the higher $9.87 cost as the base. The smaller 200-seat train was estimated to cost $8.95 per train mile, a savings of 92¢ per train mile over the MWRRS rate. Using manufacturers' data from the 1999 equipment symposium, equipment costs was adjusted upwards in the Start-up Scenario to $12.38 per train mile, to reflect the lack of economies of scale.

In High-Speed Scenarios with MWRRS Connectivity, a larger 300-seat train with its higher equipment maintenance and fuel cost is needed on the 3-C Corridor line. The 2004 study assumed a 200-seat train on all the other corridors and in all Modern and Stand-alone Scenarios.

Train costs in the 2007 update are the same as in the 2004 plan, but because of the higher forecasted ridership in the 2007 update, now reflect the use of larger 300-seat trains. These trains cost $9.87 per train-mile, the same as before, in the 110-mph scenarios. The 79-mph scenarios continue to use smaller 200-seat trains costing $8.95 per train-mile except for Columbus-Fort Wayne, which still uses the larger 300-seat train for compatibility with the MWRRS.

6.2.4 Train and Engine Crew Costs

Crew costs are those costs incurred by the onboard train operating crew. The operating crew consists 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, FICA and pensions. The cost of employee injury claims under 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. The costing of train crews was based on Amtrak's 1999 labor agreement, adjusted for inflation to 2002.

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.

Since train schedules have continued to evolve throughout the lifetime of the Ohio Hub Study, a parametric approach is needed to develop a system average per train mile rate for crew costs. Such an average rate necessarily involves some approximation across routes, but to avoid having to reconfigure a detailed crew-staffing plan whenever the train schedules change, an average rate is necessary and appropriate for a planning-level study.

Without developing a detailed base crew plan, the total number of equipment operating hours was estimated based on a prior equipment cycling analysis. For each train set, this determined a sequence of schedule pairings[45] whereby the total duration of equipment use could be measured. The total number of hours was calculated from the start of the first daily equipment assignment, until the end of the last equipment assignment. Crews would be paid for layover times, unless the layovers were long enough to allow splitting the shift. This total number of operating hours for each train set was divided by an eight-hour shift, and then rounded up to the next highest whole number.

For the High-Speed Scenario, train scheduling allows all crews to run round trips with no need for overnight accommodations except for the Cleveland-Buffalo/Toronto corridor. This highly efficient crew utilization reduces costs to $3.42 per train mile, which is lower than the system average cost assumed for MWRRS service. In the Modern Scenario, longer layovers and more overnight stays are necessary, raising the average cost to $3.94 per train mile, about the same as the MWRRS crew cost. Much poorer crew utilization in the Start-up Scenario raises the average cost to $6.60 per train mile.

Once operational, the Ohio Hub System will employ a far greater number of workers than existing passenger rail service in the Ohio region. Since operating personnel are compensated at an hourly rate, if the number of miles gained in one hour increases, the cost per mile decreases. Consequently, the operating cost per train mile drops as train speed increases. In addition, further productivity improvements can be achieved because of the higher train frequencies that reduce crew layover times at away-from-home-terminals.

[45] As defined in Section 7.5 of the MWRRS report.

6.2.5 Fuel and Energy

A 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. Savings in fuel costs were assumed because of large bulk purchases at central locations and the use of modern transfer equipment at new servicing facilities. With new trains and train-related technologies, substantial fuel savings are expected to accrue to the Ohio Hub System.

In the 2004 plan, a diesel fuel cost of $0.96 per gallon led to a train mile rate of $2.32 per train mile for a 110-mph 300-seat train. However, these fuel costs were reduced for the Ohio Hub because of use of a smaller train, and for lower speed operations in the Modern and Start-up Scenarios. This cost was reduced to $1.97 in the Ohio Hub High-Speed Scenarios for a smaller 200-seat train; and to $1.58 in the Modern Scenario, assuming an additional 20 percent fuel savings due to lower speed operations.

For the 2007 update, fuel costs were been raised from $2.32 per train-mile (for a 300-seat train) up to $3.62 per train-mile, reflecting a slightly more than 50% increase in the cost of diesel fuel. Fuel costs for smaller 200-seat or slower 79-mph trains were reduced by the same proportion that they had been in the earlier 2004 plan.

6.2.6 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. However, the Ohio Hub Study assumes none of the small 200-seat trains will have a dedicated dining or bistro car. Instead, 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. Larger 300-seat trains may be able to provide a small walk-up café area where the attendant works when not passing through the train with the trolley cart.

The goal of the 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. The key to attaining OBS profitability is selling enough products to recover the train mile related labor costs. If smaller 200-seat Ohio Hub trains were used for ramp-up, given the assumed 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 provides a slight positive operating margin for OBS service in the fully built-out 2025 network.

In practice, it is difficult for a bistro-only service to sell enough food to recover its costs. Bistro-only service may cover its costs in Amtrak's northeast corridor that operates very large trains, but it will be difficult to scale down to a MWRRS or Ohio network that operates smaller 200 to 300-seat trains. 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. Amtrak estimated labor costs, including the cost of commissary support and OBS supervision, at $1.53 per train mile. This cost is consistent with Amtrak's level of wages and staffing approach for conventional bistro car services. However, the Ohio Hub Business Plan recommends that an experienced vendor provide food services and uses a trolley cart approach.

A key 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 design requirement for the planned Ohio Hub service. The costs for this service relate to the provision of trolleys and storage space on the train, a commissary facility used to refurbish the carts and the onboard-service staff.

Exhibit 6-13: 2025 Forecast OBS Revenues and Costs

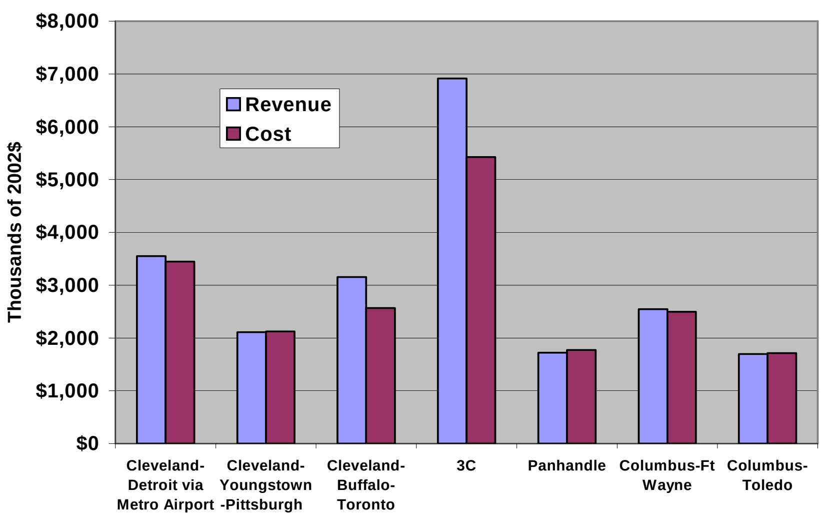


Exhibit 6-14: Summary of Unit Costs

Category	Basis	Type	MWRRS Benchmark	Ohio Hub High-Speed Scenarios
Train Crew	Train Miles	Variable	$3.95	Same as MWRRS
OBS	Train Miles + OBS Revenue	Variable	$1.53 (crew and supervision) + 50% OBS Revenue	Same as MWRRS
Equipment Maintenance	Train Miles	Variable	$9.87	Same as MWRRS
Energy/Fuel	Train miles	Variable	$2.32	$3.62
Track/ROW	Train Miles	Fixed	Lump sum (corridor wise - year wise) plus 39.5¢ /TM for out-of-pocket expense such as dispatching.	Same as MWRRS
Station Costs	Passenger	Fixed	$26,093,119 per year (full operation)	$4,613,892 per year (full operation)
Insurance	Passenger miles	Variable	$0.011	Same as MWRRS
Sales/Mktg	Passenger + Ticket Revenue	Both Fixed and Variable	$7,339,450 fixed (media and phone support) plus 57¢/Rdr variable	$2,293,538 fixed (media and phone support) plus 57¢/Rdr variable
Admin	Train miles	Fixed	$28,993,655 Fixed	$8.9 Mill Fixed plus $1.43 per TM
Bus Feeder	Bus-miles	Fixed	Lump sum (corridor wise – year wise)	Lump sum (corridor wise – year wise)
Operator's Profit	% of selected costs	Variable	10%	Same as MWRRS

Exhibit 6-14 gives a summary of the Unit Cost assumptions used for the 2007 Ohio Hub business plan update. Exhibits 6-15 and 6-16 give further detail on the forecasted financial performance of the routes for a fully built-out 110-mph system. It can be seen that the 3-C corridor incurs the heaviest operating expense, accounting for 27% of the Ohio system total.[46] The original four corridors generate 68% of the total cost with the three incremental corridors account for the remaining 32%. The largest single category of expense is for train equipment maintenance with 29%, followed by train crew (11%), fuel (10%), and on board services expense (10%). Operator profit is still set at 10% of variable costs under the operator's direct control[47], which works out to a 5% margin overall.

Exhibit 6-15: 2025 Operating Cost Detail by Corridor ($2002 Mill, 2007 Update)

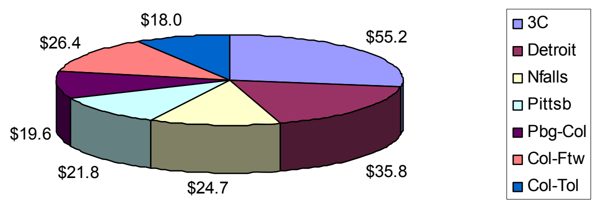
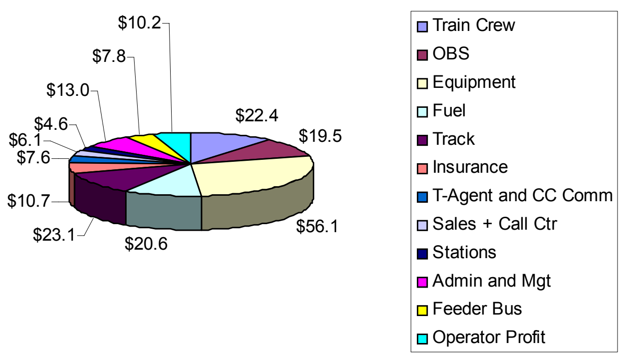


Exhibit 6-16: 2025 Operating Cost Detail by Expense Type ($2002 Mill, 2007 Update)



[46] The 3-C has 27% of total cost compared to 22% of the train-miles. However, 3-C would also generate more ridership related costs such as call center and credit card commissions, which would give it a higher share of the overall costs, because the 3-C would be the most heavily-traveled corridor on the system.

[47] Operator's costs exclude track and train equipment maintenance, which have their own profit margins already built-in.

7. Financial and Economic Viability

The analysis uses the same criteria and structure as the 1997 FRA *Commercial Feasibility Study*[48]. In that study, costs and benefits were quantified in terms of passenger rail system user benefits, other-mode user benefits and resources benefits. The study described two conditions that were considered essential for receiving federal funding support for proposed intercity passenger rail projects:

- An operating cost ratio of at least 1.0, defined as a pre-condition for an effective public/private partnership, so that once the system has been constructed, a private operator could operate the system on a day-to-day without financial loss[49], and
- A benefits/cost ratio greater than 1.0, to ensure that the project makes an overall positive contribution to the economy, at both the regional and national levels.

The *Commercial Feasibility Study* makes it clear that *"federal consideration of specific High-Speed Ground Transportation project proposals could apply additional criteria that could differ from, and be much more stringent than, this report's threshold indicators for partnership potential."*

The operating performance and financial analysis for the Ohio and Lake Erie Regional Rail - Ohio Hub system reflects economies of scale inherent in construction and operation of a large regional passenger rail service. This chapter discusses the operating performance of each corridor alternative and presents the financial analysis of the system's construction and operation. This analysis integrates capital, operating and maintenance costs and revenue projections. It was prepared at the system level for various selected route configuration options to provides insight into the viability of the overall proposed Ohio Hub system.

7.1 Financial Performance Measures

Financial performance was evaluated by analyzing the operating cash flows for each corridor. Two criteria have been identified by the Federal Railroad Administration[50] as critical to the evaluation of proposed high-speed rail projects: the operating ratio and benefit/cost ratio. The ratio of operating revenues to operating costs (i.e., operating cost ratio) provides a key indicator of the financial viability of the Ohio Hub System. The operating ratio is calculated as follows:

$$\text{Operating Ratio} = \frac{\text{Total Annual Revenue}}{\text{Total Annual Operating Cost}}$$

The benefit/cost ratio is a calculation that is based on a summation of the value of project benefits and costs, over the entire lifetime of a project. This financial measure uses a discounted

[48] U.S. Federal Railroad Administration, *High-Speed Ground Transportation for America*, pp. 3-7 and 3-8, September 1997

[49] As defined in the Commercial Feasibility Study, a positive operating ratio does not imply that a passenger service can attain "commercial profitability." Since "operating ratio" as defined here does not include any capital-related costs, this report shows that the proposed Ohio Hub network meets the requirements of the Commercial Feasibility Study by covering at least its direct operating costs and producing a cash operating surplus.

[50] Federal Railroad Administration *Commercial Feasibility Study*

cash flow, or interest-rate based, approach using the standard financial formula for calculating Present Values:

$$PV = \Sigma\ C_t / (l + r)^t$$

Where:

PV = Present value of the project benefits or costs (e.g., revenue)
C_t = Cash flow for *t* years
r = Opportunity cost of capital
t = Time

For this analysis, the discount rate, or the opportunity cost of capital was set at 3.9 percent[51]. The calculation of the benefit/cost ratio is addressed fully in Chapter 8. This chapter will focus on the operating ratio criteria.

7.2 The Three-Layered Analysis

The earlier 2004 Ohio Hub study relied upon complex allocations of capital and operating cost, as well as of revenue between routes to separate Ohio Hub financials from those of the MWRRS system, and to eliminate double counting of ridership, revenues, costs, or benefits. However, this allocations-based approach also made the Ohio Hub dependent on the MWRRS to pay its share of the costs. More recently, proposed development of a direct Columbus to Chicago service substantially increased the overlap between Ohio Hub and the MWRRS system:

- Given this increased overlap, the allocations would have become even more complicated. Instead of perpetuating the dependency of Ohio Hub on MWRRS in the 2007 update, a new approach was developed for eliminating the dependency, and making it possible to develop critical line segments on Ohio's own timetable.
- In addition, planning MWRRS and Ohio Hub separately resulted in suboptimal operations – in the 2004 plan for example, from Toledo to Cleveland, both systems operated 8 round-trips per day, a total of 16 combined round-trip frequencies – which provided more trains than the market really needed or could support, and led to poor financial performance of *both* routes. This deficiency has been rectified in the 2007 update by planning the services on an integrated basis and the financial performance of both the MWRRS Cleveland line and Ohio Hub Detroit line have been substantially improved.
- Finally, the allocations approach was incapable of dealing with the issue of connecting revenue impacts. For example, adding a Fort Wayne to Columbus link would substantially increase the revenue and ridership of the MWRRS Chicago to Fort Wayne link, without needing to add much more investment on that link. An approach was needed that would be able to identify these connecting revenue benefits and incorporate them into the Ohio Hub Cost Benefit calculations.

[51] The discount rate used in this Study is based on *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Circular N. A-94, Appendix C, issued by the Office of Management and Budget.

To develop an integrated planning approach, the three eastern MWRRS routes were incorporated into the Ohio Hub ridership and financial forecasting models. This level of integration is consistent with the previous 2004 Ohio Hub report, which assumed both MWRRS ridership interconnectivity as well as substantial cost-sharing with the MWRRS system. The key difference is that in the new analysis, revenue, ridership and financial statistics were collected and reported for the MWRRS eastern routes as well as for the Ohio Hub segments. Although these MWRRS routes were integrated into the Ohio Hub models, financial reporting was still kept separate so that route and subnetwork-level statistics could still be identified.

For implementation planning an integrated model permits any combination of MWRRS and Ohio Hub lines to be assembled in any order desired. However, a hypothetical three-layered network structure was envisioned that clustered corridors into logical subnetworks, as follows:

- MWRRS corridors first (to establish prerequisite MWRRS connectivity)
- The four Ohio Hub "core" routes then added on top of the MWRRS, corresponding to the "Preferred Option 1" identified in the earlier 2004 study, and finally
- The three "incremental" corridors in the last stage.

Exhibits 7-1 through 7-3 show these three network layers, which are intended to correspond to the historical development of the Ohio Hub system planning process. The numbers next to each line show the train frequency that was assumed over each segment in the jointly-optimized train operating plan. Additional frequencies were needed in the larger networks to accommodate increased ridership demand. These layered networks were developed to allow a preliminary assessment of connecting revenues and the financial viability of the Ohio Hub system, and served as input to development of the final implementation plan. The "Indianapolis Shortcut" shown in Exhibit 7-3 was assessed separately by a Columbus-Indianapolis parametric analysis. The Shortcut did not receive am engineering assessment in this study. The analysis of the Indianapolis Shortcut is provided in Appendix.

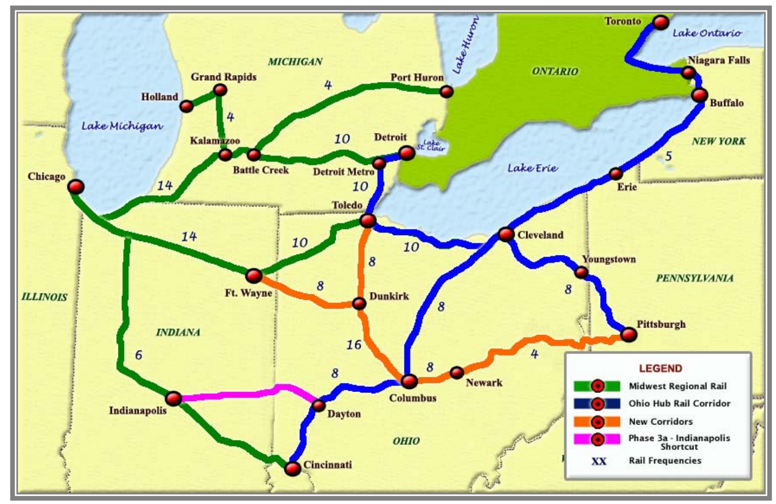
The 2025 revenue and financial forecasts for the three layered 110-mph networks are given in Exhibit 7-4 through 7-6. A 79-mph forecast for layers 2 and 3 is given in Exhibit 7-7. Total revenues include passenger fares, on board food sales, express parcel and feeder bus.

It can be seen that the 110-mph forecasts for Layer 1 are very close to the MWRRS evaluation that was published in 2004. By comparison to Exhibit 10-4 from the MWRRS plan, it can be seen that Michigan revenues are practically the same; Cincinnati line revenues are $8 million lower than they were in the MWRRS plan; but Cleveland line revenues are $2 million higher. The passenger miles and ridership results are also very close. Accordingly, the new Ohio Hub model is calibrated slightly conservatively relative to the original MWRRS forecast. The three-route Layer 1 MWRRS subnetwork would be operationally self-sufficient attaining a positive operating ratio of 1.35.

Exhibit 7-1: Layer 1- MWRRS Eastern Routes

Exhibit 7-2: Layer 2- MWRRS Eastern Routes + Ohio Core

Exhibit 7-3: Layer 3- MWRRS Eastern Routes + Ohio Core + Incremental Corridors



As compared to the original MWRRS forecasts, the differences in Cincinnati and Cleveland line revenues in Layer 1 are mostly attributed to fact that the Ohio Hub employs a different feeder bus network. Ohio Hub feeder buses tend to favor the Cleveland line, whereas the MWRRS bus network had been adjusted to favor the Cincinnati line instead. In any case, since direct rail service from Cincinnati to the east is added as soon as the 3-C corridor opens, there is no need to develop an extensive Cincinnati feeder bus network in the Ohio Hub model.

Another difference as compared to the previous MWRRS result is that reporting of Chicago to Cleveland line is broken into two parts: Chicago-Toledo and Toledo-Cleveland.[52] In Layers 2 and 3, the Toledo to Cleveland riders and revenue are all reported as part of Ohio Hub Detroit corridor rather than as a part of the MWRRS. Even so, adding 110-mph Ohio Hub core routes in Layer 2 strongly boosts the revenues of the MWRRS Cleveland line. In Layer 2, all revenues from Cleveland to Toledo accrue to the Cleveland-Detroit line; but it can be seen that the revenues of the MWRRS Cleveland line still increase from $75 million to up $87 million, in spite of the cutting-back of the MWRRS corridor to Toledo. The 2025 operating ratio of the eastern MWRRS lines improves from 1.35 to 1.48 while the four Ohio Hub corridors are forecast to generate a very strong 1.76 operating ratio, mostly because of the high average revenue yield assumption that was earlier established for the core Ohio Hub routes.

[52] By comparison to Table 4-35 in the June 2004 MWRRS Project Notebook, it can be seen that the Layer 1 results reflect a total of 282.1 million passenger-miles versus 252.1 million passenger-miles that was published in the MWRRS report. This reflects a slight strengthening of the Toledo to Cleveland forecast that occurred in the new Ohio Hub model, but the overall ridership forecast for the MWRRS Cleveland corridor is not that much greater than it was before. The reason the ridership increased from 1.12 million to 2.03 million riders is because the double-counting of riders through Toledo, which occurs now as a result of breaking the Chicago-Cleveland line into two segments for financial reporting purposes. The actual forecast ridership has not increased by that much.

Exhibit 7-4: Forecast 2025 Financial Results for Layer 1 Routes*

Corridor	Revenue	Cost	Rev/TM	Cost/TM	Surplus	Op Ratio	Riders	Psgr Miles	Load Fctr	Trip Len	Yield
Chicago-Michigan	$136	$99	$47.57	$34.84	$36	1.37	3.69	608.7	0.71	165	$0.22
Chicago-FTW-Toledo-Clev	$75	$59	$42.22	$33.51	$15	1.26	2.03	282.1	0.53	139	$0.26
Chicago-Cincinnati	$58	$41	$50.00	$35.06	$17	1.43	0.93	200.4	0.58	217	$0.29
Total MWRRS Eastern	**$268**	**$199**	**$46.42**	**$34.48**	**$69**	**1.35**	**6.64**	***1091.3***	**0.63**	**164**	**$0.25**

Exhibit 7-5: Forecast 2025 Financial Results for Layer 1 + 2 Routes

Corridor	Revenue	Cost	Rev/TM	Cost/TM	Surplus	Op Ratio	Riders	Psgr Miles	Load Fctr	Trip Len	Yield
Chicago-Michigan	$136	$96	$47.64	$33.58	$40	1.42	3.83	610.8	0.71	159	$0.22
Chicago-FTW-Toledo	$87	$54	$56.48	$35.05	$33	1.61	1.99	327.1	0.71	164	$0.27
Chicago-Cincinnati	$55	$39	$47.69	$33.29	$17	1.43	0.93	200.4	0.58	217	$0.28
Total MWRRS Eastern	**$278**	**$188**	**$50.10**	**$33.93**	**$90**	**1.48**	**6.75**	**1138.4**	**0.68**	**169**	**$0.24**
Cleveland-Cincinnati	$100	$50	$77.72	$39.11	$50	1.99	1.98	264.3	0.68	133	$0.38
Cleveland-Detroit	$55	$36	$50.42	$32.73	$19	1.54	2.11	213.8	0.65	101	$0.26
Cleveland-Niagara Falls	$43	$24	$66.43	$37.06	$19	1.79	0.88	112.1	0.58	127	$0.38
Cleveland-Pittsburgh	$34	$22	$48.64	$31.29	$12	1.55	0.93	104.6	0.50	112	$0.32
Subtotal OHIO Base	***$232***	***$132***	***$62.30***	***$35.42***	***$100***	***1.76***	***5.91***	***694.7***	***0.62***	***118***	***$0.33***
TOTAL OHIO HUB	**$232**	**$132**	**$62.30**	**$35.42**	**$100**	**1.76**	**5.91**	**694.7**	**0.62**	**118**	**$0.33**

Exhibit 7-6: Forecast 2025 Financial Results for 110-mph Layer 1 + 2 + 3 Routes

Corridor	Revenue	Cost	Rev/TM	Cost/TM	Surplus	Op Ratio	Riders	Psgr Miles	Load Fctr	Trip Len	Yield
Chicago-Michigan	$136	$97	$47.73	$34.12	$39	1.40	3.87	614.2	0.72	159	$0.22
Chicago-FTW-Toledo	$99	$64	$53.72	$34.81	$35	1.54	2.39	371.9	0.67	155	$0.27
Chicago-Cincinnati	$60	$40	$51.44	$34.42	$20	1.49	1.39	204.7	0.59	147	$0.29
Total MWRRS Eastern	**$295**	**$202**	**$50.36**	**$34.40**	**$94**	**1.46**	**7.66**	**1190.9**	**0.68**	**155**	**$0.25**
Cleveland-Cincinnati	$100	$55	$78.01	$42.88	$45	1.82	2.56	267.3	0.69	104	$0.38
Cleveland-Detroit	$51	$36	$46.44	$32.82	$15	1.41	2.23	200.0	0.61	90	$0.25
Cleveland-Niagara Falls	$45	$25	$69.49	$38.32	$20	1.81	0.91	116.5	0.60	128	$0.39
Cleveland-Pittsburgh	$30	$22	$43.17	$31.24	$8	1.38	0.86	92.9	0.44	108	$0.32
Subtotal OHIO Base	***$226***	***$138***	***$60.74***	***$36.96***	***$89***	***1.64***	***6.56***	***676.7***	***0.61***	***103***	***$0.33***
Pittsburgh-Columbus	$25	$20	$41.22	$32.98	$5	1.25	0.92	90.9	0.51	99	$0.27
Columbus-Ft Wayne	$36	$26	$45.40	$33.04	$10	1.37	1.12	142.20	0.59	127	$0.25
Columbus-Toledo	$24	$18	$42.85	$31.83	$6	1.35	0.75	94.80	0.56	127	$0.25
Subtotal OHIO Incremental	***$85***	***$64***	***$43.39***	***$32.67***	***$21***	***1.33***	***2.78***	***327.85***	***0.56***	***118***	***$0.26***
TOTAL OHIO HUB	**$311**	**$202**	**$54.76**	**$35.48**	**$110**	**1.54**	**9.34**	**1004.58**	**0.59**	**108**	**$0.31**

Exhibit 7-7: Forecast 2025 Financial Results for 110-mph Layer 1 plus 79-mph Layer 2 + 3 Routes

Corridor	Revenue	Cost	Rev/TM	Cost/TM	Surplus	Op Ratio	Riders	Psgr Miles	Load Fctr*	Trip Len	Yield
Chicago-Michigan	$136	$100	$47.73	$35.19	$36	1.36	3.87	606.4	0.71	157	$0.22
Chicago-FTW-Toledo	$87	$64	$47.28	$34.68	$23	1.36	2.11	325.0	0.59	154	$0.27
Chicago-Cincinnati	$59	$41	$50.41	$35.37	$17	1.43	1.36	200.6	0.58	147	$0.29
Total MWRRS Eastern	***$282***	***$205***	***$48.12***	***$35.06***	***$76***	***1.37***	***7.34***	***1132.1***	***0.64***	***154***	***$0.25***
Cleveland-Cincinnati	$40	$42	$30.99	$32.43	($2)	0.96	1.60	167.5	0.65	105	$0.24
Cleveland-Detroit	$28	$31	$26.07	$28.42	($3)	0.92	1.52	136.9	0.63	90	$0.21
Cleveland-Niagara Falls	$18	$19	$27.22	$29.47	($1)	0.92	0.59	75.7	0.59	128	$0.23
Cleveland-Pittsburgh	$17	$20	$24.25	$28.64	($3)	0.85	0.60	64.3	0.46	108	$0.26
Subtotal OHIO Base	***$103***	***$112***	***$27.63***	***$30.03***	***($9)***	***0.92***	***4.30***	***444.5***	***0.60***	***103***	***$0.23***
Pittsburgh-Columbus	$14	$17	$23.13	$28.99	($3)	0.80	0.62	62.1	0.52	101	$0.22
Columbus-Ft Wayne	$20	$24	$25.47	$29.72	($3)	0.86	0.79	93.54	0.59	118	$0.22
Columbus-Toledo	$14	$16	$24.04	$27.74	($2)	0.87	0.53	62.36	0.55	118	$0.22
Subtotal OHIO Incremental	***$48***	***$57***	***$24.35***	***$28.93***	***($9)***	***0.84***	***1.94***	***218.01***	***0.56***	***113***	***$0.22***
TOTAL OHIO HUB	**$151**	**$168**	**$26.50**	**$29.65**	**($18)**	**0.89**	**6.24**	**662.46**	**0.39**	**106**	**$0.23**

*** Revenue, Cost and Surplus in ($2002 millions); Riders and Passenger-Miles in Millions**

The main effect of Ohio Hub connectivity is to boost the MWRRS Cleveland corridor; the revenue effects on the Cincinnati corridor and Michigan Corridors are minor because of redistributional effects. For example, some Indianapolis and Michigan ridership shifts towards the east when Ohio Hub is added; this results in more uniform train load factors, but not much of a direct increase to the revenues of these routes. MWRRS Cincinnati to Cleveland riders shift to the direct 3-C corridor; but that loss to the MWRRS system is more than offset by added connecting riders from Indianapolis through to Dayton, Columbus and even Cleveland who take advantage of the 3-C connection available at Cincinnati. Ohio Hub connectivity certainly will not hurt the revenues of the MWRRS Cincinnati and Michigan routes, but the main effect of the Ohio Hub is to boost the ridership and revenues of the MWRRS Cleveland line.

With the addition of Layer 3 again the revenues are boosted; the three incremental corridors directly earn $85 million in 2025, of which $6 million is traffic diverted from the Ohio Hub core routes (such as Pittsburgh-Cleveland-Columbus) to more direct routings (such as the Panhandle), but another $17 million in connecting revenues are added to the MWRRS, primarily on the Cleveland line from Fort Wayne into Chicago.

As can be seen in Exhibits 7-4 through 7-6 as more corridors are added to the network, the interconnecting traffic base and revenues grow. Given a viable start-up network developed in Layer 1 that consists of the three eastern MWRRS routes, train-mile costs remain relatively stable as train-miles grow. On the one hand, average overhead costs tend to decline as fixed costs can be spread over a larger base. Offsetting this however, is the natural tendency towards higher passenger-mile and ridership-related costs, such as credit card commissions and call center expenses, as ridership and train load factors improve and larger trains can be deployed. All corridors, including the proposed new incremental corridors, are forecast to perform well and to return comfortably positive operating ratios. On an operating basis, the original four Ohio Hub core corridors tend to perform slightly better than the incremental corridors, but the core corridors also tend to have a much higher capital cost.

The 79-mph Ohio Hub forecasts shown in Exhibit 7-7 produce an operating ratio of 0.89 for the Ohio Hub system, requiring a subsidy of $18 million in 2025, as compared to the $110 million operating surplus that would be generated by a 110-mph system in the same year.

The original 2004 study implied that a 79-mph system with 110-mph connectivity might cover its operating costs out of farebox revenues. This was consistent with the modeling that had been done earlier for the MWRRS Michigan branch lines – as relatively short extensions of a new high-speed, high capacity corridor to Chicago. However, this 2007 update has adopted more conservative modal bias factor reflecting the fact that a 79-mph Ohio Hub would have entire corridors, rather than just short sections of line operating at the slower speed. For the 2007 update, it was considered more prudent to revise downward the original 79-mph forecasts, than to continue to make the assumption that the entire system would be viewed by the public as a 110-mph service, even if significant portions of it actually operate at a much slower speed.

In the new 79-mph forecasts as shown in Exhibit 7-7, the system comes close to breakeven only because of the strong positive effect of MWRRS connectivity with no fewer than three connecting 110-mph corridors. Without such connectivity, operating ratios in the 0.6 - 0.7 range would be expected for a 79-mph system. For this reason, the 79-mph option was excluded from further consideration in the development of the implementation plan in Chapter 9.

7.3 Economic Benefits Methodology

The Ohio Hub System will provide a wide range of benefits that contribute to economic growth and strengthen the region's manufacturing, service and tourism industries. It will improve mobility and connectivity between regional centers and smaller urban areas, and will create a new passenger travel alternative. This will stimulate further economic growth within the Ohio and Lake Erie region. These economic benefits were evaluated using TEMS' *RENTS*™ Model.

The methodology used to estimate economic benefits and costs is based on the approach the Federal Railroad Administration (FRA) used in its analysis of the feasibility of implementing high-speed passenger rail service in selected travel corridors throughout the country. The key elements of the economic benefits analysis conducted for this study are listed in Exhibit 7-8 and further discussed below.

Exhibit 7-8: Key Elements of the Economic Benefits Analysis

Types of Benefits	Types of Costs	Measures of Economic Benefits
Consumer surplus System revenues Benefits for users of other modes Resource benefits	Capital investment needs Operations and maintenance expenses	Benefit-cost ratio Net Present Value

Two measures of economic benefit were used to evaluate the alternative options – net present value (NPV) and cost/benefit ratio, which are defined as follows:

Net Present Value = Present Value of Total Benefits – Present Values of Total Costs

$$\text{Cost Benefit Ratio} = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}}$$

Where present values are calculated using the standard financial discounting formula, that was presented at the beginning of this chapter.

7.3.1 User Benefits

A transportation improvement is seen as providing user benefits in terms of time and cost savings, as well as convenience, comfort and reliability. User benefits are expected to include the following:

- User Benefits: The reduction in travel times and costs (consumer surplus and system revenues) that users of the Ohio Hub receive
- Benefits to Users of Other Modes: The reduction in travel times and costs that users of other modes receive as a result of lower congestion levels
- Resource Benefits: Savings in airline fares and reductions (savings) in emissions as a result of travelers being diverted from air, bus and auto to the Ohio Hub

The analysis of user benefits for the Ohio Hub 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 a Values of Time calculation. The Values of Time (VOT) used in this Study were derived from stated preference surveys conducted in this and previous study phases 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.

Benefits to users of the Ohio Hub System are measured by the sum of *system revenues* and *consumer surplus*, which is defined as the additional benefit, or *surplus* individuals receive from the purchase of a commodity or service. 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 foregone because the price of rail service is not zero. This is an equity decision made by the FRA 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 *COMPASS*™ demand model estimates 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.

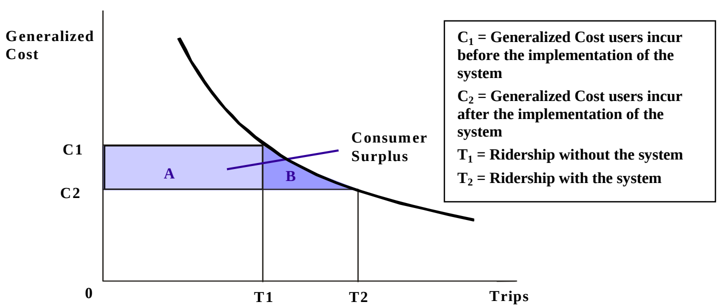
The passenger rail fares used in this analysis are the average optimal fares derived from the Revenue-maximization Analysis that was performed for each Ohio Hub corridor. User benefits incorporate both the measured consumer surplus and the system revenues, since the revenues are user benefits transferred from the rail user to the rail operator.

Consumer Surplus

In consumer surplus analysis, improvements in service (for all modes of transportation in the corridor) are measured by improvements in generalized cost (combination of time spent and fares paid by users to take a trip). In some cases, individuals (for example, current bus and rail users) may pay higher fares to use an improved mode of travel, but other aspects of the improvement will likely compensate for the increased fare. A transportation improvement that leads to improved mobility reduces the generalized cost of travel, which in turn leads to an increase in consumer surplus.

To calculate consumer surplus, the number of trips and generalized cost of travel without the Ohio Hub System were compared to the number of trips and generalized cost of travel with the system. In Exhibit 7-9, the shaded area under a typical demand curve represents improvements in the generalized cost of travel for induced and/or diverted users (the consumer surplus). The shaded area is defined by the points $(0, C_1)$, $(0, C_2)$, (T_1, C_1), and (T_2, C_2). The equation assumes that Area B is a triangle and the arc of the demand curve is a straight line. Equation 1, which follows the exhibit, measures consumer surplus.

Exhibit 7-9: Consumer Surplus Graphically Displayed



Equation 1: $CS = [(C_1 - C_2) T_1] + [(C_1 - C_2)(T_2 - T_1)(0.5)]$

Where:

CS = Consumer Surplus
Rectangle A = $(C_1 - C_2) T_1$
Triangle B = $(C_1 - C_2)(T_2 - T_1)(0.5)$

The formula for consumer surplus is as follows:

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

TEMS' *COMPASS*™ demand forecasting model estimates consumer surplus by calculating the increase in regional mobility (i.e., induced travel) and traffic diverted to the system (Area B in Exhibit 7-9), and the reduction in travel costs, measured in terms of generalized cost, for existing system users (Area A). The reduction in generalized cost generates the increase in users' benefits. Consumer surplus consists of the additional benefits derived from savings in time, fares and other utility improvements.

Passenger Revenues

Passenger revenues provide another measure of system benefit. The fare rate that passengers pay shows the direct value of the benefit they receive. Passenger revenues are calculated by multiplying the fares charged by the number of riders. Revenues are incorporated in the FRA methodology as a benefit because they are a component of consumer surplus that has been internalized by the railroad operator. Revenue benefits apply to existing rail travelers as well as new travelers who are induced or diverted to the new passenger rail system.

Benefits to Users of Other Modes

In addition to rail-user benefits, travelers using other modes will also benefit from the Ohio Hub System because it will contribute to highway congestion relief and reduce travel times for users of other modes. These benefits were measured by identifying the estimated number of air and auto passenger trips diverted to rail and multiplying each by the benefit levels used in the FRA *Commercial Feasibility Study.*

Resource Benefits

The implementation of a transportation project also has an impact on the resources all travelers use. The consequent reduction in airport congestion attributable to the Ohio Hub System will result in resource savings to airline operators and reduced emissions of air pollutants for all non-rail modes.

7.3.2 Costs

Costs are the other side of the equation in the cost/benefit analysis. Costs include up-front capital costs, as well as ongoing operating and maintenance expenses.

Capital Investment Needs

The capital investment needs for each option were calculated using input from the Engineering Assessment outlined in Chapter 2. The capital investment estimates include both infrastructure and rail equipment needs.

Operating and Maintenance Expenses

The operating and maintenance expenses for each alternative were calculated using the output of the operating cost analysis set forth in Chapter 6. A capital track maintenance component was separately calculated for the High-Speed Scenario. Since the need for infrastructure replacement does not occur for some years into the future, this cost has minimal impact on the cost/benefit ratio calculation, but has been included for completeness.

7.4 Economic Benefits Results

The 2007 Incremental Corridors update resulted in the construction of a new financial model that incorporated the three eastern MWRRS routes, in order to be able to jointly reoptimize certain MWRRS operations – particularly, those of the Chicago-Fort Wayne-Toledo-Cleveland line, which is significantly impacted by the Ohio Hub proposals. In particular, there was a desire to be able to assess the impacts of connecting revenue and ridership on the MWRRS as well as on the Ohio Hub system.

This section presents the results of a *parametric analysis*, performed *prior* to the development of a detailed implementation plan, to assess the economic benefits of sets of line investments at a *subnetwork* level. This parametric analysis does not reflect an exact calculation of cost benefit ratios but results from a projection of the 2025 operating cash flows reported in Exhibits 7-4 through 7-6 along with the capital costs of each line segment.

An eastern subnetwork of MWRRS, consisting of the three routes that together share the South-of-the-Lake improvement (Layer 1), comprised the starting point for this analysis.[53] *The MWRRS capital and operating costs and revenues were included as Layer 1* of the Three-Layer analysis and showed that this subnetwork of the MWRRS would be viable on a stand-alone basis. After this, the Ohio Hub revenues, operating costs and capital costs were added in Layers 2 and 3 and showed very strong cost benefit ratios, taking into account not only the direct revenue and ridership of the added Ohio Hub routes, but also the connecting revenue and ridership impacts on the MWRRS routes. As mentioned earlier, connecting benefits can be very significant, since they add considerably to both revenue and consumer surplus without adding much in capital cost to the line segments that had been developed earlier.

[53] Capital costs for the MWRRS routes were taken from the MWRRS report, and the operating costs and revenues were taken from the updated 2007 Ohio Hub model. Layer 1 MWRRS costs do include the cost of Cleveland to Toledo in the 3-Layer analysis, although elsewhere in the report, particularly in the *formal recalcuation*, the costs of Cleveland to Toledo are treated as an Ohio Hub capital cost.

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A second cost-benefit calculation will appear in Chapter 8, based on the exact specified implementation plan for specific Ohio Hub and MWRRS corridors. This *formal recalculation* differs from the one presented here, since no MWRRS capital, operating costs or revenues were included in the formal recalculation. *Accordingly, the formal recalculation of Ohio Hub cost benefit in Chapter 8 does not capture the full social benefit of MWRRS connecting revenues.* That is why the Cost Benefit results in Chapter 8 are somewhat more conservative than the results that are presented below. Exhibit 7-10 presents Cost Benefit ratios that were developed by the Three Layer analysis.[54]

Exhibit 7-10: Ohio Hub 110-mph system, Benefits and Costs - Three-Layer Parametric Analysis (Lifecycle Present Values in Millions of 2002$, 30 years at 3.9%)

Overall Cost Benefits	**Layer 1 - MWRRS Base**	**Layer 2- OHIO Base**	**Layer 3- OHIO Increm**
Revenue	$3,506	$6,647	$7,862
Consumer Surplus	$4,133	$6,181	$7,705
Other Mode + Resource	$3,920	$6,583	$7,988
Total Benefit	**$11,559**	**$19,412**	**$23,554**
Capital Cost	$2,138	$4,340	$5,284
Operating Cost	$2,699	$4,329	$5,292
Track Capital Maintenance	$135	$216	$265
Total Cost	**$4,972**	**$8,886**	**$10,840**
Cost/Benefit Ratio	**2.32**	**2.18**	**2.17**

Incremental Cost Benefits	**Layer 2- OHIO Base**	**Layer 3- OHIO Increm**
Revenue	$3,141	$1,214
Consumer Surplus	$2,048	$1,523
Other Mode + Resource	$2,663	$1,405
Total Benefit	**$7,852**	**$4,142**
Capital Cost	$2,202	$943
Operating Cost	$1,631	$963
Track Capital Maintenance	$82	$48
Total Cost	**$3,914**	**$1,954**
Cost/Benefit Ratio	**2.01**	**2.12**

[54] The Capital Costs shown in Layer 1 are an NPV based on a multi-year spend plan, not the direct capital cost from Chapter 2. Layer 1 includes the three MWRRS corridors as described in Chapter 2. The NPV shown for Layer 2 does not include the cost of Cleveland-Toledo, since in the three-layer analysis the cost of this line segment is treated as part of Layer 1. However, the actual Implementation plan developed in Chapter 8 implements the Detroit-Cleveland corridor earlier than the MWRRS Cleveland line, so the cost of the Cleveland-Toledo segment accrues to the Ohio Hub in the Formal Recalcuation.

In Exhibit 7-10, it can be seen that the MWRRS eastern subnetwork, even including the high cost of the South-of-the-Lake improvement, generates a very high cost benefit ratio. As already shown by the MWRRS economic impact study, the implementation of these MWRRS corridors would yield considerable economic benefits to the States of Michigan, Indiana and Ohio.

When Ohio Hub lines are added to this system in Layers 2 and 3, *additional ridership, revenue, consumer surplus and environmental benefits are added to the previously-existing corridors* without requiring a proportional capital investment. This results in a multiplier effect as more corridors are added to the system, resulting in the very strong incremental cost /benefit ratios that are reported for both the Ohio Base and Incremental Corridors network expansions if the connecting revenue effect is included in the calculation.

7.5 Conclusions

On the basis of the *Commercial Feasibility* criteria that have been established by the FRA, all the proposed Ohio Hub subnetworks are viable. Financially, the three eastern MWRRS routes, along with the 3-C and Chicago-Columbus corridors are the strongest performers; after this, more Ohio Hub routes can be added and network interconnectivity results in a multiplier effect on revenue, ridership, consumer surplus and external mode benefits. The connecting ridership effect helps maintain high operating and cost benefits ratios as the network is expanded.

In terms of the options that were evaluated in the earlier 2004 plan, it was shown that Option 1 using Detroit Metro Airport and Youngstown was the route combination that produced the best financial result. For this reason only Option 1 was carried forward into the 2007 incremental corridors plan. In terms of technology, 110-mph options are far superior to any of the 79-mph options both in operating performance and cost-benefit results. While the original 2004 analysis suggested that some 79-mph routes may be viable as feeders to an 110-mph MWRRS system, in fact the Ohio routes are all economically strong enough to justify upgrading to 110-mph except where physical constraints such as curvature or urban speed restrictions prevent this. 110-mph service would boost ridership on average by about 50%, double revenues and could enable the Ohio Hub to be viable as a stand-alone system. A 110-mph upgrade more than doubles consumer surplus and environmental benefits without proportionately raising capital or operating cost, and therefore 110-mph produces much higher cost benefit ratios than a 79-mph option.

This study has found that a 110-mph Ohio Hub system could meet the FRA *Commercial Feasibility* criteria and could even be developed separately from the MWRRS system, although clearly the results would be better if the two systems were developed together. For this reason 110-mph Option 1 (Detroit Metro Airport plus Youngstown) was taken forward for development of a detailed implementation plan for the Ohio incremental corridors system. A possible detailed implementation plan for building the Ohio Hub corridors will be discussed in the next chapter.

8. Implementation Plan

Given the scale of the Ohio and Lake Erie Regional Rail-Ohio Hub system, it is assumed that the implementation of the system will be accomplished in phases. One of the primary purposes of the Implementation Plan is to provide a framework for organizing and analyzing the cash flow in the financial analysis. It is expected that the Implementation Plan will evolve as the project advances into the detailed planning and engineering phase.

The timeframe takes the project through design and manufacture of rolling stock, project development, preliminary engineering, design and final construction of the rail system's infrastructure. Project development includes all environmental reviews and/or the steps necessary under the National Environmental Policy Act (NEPA), including public involvement and necessary engineering to obtain a *record of decision* under NEPA requirements. Such an approach allows the states to secure funding and to develop the infrastructure as needed.

The Implementation Plan has been refined so that a positive operating cash flow can be assured as early in the implementation schedule as possible. The corridors have been segmented and re-ordered in such a way as to optimize financial results. Thus, those corridors with the highest operating returns are implemented in earlier phases of the plan. The implementation plan has evolved as the study has progressed.

- Phasing proposed in the original 2004 study was very simple: starting with the 3-C Corridor in 2010, one completed route was to be added each year until the entire four-route system was operational by 2013.
- Therefore, an implementation plan has been developed for the 110-mph Ohio Hub system and the pro-forma financials presented here, as well as the cost benefit ratios presented at the end of the previous chapter all reflect the 110-mph assumption.
- The phasing plan proposed in the 2007 update recognizes the timing of planned MWRRS implementation. It interweaves implementation of three MWRRS corridors, with the original four Ohio Hub corridors and three new "Incremental" corridors that have been evaluated in this study. The phasing plan assumes each MWRRS route is implemented in the year that it is called for in the MWRRS plan. Accordingly, in some early years of the new Ohio Hub implementation plan, MWRRS connectivity is not yet fully in place.

A synergistic effect occurs as implementation of the Ohio Hub System moves from one phase to the next. Each phase provides a strong base upon which to support the next phase by strengthening and increasing the value of the passenger rail service in the region. To quickly reduce operating deficits associated with start-up, it is important to progress rapidly from phase to phase.

8.1 Ranking of Corridors – 2007 Update

An implementation plan was developed for integrating the new incremental corridors into the proposed MWRRS and Ohio Hub systems. To establish the rankings, a qualitative scoring system based on multiple criteria was used as shown in Exhibit 8-1 below. MWRRS corridors were not included in the qualitative ranking process, since it is assumed that MWRRS corridors will be implemented according to the plan that had been previously approved by the MWRRS Steering Committee. However, the suggested implementation sequencing for Ohio Hub could change if the MWRRS plan falls behind schedule.

Exhibit 8-1 – Route Segment Scoring

Corridor	Op Ratio	Cost Benefit	Constructability	Freight Capacity	Partnership	TOTAL
3-C	9	9	4	9	10	41
Cleveland-Detroit	8	5	2	10	7	32
Columbus-Chicago*	9	9	5	2	7	32
Cleveland-Pittsburgh	8	6	7	3	7	31
Toledo-Columbus-Pittsburgh	7	7	8	4	4	30
Cleveland-Buffalo-Toronto	5	2	5	7	1	20

** This partnership scoring assumes that the MWRRS South-of-the-Lake is implemented as planned, in 2012.*

Scoring Criteria

Operating Ratio	0 - Less tham 1.0 10 - Better than 1.5
Cost Benefit:	0 - Less tham 1.0 10 - Better than 2.0
Constructability:	0 - All dedicated track on new ROW with new structures and bridges 10 - Upgrade existing track in place with very little new construction
Freight Capy:	0 - Adds no capacity or adds in a place where there is little/no demand 10 - Add another track to a freight line of heavy demand
Partnership:	1 - 3 Partners 4- 2 Partners 7 - 1 Partner 10 - 0 Partners

The 3-C is financially the strongest Ohio Hub corridor because of its high ridership and revenue yield, so in the overall scoring, the 3-C line clearly emerged as the highest priority corridor for Ohio. After this, the qualitative scorings of all the remaining lines are very close, so they could be implemented in practically any order desired.

What emerged from this analysis is that complementary sets of lines focusing on either a "Cleveland Hub" or a "Columbus Hub" could be developed into a viable stand alone Ohio network, and Ohio could reasonably choose to build either network first. A "Columbus Hub" would probably be easier to build and have a lower capital cost, but a "Cleveland Hub" would serve more population and produce slightly better operating results.

Early development of the "Cleveland Hub" is more compatible with the MWRRS because of the shared line segment from Cleveland to Toledo. This suggests that if the MWRRS stays on schedule, then priority should be placed on developing the Cleveland Hub first. But if MWRRS falls behind schedule[55], then a Columbus Hub may be easier to develop first. Since the 2007 update assumes that MWRRS will be developed as planned, development of the Cleveland hub is progressed ahead of the Columbus hub in this plan. This results in a sequencing of the Ohio Hub corridors, as shown in Exhibit 8-2:

Exhibit 8-2: Proposed Implementation Sequencing

1) 3-C - 2010
2) Detroit via Metro Airport - 2011
3) Columbus-Fort Wayne* - 2012
4) Pittsburgh via Youngstown - 2013
5) Toledo-Columbus-Pittsburgh - 2014
6) Toronto via Buffalo - 2015

* Assuming implementation of MWRRS in 2012, would provide through service from Columbus-Chicago.

This proposed sequence and implementation years are consistent with both previous Ohio Hub and MWRRS efforts. As compared to the earlier Ohio Hub plan, the sequence of implementation of the original Ohio lines would remain the same, and the MWRRS lines still follow the schedule that was developed in the MWRRS plan. Assuming on-time implementation of the MWRRS plan, Columbus to Chicago connectivity via Fort Wayne would be added in 2012 ahead of construction of the Cleveland-Pittsburgh line; and Toledo-Columbus and Columbus-Pittsburgh services would both be added in 2014 ahead of the Buffalo line.

[55] If MWRRS falls behind schedule, this would delay Ohio's ability to gain access to Chicago from both Cleveland and Columbus. This suggests that Ohio should continue to promote the development of the MWRRS and support the development of the South-of-the-Lake improvement; but unfortunately the ability to progress MWRRS depends also on the cooperation of other states, along with the freight railroads and the Federal government. Therefore, the ability to gain Chicago access is not entirely under Ohio's control but also requires the active participation and support of both Indiana, Illinois and Michigan.

If the MWRRS is not implemented on time, the Columbus-Fort Wayne segment would score lower because of added Partnership requirements for developing Chicago access. The priority for Toledo-Columbus-Pittsburgh may then move higher. If MWRRS fails to progress the South-of-the-Lake initiative, the added complexity of incorporating Chicago connectivity into the Ohio Hub rather than implementing it under the MWRRS program may result in its construction being delayed for a few years. However, Chicago connectivity is clearly very important to Ohio residents and needs to be built as part of one system or the other. The following describes the current proposed build-out plan for the Ohio Hub in more detail.

8.1.1 3-C Corridor -2010

The 3-C corridor scores very high on Cost Benefit and Operating Ratio criteria since it is a very well-performing route. While some segments of it follow heavily used rights-of-way, other segments use more lightly used freight lines. Because of the assumed mixture of dedicated and co-mingled segments along the 3-C, the corridor gets an intermediate score for constructability, but a very high score for adding capacity to freight lines in places where added capacity is needed. Finally, the 3-C gets a "10" the highest rating possible for partnership, since it is entirely an intrastate corridor and no partnerships with other states are required to develop the line. As shown in Exhibit 8-3, the 3-C would be implemented concurrently with planned MWRRS improvements to the Chicago-Detroit line.

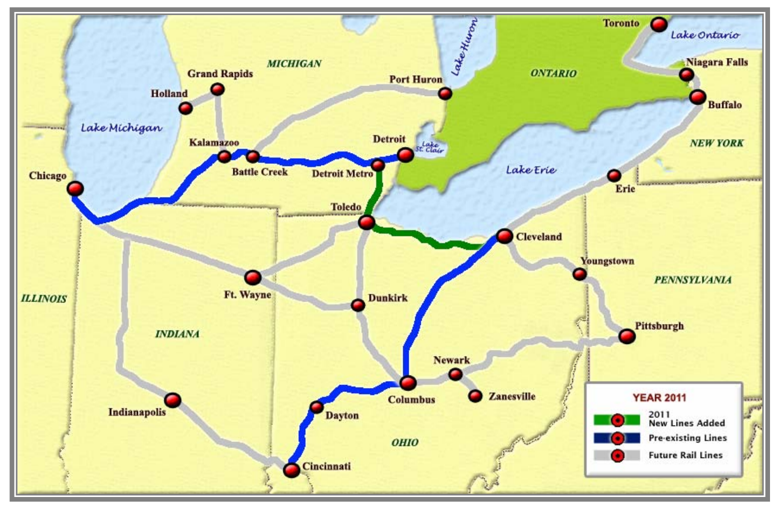
Exhibit 8-3 – Year 2010

8.1.2 Cleveland-Detroit Corridor -2011

There are two ways to connect Detroit to Pittsburgh, via either Columbus or Cleveland. The scoring of these alternative is very close; however, since the Cleveland-Toledo segment is also needed as part of the MWRRS Cleveland-Chicago line, it is suggested that the Cleveland-Detroit via Detroit Metro Airport corridor be built next, in 2011.

As shown in Exhibit 8-4, Ohio's Cleveland to Detroit line would connect the 3-C corridor to the MWRRS Chicago-Detroit line, thereby permitting some Cleveland to Chicago through travel via Detroit. Because of the added network connectivity it provides at Detroit, a Cleveland-Detroit extension is slightly favored over Cleveland-Pittsburgh. If however Michigan fails to develop its MWRRS corridor on time, then the Cleveland-Pittsburgh line or even the Panhandle route could emerge as Ohio's next priority. A Cleveland-Detroit extension will be relatively expensive to construct because of its extensive use of dedicated track and the fact that it operates over at least three different railroads. On the other hand, Cleveland-Detroit does add a lot of track capacity in places that could be useful to the freight railroads. The partnership score is high since only one state partner is needed, but the urgency for building this corridor is heavily dependent on continued progress of the MWRRS initiative and Michigan DOT's support.

Exhibit 8-4: Year 2011

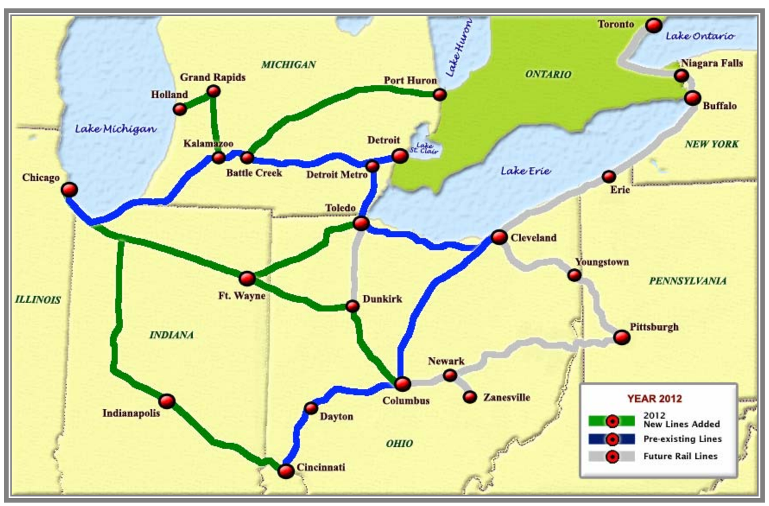


8.1.3 Columbus - Fort Wayne - Chicago Extension - 2012

The proposed Columbus- Fort Wayne- Chicago extension anticipates implementation of MWRRS South-of-the-Lake improvements by 2012. If the MWRRS is built on-time, only one state partner is needed to reach Fort Wayne and the constructability is relatively easy. A Columbus-Chicago extension scores very high on both Operating Ratio and Cost Benefit criteria, because of the strength of the Chicago market. As shown in Exhibit 8-5, adding a Columbus to Fort Wayne link in 2012 would implement direct Chicago service to Cincinnati, Cleveland, and Columbus all at the same time. In the MWRRS, Michigan branch lines would also come on-line in 2012 to utilize the added capacity provided when the South-of-the-Lake improvement opens. Rather than terminating Chicago-Columbus trains in downtown Columbus where there is no place to store them, these trains may be operated a little farther east to actually originate at the Port Columbus airport rather than at the downtown station.

If the South-of-the-Lake improvement is not implemented on time, a Chicago extension would become more difficult – comparatively, much more difficult than proceeding with the in-state Ohio corridors, because of the need to coordinate with three other states: Indiana, Michigan, and Illinois. Without the full cooperation of these other states to maintain a high priority on South-of-the-Lake implementation, Ohio would need to shift it attention to completing the development of its own in-state rail network. Nonetheless, for the current plan it is assumed that the Chicago lines are all implemented in 2012.

Exhibit 8-5: Year 2012



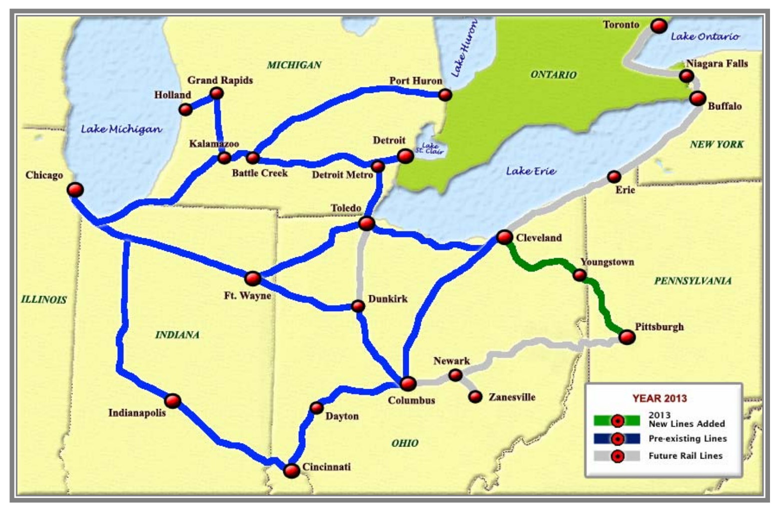
8.1.4 Cleveland-Pittsburgh Corridor - 2013

Like the Cleveland-Detroit line, the Pittsburgh extension would only require one state partner to work with. It is hard to predict the reaction of other State DOT's, but Pennsylvania DOT is known to strongly support the development of rail on its Keystone corridor between Philadelphia and Harrisburg. The Keystone corridor however, does not currently extend as far west as Pittsburgh. For this reason, development of this corridor has been initially prioritized lower than Cleveland-Detroit, but could change depending on the level of Penn DOT's interest.

As shown in Exhibit 8-6, the Cleveland-Pittsburgh via Youngstown line scores well on constructability and cost benefit criteria due to its extensive use of abandoned or lightly used freight rights of way; although there would still be some significant sections of dedicated track alongside heavily used freight line segments. The extension does well on Operating Ratio criteria as well, and would do even better with an eastern Keystone connection.

The freight capacity score for this line is relatively low since this project would develop an essentially dedicated passenger corridor on a separate right-of-way, and it is not clear that freight railroads would share much interest in using it.

Exhibit 8-6 – Year 2013



8.1.5 Toledo-Columbus-Pittsburgh "Incremental" Corridors - 2014

As shown in Exhibit 8-7, two separate line segments would both be implemented in the same year. These incremental corridors score well in terms of constructability, since they are lightly used lines and much of the Panhandle line is already owned by ORDC. However, the corridors do have some implementation challenges, particularly with the need for some grade separations at crossings with other rail lines, relocating bike trails on the Panhandle line, and for the need for urban terminal rail capacity mitigation.

The incremental corridors receive a moderate freight capacity score since the Panhandle upgrade may reopen a Pittsburgh-Columbus shortcut to a limited number of freight trains. This may prove valuable for adding eastern rail connectivity, such as from New York to the Rickenbacker logistics park. The proposed Panhandle line improvements may also include an optional service extension of some passenger trains from Newark to Zanesville, the feasibility of which has been proposed but not evaluated by this study.

The partnerships issue for both corridors requires the cooperation of two states. The Toledo to Detroit segment should already have been completed by this time, but cooperation of Michigan DOT will still be required to extended the proposed Columbus-Toledo trains through to Detroit.

Exhibit 8-7: Year 2014

8.1.6 Buffalo - Niagara Falls - Toronto Line Extension -2015

The proposed corridor extension to Toronto shown in Exhibit 8-8 has very promising potential, but the current plan still has several high-risk elements, particularly with respect to the proposed border crossing at Niagara Falls as well as the train's treatment once it gets into Canada. A partnership with three other state or provincial entities – one of them Canadian – as well as with the U.S. Homeland Security department and VIA Rail Canada would be required to make this project a success. For this reason, this segment has been prioritized lowest in the list.

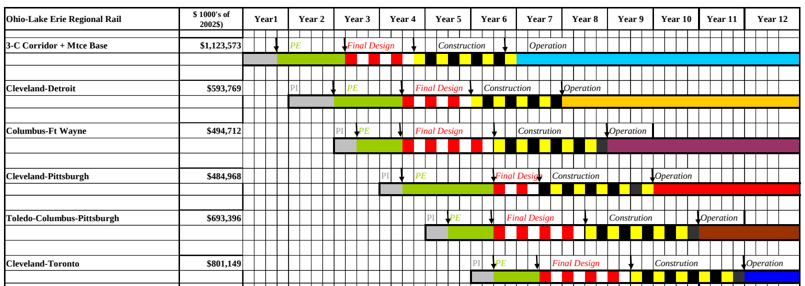
If the Buffalo line could be fed by *both* Toronto and Empire Corridor connecting traffic, the forecast could be very strong. The corridor ridership projection for this line is currently rather weak and can only support five round trips per day. In view of this, the constructability and Cost Benefit aspects for the project are marginal because of the very extensive assumed use of dedicated track on the CSX alignment. However, addition of the proposed third track to the CSX corridor would add significant freight capacity to the corridor. Alternatively, by shifting the project to the NS line instead of CSX or by quantifying and including freight benefits, it is possible that the cost benefit ratio might be improved.

Exhibit 8-8: Year 2015

8.1.7 2007 Implementation Plan Summary

Exhibits 8-9 and 8-10 summarize the results of the revised implementation plan for the $4.8 billion Ohio Hub system. Year 6 would be the year of the greatest expense since the 3-C, Cleveland-Detroit and Columbus-Fort Wayne lines would all be under construction at the same time. As shown in Exhibit 8-10, during that year a funding capability of $850 million would have to be in place. It is anticipated that this can be obtained using a combination of direct State and Federal grants, plus financing for any amounts that exceed the Federal funding cap.

Exhibit 8-9: Proposed 2007 Implementation Plan and Costs

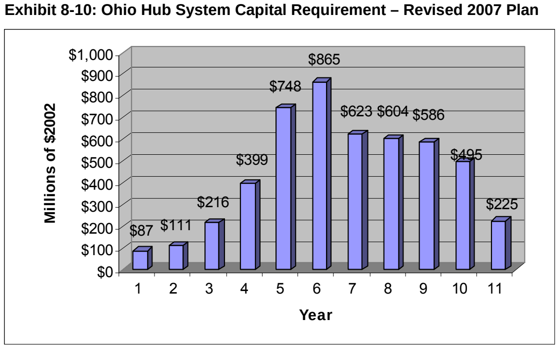


Total Investment Costs by Year		Year1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Planning and Implementation (PI)	$261,973	$70,223	$37,111	$30,920	$30,311	$43,337	$50,072						
Preliminary Engineering (PE)	$366,762	$16,385	$74,201	$58,237	$44,590	$45,616	$59,204	$56,846	$11,683				
Final Design	$419,157			$56,179	$85,867	$54,424	$48,984	$58,918	$74,727	$40,057			
Construction	$3,143,675				$105,335	$477,006	$585,048	$397,980	$386,007	$471,528	$495,449	$225,323	
Total Infrastructure	$4,191,567	$86,609	$111,311	$145,335	$266,102	$620,383	$743,307	$513,744	$472,417	$511,586	$495,449	$225,323	
Total Land	$320,447			$70,754	$57,930	$52,548	$47,352	$34,691	$57,172				
Total Rolling Stock	$447,500				$74,584	$74,584	$74,583	$74,583	$74,583	$74,583			
Total Investment	$4,959,514	$86,609	$111,311	$216,089	$398,616	$747,515	$865,242	$623,018	$604,172	$586,169	$495,449	$225,323	

Key to Implementation Stages: Project Development; Preliminary Engineering; Final Design; Construction

Key to Operation Phases: Phase 1; Phase 2; Phase 3; Phase 4; Phase 5; Phase 6

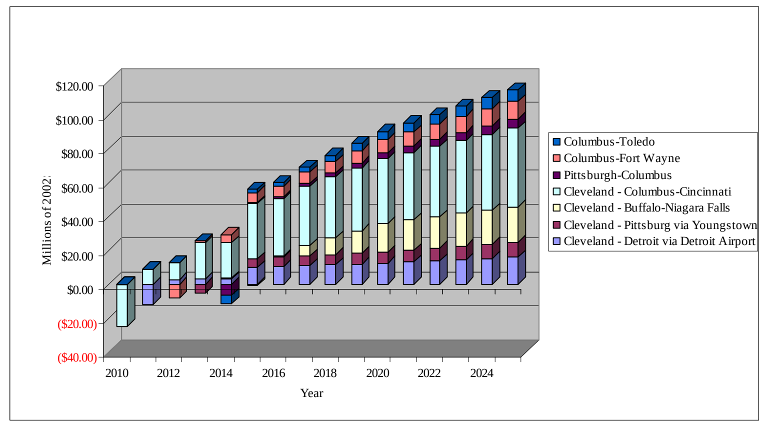
Exhibit 8-10: Ohio Hub System Capital Requirement – Revised 2007 Plan



8.2 Financial Results of the Implementation Plan

The 2007 Ohio Hub plan update resulted in an update to the model demographics, an upwards revision of the forecast for the Pittsburgh, Buffalo and Detroit corridors, the addition of three new corridors to the system, a joint reoptimization of the Ohio Hub and MWRRS Operating plans, and an updating of the operating cost assumptions as described in previous sections. These revisions resulted in a substantial improvement to the forecast financial results for the original four corridors, as well as the development of financial projections for the three added incremental corridors. Exhibit 8-11 shows the projected operating cash flow (surplus or subsidy requirement) by route.[56] Total revenues and operating expense projections for the seven-route Ohio Hub system for 2004 through 2040, and the resultant cash flow are presented in Exhibit 8-12.

Exhibit 8-11: Corridor Level Operating Cash Flow (2007 Incremental Corridors Update)



[56] As compared to Exhibit 8-5 from the 2004 study, it can be seen that *all* routes and not just the 3-C corridor are generating operating surpluses by 2015, although the 3-C corridor continues to be the strongest performer.

Exhibit 8-12: Ohio Hub Preliminary Operating Statement (2007 Incremental Corridors Update)

Thousands of 2002 $	Total to 2040	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Revenues											
Ticket Revenue	**$15,326,362**	$46,811	$124,601	$222,252	$315,537	$359,032	$431,849	$441,508	$455,265	$466,973	$478,680
On Board Services	**$1,226,109**	$3,745	$9,968	$17,780	$25,243	$28,723	$34,548	$35,321	$36,421	$37,358	$38,294
Express Parcel Service (Net Rev)	**$766,318**	$2,341	$6,230	$11,113	$15,777	$17,952	$21,592	$22,075	$22,763	$23,349	$23,934
Bus Feeder	**$189,100**	$910	$2,060	$2,986	$3,881	$4,634	$5,368	$5,478	$5,621	$5,747	$5,874
Total Revenues	**$17,507,890**	$53,806	$142,859	$254,131	$360,437	$410,341	$493,357	$504,383	$520,070	$533,426	$546,783
Train Operating Expenses											
Energy and Fuel	**$1,215,846**	$8,792	$15,841	$31,112	$35,220	$39,413	$41,749	$41,749	$41,749	$41,749	$41,749
Train Equipment Maintenance	**$3,317,941**	$23,993	$43,230	$84,902	$96,111	$107,554	$113,929	$113,929	$113,929	$113,929	$113,929
Train Crew	**$1,324,487**	$9,578	$17,257	$33,892	$38,367	$42,935	$45,479	$45,479	$45,479	$45,479	$45,479
On Board Services	**$1,127,386**	$5,592	$11,685	$22,051	$27,520	$31,034	$34,935	$35,321	$35,871	$36,340	$36,808
Service Administration	**$756,615**	$12,376	$15,163	$21,201	$22,825	$24,483	$25,406	$25,406	$25,406	$25,406	$25,406
Operating Profit	**$584,351**	$4,603	$7,507	$13,483	$15,677	$17,522	$18,997	$19,098	$19,238	$19,358	$19,479
Total Train Operating Expenses	**$8,326,626**	$64,935	$110,684	$206,641	$235,720	$262,941	$280,495	$280,983	$281,673	$282,261	$282,850
Other Operating Expenses											
Track & ROW Maintenance	**$1,320,893**	$10,913	$18,300	$34,302	$37,551	$41,945	$45,303	$45,303	$45,303	$45,303	$45,303
Station Costs	**$325,992**	$3,160	$3,298	$8,986	$9,591	$10,497	$11,172	$11,172	$11,172	$11,172	$11,172
Sales & Marketing	**$778,014**	$5,019	$8,392	$12,610	$16,781	$19,134	$22,288	$22,727	$23,335	$23,858	$24,382
Insurance Liability	**$685,860**	$2,483	$5,998	$10,519	$14,604	$16,585	$19,598	$20,002	$20,541	$21,012	$21,484
Bus Feeder	**$315,167**	$1,516	$3,433	$4,977	$6,468	$7,724	$8,946	$9,131	$9,368	$9,579	$9,790
Total Other Operating Expenses	**$3,425,925**	$23,091	$39,421	$71,393	$84,995	$95,884	$107,306	$108,335	$109,718	$110,924	$112,130
Total Operating Expenses	**$11,752,552**	$88,026	$150,105	$278,034	$320,714	$358,825	$387,801	$389,317	$391,391	$393,185	$394,980
Cash Flow From Operations	**$5,755,338**	($34,220)	($7,246)	($23,903)	$39,723	$51,516	$105,555	$115,065	$128,679	$140,241	$151,803
Operating Ratio	**1.49**	0.61	0.95	0.91	1.12	1.14	1.27	1.30	1.33	1.36	1.38

Exhibit 8-12: Ohio Hub Preliminary Operating Statement, ctd. (2007 Incremental Corridors Update)

Thousands of 2002 $	Total to 2040	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Revenues											
Ticket Revenue	**$15,326,362**	$490,388	$498,471	$506,554	$514,637	$522,720	$530,803	$538,474	$546,145	$553,816	$561,487
On Board Services	**$1,226,109**	$39,231	$39,878	$40,524	$41,171	$41,818	$42,464	$43,078	$43,692	$44,305	$44,919
Express Parcel Service (Net Rev)	**$766,318**	$24,519	$24,924	$25,328	$25,732	$26,136	$26,540	$26,924	$27,307	$27,691	$28,074
Bus Feeder	**$189,100**	$6,000	$6,098	$6,196	$6,293	$6,391	$6,488	$6,583	$6,678	$6,772	$6,867
Total Revenues	**$17,507,890**	$560,139	$569,370	$578,602	$587,833	$597,064	$606,295	$615,058	$623,822	$632,585	$641,348
Train Operating Expenses											
Energy and Fuel	**$1,215,846**	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749
Train Equipment Maintenance	**$3,317,941**	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929
Train Crew	**$1,324,487**	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479
On Board Services	**$1,127,386**	$37,276	$37,600	$37,923	$38,246	$38,569	$38,893	$39,200	$39,507	$39,813	$40,120
Service Administration	**$756,615**	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406
Operating Profit	**$584,351**	$19,599	$19,684	$19,769	$19,855	$19,940	$20,025	$20,106	$20,188	$20,269	$20,350
Total Train Operating Expenses	**$8,326,626**	$283,438	$283,847	$284,255	$284,664	$285,073	$285,481	$285,869	$286,257	$286,646	$287,034
Other Operating Expenses											
Track & ROW Maintenance	**$1,320,893**	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303
Station Costs	**$325,992**	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172
Sales & Marketing	**$778,014**	$24,906	$25,272	$25,638	$26,005	$26,371	$26,738	$27,086	$27,435	$27,784	$28,133
Insurance Liability	**$685,860**	$21,955	$22,302	$22,649	$22,996	$23,342	$23,689	$24,016	$24,343	$24,669	$24,996
Bus Feeder	**$315,167**	$10,001	$10,163	$10,326	$10,489	$10,651	$10,814	$10,972	$11,130	$11,287	$11,445
Total Other Operating Expenses	**$3,425,925**	$113,336	$114,212	$115,088	$115,964	$116,840	$117,716	$118,549	$119,382	$120,216	$121,049
Total Operating Expenses	**$11,752,552**	$396,775	$398,059	$399,344	$400,628	$401,912	$403,197	$404,418	$405,640	$406,861	$408,083
Cash Flow From Operations	**$5,755,338**	$163,364	$171,311	$179,258	$187,205	$195,152	$203,099	$210,640	$218,182	$225,723	$233,265
Operating Ratio	**1.49**	1.41	1.43	1.45	1.47	1.49	1.50	1.52	1.54	1.55	1.57

Exhibit 8-12: Ohio Hub Preliminary Operating Statement, ctd. (2007 Incremental Corridors Update)

Thousands of 2002 $	Total to 2040	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Revenues												
Ticket Revenue	**$15,326,362**	$569,158	$577,429	$585,700	$593,971	$602,242	$610,513	$619,098	$627,684	$636,269	$644,855	$653,441
On Board Services	**$1,226,109**	$45,533	$46,194	$46,856	$47,518	$48,179	$48,841	$49,528	$50,215	$50,902	$51,588	$52,275
Express Parcel Service (Net Rev)	**$766,318**	$28,458	$28,871	$29,285	$29,699	$30,112	$30,526	$30,955	$31,384	$31,813	$32,243	$32,672
Bus Feeder	**$189,100**	$6,962	$7,063	$7,164	$7,264	$7,365	$7,466	$7,570	$7,674	$7,778	$7,882	$7,986
Total Revenues	**$17,507,890**	$650,111	$659,558	$669,005	$678,452	$687,898	$697,345	$707,151	$716,957	$726,763	$736,568	$746,374
Train Operating Expenses												
Energy and Fuel	**$1,215,846**	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749	$41,749
Train Equipment Maintenance	**$3,317,941**	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929	$113,929
Train Crew	**$1,324,487**	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479	$45,479
On Board Services	**$1,127,386**	$40,427	$40,758	$41,089	$41,420	$41,750	$42,081	$42,425	$42,768	$43,111	$43,455	$43,798
Service Administration	**$756,615**	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406	$25,406
Operating Profit	**$584,351**	$20,432	$20,519	$20,607	$20,694	$20,781	$20,869	$20,959	$21,050	$21,140	$21,231	$21,321
Total Train Operating Expenses	**$8,326,626**	$287,422	$287,840	$288,259	$288,677	$289,095	$289,513	$289,947	$290,381	$290,815	$291,249	$291,683
Other Operating Expenses												
Track & ROW Maintenance	**$1,320,893**	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303	$45,303
Station Costs	**$325,992**	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172	$11,172
Sales & Marketing	**$778,014**	$28,482	$28,857	$29,232	$29,607	$29,982	$30,357	$30,745	$31,133	$31,521	$31,909	$32,297
Insurance Liability	**$685,860**	$25,323	$25,675	$26,027	$26,379	$26,732	$27,084	$27,446	$27,809	$28,171	$28,534	$28,896
Bus Feeder	**$315,167**	$11,603	$11,771	$11,939	$12,107	$12,275	$12,444	$12,617	$12,790	$12,964	$13,137	$13,310
Total Other Operating Expenses	**$3,425,925**	$121,882	$122,778	$123,673	$124,568	$125,463	$126,359	$127,283	$128,206	$129,130	$130,054	$130,978
Total Operating Expenses	**$11,752,552**	$409,305	$410,618	$411,931	$413,245	$414,558	$415,872	$417,230	$418,587	$419,945	$421,303	$422,661
Cash Flow From Operations	**$5,755,338**	$240,806	$248,940	$257,073	$265,207	$273,340	$281,473	$289,921	$298,369	$306,817	$315,265	$323,713
Operating Ratio	**1.49**	1.59	1.61	1.62	1.64	1.66	1.68	1.69	1.71	1.73	1.75	1.77

8.3 Cost Benefit Ratios – Ohio Hub Formal Recalculation

Exhibit 8-13 reports the results of a formal recalculation of the Ohio Hub cost benefit ratio, based on the implementation plan described in this Chapter. However, unlike the three-layer analysis, this formal recalculation includes only Ohio Hub's own direct capital and operating costs, revenue, consumer surplus and environmental benefits. It does not include connecting revenue, consumer surplus or environmental benefits that accrue on the MWRRS lines, and for this reason the results are more conservative. The formal recalculation differs from the Three-Layer analysis in the following additional ways:

- Ohio Hub capital costs are somewhat higher, since in the formal recalculation, the Toledo-Cleveland capital cost is now considered part of the Ohio Hub, whereas in the Three Layer analysis, Toledo-Cleveland was considered part of Layer 1, and its cost was attributed to the MWRRS network.
- Only direct Ohio Hub operating costs and revenues are reflected in the analysis; the collateral impact on MWRRS connecting revenues and costs are not included. Therefore the revenues, operating costs, consumer surplus and environmental benefits are all somewhat lower here, than they were in the Three-Layer analysis.

The result of this recalculation, as shown in Exhibit 8-13, is a still-healthy 1.56 Benefits to Cost ratio. Although not as strong as the +2.00 ratios that include connecting MWRRS benefits, the new ratios are still very robust. Even so, the Benefit to Cost ratios resulting from the formal recalculation are stronger than those obtained in the earlier 2004 study. This improvement reflects the strengthened demand forecast in the Detroit, Pittsburgh and Buffalo corridors, as well as joint MWRRS-Ohio Hub operating plan optimization over the shared line segments.

Exhibit 8-13: Ohio Hub Benefits and Cost – Formal Recalculation based on Implementation Plan (Lifecycle Present Values in Millions of 2002$, 30 years at 3.9%)

	Ohio Hub Impl Plan
Revenue	$3,773
Consumer Surplus	$3,094
Other Mode + Resource	$3,524
Total Benefit	**$10,391**
Capital Cost	$3,999
Operating Cost	$2,528
Track Capital Maintenance	$126
Total Cost	**$6,653**
Cost/Benefit Ratio	**1.56**

8.4 Project Financing

The 2004 financial model for the Ohio Hub System was updated to evaluate possible sources of funds and net cash flow projections for the system, with the addition of the three incremental corridors. Following Government Accounting Office (GAO) requirements, this analysis was done in real term values without considering inflation. All operating revenues or operating costs are in constant 2002 dollars.

Sources and Uses of Funds

As shown in Exhibit 8-14, a model was developed to examine the projected cash flows of the project based on the phasing incorporated in the implementation schedule and on the projected financing requirements.

Exhibit 8-14: Results of Financial Analysis – Sources and Uses of Funds (2007 Ohio Hub Plan)

Sources and Uses of Funds (2004-2015)	Total (2004-2015)
Sources of Funds	
Short-term loan/GANS	**$529.7**
Initial Working Capital Contribution	**$30.0**
TIFIA Loans for Ramp-up Operating Losses	**$65.4**
TIFIA Loans for Accrued Interest/Issuance Fees on GANs	**$81.5**
Total TIFIA Funds	**$176.9**
Federal Government Contribution	**$3,967.6**
State Contribution	**$991.9**
Total Sources of Funds	**$5,666.1**
Uses of Funds	
Infrastructure Costs (Including P&E)	**$4,191.6**
Land costs	**$320.4**
Rolling Stock Costs	**$447.5**
Total Capital Costs	**$4,959.5**
TIFIA Uses of Funds:	
Start-up Costs	**$30.0**
Ramp-up Operating Costs	**$65.4**
Accrued Interest on GANs	**$80.5**
GAN Issuance Fees	**$1.0**
Total TIFIA Funds Uses	**$176.9**
Repayment of GANS	**$529.7**
Total Uses of Funds	**$5,666.1**

In this scenario, state bonds are combined with TIFIA assistance and financing to meet the annual capital cost for infrastructure and rolling stock during the project's implementation period. An initial start-up cost of $30 million was assumed for this phase of the Ohio Hub Study to cover initial working capital requirements. With a federal funding ceiling set at $400 million a year, the project would need to borrow $529.7 million, with a participating state contribution of $991.9 million. Detailed sources and uses of funds are provided in the Appendices.

Net Cash Flow

Using the results of operating cash flows and source and uses of funds, Exhibit 8-15 summarizes and projects the net cash flow for the proposed Ohio Hub System.

Exhibit 8-15: Results of Financial Analysis – Net Cash Flow Projections (2007 Ohio Hub Plan)

Cash Flow Analysis (Thousands of 2002$)	Total (2004 - 2040)
Sources of Cash:	
Operating Cash Flow	**$5,755,338**
Tifia Loan for Ramp-Up Operating Losses	**$65,369**
Interest Income on Working Capital Fund (2%)	**$5,509**
Gross Cash Flow From Operations	**$5,826,216**
Applications of Cash:	
Capital MofW Financing by Ohio Hub	**($362,872)**
Contribution to Working Fund (5%)	**($275,442)**
Net Cash Flow before Debt Service	**$5,187,901**
Change in Cash Balance (Proforma):	
Beginning Cash Balance	**$0**
Increase/(Decrease) in Cash	**$5,187,901**
Ending Cash Balance	**$5,187,901**
Net Cash Flow before TIFIA Debt Service	**$5,187,901**
TIFIA loans Outstanding:	
Beginning Balance	
Ramp-up Operating Loss	**($65,403)**
Working Capital Deposit	**($30,000)**
GANs Interest / Issuance Fees	**($67,753)**
Accrued Interest on TIFIA	**($35,991)**
Net Cash Flow After TIFIA Debt Re-payment	**$4,988,754**

The 30-year net cash flow of the Ohio Hub System, after capital Maintenance-of-Way requirements and TIFIA debt repayment, is projected to be $4.98 billion (not an NPV). This improved cash flow reflects the improvement to the demand forecast for the original Ohio Hub routes as well as addition of three more routes to the system. A detailed cash flow pro forma analysis for the Ohio Hub System is provided in the Appendices.

9. Summary of Institutional Framework Alternatives

The recent market trend of an increasingly diverse service-oriented economy has put more emphasis on the role of the private sector in implementing changes and setting new standards in the transportation industry. The private sector, using two major management tools—productivity gains by investment in new technologies and marketing strategies directed at opportunities that are emerging in the transportation market—has been significantly involved in the development of new standards in the transportation industry. During the process of conceptualizing the Ohio Hub System, the focus has been put onto effectively improving the productivity and partnering benefits of adopting private sector tools, where appropriate.

The following list shows a range of potential public-private arrangements that the Ohio Hub System could adopt:

- **Full Privatization** – The private sector finances and runs the whole operation.
- **Cost and Risk Sharing** (e.g., turnkey development) – A hybrid privatization approach where the public helps with capital financing, but the private sector is expected to also provide substantial capital, and to subsequently operate the system on a commercially profitable basis including the responsibility to repay its own capital costs.
- **Public Financing with Operating Franchises** – A public/private initiative where the public sector provides all the capital, primarily for infrastructure, while the private sector runs the trains. Such an operation must at least cover its operating cost, but without the responsibility for repaying initial capital investment, a positive operating ratio (greater than 1.00) would produce an operating profit.
- **Contracting –** The public sector provides both capital and operating funds. Operations may be contracted to the private sector, but the responsibility for commercial business decision-making rests with the sponsoring public agency.
- **Cooperative Agreements for Technology Development** – This is a special purpose public/private partnership established for the purpose of research, development and technology transfer.

Full privatization is extremely difficult to achieve in passenger rail, due to government capital subsidies provided to other modes of transportation, and because the cost-structure of automobile ownership makes it difficult to charge a rail fare that is high enough to fully recover capital costs. This financing model has been tried on several high-speed rail projects in the US, such as the proposed Texas TGV and Florida FOX systems, but none of these projects has been able to achieve the financial rates of return needed to attract private investment.

Recognizing that high-speed rail projects are unlikely to be financed purely by the private sector, cost and risk-sharing arrangements have recently been proposed for High-speed rail systems in Florida and elsewhere. These appear to have a higher chance for success than the earlier efforts that were based on a full privatization model.

For a system such as the Ohio Hub, however, the benefits of private sector participation can be attracted if a large measure of financial "risk" – most notably associated with infrastructure investment – can be shifted to the public sector. The FRA, in their proposals for developing public/private partnerships, has identified the need for amelioration of this "risk." The FRA has proposed that the public sector be responsible for providing capital, while the private sector operates the system without an operating subsidy. Two critical conditions have to be met in order for this "franchising model" to work:

- Once started, the rail system must be able to generate at least enough revenue to cover its own operating costs.
- The investment must produce a positive benefit/cost ratio (greater than 1.00) that shows the overall project makes a net contribution to the US economy.

A franchising arrangement takes the form of a concession, granted in return for either an up-front or an ongoing payment, which grants the right to use the publicly provided rail assets for providing passenger service on the Ohio Hub System. Commercial decision making – the right to determine schedules, fares and service frequencies – is then left up to the franchise operator, who can operate with a minimum of government interference or regulation so long as the basic conditions of the franchise continue to be met.

In contrast, a contracting arrangement implies that the responsibility for commercial decision-making resides with the sponsoring government entity. While a contracting arrangement may be necessary for a loss-making transit service, for an intercity passenger system today, it is the least attractive option since it "crowds out" the private sector's ability to tailor its services to best meet the need of the marketplace.

For evaluating the Ohio Hub System's business potential, it is anticipated that varying levels of private sector participation may be possible. It is likely that the private sector could participate with the passenger rail system in provision of the following services:

- Train operations
- Station operations
- Express parcel service
- Call center operations
- On-board services
- Feeder bus services
- Vehicle maintenance
- Track maintenance
- Parking

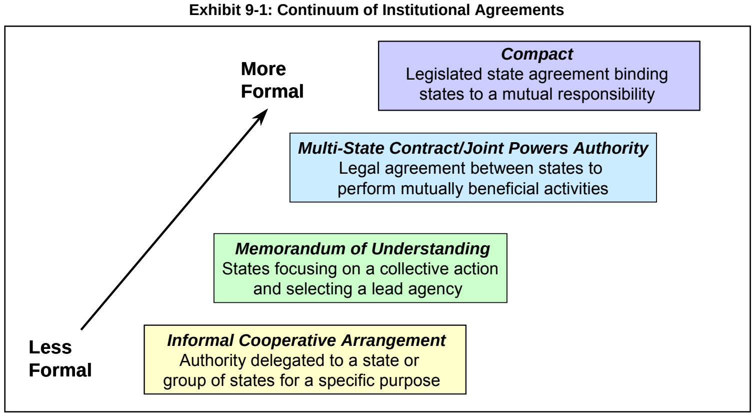
New technologies in the communication industry have greatly enhanced transportation management control, by allowing businesses to monitor and diagnose the performance of their operations and to provide effective and efficient customer response service. As a result of these changes in transportation management control, both capital and operating costs in the transportation industry has decreased while service capabilities have improved.

9.1 Institutional Agreement Framework

As the Ohio and Lake Erie Regional Rail - Ohio Hub Study progresses to more detailed planning and ultimately to securing funding for implementation of the Ohio Hub System, multi-state participation and cooperation become necessary for the system's success. With the progression of a series of activities, it is important to define the institutional arrangement that meets the needs of the Ohio Hub Study collective action while minimizing intrusion on the authorities, powers and immunities of each state.

Institutional arrangements are the organizational structure and agreements between participating entities (e.g., states) responsible for undertaking or overseeing project-related activities. A continuum and definition of institutional arrangements range from less formal arrangements such as a Letter of Agreement to a more formal multi-state legislated compact arrangement. The level of arrangement selected will reflect the administrative needs of the states and the degree of complexity of the issues being dealt with. Exhibit 9-1 depicts the continuum of institutional agreement.

Exhibit 9-1: Continuum of Institutional Agreements



An example of an existing passenger rail compact is the Interstate Rail Passenger Advisory Council (Interstate High-Speed Intercity Rail Passenger Network Compact). Its purpose is to explore the potential for high-speed rail within the Great Lakes region and to encourage a cooperative and coordinated regional approach for planning and development activities. It is the policy of the Compact member states "to cooperate and share jointly the administrative and financial responsibilities of preparing a feasibility study concerning the operation of such a (passenger rail) system connecting major cities in Ohio, Indiana, Michigan, Pennsylvania and Illinois."

The origin of this Interstate Rail Passenger Advisory Council is traced to January 30, 1979, when a bill was introduced in the Ohio legislature to create a high-speed rail compact with Ohio's neighboring states. That bill was signed into law on August 28, 1979, and neighboring states were contacted and urged to join the Compact. By 1981, Michigan, Pennsylvania, Illinois and Indiana had joined the Compact. In the early 1990's, New York and Missouri also became members of the Compact.

The Council continues to provide an institutional framework in which state rail transportation officials assemble to advance interstate rail projects. The Council's current project involves overseeing the development of the Ohio and Lake Erie Regional Rail - Ohio Hub Study.

9.1.1 Guiding Principle in Selecting Institutional Arrangements

It is essential to take account a certain guiding principles to support Ohio Hub activities when considering and ultimately selecting institutional. The overall objectives of the principles should support the achievement of project goals without expanding or creating new bureaucracies. Most importantly, key to the success of a successful institutional arrangement is to ensure that the arrangement is designed in a manner that minimizes intrusion upon states' powers and immunities. Moreover, while the form of arrangements is important, it is equally important to identify when multi-state arrangements are necessary and what authorities need be incorporated into these arrangements.

9.1.2 Multi-State Participation Activities

Since the Ohio Hub System involves the Ohio Rail Development Commission, four states of Ohio, Michigan, Pennsylvania and New York, and VIA Rail, Canada, the multi-state/agency participation is required in order to implement the Ohio Hub System. The activities and institutional issues requiring multi-state/agency participation for the Ohio Hub Study fall into three broad categories: project planning, business arrangements, and policy/operational oversight. Exhibit 9-2 lists these activities by project category.

Exhibit 9-2: Typical Institutional Arrangement Activities by Category

Project Planning	Business Arrangement	Policy
Hiring consultants Project planning oversight Environmental review Garnering project support	Issue and retire state debt Federal grant activities Major procurements System construction Outsourcing decisions	Train operator oversight Capital investments Service quality standards Receipt of revenue Payment to contractors Disbursements to states

In the Project Planning activities, arrangements support joint funding and collective oversight of the planning process among states and any relevant agencies. Then, the Business Arrangement activities involve the contractual agreement(s) with lending institutions, investors, suppliers, contractors, freight, and commuter railroads while protecting the interest of states, defining fiduciary responsibility, and achieving objectives according to a schedule and within limits of affordability.

While some Ohio Hub activities can be accomplished by individual states, others will require varying levels of institutional arrangements. Institutional arrangements would identify state responsibilities in deciding on Ohio Hub policies and broad service delivery issues. Then, the establishment of a policy oversight entity would interact with the rail operator through the provision of required funds and the specification of service plans. Exhibit 9-3 illustrates those activities relating to planning that can be accomplished through different cooperative agreements.

Exhibit 9-3: Actions and Potential Institutional Arrangements

Ohio Hub Study Potential Actions and Responsibilities	Informal Cooperative Agreement	Memorandum of Agreement	Multi-State Agreement	Multi-State Compact
Level of Institutional Action Required				
Agency Approval	X	X	X	
Legislative Approval				X
Arrangements Supporting Planning Activities				
System Plan	X	X	X	X
Service Plan	X	X	X	X
Service Standards	X	X	X	X
Arrangements Supporting State Management Activities				
Stakeholder Support	X	X	X	X
Procurements		X	X	X
System Construction Oversight			X	X
Vendor Selection		X	X	X
System Implementation Oversight			X	X
Full Time Administrative Support			X	X
System Accounting			X	X
Arrangements Supporting State Financial Responsibilities				
Federal Grant Applications and Awards			X	X
Capital Program Development			X	X
Multi-State Cost Sharing			X	X
Multi-State Revenue Distribution			X	X

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9.2 Multi-State/Agency Participation Institutional Framework

In the Ohio Hub Study, the multi-state/agency participation is required in order to implement proposed system. There are mainly two kinds of institutional arrangements possible between states. These are *State-to-State Contract* and *Interstate Compact* and details of each arrangement are discussed below.

State-to-State Contract

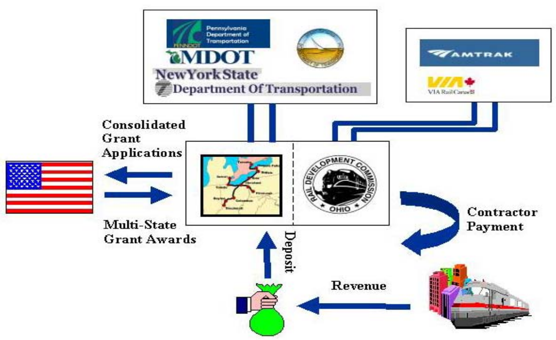
- Agreements among states to make the contractual arrangements that would be necessary to achieve intercity service within the jurisdictions of the states.
- Possibility to establish the arrangement without prescribing the precise form or content or separate enactment by each participating state.
- Requirements of assurance for the participating states to enact all necessary legislation and regulations to implement the plan for the Ohio Hub System.
- The advantages of the speedy and flexible agreement structure, since legislative approval is not required, and the ability of a contract to hold a state harmless from legal liability.
- The disadvantage of possibility of not being able to fully reflect the collective good and credibility that might be achieved with a more formal agreement.

Interstate Compact

- Permission by congress to allow states, agencies, or authorities created by states to enter specific agreements that involve interstate commerce.
- The most recent consent of the Amtrak Reform and Privatization Act in 1997, which grants the consent of Congress to states to enter into interstate compacts to promote the provision of intercity passenger rail service.
- Agreements among states to establish a system, which would operate across state lines, and cooperate and share jointly the administrative and financial responsibilities of implementing the operations of such a system.
- The compact could also describe the institutional framework, such as a Policy Board consisting of members from each of the participating states directing an operator. It could identify the terms for enactment, such as providing that the compact could become effective upon the adoption or enacting into law by two or more participating states.
- Identical agreed-upon compact language for each state.
- Allowance of waiving sovereign immunity to a specific action, such as contracts, provision of public services, or certain types of torts, by states.
- Its main advantage lies in the formal structure, which is recognized by Congress to seek federal funding for significant infrastructure improvements and to establish the Ohio Hub System.
- The disadvantage of a time frame and state legislative approval requirements.

With the guidance of the Ohio Rail Development Commission (ORDC) and steering committee approval, a general institutional arrangement framework for the Ohio Hub System was suggested to be a bi/multi-state agreement between the ORDC and the four states of Ohio, Michigan, New York, and VIA Rail. This proposal will require further discussion as the project moves forward into project development and implementation. VIA Rail represents Canadian interests in the Ohio Hub System, while Amtrak's role is advisory. This bi-national/multi-state agreement institutional arrangement is depicted in Exhibit 9-4, illustrating the flow of federal funding and revenue.

Exhibit 9-4: Federal Funding and Revenue Flow For a Bi/Multi-State Agreement Institutional Arrangement



10. Summary, Conclusions and Next Steps

The Ohio and Lake Erie Regional Rail - Ohio Hub Study has identified the costs associated with, and the benefits to be derived from the construction and operation of the proposed intercity/interstate passenger rail system. The study has defined the market for passenger rail service, developed service characteristics, train operating plans and costs, and train schedules, and identified the corridor capacity improvements along with the estimated capital costs. Furthermore, the Midwest Regional Rail System is integrated into the implementation plan for a full build-out of the interstate system. The study uses the suggested project phasing as the basis for the analysis of the economic feasibility as well as the analysis of the financing needs and preliminary financing plan. Finally, there was an evaluation of the institutional arrangements needed to guide the planning, implementation and operation of the Ohio Hub System.

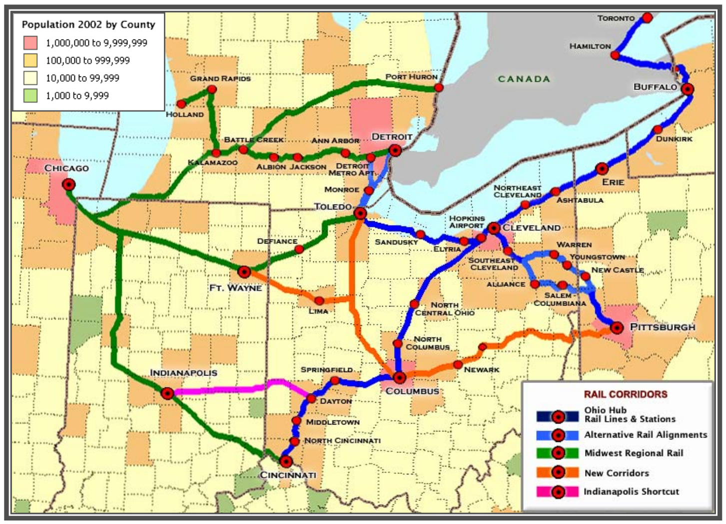
One of the primary system planning goals is to create a national passenger rail network by linking the Ohio Hub to other regional rail corridors. The Ohio Hub study has confirmed that an interconnected national passenger rail network will create economies of scale that will increase regional rideship and revenue and reduce overall system operating costs. While the Ohio Hub provides connections to the east at Pittsburgh, Buffalo, and Toronto, it is also very closely tied to Chicago and the Midwest Regional Rail System.

The updated 2007 Ohio Hub Study advanced an integrated systems planning approach, where the three eastern MWRRS routes are directly incorporated into the Ohio Hub ridership and financial forecasting models. The layered networks allow an assessment of connecting revenues and the overall financial viability of the Ohio Hub system, and served as input to the implementation plan. The three-layered network structure provided a comprehensive analysis of the potential intercity/interstate corridors in the region and clusters them into logical sub networks as follows:

- Layer One: MWRRS Eastern Routes:
  - Chicago to Michigan (all routes)
  - Chicago to Toledo and Cleveland
  - Chicago to Indianapolis and Cincinnati
- Layer Two: Ohio Hub Four Corridor Route System
  - Cleveland to Columbus, Dayton and Cincinnati
  - Cleveland to Toledo and Detroit
  - Cleveland to Pittsburgh
  - Cleveland to Buffalo and Toronto
- Layer Three: Ohio Hub Incremental Corridor Additions
  - Columbus to Lima, Fort Wayne and Chicago
  - Columbus to Pittsburgh
  - Columbus to Toledo and Detroit

Exhibit 10-1 shows the envisioned fully-built out MWRRS and Ohio Hub networks, overlaid on a population density map of the Upper Midwest region. The original four-route Ohio Hub System, in blue, was presented in the 2004 Study and encompassed approximately 860 route miles covering four states and one Canadian province. The updated Ohio Hub Study enhances the system by adding the three "incremental corridors" which are in orange or approximately 410 route miles, bringing the total size of the proposed Ohio Hub system to approximately 1,244 route miles, not including the connecting MWRRS corridors. The total system miles for all three layers, not including the shortcut, is 2,326-miles.

Exhibit 10-1: MWRRS and Ohio Hub Rail Systems with Incremental Corridors Added



By incorporating new technology and improving transportation inter-connectivity, the Ohio Hub service characteristics are identical to those proposed for MWRRS, with average train speeds comparable to that of Amtrak's Northeast Corridor. As a stand-alone system, the Ohio Hub System would serve a broad market of nearly 22 million people in the Ohio and Lake Erie region. The total travel market population served by the MWRRS eastern corridors and Ohio Hub System is estimated at 33 million.

The phasing of Ohio Hub corridor development was based on the prospect of ridership and projected farebox revenue. The implementation plan that was developed for the original four-route system has been enhanced, by interweaving the new incremental corridors as well as explicitly coordinating the timing of Ohio Hub corridor implementation with the MWRRS plan.

10.1 Study Conclusions and Key Findings

On the basis of the *Commercial Feasibility* criteria that has been established by the FRA, all of the proposed Ohio Hub sub-networks are viable. Financially, the three eastern MWRRS routes, along with the 3-C and Chicago-Columbus corridors are the strongest performers; after this, more Ohio Hub routes can be added and network interconnectivity results in a multiplier effect on revenue, ridership, consumer surplus and external mode benefits. The connecting ridership effect helps maintain high operating and cost benefits ratios as the network is expanded.

In terms of the options that were evaluated in the earlier 2004 plan, it was shown that Option 1 using Detroit Metro Airport and Youngstown was the route combination that produced the best financial result. For this reason only Option 1 was carried forward into the 2007 incremental corridors plan. In terms of technology, 110-mph options are far superior to any of the 79-mph options both in operating performance and cost-benefit results. While the original 2004 analysis suggested that some 79-mph routes may be viable as feeders to a 110-mph MWRRS system, in fact the Ohio routes are all economically strong enough to justify upgrading to 110-mph except where physical constraints such as curvature or urban restrictions prevent this speed increase. 110-mph service would boost ridership on average of 50%, double revenues and could enable the Ohio Hub to be viable as a stand-alone system. A 110-mph upgrade more than doubles consumer surplus and environmental benefits without proportionately raising capital or operating cost. Therefore, 110-mph produces much higher cost benefit ratios than a 79-mph option.

This study has found that a 110-mph Ohio Hub system could meet the FRA *Commercial Feasibility* criteria and could even be developed separately from the MWRRS system, although clearly the results would be better if the two systems were developed together. For this reason 110-mph Option 1 (Detroit Metro Airport plus Youngstown) was taken forward for development of a detailed implementation plan for the Ohio incremental corridors system.

The following are the key findings of this Study:

- Consistent with previous studies, this business plan update has recognized the importance of Chicago access and has assumed connectivity to the three proposed MWRRS eastern corridors. The financial modeling work has shown that these three corridors would be operationally viable on a stand alone basis if necessary independent of the MWRRS system, and that their implementation would develop a solid system of core routes that could be extended by the Ohio Hub system.
- However, since MWRRS development requires the cooperation of a number of States and is dependent upon the progress of the South-of-the-Lake improvement through the CREATE project, some preliminary financial assessments were developed in support of implementation planning. These assessments have suggested that a stand-alone Ohio Hub network, based on either a Cleveland or Columbus hub, would be economically and financially viable. At present, it appears that a Columbus hub network may be easier and less expensive to develop. A Cleveland hub would generate higher ridership and stronger operating performance, but would be more difficult to develop because the rail lines it would rely upon for access to Cleveland are all very heavily used by freight trains.

- The 3-C corridor lies entirely within Ohio's borders and is financially the strongest corridor. Therefore, 3-C development is Ohio's obvious first priority. Beyond this, financial modeling shows that there is a lot of flexibility for determining which corridors should be added next. The corridors can be added in a different order than was assumed in Chapter 8 while still producing positive operating results. It is suggested that the actual prioritization of corridor extensions beyond 3-C be based on partnership potential with adjoining states, and on the level of cooperation that can be developed with the host freight railroads. It is recommended that ORDC begin to engage the neighboring states as well as freight railroads with the results of this expanded study, to determine which corridor(s) will actually be developed next.
- The Ohio & Lake Erie Regional Rail – Ohio Hub System will increase the regional transportation system capacity by improving the railroads for both passenger and freight trains. The capital investments suggested in the Ohio Hub plan will help remove impediments and improve the fluidity of railroad operations. The nation's privately owned freight railroads are a vital part of the transportation system and the Ohio Hub capital investments will help ensure that the railroads continue to serve commerce and economic growth.
- The Ohio & Lake Erie Regional Rail – Ohio Hub System is an appropriate extension of the nation's future passenger rail system. The Ohio Hub should be federally designated as part of the national passenger rail network.
- The Ohio Hub rail investments will improve highway/railroad crossing safety. The original four-route Ohio Hub system would invest $236 million in highway/railroad grade crossing safety improvements. Incremental corridors would add $154 million to this total, bringing the Ohio Hub investment in crossings to $390 million, not including investment that would be made on the MWRRS routes. This would expand upon ODOT's ongoing $200 million Grade Separation Program, and obviously would greatly expand on ORDC's annual $15 million investment in highway crossing improvements.

10.2 Challenges

The proposed Ohio Hub System will encounter a series of challenges as the project proceeds through the planning and implementation stages. These challenges include:

10.2.1 Public Funding

Securing federal funding requires the states to form a strong coalition to advocate for funding to the U.S. Department of Transportation and its agencies as well as the U.S. Congress, particularly to obtain the 80/20 federal match assumed in the Financial Analysis. A grassroots effort to promote the project to the state leadership, local communities, businesses, Congress and other interested groups will need to be undertaken to gain funding support.

10.2.2 Long-term Dept

The issuance of long-term debt requires advance financial planning by each state and significant coordination among the states. Modifications to state laws and debt ceilings might be required by some states' legislatures. Additionally, some states might not possess the expressed authority to issue bonds for transportation purposes. Consequently, appropriate actions would need to be taken by these states to obtain this authority or identify an alternative financing strategy.

10.2.3 Freight Railroads

A critical component of the Ohio Hub implementation is the use of freight railroad tracks and rights-of-way for passenger services. While Amtrak has the right to operate on lines owned by the freight railroads, capital investment in, and operation of, the Ohio Hub System must be carefully integrated with the needs of the railroads to secure their cooperation and support for the project.

A key element in this study has been a review and discussion of the freight railroads' needs with respect to infrastructure. As a result of these reviews and discussions, this Study incorporated the suggested 28-foot track separation requirement for passenger rail operation exceeding 90-mph service on heavily-used freight corridors. Further details must still be coordinated with the freight railroads to ensure sufficient capacity for existing and future freight and passenger rail service needs. The funding for the improvements needed to meet the safety standards for the passenger rail service has been incorporated in the capital cost estimates for the Ohio Hub System.

The Ohio Hub Study has attempted to resolve the issues related to the costs for track maintenance and fees for access to railroad tracks and rights-of-way. The FRA funded an in-depth analysis of potential track maintenance costs associated with high-speed rail operations and these results have been added to the operating cost estimates in this study. The study also identifies and provides a capital cost placeholder for potential land costs associated with access to tracks and rights-of-way.

10.3 Suggested Next Steps

Concurrent with continuing efforts to broaden and strengthen support for the Ohio Hub System from local, state and federal stakeholders, the business community and citizens, there is a need to advance the technical planning for the proposed system, refine the financing plan and strategies and develop institutional arrangements related to the Ohio Hub System. Additionally, it is important to secure federal/state funds for required environmental reviews and railroad coordination, preliminary engineering and design, project construction and finalizing operating plans and system implementation. Moreover, the development of innovative marketing programs will further enhance the case for the Ohio Hub System and contribute to the system's long-term success. To summarize, the short-term actions that the participating states need to take include:

- Continue coordination with the railroads;
- Obtain plan endorsement by the affected local governments;
- Obtain plan endorsement by the states and the federal government;
- Build grassroots support for the project by holding citizen participation and outreach meetings; and
- Secure federal/state/local funds for advanced project planning, development and engineering.

10.3.1 Ohio Hub Programmatic Environmental Impact Statement

The next step in project development involves the advancement of a Programmatic Environmental Impact Statement (PEIS) or a Tier 1 environmental review of the Ohio Hub rail corridors. As a result of the Ohio Hub Study, the Ohio Rail Development Commission recognizes that complex environmental, location, design, and technical issues that must be resolved before the project qualifies for potential federal funds for capital investment.

Rail system planning issues may be addressed as part of the environmental reviews and project development process under the National Environmental Policy Act (NEPA) process. Rail corridor planning and conceptual engineering, including the selection of final routes, the resolution of railroad capacity improvements, the delineation of a final implementation plan, and the decision to "build" or "don't build" will be addressed during a NEPA Tier 1 and PEIS planning and environmental review process.

While the Federal Railroad Administration has suggested that the Tier 1 PEIS be advanced to satisfy the requirements under NEPA, this could follow many of the project development steps outlined by the Ohio Department of Transportation. The intent would be to advance the Ohio Hub using a process that is similar to the Ohio Department of Transportation's 14-step project development process.

10.3.2 Analysis of Alternative Ohio Hub Routes under a Tier 1 PEIS

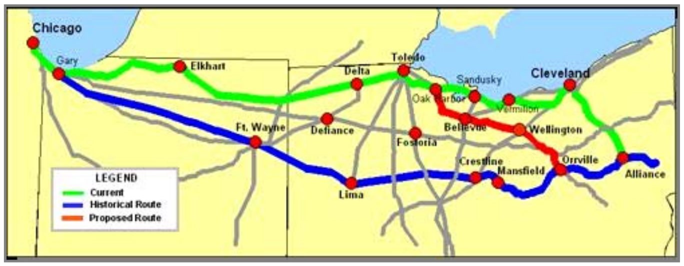
While the current Ohio Hub Study evaluated alternative options for Cleveland-Detroit and Cleveland-Pittsburgh corridors, other options should be examined to optimize the benefits of the Ohio Hub System. The advantage of advancing the PEIS process is that it will lead to a formal "Record of Decision" that is a key requirement for obtaining federal funding. Exhibits 10-2 through 10-5 show a variety of potential route and network options that are available to both passenger and freight traffic in the Ohio region.

Exhibit 10-2: Ohio Hub Network Using only NS Lines

Exhibit 10-3: Ohio Hub Network Using only CSX Lines

Exhibit 10-4: Columbus-Cleveland-Pittsburgh "Triangle"

Exhibit 10-5: Potential Orrville-Bellevue Freight Re-route



10.3.3 List of Other Areas Requiring Analysis

During the course of the Ohio Hub study, a variety of potential route options and freight rail capacity improvement projects were identified. All of these will need to be examined in more detail as part of the Ohio Hub PEIS. An initial list of route alternatives and capacity improvement projects are identified below. The following list is expected to expand as the Ohio Hub PEIS is initiated.

- Cleveland-Columbus-Dayton-Cincinnati: While the 3-C corridor has already been federally designated as one of the nation's high-speed passenger rail corridors, further analysis on route alternatives should be conducted.
  - Alternative routes through the City of Hamilton between Cincinnati and Dayton: If the CSX Indianapolis to Hamilton rail line were used to provide an Indianapolis to Columbus connection as envisioned by the parametric analysis, the 3-C corridor would probably need to use the CSX rail line through Hamilton rather than the parallel NS route through Sharonville. Adding a stop on the 3-C corridor at Hamilton may slightly lengthen the train schedules but would add a strong intermediate traffic generator, which may prove beneficial to 3-C ridership in any case. However, there is substantial freight traffic congestion today on the shared CSX/NS rail line through downtown Hamilton. To make passenger rail service to Hamilton feasible, an effective strategy would have to be developed to mitigate this congestion.
  - Mill Creek Valley Railroad Capacity: Further study of the possibility of entering Cincinnati from the east to avoid the need to operate passenger trains through the congested Mill Creek Valley.
  - 3-C Corridor Capital Costs and Railroad Specifications: As a result of railroad input into the Ohio Hub study, freight railroad authorities specifically suggested the 28-foot track separation for passenger rail services exceeding 90-mph. Since the infrastructure cost assessment for the Cleveland-Columbus-Cincinnati corridor under this specification has not been conducted, the infrastructure cost for this corridor should be re-evaluated. Freight traffic is lighter from Galion to Dayton, so with sufficient capacity improvements to either the 3-C corridor or parallel freight lines, new dedicated passenger track may not be needed everywhere.

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- Cleveland-Columbus: There are two alternative routes between Cleveland and Columbus that require some additional study:
  - Columbus-Delaware-Marion-Bucyrus-Chatfield-Greenwich, and
  - Columbus-Coshocton-Brewster-Canton-Akron-Cleveland.
  - The Canton-Akron-Cleveland alignment is part of a possible Columbus-Cleveland-Pittsburgh "triangle" as shown in Exhibit 10-3.
- Cleveland-Pittsburgh: For the Cleveland-Pittsburgh corridor, additional analysis of the following potential routes and route segments is needed:
  - The direct Erie railroad alignment from Cleveland-Warren, including the Randall Secondary and portions of the abandoned corridor between Mantua, OH and Leavittsburg, OH;
  - A new cross-country connection between Mantua and the Norfolk Southern Freedom Secondary;
  - Using the W&LE from Cleveland to Earlville would reduce the need for extensive double-tracking on the Cleveland to Ravenna segment;
  - The Ohio Central-owned portion of the Erie line between Warren and Niles;
  - The old Lake Erie and Eastern railroad corridor through the Youngstown area;
  - The CSX alignment from Akron-Youngstown that was considered in earlier studies conducted by the Ohio Rail Development Commission.
- Cleveland-Buffalo: The CSX railroad corridor between Cleveland and Buffalo is heavily used. As a result of the Ohio Hub study, it was found that the parallel Norfolk Southern route offers a potential alternative that should be evaluated as part of the next steps in project development. In addition, the need for upgrading and maintaining only one track on the NS alignment as opposed to two tracks on the CSX alignment mitigates in favor of conducting a detailed evaluation of the NS alignment.
  - Niagara Falls Border Crossing: The scope of this study did not allow for the development of a detailed concept of the border crossing at Niagara Falls. There are two existing border crossings, separated by only 500-600 feet on either side of the river, one in the U.S. and one in Canada. This frequently causes a travel time delay of one or more hours. Thus, the next phase of the Ohio Hub study should address this issue and evaluate various issues and opportunities at the border crossing. The concept of one border crossing facility in Niagara Falls should be further explored by working with US Border Guard and US Customs to determine what options may be possible. Another possibility may be to establish US Homeland Security clearance points at VIA's Toronto and Hamilton, Ontario stations. Then it may be possible to "pre-clear" US-bound passengers before boarding the train, eliminating the need to stop the train at the border.
  - In addition to Niagara Falls, the development of an additional international gateway by extending VIA Rail service to downtown Detroit is also suggested. In addition, the development of a new rail service from Detroit to Flint, Saginaw and Bay City, Michigan would be a good fit with the proposed Ohio Hub Detroit-Cleveland and Detroit-Columbus corridors.

- Columbus-Pittsburgh: For the Columbus to Pittsburgh corridor via the Panhandle, the feasibility of using all or a portion of the W&LE alignment between Bowerston, OH and Bridgeville, PA should be evaluated. Using W&LE over this segment would avoid the need to replace the abandoned segment of the Panhandle east of Steubenville. It is also recommended as part of this study to evaluate the feasibility of clearing the Columbus to Pittsburgh line via the Panhandle for double-stack freight trains, possibly for establishing a direct link from New York's on-dock Expressrail container terminals to the new Rickenbacker logistics park now under development in Columbus.
- Columbus-Indianapolis: Based on the positive results of the parametric analysis that was performed for Indiana DOT, further study of the feasibility of re-establishing a direct rail link between Columbus and Indianapolis is recommended. Study of an additional corridor that would connect Louisville, Indianapolis, Fort Wayne, Toledo and Detroit is also recommended in the context of an Indiana State Rail Plan.
- Cincinnati-Toledo: A direct Cincinnati-Toledo passenger service is suggested for future study. This service could be developed by using the I&O Railway from Springfield to Bellefontaine; then constructing a dedicated track parallel to the CSX main line from Bellefontaine to Ridgeway, finally using the CSX Scottslawn subdivision from Ridgeway to Toledo. Optionally, NS Cincinnati freight trains could also obtain trackage rights over CSX from Marion to Bellefontaine to use this same route for bypassing terminal congestion in downtown Columbus.
- Orrville Freight Rail Reroute: An evaluation of the feasibility of re-routing heavy through freight traffic away from the Cleveland area should be conducted. Particularly, an Orrville freight reroute option would facilitate Ohio Hub plans by diverting heavy NS freight away from corridors that are envisioned for upgrading for passenger rail use. Additionally, the diversion of freight trains off the Alliance to Cleveland segment via Orrville and Bellevue may improve the feasibility of using the NS Cleveland Line via Alliance for passenger service. The Orrville freight reroute is illustrated in Exhibit 10-4.
- Line Capacity and Simulation: Detailed line capacity simulation work is needed to confirm the infrastructure requirements and capital cost estimates. To date, as part of the MWRRI Study, a preliminary line capacity analysis was completed only for the Cleveland-Toledo segment, but this analysis did not include the additional train frequencies operated as part of the Ohio Hub system.
- Potential Joint Development with Commuter Rail Projects: In addition to business and leisure travelers, the study found that the Ohio Hub could also serve a significant number of commuters. The study examined the potential commuter rail market between Toledo and Detroit and found that 20 to 30 percent of the corridor ridership would include commuter traffic. A strategy for integrating Ohio Hub with proposed local public transportation services in Cleveland, Detroit, Columbus, Cincinnati and Pittsburgh should be developed.