HIGH SPEED RAIL PLANNING SERVICES

FINAL REPORT

March 2012

HNTB

GDOT

Georgia Department of Transportation

3/29/2012

Prepared for:

Georgia Department of Transportation
One Georgia Center
600 Peachtree Street NW
Atlanta, Georgia 30308
(404) 631-1226

Prepared by:

HNTB Corporation
3715 Northside Parkway
200 Northcreek, Suite 800
Atlanta, Georgia 30327
(404) 946-5700

[Page intentionally left blank]

TABLE OF CONTENTS

ATLANTA-BIRMINGHAM EXECUTIVE SUMMARY

Background and Purpose ... *ES-1*
Purpose and Objective ... *ES-2*
Corridor Description and History ... *ES-2*
Representative Route Development ... *ES-2*
Corridor Evaluation ... *ES-3*
Operating Plan ... ES-6
Ridership and Revenue ... ES-6
Capital Costs ... ES-7
Operating and Maintenance Costs ... ES-8
Corridor Evaluation ... ES-9
Operating Ratio ... ES-9
Benefit-Cost ... ES-10
Key Findings ... ES-10
Hybrid High Performance Scenario ... *ES-11*
Ridership and Revenue ... ES-12
Costs ... ES-13
Feasibility Evaluation ... ES-14
Final Conclusions ... *ES-15*

SECTION I: BACKGROUND INFORMATION AND METHODOLOGIES

1 INTRODUCTION AND BACKGROUND ... 1-1
1.1 Description/History of High-Speed Rail and Designated Corridors ... *1-1*
1.2 Technology Considerations ... *1-2*
1.2.1 Alternative 1: 90-110 mph Emerging High-Speed Rail ... 1-2
1.2.2 Alternative 2: 180-220 mph Express High-Speed Rail ... 1-2
1.2.3 Alternative 3: 220+ mph Maglev ... 1-3
2 STUDY PURPOSE AND OBJECTIVES ... 1-5
2.1 Corridor Descriptions and History ... *1-5*
2.1.1 Atlanta – Birmingham ... 1-5
2.1.2 Atlanta – Macon – Jacksonville ... 1-6
2.1.3 Atlanta – Chattanooga – Nashville – Louisville ... 1-7
2.2 Purpose and Objectives ... *1-9*
3 ASSUMPTIONS AND METHODOLOGIES ... 1-11
3.1 Corridor Alternatives Development ... *1-11*
3.1.1 Existing Conditions ... 1-11
3.1.1.1 Base Data ... 1-11
3.1.1.2 Environmental Data ... 1-12
3.1.1.3 Demographic Data ... 1-14
3.1.1.4 Existing Travel Patterns ... 1-15
3.1.2 Stakeholder Outreach ... 1-16
3.1.3 Corridor Screening and Analysis Process ... 1-18
3.1.4 Step 1: Identification of Universe of Corridor Alternatives ... 1-19
3.1.4.1 90-110 mph Shared Use ... 1-19
3.1.4.2 180-220 mph Dedicated Use ... 1-19
3.1.5 Step 2: Alternative Screening and Representative route Selection ... 1-21
3.1.5.1 90-110 mph Shared Use ... 1-21
3.1.5.2 180-220 mph Dedicated Use ... 1-22
3.1.6 Step 3: Refinement of Representative routes ... 1-22
3.1.7 Step 4: Evaluate Feasibility of Each Representative Corridor ... 1-23
3.2 Capital Cost Methodology ... *1-24*
3.2.1 FRA Standard Cost Categories (SCC) ... 1-24
3.2.2 Unit Cost Development Method ... 1-30
3.2.2.1 Quantities ... 1-31
3.2.2.2 Unit Costs ... 1-31

3.2.3 Detailed Methodologies 1-37
3.2.3.1 Shared Use and Dedicated Use Track 1-37
3.2.3.2 Track Geometry 1-47
3.2.3.3 Interstate Interchanges 1-48
3.2.3.4 At-Grade Crossings 1-50
3.2.3.5 Earthwork 1-51
3.2.3.6 Structures 1-52
3.2.3.7 Stations 1-57
3.2.3.8 Right-of-Way/Real Estate 1-59
3.2.3.9 Signaling and Communication 1-60
3.2.3.10 Cost of Vehicles 1-61
3.2.3.11 Professional Services 1-63
3.2.3.12 Contingencies 1-64
3.2.3.13 Phasing Scenarios for Capital Costs 1-64
3.3 Ridership and Revenue Methodology 1-64
3.3.1 Geographic Scope and Zoning Structure 1-65
3.3.2 Market Analysis 1-67
3.3.2.1 Inter-Urban Travel Market 1-67
3.3.2.2 Local Travel Market 1-68
3.3.2.3 Connect Air Market 1-69
3.3.3 Demand Estimation Model 1-69
3.3.3.1 Step 1: In-Scope Travel Market 1-71
3.3.3.2 Step 2: Market Future Growth 1-73
3.3.3.3 Step 3: Level of Service Characteristics 1-73
3.3.3.4 Step 4: Mode Choice 1-75
3.3.3.5 Step 5: Induced Demand 1-79
3.3.3.6 Step 6: Rail Farebox Revenue 1-81
3.4 Operating and maintenance Methodology 1-81
3.4.1 Operating plan Development 1-81
3.4.1.1 Train Service and Operating Assumptions 1-81
3.4.1.2 Potential Station Locations 1-82
3.4.1.3 Train Technology Assumptions 1-82
3.4.1.4 Other Rolling Stock and Operational Requirements 1-83
3.4.2 Operating Plan Model 1-84
3.4.2.1 Train Performance 1-84
3.4.2.2 Train Scheduling and Fleet Requirements 1-85
3.4.2.3 Train Size, Frequency and Load Factors 1-86
3.4.3 Operating and Maintenance Costs 1-86
3.4.4 Public-Private Benefit Analysis 1-90
3.4.4.1 Benefit-Cost Analysis 1-91
3.4.4.2 Estimate of Economic Benefits 1-92
3.4.4.3 User Benefits – Consumer Surplus 1-93
3.4.4.4 Non-User Benefits 1-95
3.4.4.5 Public and Private Benefit Estimations 1-98
3.4.5 Evaluation Ranges 1-98
3.4.5.1 Conservative Scenario 1-99
3.4.5.2 Intermediate Scenario 1-99
3.4.5.3 Optimistic Scenario 1-99

SECTION II: ATLANTA TO BIRMINGHAM

1 EXISTING CONDITIONS AND BACKGROUND 2-1
1.1 Evaluated Alternatives........ 2-3
1.1.1 90-110 mph Shared Use Corridors 2-3
1.1.2 180-220 mph Dedicated Use Corridors 2-6
1.2 Demographics and Socioeconomics 2-8
1.2.1 Total Population, Density, Race and Age........ 2-8
1.2.2 Employment and Employment Centers 2-12
1.2.3 Socioeconomic Characteristics - Income 2-14
1.2.4 Environmental Justice 2-17
1.3 Land Use – Urban vs. Rural........ 2-19
1.4 Travel patterns 2-21
1.4.1 Automotive Travel 2-21
1.4.2 Air Travel 2-21
1.5 Environmental Issues........ 2-22
1.5.1 Threatened and Endangered Species 2-22
1.5.2 Cultural Resources........ 2-23
1.6 Issues and Opportunities 2-24
2 STAKEHOLDER OUTREACH 2-27
3 REPRESENTATIVE ROUTES 2-31
3.1 90-110 mph Emerging High-Speed Rail (Shared Use)........ 2-31
3.1.1.1 Major Terminal Stations 2-33
3.1.1.2 Intermediate Stations 2-37
3.2 180-220 mph Express High-Speed Rail (Dedicated Use)........ 2-40
3.2.1 Proposed Stations 2-42
4 OPERATING PLAN AND SCHEDULE........ 2-43
4.1 90-110 mph Shared Use 2-43
4.1.1 Speed Profile and Timetable 2-43
4.1.2 Operating Plan........ 2-44
4.2 180-220 mph Dedicated Use 2-45
4.2.1 Speed Profile and Timetable 2-45
4.2.2 Operating Plan........ 2-46
5 RIDERSHIP AND REVENUE 2-47
5.1 Corridor Demographics........ 2-47
Existing (2010)........ 2-47
5.1.1 Future Year (2020-2035) Demographics 2-49
5.2 Market Analysis 2-53
5.2.1 The Inter-Urban Market 2-53
5.2.1.1 Automobile Travel 2-53
5.2.1.2 Bus Service........ 2-55
5.2.1.3 Direct Air Service 2-56
5.2.1.4 Rail Service........ 2-57
5.2.2 Local Travel Market 2-57
5.2.3 Connect Air Market 2-58
5.3 Forecasts........ 2-59
5.3.1 90-110 mph Shared Use Ridership and Revenue Forecasts (2021-2040)........ 2-60
5.3.2 180-220 mph Dedicated Use Ridership and Revenue Forecasts (2021-2040)........ 2-61
5.3.3 Ridership and Revenue Forecast Comparison (2021-2040) 2-62
5.4 Sensitivity Analysis........ 2-63
5.4.1 Shared Use Fare Sensitivity 2-63
5.4.2 Dedicated Use Fare Sensitivity 2-64
5.4.3 Shared and Dedicated Use Total Ridership and Revenue Summary 2-65
5.4.4 Evaluation Scenarios 2-65
5.4.4.1 Conservative Scenario Estimates 2-66
5.4.4.2 Intermediate Scenario Estimates........ 2-66
5.4.4.3 Optimistic Scenario Estimates 2-66

6 FORECASTED COSTS 2-69
6.1.1 90-110 mph Shared Use 2-69
6.1.2 180-220 mph Dedicated Use 2-76
6.1.3 Comparing Capital Costs 2-83
6.2 Operating and maintenance Costs 2-83
6.2.1 90-110 mph Shared Use 2-84
6.2.2 180-220 mph Dedicated Use 2-84
7 CORRIDOR EVALUATION 2-85
7.1 Feasibility Measurements 2-85
7.1.1 90-110 mph Shared Use 2-86
7.1.1.1 Operating Ratio 2-86
7.1.1.2 Benefit-Cost 2-86
7.1.2 180-220 mph Dedicated Use 2-87
7.1.2.1 Operating Ratio 2-87
7.1.2.2 Benefit-Cost 2-88
7.1.3 Key Findings 2-88
8 HYBRID HIGH PERFORMANCE SCENARIO 2-91
8.1 Ridership and Revenue 2-92
8.2 Costs 2-93
8.3 Feasibility Evaluation 2-94
8.4 Phasing Scenarios for Capital Costs 2-95
8.4.1 Additional Implementation Options – Commuter Rail 2-96
8.5 Conclusion 2-97

SECTION V: CONCLUSIONS AND NEXT STEPS

1 CORRIDOR COMPARISONS 5-1
1.1 Shared Use 5-1
1.2 Dedicated Use 5-2
1.3 Hybrid High Performance Scenario 5-3
1.4 Key Conclusions 5-4
2 SYSTEM INTEGRATION ANALYSIS 5-5
2.1 System Integration Analysis 5-5
3 FUNDING OPPORTUNITIES 5-9
3.1 Federal Capital Grants 5-10
3.1.1 Passenger Rail Investment and Improvement Act of 2008 (PRIIA) 5-10
3.1.2 American Recovery and Reinvestment Act of 2009 (ARRA) and Transportation Investment Generating Economic Recovery (TIGER) 5-10
3.1.3 High-Speed and Intercity Passenger Rail (HSIPR) 5-11
3.1.3.1 Service Develop Program Grants 5-11
3.1.3.2 Individual Project Grants 5-12
3.1.3.3 Planning Grants 5-13
3.1.4 Section 130 Highway-Rail Grade Crossing Improvement Program 5-14
3.1.5 Rail Line Relocation and Improvement Capital Grant Program 5-14
3.1.6 FHWA Congestion Mitigation and Air Quality 5-14
3.1.7 FHWA Surface Transportation Program 5-15
3.1.8 FHWA Transportation Enhancement Program 5-15
3.1.9 High-Speed Rail Crossing Improvement Program 5-15
3.2 Federal Financing and Loan Programs 5-16
3.2.1 Rail Rehabilitation and Improvement Financing Program (RRIF) 5-16
3.2.2 US DOT Transportation Infrastructure Finance and Innovation Act (TIFIA) 5-17
3.2.3 FHWA Grant Anticipation Revenue Vehicle Bond (GARVEE) 5-17
3.2.4 IRS Tax Exempt Private Activity Bonds (PAB) 5-18
3.3 State and Local Capital Match Funding 5-19
3.3.1 State General Fund Appropriations 5-19
3.3.2 State General Obligation and General Revenue Bonds 5-19
3.3.3 Freight Railroad Contributions 5-19

3.3.4 Transportation Equity Funds 5-20
3.3.5 Local General Fund Appropriations 5-20
3.3.6 Local Bonding 5-20
3.3.7 Value Capture Taxes 5-20
3.3.7.1 Land Value Taxes 5-21
3.3.7.2 Local Tax Incremental Financing (TIF) and Tax Allocation Districts (TAD) 5-21
3.3.7.3 Special Assessments - Community Improvement Districts (CID) 5-21
3.3.7.4 Developer Impact Fees 5-22
3.3.7.5 Air Rights 5-22
3.3.7.6 Joint Development 5-22
3.3.8 Special Purpose Local Option Sales Tax (SPLOST) 5-22
3.3.9 Specialized Local Funding Programs 5-23
3.3.9.1 Georgia Regional TSPLOST 5-23
3.3.9.2 Tennessee: Gasoline Tax for Local Transportation Funding 5-23
3.3.10 Public Private Partnerships (P3) 5-24
3.4 Funding Sources and Strategies for Operating Support 5-24
3.4.1 State Appropriations 5-24
3.4.2 Congestion Mitigation and Air Quality Funds (CMAQ) 5-24
3.4.3 FHWA Traffic Mitigation Funding 5-25
3.4.4 Revenue Maximizing Strategies 5-25
3.4.5 Operating Cost Control Strategies 5-26
3.5 Private Sector Alternatives 5-27
3.5.1 Joint Development 5-27
3.5.2 Public Private Partnerships 5-27
3.6 Funding Summary 5-28

[Page intentionally left blank]

LIST OF TABLES

TABLE 3-2: ENVIRONMENTAL DATA AND SOURCES 1-13
TABLE 3-3: DEMOGRAPHIC DATA AND SOURCES 1-14
TABLE 3-4: TRAVEL DATA AND SOURCES 1-15
TABLE 3-5: TRANSPORTATION INFRASTRUCTURE DATA AND SOURCES 1-15
TABLE 3-6: CORRIDOR STAKEHOLDERS 1-18
TABLE 3-7: LEVEL OF ACCURACY VS. PROJECT DEVELOPMENT 1-24
TABLE 3-8: FRA STANDARD COST CATEGORIES 1-25
TABLE 3-9: FRA COST ITEMS 1-25
TABLE 3-10: FRA COST ITEM EXPANSION 1-30
TABLE 3-11: SCC SUB-CATEGORY UNIT COSTS 1-32
TABLE 3-12 CURRENT CORRIDOR FREIGHT DENSITIES 1-38
TABLE 3-13: FUTURE FREIGHT DENSITY INCREASES 1-39
TABLE 3-14: EVALUATED CORRIDOR DENSITIES 1-40
TABLE 3-15: CAPACITY IMPROVEMENT METHODOLOGY 1-42
TABLE 3-16: HIGH-SPEED RAIL INTERCHANGE OPTIONS 1-48
TABLE 3-17: STRUCTURE COSTS 1-53
TABLE 3-18: UNIT COST BY STRUCTURE TYPE 1-53
TABLE 3-19: REAL ESTATE COST ITEMS 1-60
TABLE 3-20: PROFESSIONAL SERVICES PERCENTAGES 1-64
TABLE 3-21: VALUES OF TIME 1-78
TABLE 3-22: OPERATING COST CATEGORIES AND PRIMARY COST DRIVERS 1-88
TABLE 3-23: UNIT OPERATING AND MAINTENANCE COSTS 1-90
TABLE 3-24: KEY ELEMENTS OF THE BENEFIT-COST ANALYSIS 1-91
TABLE 3-25: COST PER TON OF POLLUTANT (VOC, CO, NO_x, PM10 AND SO_x) 1-96
TABLE 1-1: ATLANTA-BIRMINGHAM RACE OF STUDY AREA POPULATION 2-10
TABLE 1-2: ATLANTA-BIRMINGHAM INTERCITY AUTO TRIP TABLE (ATS 1995) 2-21
TABLE 1-3: LOCAL AIR TRIPS IN 2010 2-21
TABLE 1-4: ATLANTA-BIRMINGHAM AIR SERVICES SUMMARY 2-22
TABLE 1-5: ATLANTA-BIRMINGHAM STUDY AREA COUNTIES KNOWN ENDANGERED AND THREATENED SPECIES 2-23
TABLE 1-6: ISSUES AND OPPORTUNITIES Hπ24
TABLE 2-1: STAKEHOLDER OUTREACH MEETINGS 2-28
TABLE 3-1: ATLANTA-BIRMINGHAM SHARED USE ROUTE CHARACTERISTICS 2-31
TABLE 3-2: ATLANTA-MACON-JACKSONVILLE SHARED USE PROPOSED STATIONS 2-33
TABLE 3-3: ATLANTA-BIRMINGHAM DEDICATED USE CHARACTERISTICS 2-40
TABLE 4-1: ATLANTA-BIRMINGHAM SHARED USE SPEED AND TRAVEL TIME TABLE 2-44
TABLE 4-2: ATLANTA-BIRMINGHAM SHARED USE TRAIN FREQUENCY AND SIZE 2-44
TABLE 4-3: ATLANTA-BIRMINGHAM DEDICATED USE SPEED AND TRAVEL TIME TABLE 2-46
TABLE 4-4: ATLANTA-BIRMINGHAM DEDICATED USE TRAIN FREQUENCY AND SIZE 2-46
TABLE 5-1: HISTORICAL POPULATION TREND FOR MPO COVERAGE AREAS 2-48
TABLE 5-2: HISTORICAL EMPLOYMENT TREND FOR MPO COVERAGE AREAS 2-49
TABLE 5-3: POPULATION FORECASTS FOR MPO COVERAGE AREAS 2-51
TABLE 5-4: EMPLOYMENT FORECASTS FOR MPO COVERAGE AREAS 2-53
TABLE 5-5: ATLANTA-BIRMINGHAM SELECTED TRAFFIC COUNTS 2-53
TABLE 5-6: TRAVEL TIMES AND DISTANCES BETWEEN CITY PAIRS 2-54
TABLE 5-7: OBSERVED AUTO TRAFFIC GROWTH (IN AADT) BETWEEN 1995 AND 2010 2-54
TABLE 5-8: ATLANTA-BIRMINGHAM BUS SERVICE SUMMARY 2-55
TABLE 5-9: ATLANTA-BIRMINGHAM MAJOR AIRPORT CHARACTERISTICS 2-56

Table 5-10: Origin-Destination Air Trips by Direction (Q4 2009-Q3 2010) 2-57
Table 5-11: Air Services Summary 2-58
Table 5-12: External Factor Analyses 2-60
Table 5-13: 90-110 mph Shared Use Base Annual Ridership and Revenue (2021-2040 in 2010$) 2-61
Table 5-14: Shared Use Base 2035 Annual Station Boardings and Segment Volumes (Bi-Directional) 2-61
Table 5-15: 180-220 mph Dedicated Use Base Ridership and Revenue (2021-2040 in 2010$) 2-62
Table 5-16: Dedicated Use Base Case 2035 Annual Station Boardings and Segment Volumes (bi-directional) 2-62
Table 5-17: Fare Sensitivity for Shared Use High-Speed Rail Service (2021-2040 in 2010$) 2-64
Table 5-18: Fare Sensitivity for Dedicated Use High-Speed Rail Service 2-64
Table 5-19: Shared Use Total Ridership and Revenue Summary (2021-2040) 2-65
Table 5-20: Dedicated Use Total Ridership and Revenue Summary (2021-2040) 2-65
Table 5-21: Intermediate Scenario Annual Ridership and Revenue Estimates (2021-2040 in 2010$) 2-66
Table 5-22: Optimistic Scenario Annual Ridership and Revenue Estimates (2021-2040 in 2010$) 2-67
Table 6-1: FRA Standard Cost Categories 2-69
Table 6-2: Atlanta-Birmingham Total Shared Use Capital Cost by SCC Category (2010$) 2-70
Table 6-3: Atlanta-Birmingham Total Shared Use Capital Cost Segment One 2-71
Table 6-4: Atlanta-Birmingham Total Shared Use Capital Cost Segment Two 2-72
Table 6-5: Atlanta-Birmingham Total Shared Use Capital Cost Segment Three 2-73
Table 6-6: Atlanta-Birmingham Total Shared Use Capital Cost Segment Four 2-74
Table 6-7: Atlanta-Birmingham Total Shared Use Capital Cost Segment Five 2-75
Table 6-8: Atlanta-Birmingham Total Dedicated Use Capital Cost (2010$) 2-76
Table 6-9: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment One 2-77
Table 6-10: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Two 2-78
Table 6-11: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Three 2-79
Table 6-12: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Four 2-80
Table 6-13: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Five 2-81
Table 6-14: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Six 2-82
Table 6-15: Total Capital Cost by Route/Technology 2-83
Table 6-16: Atlanta-Birmingham Fixed and Variable Cost Categories 2-84
Table 6-17: Atlanta-Birmingham Shared Use O&M Costs (2010$ millions) 2-84
Table 6-18: Atlanta-Birmingham Dedicated Use O&M Costs (2010$ millions) 2-84
Table 7-1: Atlanta-Birmingham Shared Use Operating Ratio (2010$ millions) 2-86
Table 7-2: Atlanta-Birmingham Shared Use Benefit-Cost Analysis (2021-2050) 2-87
Table 7-3: Atlanta-Birmingham Dedicated Use Operating Ratio 2-87
Table 7-4: Atlanta-Birmingham Dedicated Use Benefit-Cost Analysis 2021-2050 2-88
Table 8-1: Atlanta-Birmingham Operations Comparison 2-92
Table 8-2: Atlanta-Birmingham Hybrid Operating Plan 2-92
Table 8-3: Atlanta-Birmingham Hybrid High Performance alternative Ridership and Revenue (in millions and 2010$) 2-93
Table 8-4: Atlanta-Birmingham Total Hybrid Capital Cost by SCC Category (2010$) 2-93
Table 8-5: Atlanta-Birmingham Hybrid O&M Costs (2010$ millions) 2-94
Table 8-6: Atlanta-Birmingham Hybrid Operating Ratio 2-95
Table 8-7: Atlanta-Birmingham Hybrid Benefit-Cost Analysis (2021-2050) 2-95
Table 1-1: Study Corridors 110 mph Diesel-Electric Shared Use Comparison 5-1
Table 1-2: Study Corridors Steel-Wheel/Maglev Dedicated Use Comparison 5-2
Table 1-3: Study Corridors Hybrid Comparison 5-3
Table 2-1: High-Speed Rail System Operating Ratios (2021-2040) 5-6
Table 2-2: High-Speed Rail System Benefit-Cost Ratios (2021-2050) 5-7

LIST OF FIGURES

FIGURE 3-2: AT-GRADE, CLOSED DRAINAGE TYPICAL SECTION 1-45
FIGURE 3-3: TRENCH/RETAINED CUT TYPICAL SECTION 1-45
FIGURE 3-4: DEDICATED TRACK WITHIN EXISTING FREIGHT CORRIDOR TYPICAL SECTION 1-46
FIGURE 3-5: HIGH-SPEED RAIL INTERCHANGE OPTION DETAILS 1-49
FIGURE 3-6: TYPICAL GRADE SEPARATIONS (OVERPASS AND UNDERPASS) 1-51
FIGURE 3-7: INTERSTATE CROSSING 1-54
FIGURE 3-8: MINOR ROADWAY 1-54
FIGURE 3-9: MAJOR WATERWAY 1-54
FIGURE 3-10: MINOR WATERWAY 1-55
FIGURE 3-11: VIADUCT GUIDEWAY 1-56
FIGURE 3-12: INTERMEDIATE STATION FOOTPRINT 1-58
FIGURE 3-13: TALGO SERIES 8 1-62
FIGURE 3-14: ALSTON AGV AND SIEMENS VELARO EMU (LEFT TO RIGHT) 1-62
FIGURE 3-15 TRANSRAPID MAGLEV 1-63
FIGURE 3-16: GEOGRAPHIC STUDY AREA 1-66
FIGURE 3-17: DEMAND ESTIMATION MODEL PROCESS 1-70
FIGURE 3-18: DIVERSION MODEL 1-76
FIGURE 3-19: EXAMPLE 110 MPH SPEED PROFILE 1-85
FIGURE 3-20: EXAMPLE SEGMENT LOADING CHART 1-86
FIGURE 3-21: ECONOMIC MEASURE OF CONSUMER SURPLUS 1-94
FIGURE 3-22: CONSUMER SURPLUS CALCULATION AS SHOWN IN THE MAGLEV DEPLOYMENT PROGRAM 1-95
FIGURE 1-1: ATLANTA-BIRMINGHAM STUDY AREA 2-2
FIGURE 1-2: ATLANTA-BIRMINGHAM SHARED USE EVALUATED ALTERNATIVES 2-5
FIGURE 1-3: ATLANTA-BIRMINGHAM DEDICATED USE EVALUATED ALTERNATIVE 2-7
FIGURE 1-4: ATLANTA-BIRMINGHAM POPULATION DENSITY 2-9
FIGURE 1-5: ATLANTA-BIRMINGHAM MINORITY POPULATIONS 2-11
FIGURE 1-6: ATLANTA-BIRMINGHAM EMPLOYMENT DENSITY 2-13
FIGURE 1-7: ATLANTA-BIRMINGHAM AVERAGE ANNUAL HOUSEHOLD INCOME 2009 2-16
FIGURE 1-8: ATLANTA-BIRMINGHAM URBANIZED AREAS 2-20
FIGURE 2-1: ATLANTA-BIRMINGHAM ISSUES AND OPPORTUNITIES 2-29
FIGURE 3-1: ATLANTA-BIRMINGHAM SHARED USE REPRESENTATIVE ROUTE AND STATIONS 2-32
FIGURE 3-2: H-JAIA STATION LOCATION 2-34
FIGURE 3-3: ATLANTA MMPT STATION LOCATION 2-35
FIGURE 3-4: BIRMINGHAM INTERMODAL TRANSPORTATION FACILITY 2-36
FIGURE 3-5: DOUGLASVILLE INTERMEDIATE STATION 2-38
FIGURE 3-6: ANNISTON INTERMEDIATE STATION 2-39
FIGURE 3-7: ATLANTA-BIRMINGHAM DEDICATED USE REPRESENTATIVE ROUTE AND STATIONS 2-41
FIGURE 3-8: ANNISTON, AL DEDICATED USE STATION LOCATION 2-42
FIGURE 4-1: ATLANTA-BIRMINGHAM SHARED USE SPEED PROFILE 2-43
FIGURE 4-2: ATLANTA-BIRMINGHAM DEDICATED USE SPEED PROFILE 2-45
FIGURE 5-1: ATLANTA-BIRMINGHAM BASE YEAR (2010) POPULATION MAP 2-47
FIGURE 5-2: ATLANTA-BIRMINGHAM BASE YEAR (2010) EMPLOYMENT MAP 2-48
FIGURE 5-3: ATLANTA-BIRMINGHAM 2020 POPULATION 2-49
FIGURE 5-4: ATLANTA-BIRMINGHAM 2035 POPULATION 2-50
FIGURE 5-5: ATLANTA-BIRMINGHAM 2020-2035 POPULATION GROWTH 2-50
FIGURE 5-6: ATLANTA-BIRMINGHAM 2020 EMPLOYMENT 2-51
FIGURE 5-7: ATLANTA-BIRMINGHAM 2035 EMPLOYMENT 2-52
FIGURE 5-8: ATLANTA-BIRMINGHAM 2020-2035 EMPLOYMENT GROWTH 2-52

Figure 5-9: Atlanta-Birmingham Observed Auto Traffic (in AADT) in 1995 and 2010 2-55
Figure 5-10: Atlanta-Birmingham Corridor Total Ridership and Revenue Forecasts (2021-2040 in 2010$) 2-63
Figure 6-1: Atlanta-Birmingham Shared Use Segment One 2-71
Figure 6-2: Atlanta-Birmingham Shared Use Segment Two 2-72
Figure 6-3: Atlanta-Birmingham Shared Use Segment Three 2-73
Figure 6-4: Atlanta-Birmingham Shared Use Segment Four 2-74
Figure 6-5: Atlanta-Birmingham Shared Use Segment Five 2-75
Figure 6-6: Atlanta-Birmingham Dedicated Use Segment One 2-77
Figure 6-7: Atlanta-Birmingham Dedicated Use Segment Two 2-78
Figure 6-8: Atlanta-Birmingham Dedicated Use Segment Three 2-79
Figure 6-9: Atlanta-Birmingham Dedicated Use Segment Four 2-80
Figure 6-10: Atlanta-Birmingham Dedicated Use Segment Five 2-81
Figure 6-11: Atlanta-Birmingham Dedicated Use Segment Six 2-82
Figure 6-12: Total Capital Cost by Technology 2-83

GLOSSARY OF TERMS

AADT –Annual Average Daily Traffic

ABS –Automatic Block Signals

ACS – American Community Survey

ADECA – Alabama Department of Economic and Community Affairs

ALDOT – Alabama Department of Transportation

ARC – Atlanta Regional Commission

AREMA – American Railway Engineers and Maintenance Association

ARRA – American Recovery and Reinvestment Act

ATS – American Travel Survey

BJCTA – Birmingham Jefferson County Transit Authority

BPR – Bureau of Public Roads

BRT – Bus Rapid Transit

BTS – Bureau of Transportation Statistics

CCI –Construction Cost Index

CE – Categorical Exclusion\

CHRPA – Chattanooga-Hamilton County Regional Planning Agency

CID – Community Improvement District

CMAQ – Congestion and Mitigation Air Quality Program

CORE MPO – Chamber County-Savannah Metropolitan Planning Committee

CTC – Centralized Traffic Control

DB1B – Airline Origin and Destination Survey

DCA – Department of Community Affairs

DNR – Department of Natural Resources

EARPC –East Alabama Regional Planning Commission

EIS – Environmental Impact Study

EJ – Environmental Justice

EMU – Electric Multiple Units

FAA – Federal Aviation Administration

FD – Final Design

FRA – Federal Rail Administration

FTA – Federal Transit Authority

FWHA – Federal Highway Administration

GARVEE – Grant Anticipation Revenue Vehicle Bond

GDOT – Georgia Department of Transportation

GIS – Geographic Information System

GNAHRGIS – Georgia's natural Archaeological and Historical Resources GIS

GO – General Obligation

GPA – Georgia Ports Authority

GRPA – Georgia Regional Passenger Authority

H-JAIA – Hartsfield-Jackson Atlanta International Airport

HSGT – High Speed Ground Transportation

HSIPR – High Speed and Intercity Passenger Rail

JTA – Jacksonville Transit Authority

KRPDA – Kentuckiana Regional Planning and Development Agency

KYTC – Kentucky Transportation Cabinet

LOS – Level of Service

Maglev – Magnetic Levitation

MBPZ - Macon-Bibb Planning and Zoning

MHSRC –Midwest High Speed Rail Coalition

MMPT – Multi-Modal Passenger Terminal

MPO – Metropolitan Planning Organization

MSA – Metropolitan Statistical Area

MWRRS – Midwest Regional Rail System

NEPA – National Environmental Policy Act

NHRP – National Register of Historic Places

NIST – National Institute of Standards and Technology

NNEPRA – Northern New England Passenger Rail Authority

NPV – Net Percent Value

NS – Norfolk Southern

OBS – On Board Service

OMB – Office of Management and Budget

P3 – Public Private Partnerships

PRIIA – Passenger Rail Investment and Improvement Act of 2008

PTC – Positive Train Control

RPCGB – Regional Planning Commission of Greater Birmingham

RRIF – Railroad Rehabilitation and Improvement Financing Program

SAFETEA-LU – Safe Automobile Flexible Efficient Transportation Equity Act: A Legacy for Users

SCC – Standard Cost Categories

SDP – Service Development Programs

SEHSR – Southeast High Speed Rail

SMART – Suburban Mobility Authority for Regional Transportation

SPLOST – Special Purpose Local Option Sales Tax

STP – Surface Transportation Program

TAD – Tax Allocation Districts

TDOT – Tennessee Department of Transportation

TEA-21 – Transportation Equity Act for the 21st Century of 1998

TIF – Tax Incremental Financing

TIGER – Transportation Investment Generating Economic Recovery

TIFIA – Transportation Infrastructure Finance and Innovation Act

TMP – Transportation Management Plan

TPO – Transportation Planning Organization

TRB – Transportation Research Board

TSPLOST – Transportation Special Purpose Local Option Sales Tax

TTI – Texas Transportation Institute

TWC –Track Warranted Control

UGA – University of Georgia, Athens

UIC – International Union of Railways

US FWS – United States Fish and Wildlife Services

US DOT – United States Department of Transportation

VMT – Vehicle Miles Traveled

ATLANTA-BIRMINGHAM EXECUTIVE SUMMARY

BACKGROUND AND PURPOSE

The purpose of this High Speed Rail Planning Study is to evaluate the feasibility of high-speed rail for three corridors in the southeastern United States. The corridors are as follows:

- Atlanta, GA to Birmingham, AL;
- Atlanta, GA to Macon, GA to Jacksonville, FL; and
- Atlanta, GA to Chattanooga, TN to Nashville, TN to Louisville, KY.

The feasibility of implementing and operating high-speed and intercity passenger rail was examined within each corridor for Emerging High-Speed Rail (90-110 mph) and Express High-Speed Rail (180-220 mph) in all three corridors; and Maglev (220+ mph) in the Atlanta-Chattanooga-Nashville-Louisville corridor.

A representative route was elected for each corridor for both Emerging High-Speed Rail (Shared Use) with speeds up to 90-110 mph, and Express High-Speed Rail (Dedicated Use) with speeds up to 150-220 mph. Additionally, Maglev technology was included in the Atlanta-Chattanooga-Nashville-Louisville Corridor. It should be noted that the representative routes are not preferred or recommended alternatives, but are presented as an example of an alternative to develop reasonable estimates for each corridors' high-speed rail performance. Each representative route may have a variety of specific alignments that will be analyzed through the NEPA process, should the route be selected for future analysis.

Emerging High-Speed Rail generally involves utilizing an existing rail corridor owned and operated by a freight railroad. This type of service is also commonly called "Shared Use". Diesel-electric Tilt Train Technology is proposed for Shared Use corridors due to curvature and topography on these routes and typically achieves top speeds of 90-110 mph.

Express High-Speed Rail achieves top speeds from 180 to 220 mph on completely grade-separated, electrified, dedicated track (with the possible exception of some shared right-of-way in terminal areas). Express High-Speed Rail intends to relieve air and highway capacity constraints. In this report, Express High-Speed Rail is referred to as "Dedicated Use".

Magnetic Levitation, abbreviated as Maglev, was only considered along the Atlanta-Chattanooga-Nashville-Louisville corridor, per special permission from the Federal

Railroad Administration (FRA). Maglev is an advanced train technology in which magnetic force lifts, propels, and guides a vehicle over a Guideway. Maglev permits cruising speeds between 250 and 300 mph. This alternative also involves establishing a new passenger rail corridor, designated solely to high-speed passenger rail service.

PURPOSE AND OBJECTIVE

The overall purpose of this study is to determine the relative feasibility of each corridor with regards to capital costs, funding and financing opportunities, operation and maintenance costs, ridership and revenue, operating ratios and benefit-cost analysis. Each corridor is studied independently of one another, and the feasibility of each corridor is dependent upon the potential benefits anticipated from investment in transportation between the major cities and along each of the corridors.

CORRIDOR DESCRIPTION AND HISTORY

The Atlanta-Birmingham corridor extends from the Hartsfield-Jackson Atlanta International Airport (H-JAIA) to the proposed downtown Atlanta Multi Modal Passenger Terminal (MMPT) and onto downtown Birmingham, AL. This particular rail corridor was included in the 1997 *High-Speed Ground Transportation for America* report and is one of the 11 federally-designated high-speed rail corridors.

Georgia Department of Transportation (GDOT), in partnership with the Regional Planning Commission of Greater Birmingham (RPCGB) analyzed this route segment as a part of this feasibility study as a connection between the Gulf Coast High-Speed Rail Corridor (New Orleans-Birmingham-Atlanta) and the Southeast High-Speed Rail Corridor (Atlanta-Charlotte-Raleigh-Washington D.C.).

There are two major multi-modal projects underway in Atlanta and Birmingham that support the potential need for high-speed rail service between the two cities. In Atlanta, the Atlanta MMPT is proposed to be located in downtown Atlanta. In Birmingham, the Birmingham-Jefferson County Transit Authority (BJCTA) is designing a new multi-modal center adjacent to the existing Amtrak station that will accommodate rail, bus, and taxi services.

REPRESENTATIVE ROUTE DEVELOPMENT

One of the first steps for this feasibility study was to identify representative corridor routes for each study corridor. Once the representative routes were established, capital costs, forecast ridership, revenues, operating costs, operating ratio, benefit-cost ratio and other comparative factors were calculated.

A high-level screening analysis was applied to the Atlanta-Birmingham corridor to identify a representative route for each technology for further evaluation.

Representative routes were identified for: 1) 90-110 mph Emerging High-Speed Rail (Shared Use) on a shared-use freight corridor; and 2) 180-220 mph Express High-Speed Rail (Dedicated Use) on a dedicated, fully grade-separated corridor. The screening and analysis methodology employed to identify a representative route for each operating technology consisted of four steps:

1. Identify the initial universe of route alternatives for each operating technology based on identifying those routes which provide basic connectivity for each of the major city pairs;
2. Screen the initial universe of route alternatives using both quantitative and qualitative factors to identify a representative route for each technology. Representative routes were chosen primarily based on the following quantitative and qualitative factors to deliver the highest level of service with the least public and environmental cost:
    - Route alternative geometry and travel time,
    - Route alternative freight traffic density (for Shared Use routes),
    - Stakeholder knowledge and input on route alternative issues and opportunities, and
    - Intermodal connectivity through potential stations.

   These routes contain several alignment alternatives that would be further analyzed through the NEPA process, should the corridors pass the feasibility threshold;
3. Further refine representative route alignments based upon a more detailed analysis including: service goals including travel time, station location and accessibility, operating feasibility, engineering feasibility, and cost factors; and
4. Evaluate each representative route in terms of its feasibility with regard to capital costs, forecast ridership, revenues, operating costs, operating ratio, benefit-cost ratio and other comparative factors.

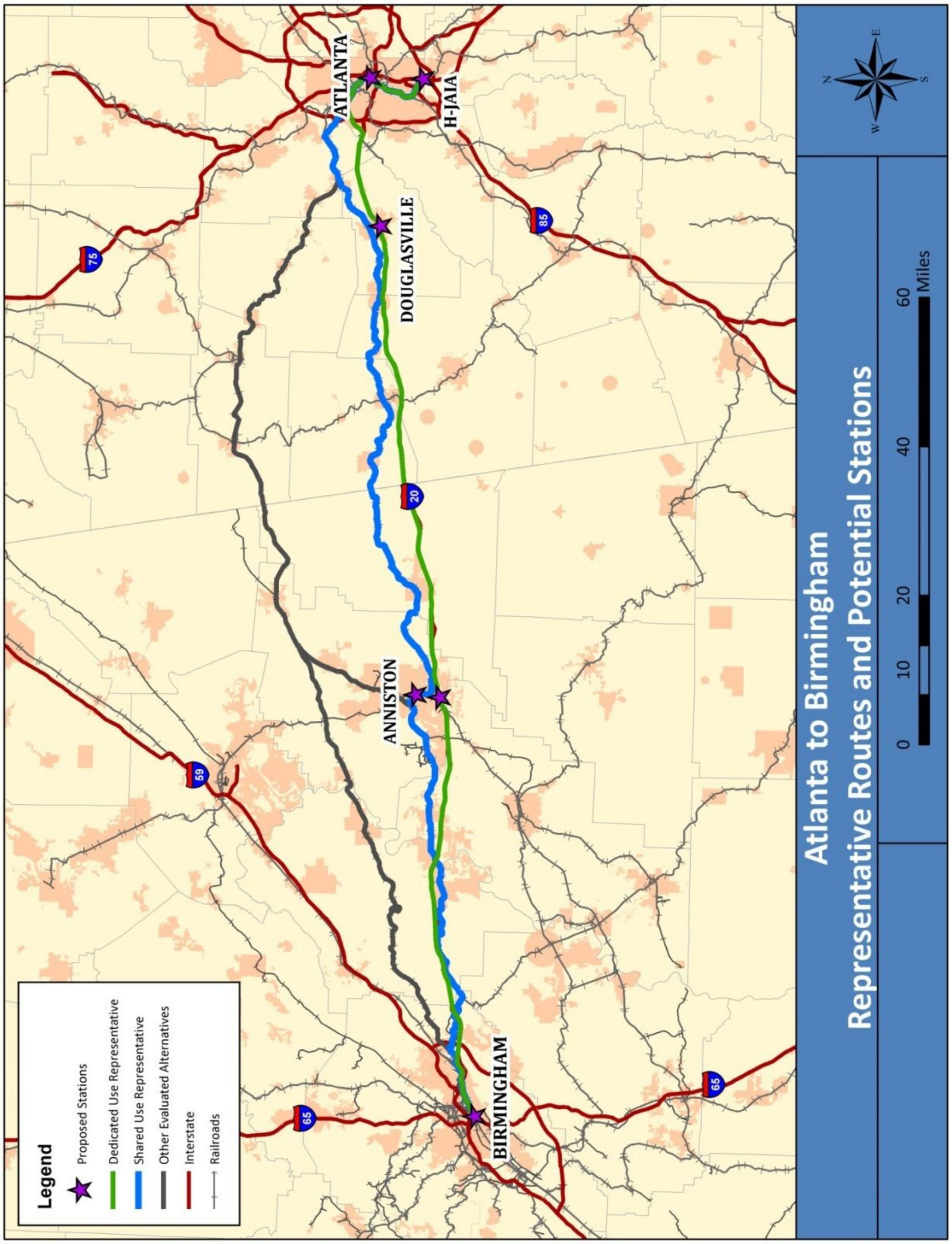
CORRIDOR EVALUATION

The Atlanta-Birmingham Corridor is the shortest of the three study corridors and connects Atlanta, GA and Birmingham, AL. Representative routes for 90-110 mph Shared Use and 180-220 mph Dedicated Use corridor operations were identified based on a technical and stakeholder review of the corridor. The selected routes are shown in Figure 1 on page ES-4, along with alternatives that were reviewed.

The Shared Use route follows the NS and Amtrak Crescent corridor, with potential stations at H-JAIA, Atlanta MMPT, Douglasville, GA, Anniston, AL and downtown Birmingham. The Dedicated Use route follows, primarily, the I-20 interstate corridor and transitions to freight route (utilizing freight right-of-way, but on separate tracks) entering and exiting Atlanta and Birmingham. The Dedicated Use route uses the same stations as Shared Use, with the exception of moving the

Anniston station southward 3.2 miles in order to intersect with the Dedicated Use route (illustrated in Figure 1).

Figure 1: Atlanta-Birmingham Representative Routes and Stations



Operating Plan

Operating plans and schedules were developed for the Shared Use and Dedicated use routes. The Atlanta-Birmingham Corridor Shared Use route will have an average speed of 64 mph and will take approximately 2 hours and 46 minutes to travel the corridor, 20 minutes slower than average auto travel time using the Interstate highway. Although diesel-electric equipment technology can provide top speeds of 110 mph, curves and station stops reduce average speeds. The Dedicated Use 180-220 mph route will have an average speed of 117 mph and will take 1 hour and 18 minutes to travel the 151 mile corridor, a 1 hour and 8 minute travel time savings over auto travel. The frequencies were established to create a balance between ridership and operating and maintenance costs.

Table 1: Atlanta-Birmingham Operating Plans

	Shared Use	Dedicated Use
Rail Distance (miles)	176.0	150.7
Travel Time (hr : min)	2:46	1:18
Average Speed (mph)	64	117
Frequency (round trips per day)	6	10
Estimated Auto Time (hr : min)	2:26	2:26
Travel Time – Auto Time	+0:20	-1:08

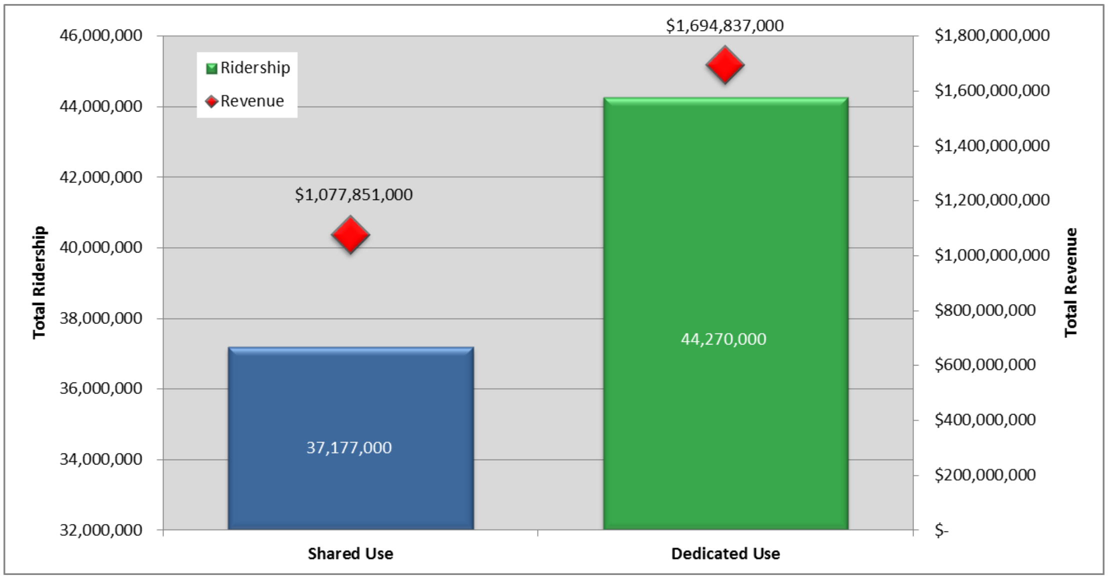
Ridership and Revenue

The study developed the annual ridership and revenue forecasts for both the Shared Use and Dedicated Use routes. The ridership and revenue analysis demonstrated that lower fare structures produce higher ridership levels, but generate lower revenues. Therefore, in order to optimize and balance ridership, revenue, and overall transportation system benefits (consumer surplus) study concluded that the $0.28/mile fare structure for Shared Use and $0.40/mile for Dedicated Use resulted in the optimum balance. Table 4 and Figure 2 illustrate ridership and revenue for years 2021, 2030 and 2040 as well as total ridership and revenue (2021-2040) for the two representative routes. The table and graph show that an increase in level of service and higher travel speeds associated with the 220 mph Dedicated Use corridor service results in an increase in both ridership and revenue for the corridor. The graph also indicates that while ridership may not increase substantially between Shared Use and Dedicated Use technologies, the higher fare used results in a significant increase in the overall revenue.

Table 2: Atlanta-Birmingham Total Ridership and Revenue (2021-2040 in 2010$)

	Shared Use		Dedicated Use	
	Ridership	Revenue	Ridership	Revenue
2021	1,613,000	$46,054,000	1,946,000	$72,791,000
2030	1,847,000	$53,480,000	2,199,000	$84,113,000
2040	2,087,000	$61,731,000	2,481,000	$96,693,000
Total	**37,177,000**	**$1,077,851,000**	**44,270,000**	**$1,694,837,000**

Figure 2: Atlanta-Birmingham Total Ridership and Revenue (2021-2040 in 2010$)



Capital Costs

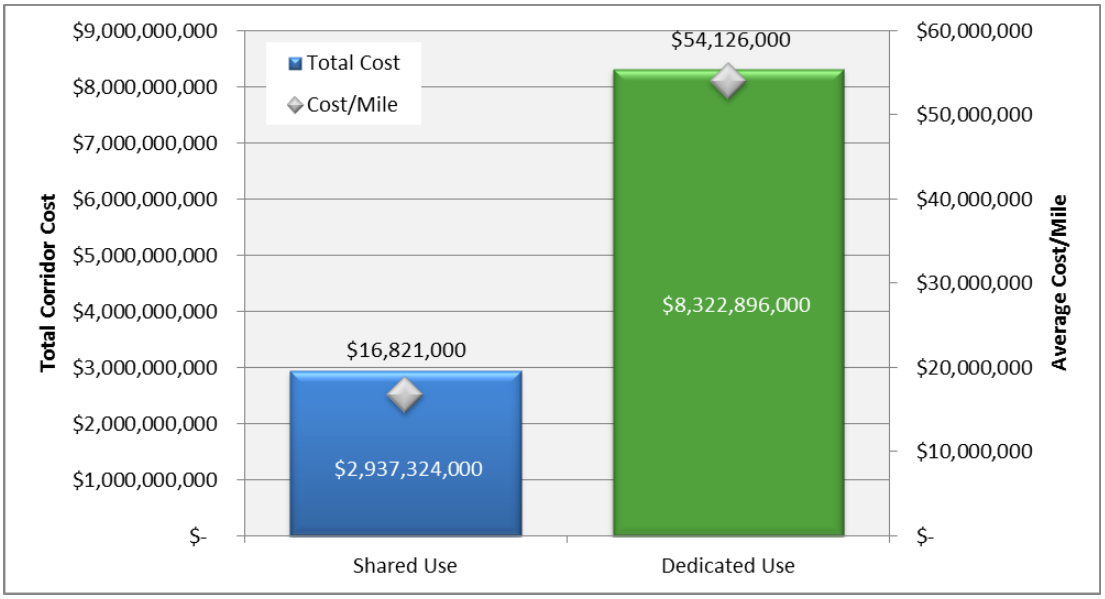
The Atlanta-Birmingham Corridor has the least expensive capital costs of the three corridors. This is primarily due to the short length of the corridor, but may also be partially attributed to the topography and geometry of the track along the corridor.

Table 5 and Figure 3 outline the total capital costs and costs per mile for Shared Use and Dedicated Use routes. The high Dedicated Use costs are mostly associated with the electrification of the track, comprising about 25 percent of the total capital cost and a significant portion of the operations and maintenance costs as well.

Table 3: Atlanta-Birmingham Total Capital Costs (2010$)

	Shared Use	Dedicated Use
Total Cost	$2,937,324,000	$8,322,896,000
Cost per Mile	$16,821,000	$54,126,000

Figure 3: Atlanta-Birmingham Total Capital Costs (2010$)



Operating and Maintenance Costs

Table 6 shows a breakdown of variable and fixed costing categories used to calculate total operating and maintenance costs. Table 7 illustrates the operating and maintenance costs for 2021, 2030 and 2040 as well as total costs (2021-2040). Total Shared Use operating and maintenance costs equate to approximately $930.3 million compared to the Dedicated Use estimate of $1.7 billion for the same time period.

Table 4: Fixed and Variable Operating and Maintenance Categories

Variable Costs
Train Crew
On-Board Services
Equipment Maintenance
Fuel or Energy
Insurance
Call Center
Credit Car + Travel Agency Commissions
Fixed Costs
Stations
Track and Electrification Maintenance
Administration and Management

Table 5: Atlanta-Birmingham Total Operating and Maintenance Costs (2021-2040 in $ millions and 2010$)

	Shared Use			Dedicated Use		
	Variable	Fixed	Total	Variable	Fixed	Total
2021	$20.9	$22.5	$43.4	$35.0	$44.4	$79.4
2030	$21.8	$22.5	$44.3	$36.6	$44.4	$81.0
2040	$22.7	$22.5	$45.2	$38.1	$44.4	$82.5
Total	**$457.8**	**$472.5**	**$930.3**	**$767.9**	**$932.4**	**$1,700**

CORRIDOR EVALUATION

High-speed rail service in the Atlanta-Birmingham Corridor was evaluated by using both operating ratios and benefit-cost analyses. The study evaluated three scenarios, Conservative, Intermediate and Optimistic, to show the impact of a range of ridership, revenue, capital and operating cost estimates typically encountered in a feasibility-level analysis. Unadjusted base forecasts for ridership, revenue, capital and operating costs were used for the Conservative scenario. Base ridership and revenue estimates were increased for Dedicated Use corridors to establish the Intermediate and Optimistic scenarios.[1] Operating costs were adjusted by the appropriate ridership drivers. Capital cost estimates were adjusted downward in the Intermediate and Optimistic scenarios for all technologies.

Operating Ratio

Both the 90-110 mph Shared use and 180-220 mph Dedicated Use representative routes performed well under each of the three sensitivity scenarios, all operating above a 1.0 ratio as outlined in Table 8. It is notable that significant operating revenue surpluses are shown for both technologies during the first year of operation in 2021 using even the most conservative ridership and revenue forecasts. The revenue surpluses then steadily increase over the 20-year planning period to 2040. This provides a strong incentive for potential private sector investors and operators.

---

[1] Ridership adjustments for Intermediate and Optimistic Scenarios were only made for Dedicated Use corridor 180-220 mph electrified, steel-wheel and Maglev technologies (Maglev in Atlanta-Louisville corridor only) based on a peer review of regional and national high-speed rail corridor studies. No scenario ridership adjustment was made for Shared Use corridor diesel-electric technology results based on a peer review of other shared-use corridor studies.

HNTB

Table 6: Atlanta-Birmingham Operating Ratios (2021-2050)

	Conservative	Intermediate	Optimistic
Shared Use[2]			
2021	1.15	1.15	1.15
2030	1.32	1.32	1.32
2040	1.49	1.49	1.49
Dedicated Use			
2021	1.10	1.72	1.87
2030	1.25	1.86	2.00
2040	1.41	2.00	2.12

Benefit-Cost

Similar to operating ratios, the study evaluated the benefit-cost ratio for the two representative routes and all three sensitivity scenarios. The results in Table 9 show that the Shared Use route alternative does not demonstrate a benefit-cost ratio over 1.0 for any of the sensitivity scenarios and Dedicated Use route alternative produces a benefit-cost ratio above 1.0 for the Optimistic scenario.

Table 7: Atlanta-Birmingham Benefit-Cost Ratios (2021-2050)

	Conservative	Intermediate	Optimistic
Shared Use	0.80	0.88	0.95
Dedicated Use	0.48	0.92	1.13

KEY FINDINGS

The Shared Use and Dedicated Use alternatives perform well under the operating ratio analysis, resulting in ratios well above 1.0 for all three scenarios. This indicates strong operations with lower associated risks to owners and operators. Positive operating ratios indicate an ability to pay down debt services and bonds, and can lead to reduced reliability on public investment subsidies. Additionally, operating surpluses on an annual basis may finance a "rail maintenance fund", requiring less

[2] Shared Use operating ratios did not vary between the three sensitivity levels because the same "Conservative Scenario" base case ridership and revenue forecasts were used for each of the scenarios. No scenario ridership adjustment was made for Shared Use corridor diesel-electric technology results based on a peer review of other shared-use corridor studies.

investment in future years for capital maintenance costs. Positive operating ratios will likely spark private sector investment interest in the corridor, providing additional funding opportunities.

The Dedicated Use route using 180-220 mph electrified, steel-wheel technology shows a benefit-cost ratio of 1.13 for the Optimistic scenario. None of the Shared Use route scenarios show a benefit-cost ratio greater than 1.0.

It should be noted that this feasibility study includes very high-level data and estimates. A more detailed corridor analysis with more definitive study boundaries, travel demand models, and cost estimates, could yield a better benefit-cost evaluation, narrowing the range of estimates.

Taking into account both the operating ratios and benefit-cost ratio and benefit-cost analysis, the study recommends that the results of this analysis be used to set priorities for future state planning and corridor development activities In particular, this study finds that high speed rail service is feasible in the Atlanta-Birmingham Corridor.

Hybrid High Performance Scenario

One of the results from the Shared Use and Dedicated Use analyses was the introduction of a "hybrid" alternative to offset a portion of the initial capital costs (compared to the Dedicated Use) while improving the travel speeds (compared to the Shared Use), thus positively impacting the operating ratio and benefit-cost analysis. While some analyses were completed for the Hybrid High Performance scenario, there was insufficient data available for a full analysis to be completed. Therefore, more performance and financial details regarding the Hybrid High Performance scenario will need to be explored through the NEPA process. This feasibility study intends to introduce the concept of the Hybrid High Performance scenario and provide a high-level feasibility estimates based on the results found during the Shared Use and Dedicated Use analyses. These estimates include:

- Operational estimates;
- Ridership and revenue;
- Capital Costs; and
- Operating and Maintenance Costs.

From these estimates, the study calculates the high-level operating ratio and Benefit-Cost ratio to compare against the previously identified Shared Use and Dedicated Use ratios to determine if the Hybrid High Performance scenario should be included in a future NEPA analysis.

The study developed a Hybrid High Performance scenario that provides a level of service between Shared Use and Dedicated Use, utilizing fully grade-separated track geometry with no shared-use freight operations. However, rather than electrified high-speed technology, the Hybrid High Performance scenario would implement Diesel-Electric Tilt Technology initially, and when ridership and revenue increase in later operating years, it can be upgraded to a fully-electrified system, obtaining travel speeds of 220 mph or more.

One of the main benefits of the Hybrid High Performance scenario includes significantly lower capital costs compared to the 180-220 mph electrified technology assumed for the Dedicated Use route. However, the Hybrid High Performance scenario still has the potential to reach speeds of up to 130 mph. The study estimated that the Hybrid High Performance scenario would only take approximately 22 minutes longer than the electrified train on the Dedicated Use route. The 130 mph Hybrid High Performance scenario is approximately 1 hour, 16 minutes faster than auto travel by interstate from Atlanta to Birmingham (Table 10).

Table 8: Atlanta-Birmingham Hybrid High Performance Operations

Segment	Shared Use	Dedicated Use	Hybrid High Performance
Rail Distance (miles)	176.0	150.7	150.7
Travel Time (hr : min)	2:46	1:18	1:40
Average Speed (mph)	64	117	90
Frequency (round trips/day)	6	10	10
Estimated Auto Time (hr : min)	2:56	2:56	2:56
Travel Time – Auto Time	+0:10	-1:38	-1:16

Ridership and Revenue

The study estimated based on the decrease in average speed and increase in corridor travel time, the revenue for the Hybrid High Performance scenario would decrease 7.3 percent from the Dedicated Use forecasts (refer to Appendix G). Table 11 shows the estimated ridership and revenue for the Hybrid High Performance scenario for 2021, 2030, and 2040 as well as a total ridership and revenue (2021-2040) as compared to Dedicated Use forecasts.

Table 9: Atlanta-Birmingham Hybrid High Performance Ridership and Revenue (2021-2040 in 2010$)

	Hybrid High Performance		Dedicated Use	
	Ridership	Revenue	Ridership	Revenue
2021	1,805,000	$67,484,000	1,946,000	$72,791,000
2030	2,039,000	$77,981,000	2,199,000	$84,113,000
2040	2,300,000	$89,644,000	2,481,000	$96,693,000
Total	**41,043,000**	**$1,571,284,000**	**44,270,000**	**$1,684,837,000**

Costs

As previously mentioned, the capital costs, operating costs, and maintenance costs for the Hybrid High Performance scenario will be significantly less than the Dedicated Use route due to the elimination of the track electrification. This also results in decreased in vehicle cost since diesel vehicles are also less expensive than fully electrified vehicles.

Table 12 outlines the Hybrid High Performance scenario capital cost estimates compared to the Dedicated Use technology. Capital costs for the 130 mph Hybrid High Performance scenario are almost two-thirds (2/3) of those for the 180-220 mph electrified steel-wheel technology.

Table 10: Atlanta-Birmingham Hybrid High Performance Rail Capital Costs (2010$)

	Hybrid High Performance	Dedicated Use
Total Cost	$5,455,325,000	$8,322,897,000
Cost per Mile	$35,477,000	$54,399,000

Operating and maintenance costs for the Hybrid High Performance scenario will also be reduced from the Dedicated Use estimates due to less required track inspection and maintenance because heavy freight trains will not be sharing the track. Table 13 illustrates the estimates the Hybrid High Performance scenario operating and maintenance costs for 2021, 2030 and 2040 as well as total operating and maintenance costs (2021-2040) compared to the Dedicated Use route.

Table 11: Atlanta-Birmingham Hybrid High Performance Scenario Operating and Maintenance Costs (2021-2040 in $ millions and 2010$)

	Hybrid High Performance Rail			Dedicated Use		
	Variable	Fixed	Total	Variable	Fixed	Total
2021	$34.4	$31.8	$66.2	$35.0	$44.4	$79.4
2030	$35.8	$31.8	$67.6	$36.6	$44.4	$81.0
2040	$37.2	$31.8	$69.0	$38.1	$44.4	$82.2
Total	**$751.8**	**$667.8**	**$1,420**	**$767.9**	**$932.4**	**$1,700**

__Feasibility Evaluation__

Similar to the Shared Use and Dedicated Use routes, the study developed an operating ratio and benefit-cost ratio for the Hybrid Performance alternative. Table 14 and Table 15 illustrate the results of these analyses for the three sensitivity scenarios: Conservative, Intermediate and Optimistic as compared to the Dedicated Use route.

Table 12: Atlanta-Birmingham Hybrid High Performance Scenario Operating Ratio

	Conservative	Intermediate	Optimistic
Hybrid High Performance			
2021	1.18	1.85	2.02
2030	1.34	2.00	2.14
2040	1.51	2.13	2.26
Dedicated Use			
2021	1.10	1.72	1.87
2030	1.25	1.86	2.00
2040	1.41	2.00	2.12

Table 13: Atlanta-Birmingham Hybrid High Performance Scenario Benefit-Cost Ratio (2021-2050)

	Conservative	Intermediate	Optimistic
Hybrid High Performance	0.72	1.28	1.62
Dedicated Use	0.48	0.92	1.13

Initial investigation into the Hybrid High Performance scenario indicates that an incremental approach to high-speed rail may provide significant advantages in the Atlanta-Birmingham Corridor both in terms of reducing initial capital cost requirement and increasing benefit-cost ratios.

The study used high-level estimates for revenue and costs associated with the Hybrid High Performance scenario. Therefore, a more detailed analysis of this alternative is needed to make definitive conclusions regarding the feasibility of the Hybrid High Performance scenario. The study recommends that the Hybrid High Performance scenario be included in the next phase of the passenger rail planning analysis as a viable technology alternative for passenger rail within the Atlanta-Birmingham Corridor.

FINAL CONCLUSIONS

High-speed rail service in the Atlanta-Birmingham Corridor presents an opportunity to provide needed transportation solutions and promotes economic development. While high-speed rail is not the only transportation solution, this study gives evidence that passenger high-speed rail will provide added mobility and transportation choices to consumers. High-speed rail can provide more efficient and cost-effective means to consumers, providing added connectivity to major cities such as Atlanta and Birmingham through commercial centers and national/international destinations.

This study illustrates that although the initial investment in high-speed rail is significant, the mobility and economic opportunities offered by this new mode are also significant. Based on the analysis findings, this study determines that high-speed rail is feasible in the Atlanta-Birmingham Corridor. It is further recommended that a Tier 1 NEPA Document and Service Development Plan be pursued for high-speed rail service within the corridor. This analysis should continue to address a range of technology alternatives including the Hybrid High Performance implementation approach.

SECTION I:

BACKGROUND INFORMATION AND METHODOLOGIES

Section I: Background Information and Methodologies

1 Introduction and Background

1.1 Description/History of High-Speed Rail and Designated Corridors

The U.S. Department of Transportation (DOT), in conjunction with the Transportation Research Board (TRB) has undertaken research that indicates that high-speed ground transportation (HSGT) systems, including high-speed rail, could be a competitive alternative to highway and domestic air travel in high-density travel markets and corridors in the United State, including the Boston to New York, New York to Washington and San Francisco to Los Angeles corridor. TRB Special Report 233, *In Pursuit of Speed, New Options for Intercity Passenger Transport*, concludes that "HSGT systems could be an effective alternative in corridors where travel demand is increasing but expanding capacity to reduce highway and airport congestion and delays is very difficult."

The Federal Railroad Administration (FRA) also completed a study of the potential for HSGT systems, drawing similar conclusions to the TRB. In its 1997 study *High-Speed Ground Transportation for America*, (commonly referred to as the Commercial Feasibility Study or CFS) the FRA estimated the total costs and benefits if implementing a range of HSGT systems from incremental high-speed rail with top speeds of 90 to 150 mph ("IHSR," termed "Accelerail" in the 1997 report) to new high-speed rail (with 175-200 mph top speeds) and maglev (up to 300 mph) in 11 illustrative corridors. The study identified the potential for diverted trips to competitive high-speed rail and ground transportation services, especially for trips between 100 and 600 miles. The study found that HSGT's total benefits exceed total costs in many of the illustrative corridors.

The purpose of this High Speed Rail Planning Study is to evaluate the feasibility of high-speed rail for three corridors in the southeastern United States. The corridors are as follows:

- Atlanta, GA to Birmingham, AL;
- Atlanta, GA to Macon, GA to Jacksonville, FL; and
- Atlanta, GA to Chattanooga, TN to Nashville, TN to Louisville, KY.

The feasibility of implementing and operating high-speed and intercity passenger rail was examined within each corridor for Emerging High-Speed Rail (90-110 mph); Express High-Speed Rail (180-220 mph) in all three corridors; and Maglev (220+ mph) in the Atlanta-Chattanooga-Nashville-Louisville Corridor.

1.2 TECHNOLOGY CONSIDERATIONS

Three levels of service alternatives for intercity high-speed passenger rail service will be evaluated based on developed service scenarios and operating plans. However, Magnetic Levitation technology (Maglev) will only be considered for the Atlanta-Chattanooga-Nashville-Louisville Corridor.

1.2.1 ALTERNATIVE 1: 90-110 MPH EMERGING HIGH-SPEED RAIL

FRA defines Emerging High-Speed Rail as "developing corridors of 100-500 miles, with strong potential for future high-speed regional and/or express service. Top speeds of up to 90-100 mph on primarily shared track (eventually using positive train control technology), with advanced grade crossing protection or separation. Emerging High-Speed Rail is intended to develop the passenger rail market, and provide some relief to other modes."

Emerging High-Speed rail generally involves utilizing an existing rail corridor owned and operated by a freight railroad. This type of service is also commonly called "Shared-Use". Operating, service level and maintenance agreements need to be negotiated with the freight railroad for passenger service to operate. This alternative is very limited in that it is bound to the existing rail network between the points of interest. Maximum speeds for the shared-use alternative is 110 mph based on acceptance by the freight railroads.

Diesel-electric Tilt Train Technology will be utilized on the Shared Use corridors due to curvature and topography on these corridors and typically achieves top speeds of 90-110 mph. With the system, car bodies are tilted at curves to compensate for unbalanced car body centrifugal acceleration to a greater extent than the compensation produced by the track cant, so that passenger do not feel centrifugal acceleration and thus trains can run at higher speed along curves.

1.2.2 ALTERNATIVE 2: 180-220 MPH EXPRESS HIGH-SPEED RAIL

FRA defines Express High-Speed Rail as "frequent, express service between major population centers 200-600 miles apart, with few Intermediate stops. Top speeds will range from 180 to 220 mph on completely grade-separated, dedicated rights-of-way (with the possible exception of some shared track in terminal areas)." Express High-Speed Rail intends to relieve air and highway capacity constraints. In this report, Express High-Speed Rail is referred to as "Dedicated Use".

This alternative primarily involves establishing a new passenger rail corridor, designated solely to high-speed passenger rail service. In developing corridor service alternatives for consideration, the study examined existing interstate and state highway corridors, power and other utility corridors, the Governor's Road Improvement Program (GRIP) network in Georgia, private railroad rights-of-way and "greenfield" routes. Electrification will be utilized with a Push-Pull Train.

1.2.3 ALTERNATIVE 3: 220+ MPH MAGLEV

Magnetic Levitation, abbreviated as Maglev, is advanced trains technology in which magnetic force lifts, propels, and guides a vehicle over a guideway. Utilizing state-of-the-art electric power and control systems, this configuration eliminates contact between vehicle and guide way and permits cruising speeds between 250 and 300 mph.

These trains systems use electromagnetic forces to lift and propel trains along a guide way within exclusive right-of-way. The trains, when operating, hover a small distance above the guideway, eliminating friction and rolling resistance, while operating at speeds of up to 310 mph. The operating speeds of Maglev make it appropriate for consideration within an intercity corridor. A Maglev system operating in Shanghai, China is the only one in operation today. Test facilities exist in Germany and Japan.

This alternative primarily involves establishing a new passenger rail corridor, designated solely to high-speed passenger rail service. Significant portions of the Guideway may be elevated on a structure between the points of interest. Again, for this level of service, the study examined existing interstate and state highway corridors, power and other utility corridors, the GRIP network, private railroad rights-of-way and “greenfield” routes. Maglev was only considered along the Atlanta-Chattanooga-Nashville-Louisville Corridor, based on Maglev consideration in other studies along this corridor and special permission from FRA.

2 STUDY PURPOSE AND OBJECTIVES

2.1 CORRIDOR DESCRIPTIONS AND HISTORY

2.1.1 ATLANTA – BIRMINGHAM

The Atlanta-Birmingham Corridor extends from Hartsfield-Jackson Atlanta International Airport (H-JAIA) to the Atlanta Multi-Modal Passenger Terminal (MMPT) and onto the existing Birmingham downtown Amtrak station. This particular rail corridor was included in the 1997 *High-Speed Ground Transportation for America* report and is one of the 11 federally-designated high-speed rail corridors.

Georgia Department of Transportation (GDOT), in partnership with the Regional Planning Commission of Greater Birmingham (RPCGB) views this route as a connecting segment between the Gulf Coast High-Speed Rail Corridor (New Orleans-Birmingham-Atlanta) and the Southeast High-Speed Rail Corridor (Atlanta-Charlotte-Raleigh-Washington D.C.).

As outlined in the Georgia State Rail Plan (2009), Amtrak currently serves both cities as a part of the Crescent service; however, there are limitations of speed due to the sharing of track with NS. Therefore, the plan states that there may be a need for high-speed passenger rail service between the two cities to create competition for other modes of travel along the corridor (such as automobiles and airplanes).

There are two major multi-modal projects underway in Atlanta and Birmingham that support the potential need for high-speed rail service between the two cities. In Atlanta, the Atlanta Multi-Modal Passenger Terminal (MMPT) is proposed to be located in downtown Atlanta. Recently, GDOT began an Environmental Impact Statement (EIS) and selected a Master Developer study to explore additional opportunities. It is envisioned that the terminal will serve as the hub for high-speed rail, commuter rail, heavy-rail (MARTA) and other ground transportation (bus, taxi, etc.) for the Atlanta region.

In Birmingham, the Birmingham Multi-Modal Transit Center received $8 million in American Recovery and Reinvestment Act (ARRA) funding, jumpstarting the planning process. The center will coordinate all existing transit services in the region, including Amtrak, Suburban Mobility Authority for Regional Transportation (SMART) bus service, airport connections, and taxi services. In addition, a new level of bus service will be added to connect Birmingham to other transit hubs across the northern Alabama region.

2.1.2 Atlanta – Macon – Jacksonville

The Atlanta-Macon-Jacksonville Corridor extends from the Atlanta MMPT through to the existing Macon station, and travels to Savannah, GA onto the proposed Jacksonville terminal station. The Atlanta-Macon-Jacksonville Corridor is a variation of the federally designated high-speed rail corridor. The original corridor travels from Atlanta to Macon and Jesup, GA and onto Jacksonville, FL. This route was included in the route alternative analysis; however, the route including Savannah, GA was chosen based on the increase in ridership and revenue associated with the higher population. The Savannah metropolitan statistical area (MSA) is the fourth largest travel market in the state of Georgia. The Savannah to Jacksonville Corridor is also part of the federally-designated Southeast High-Speed Rail Corridor (SEHSR) which extends from Raleigh, NC to Jacksonville, FL via Columbia, SC and Savannah, GA.

An Atlanta to Jacksonville corridor was studied in the 2003 *Atlanta to Jacksonville Intercity Passenger Rail Service Study* by GDOT, the Georgia Regional Passenger Authority (GRPA), and Amtrak. High-speed service was evaluated in addition to conventional and moderate services (up to 79 mph). This study followed the U.S. dedicated corridor providing service in Macon and Jesup, and bypassing Savannah. In this study, total capital costs (2003 dollars) required to implement the service was estimated to be between $104 million and $393 million depending on service level and frequency.

A portion of the proposed corridor coincides with the 2008 Volpe National Transportation System Center study *Evaluation of High-Speed Rail Options in the Macon-Atlanta-Greenville-Charlotte Rail Corridor*. This study included four stations location within a portion of the current feasibility study area including stations in Macon, Griffin, H-JAIA, and the Atlanta MMPT. The study developed seven potential scenarios in which some or all of these four stations were served. The report concluded that the best alternative for the corridor is 125-150 mph Diesel high-speed rail technology with 14 station stops (including all four stations previously mentioned).

Over the past two decades, the corridor between Atlanta and Macon has also been studied as a potential commuter rail line to serve populations traveling between these cities. The commuter rail would encompass 103-mile corridor with 13 potential stations including the proposed Atlanta MMPT, Hapeville, Morrow, Hampton, Griffin, Forsyth and Macon. The study estimates that the cost for this project is approximately $400 million (2010 dollars) and operating costs about $25 million per year

The Atlanta-Macon-Jacksonville Corridor also ties into recent studies in Florida, including the *Northeast Florida Commuter Rail Feasibility Study* from Jacksonville Transportation Authority (JTA) in 2008. This study evaluated various commuter rail options from Jacksonville to other areas of Northeast Florida. The proposed high-speed rail corridor would use this system as a feeder system to generate ridership.

Finally, there are a number of proposed multi-modal centers that would accommodate the high-speed rail service in this corridor. As previously mentioned, the northern terminus of the corridor is the Atlanta MMPT proposed for downtown Atlanta. Additionally, there are three other centers in existence or proposed:

- **Macon Intermodal Passenger Terminal Facility:** In 2001, Macon Planning and Zoning Commission (MBPZ) contracted for an intermodal Terminal Facility to accommodate the potential upgrades in commuter, intercity and high-speed rail through Macon, GA. The project location is adjacent to the Macon Terminal Station on Fifth Street in downtown Macon.
- **Coastal Region Mobility Center:** A study is currently being conducted to plan the location and function of the Coastal Region Brunswick Mobility Center, an intermodal transportation hub to serve the areas of Brunswick, GA, Fort Stewart and King Bay's Naval Base. The center will include the regional rural (FTA Section 5311) transit service, Greyhound, and a fixed-route transit system planned for Brunswick. The Coastal Region is currently looking at two potential locations near Brunswick and Everett, GA.
- **Jacksonville Regional Transportation Center (JRTC):** The City of Jacksonville, in conjunction with the Jacksonville Transportation Authority (JTA), is currently in the final design phase for a new regional transportation center to be located at the current location of the Convention Center. The JRTC will serve rail and ground transportation services for the region including Amtrak and Greyhound in the near future and potentially high-speed rail long term.

2.1.3 Atlanta – Chattanooga – Nashville – Louisville

The Atlanta-Chattanooga-Nashville-Louisville Corridor connects in Louisville with federally designated high-speed rail corridors servicing Illinois, Indiana, Michigan, and Ohio. This rail corridor was not included in the 1997 *High-Speed Ground Transportation for America* report. GDOT in partnership with Kentucky Transportation Cabinet (KYTC), Tennessee Department of Transportation (TDOT) and City of Chattanooga analyzed this route segment as an extension and connection of the Midwest Network (Chicago to Louisville) and requested that it be placed on the national system. This corridor provides high-speed rail connection between the eastern portion of the Midwest region to the southeast region.

Currently, GDOT is also studying the potential for HSGT between Atlanta and Chattanooga as part of a Tier I EIS. This feasibility study uses the Tier I EIS as a benchmark to ensure that estimates are consistent with the concurrent work in the Atlanta to Chattanooga Corridor. Maglev technology was originally the focus of this corridor study effort, but the study effort has been broadened to consider all potential HSGT technologies. The Tier I environmental document is not yet complete, but it appears that it will recommend the I-75 corridor as the preferred route. The Atlanta to Chattanooga corridor has been a subject of study for over 10 years and was part of the GDOT 1997 Intercity Rail Plan. The Atlanta Regional Commission (ARC) has also studied the corridor from 1999 to 2003.

In 1999, the KYTC assessed the potential for high-speed passenger service through a study *Examination of I-75, I-64 and I-71 High Speed Rail Corridors* between the Kentucky cities of Lexington, Louisville and Covington. Detailed ridership estimates were not developed; instead, comparisons were made to rail systems in operation in the U.S. at the time, adjusting for some of the differences in the Kentucky corridors. An order of magnitude cost estimate for the 266-route mile system was placed at $5.48 billion (1998 dollars) plus the cost of vehicles. The conclusion of the document indicates that ridership would only contribute to 15 percent of the revenue needed to cover costs of the system.

Also in 2002-2003, Tennessee and Kentucky completed State Rail Plans that explored the opportunity for high-speed rail service. Tennessee explored the potential for high-speed rail from Chattanooga to Nashville and beyond to Louisville, KY. The State Rail Plan included two other corridors from Knoxville to Chattanooga and Knoxville to Nashville. The Kentucky State Rail Plan outlined the potential for the state to join the Midwest High Speed Rail Coalition (MWRRC) which was founded in 1996.

In 2008, Tennessee conducted a study connecting Chattanooga to Nashville titled *Accelerate Your Journey – Chattanooga to Nashville Maglev Feasibility Study.* This study recommended a Maglev technology route largely in the I-24 corridor with five passenger station locations: downtown Nashville, Nashville Airport, Murfreesboro, downtown Chattanooga and the Chattanooga airport. This route, when joined with the Atlanta-Chattanooga planning and evaluation efforts was intended to provide a Maglev connection between Atlanta and Nashville.

Commuter rail service is available in Nashville in an eastern corridor between downtown Nashville and Lebanon, TN. This service is operated by the Regional Transit Authority (RTA) on an existing short line railroad. The Nashville region is also considering commuter rail service between downtown Nashville and Clarksville, TN. Louisville has also explored the potential of commuter rail service between downtown Louisville and Elizabethtown, KY (adjacent to Fort Knox).

The Atlanta-Chattanooga-Nashville-Louisville Corridor has the potential to connect several key military installations; Arnold Air for Base in Tennessee, Fort Campbell and Fort Knox in Kentucky. These facilities may benefit from good connectivity along the rail corridor and access to major airports and cities.

The terrain in the corridor, particularly around Chattanooga and to a lesser extent north of Nashville represents a significant issue to high-speed rail routes. The mountainous/rolling terrain has limited the potential for Shared Use routes through these areas. The existing freight lines for the CSXT are heavily used between Atlanta and just north of Nashville, and from Atlanta to Chattanooga for the NS rail lines.

2.2 PURPOSE AND OBJECTIVES

The overall purpose of this study is to determine the overall feasibility of each corridor with regards to capital costs, funding and financing opportunities, operating and maintenance costs, ridership and revenue, operating ratios and benefit-cost analyses. Each corridor is studied independently of one another, and the feasibility of each corridor is dependent upon the potential benefits anticipated from investment in transportation between the major cities and along each of the corridors.

A representative route was selected for each corridor for both Emerging High-Speed Rail (Shared Use) with speeds up to 90-110 mph, and Express High-Speed Rail (Dedicated Use) with speeds up to 150-220 mph. Additionally, Maglev technology was included in the Atlanta-Chattanooga-Nashville-Louisville Corridor. It should be noted that the representative routes are not preferred or recommended alternatives, but are presented as an example of an alternative to develop reasonable estimates for each corridors' high-speed rail performance. Each representative route may have a variety of specific alignments that will be analyzed through the NEPA process, should the route be selected for future analysis.

Once the representative routes were established, a detailed analysis of capital, operating and maintenance cost, and ridership and revenue was performed. The feasibility of the routes was dependent upon the projected improvements in transportation between the major cities and along the routes in each of the corridors.

Section I, Chapter 3 - Assumptions and Methodologies, outlines the process and methods used for estimating the variability for each corridor. Sections II through IV of this report outline the findings, results and recommendations for the Atlanta-Birmingham, Atlanta-Macon-Jacksonville and Atlanta-Chattanooga-Nashville-Louisville Corridors, respectively. Section V presents corridor comparisons and recommended next steps for each of the corridors.

3 ASSUMPTIONS AND METHODOLOGIES

3.1 CORRIDOR ALTERNATIVES DEVELOPMENT

One of the first steps of the analysis process was to outline representative routes for each of the three corridors. This feasibility study did not determine a preferred alternative, but rather selected routes that were thought to provide an overall representation of the performance of the corridor and the technology options. If the corridors are determined to be feasibility, it will be the responsibility of future studies to determine the preferred alternative, specific alignments and station locations.

A representative route was developed for both the Shared Use and Dedicated Use technologies. Developing these routes comprised of a three-step process including baseline (existing) conditions, a technical corridor screening process and stakeholder outreach for each corridor.

3.1.1 EXISTING CONDITIONS

To estimate the improvements that high-speed rail will bring to the corridors, a baseline of existing conditions was collected and documented for the representative routes in each corridor. Existing conditions included a variety of factors and characteristics including population demographics and socioeconomic characteristics, employment patterns, land use patterns, transportation systems and environmentally critical areas. The subsequent sections (Sections II-IV) outline the unique existing conditions for each of the three corridors.

The study collected and integrated relevant geographic information system (GIS) data and other data for the three study corridors and their surrounding areas. The study coordinated with states, regions, counties, cities and other key stakeholders within each corridor to collect a large amount of data to effectively complete the studies with meaningful results and recommendations.

3.1.1.1 Base Data

The study collected base data elements that make up the foundation for maps and data associated with the three corridors for Alabama, Florida, Georgia, Kentucky and Tennessee. Table 3-1 outlines the collected base data.

Table 3-1: Base Data and Sources

Data Element	Description	Source
State Boundaries	State Boundaries for each of the five states	U.S. Census Bureau
County Boundaries	County boundaries for each of the five states	U.S. Census Bureau
Census Tract Boundaries	Census track Boundaries for each of the five states	U.S. Census Bureau
Census Block Group Boundaries	Census Block Group Boundaries for each of the five states	U.S. Census Bureau
City Boundaries	City boundaries for each of the five states	State GIS Resources[7]
MPO Boundaries	Metropolitan Planning Organization boundaries for each of the five states	State GIS Resources
MSA Boundaries	Metropolitan Statistical Area boundaries for each of the five states	State GIS Resources
Congressional Districts	Congressional District boundaries for each of the five states	State GIS Resources
Community Facilities	Includes hospitals, schools, colleges and universities	State GIS Resources
Land Use (Current and Future)	Current and Future land uses for the study corridors	State GIS Resources

3.1.1.2 Environmental Data

Environmental data for this feasibility study refers to the natural landscapes within the study area. There was an emphasis placed on any potentially critical areas such as wetlands, ponds and streams which were mapped and analyzed to understand the potential mitigation efforts necessary in future planning studies. Table 3-2 summarizes the environmental data needed for this feasibility study. It should be noted that historical resources are included in the environmental section due to their relations with the National Environmental Policy Act (NEPA) planning process.

[7] State GIS Resources refer to GIS and Database sites provided by the states within the study areas.

Table 3-2: Environmental Data and Sources

Data Element	Description	Source
Lakes	Lakes	State GIS Resources
Rivers/Streams	Rivers and Streams	State GIS Resources
Wetlands	Wetlands	National Wetland Inventory
Floodplains	Floodplains	Federal Emergency Management Administration (FEMA)
Parks/Recreational	Parks and Recreational areas	State GIS Resources
Conservation Land	Conservation lands including national and state parks, cultural centers, monuments	State GIS Resources, National Park Service
Forests	National and State Forests	National and State Forestry Services
Non-Attainment Areas	N_{OX}, Ozone, PM_{10}, $PM_{2.5}$, S_{OX}	State GIS Resources
USGS Topographic Quadrants	Topographic quadrants	U.S. Geological Survey (USGS)
National Historic Resources	Known eligible and registered historic resources	State Historic Preservation Officer (SHPO)

There are additional environmental data that was not included as a part of the data collection and mapping efforts due to the high-level of a feasibility and data required for thorough consideration, but are important aspects of the FRA Procedures for Considering Environmental Impacts[8]. These items will need to be taken into consideration if further analysis (including the NEPA process) is recommended for each study corridor. These additional aspects include:

- Noise and vibration;
- Solid waste disposal;
- Coastal zone management;
- Use of energy resources;

[8] Federal Railroad Administration, Procedures for Considering Environmental Impacts [FRA Dicejt Bi, EO-1, Notice 5], Federal Register, Vol. 64, No. 101(https://www.fra.dot.gov/Downloads/RRDev/FRAEnvProcedures.pdf)

- Use of other natural resources;
- Aesthetic and design quality impacts;
- Possible barriers to the elderly and handicapped;
- Existing and planned land use;
- Public Health;
- Public safety;
- Use of 4(f)-protected properties; and
- Construction period impacts.

Some of these items are touched on in the environmental and demographics analysis for each corridor, but each aspect will need to be carefully considered in future studies.

3.1.1.3 Demographic Data

Demographic data refers to current and future socioeconomic information including race and ethnicity, employment and income levels. It is important to understand the current conditions of the population to accurately measure the demand for transportation infrastructure and estimate future ridership and revenue levels. It is also important to understand potential environmental justice (EJ) populations that may need to be considered in future planning efforts.

The demographic data collected as a part of the existing conditions will help project ridership of a high-speed passenger rail. Current demographics refer to the 2010 U.S. Census, when available. Otherwise, demographic information is the most recent available from the U.S. Census Bureau. Table 3-3 outlines the demographic data collected and their sources.

Table 3-3: Demographic Data and Sources

Data Element	Description	Source
Total Population	Total existing population	U.S. Census Bureau
Race/Ethnicity	Current race and ethnicity at the county level	U.S. Census Bureau
Age	Current age distribution at the county level	U.S. Census Bureau
Employment	Total current employment at the county level	U.S. Census Bureau
Household Income	Current median household income at the county level	U.S. Census Bureau
Low-Income	Current number of persons living below poverty level at the county level	U.S. Census Bureau

3.1.1.4 Existing Travel Patterns

High-speed rail feasibility is partially determined by the success of other modes of travel between major cities in the same corridor. High-speed rail competes with both air and automotive travel, and will therefore be more successful where air and auto travel have consistently moderate to high travel between the major cities. In order to understand the existing travel patterns for each of the three study corridors, Table 3-4 outlines the data employed to estimate the market share for high-speed rail.

Table 3-4: Travel Data and Sources

Data Element	Description	Source
Intercity Auto Trips	Annual Person Auto Trips (Round Trips)	1995 American Travel Survey
Local Air Trips	Annual Person Local Air Trips (round trips)	2010 USDOT DB1B and T-100 Airline Database
Connecting Air Volumes	Total Enplanements an Connecting Air volumes	2010 T-100 Airline Database

Additionally, data was collected on the existing transportation system infrastructure to understand the existing travel patterns outlined above. Table 3-5 illustrates the infrastructure data collected as a part of the feasibility study.

Table 3-5: Transportation Infrastructure Data and Sources

Data Element	Description	Source
Interstates	Interstate System	National Transportation Atlas
Major highways/roads	Major highways and local roads	National Transportation Atlas
Roadway Bridges	Roadway bridge locations	National Transportation Atlas
Rail Lines	Existing and abandoned railroads	National Transportation Atlas
Rail Owners, Corridor Volumes and Frequencies	Rail line owners, number of trains per day, and frequency of trains	Railroad Owners
Track Charts	Tracking charts for all railroads in study corridors	Railroad Owners
Rail Crossings	All rail/road crossings including at grade/grade separated data	National Transportation Atlas
Rail Bridges	Railroad bridge locations	National Transportation Atlas
Amtrak Stations	Locations of Amtrak Stations	National Transportation Atlas

Existing travel patterns are first used to quantify the base year trip tables for the current modes by trip purpose and market segment. These current trip tables are then used in conjunction with future demographic and socioeconomic characteristics to explain the size of each market segment and to calculate mode-specific growth rates using growth models (direct demand models).

The existing travel patterns are first used to derive the existing mode shares and trip volumes for each mode between the major city pairs in the region. The trip tables estimated using the existing travel patterns are then grown to future years using newly estimated direct demand models that use the existing and future demographic characteristics as inputs. These direct demand models explain the relationship between demographic characteristics and the travel patterns.

The demand forecasting methodology uses binary diversion models to calculate high-speed rail ridership. Each diversion model computes, for each combination of trip purpose, market segment and current mode, the probability that a traveler would choose high-speed rail over its current mode of travel as a function of each mode's level of service attributes. The probabilities are then multiplied by the future year mode-specific travel volumes to calculate the diverted volumes from the existing modes to the new high-speed rail system. The inclusion of each mode's level of service attributes in the diversion models enables the study to test several high-speed rail service frequencies and to accordingly adjust them to the ridership level. The forecasting approach is explained in more detail in Section 3.3 as well as graphically shown in Figure 3-18.

3.1.2 STAKEHOLDER OUTREACH

Stakeholder outreach is an essential component of a high-speed rail feasibility study and outreach occurred along each corridor throughout the study process. Outreach efforts intend to educate, inform and involve the corridor stakeholders as to the purpose and progress of the project by highlight local issues, technical considerations and potential impacts. Outreach techniques were designed to education and update key stakeholders on the potential for high-speed rail along each corridor.

The study engaged key stakeholders along each corridor including elected officials, financial partners, federal, state and regional agencies and interest groups throughout the study process. The goal for the outreach was to include a group of agencies that would have valuable input at the feasibility level. A comprehensive list of stakeholders was compiled for each corridor and included all state, regional and local agencies within a 50-mile buffer of the corridor. GDOT, along with other state financial partners, reviewed the list and refined it to key stakeholders with a high-level perspective on high-speed rail. Stakeholders generally included state and regional agencies involved in transportation projects and local cities and MPOs of the major cities along each corridor.

Communication with these entities was on-going, but the study conducted three formal stakeholder outreach meetings at the beginning, middle and end of the study timeline to provide updates and input into the study processes and analyses techniques. For each of the corridors, the study first met with key stakeholders early on in the study process to introduce the study and its purpose and need. Additionally, the study presented a number of meeting materials outlining the corridor screening process (Section 3.1.3) and solicited input into opportunities and issues along each corridor to help determine the representative routes for the Shared Use and Dedicated Use alternatives within the corridors. Refer to Appendix A for meeting materials and handouts.

Toward the middle of the study timeline, once preliminary capital cost and ridership and revenue analyses were completed, the study conducted a series of webinar-based conference calls with stakeholders from each of the corridors to update on the corridors' progress and present the initial technical data. The study, again, solicited questions from the stakeholders in order to clarify any concerns or issues along the corridor. Refer to Appendix A for meeting materials.

At the end of the feasibility study, the study met with stakeholders along the various corridors to present the final costing, ridership and revenue analyses as well as operating ratios and benefit-cost analyses. The study outlined the findings and recommendations for each of the corridors and presented the next steps for the corridor. Refer to Appendix A for meeting materials. Table 3-6 outlines the stakeholders for each of the three corridors that attended the outreach meetings.

Table 3-6: Corridor Stakeholders

Atlanta- Birmingham	Atlanta-Macon-Jacksonville	Atlanta-Chattanooga-Nashville-Louisville
• Alabama Department of Economic and Community Affairs • Alabama Department of Transportation • Birmingham-Jefferson County Transit Authority • City of Birmingham • City of Anniston • East Atlanta Regional Planning Commission • Regional Planning Commission of Greater Birmingham	• Bibb County • City of Macon • Coastal Regional Commission • Jacksonville Transportation Authority • Macon-Bibb Planning and Zoning • North Florida Transportation Planning Organization • Savannah Metropolitan Planning Commission	• City of Chattanooga • City of Lexington • Chattanooga-Hamilton County Regional Planning Agency • Clarksville Metropolitan Planning Organization • The Enterprise Center (Chattanooga-Hamilton County, TN) • Kentuckiana Regional Planning and Development Agency • Kentucky Transportation Cabinet • Nashville Area Metropolitan Planning Organization • The Transit Alliance (Middle Tennessee) • Transit Authority of River City • Tennessee Department of Transportation

3.1.3 Corridor Screening and Analysis Process

One of the first steps for this feasibility study was to identify a representative corridor route for each study corridor, technology and speed in which the study could evaluate in more detail with regard to capital costs, forecast ridership, revenues, operating costs, operating ratio, benefit-cost ratio and other comparative factors.

A high-level screening analysis was applied to the three study corridors to identify a representative route for each technology for further evaluation. Representative routes were identified for: 1) 90-110 mph Emerging High-Speed Rail (Shared Use) on a shared-use freight corridor; 2) 180-220 mph Express High-Speed Rail (Dedicated Use) on a dedicated, fully grade-separated corridor; and 3) 220+ mph Maglev on a dedicated, fully grade-separated corridor (for Atlanta-Chattanooga-Nashville-Louisville Corridor). The screening and analysis methodology to identify a representative route for each operating technology consists of four steps:

1. Identify the initial universe of route alternatives for each operating technology based on identifying those routes which provide basic connectivity for each of the major city pairs;
2. Screen the initial universe of route alternatives using both quantitative and qualitative factors to identify a representative route for each technology. Representative routes were chosen primarily based on the following quantitative and qualitative factors to deliver the highest level of service with the least public and environmental cost:
   - Route alternative geometry and travel time,
   - Route alternative freight traffic density (for Shared Use routes),
   - Stakeholder knowledge and input on route alternative issues and opportunities, and
   - Intermodal connectivity through potential stations.

   These routes contain several alignment alternatives that would be further analyzed through the NEPA process, should the corridors pass the feasibility threshold;
3. Further refine representative route alignments based upon a more detailed analysis including: service goals including travel time, station location and accessibility, operating feasibility, engineering feasibility, and cost factors; and
4. Evaluate each representative route in terms of its feasibility with regard to capital costs, forecast ridership, revenues, operating costs, operating ratio, benefit-cost ratio and other comparative factors.

3.1.4 Step 1: Identification of Universe of Corridor Alternatives

3.1.4.1 90-110 mph Shared Use

In the case of the 90-110 mph Shared Use alternatives, all current, abandoned and historic freight rail corridor routes serving major city pairs in the three study corridors were inventoried.

3.1.4.2 180-220 mph Dedicated Use

The screening process for identifying representative routes for 180-220 mph Dedicated Use operations uses a one-step level of analysis followed with a more detailed evaluation to confirm the feasibility of the selected corridor. The study first identified a universe of potential corridor routes including freight rail, electric transmission easements, cross-county greenfield routes and interstate highway corridors.

Existing freight rail corridors were discarded due to the existing track geometry which included numerous curves that severely limit top speeds and travel times.

Thirty minute (30’) curves are generally considered to be the upper limit of curvature that can support 180-220 mph operations, with 15 minute (15’) curves considered most desirable. The exception to this is within urban areas where existing freight rail corridors often offer the best accessibility to proposed or existing station locations. Average speeds within urban areas are typically slower than for inter-city travel, allowing the existing freight right-of-way to provide the best alternative within these relatively short “last mile” routes.

The study then reviewed the potential use of electric transmission line corridor easements. The study determined that these utility easements were generally not feasible because they are typically laid out in tangent sections without regard for vertical profile changes. The resulting sharp changes in elevation were found to be inconsistent with the geometric requirements of 180-220 mph (generally less than 3 percent grades). In addition, electric utility corridors are often buried underground in urban areas and did not typically offer “last mile” rail connectivity to existing or proposed station locations.

True cross-county greenfield corridors were also considered. The study concluded, however, that the level of engineering analysis required to lay out a viable “pure” greenfield corridor was beyond the scope of a feasibility analysis. The goal of this feasibility study was to provide an evaluation of feasibility of a representative route for each of the three study corridors and speed technologies so that the application of this operating technology could be compared among the three corridors. Therefore, the representative routes generally follow interstate corridors where more accurate information could be obtained (e.g., route geometry and topography) for a high-level analysis.

The study determined that the interstate highway corridors offered the best opportunity for use as Dedicated Use representative routes. The interstates are generally designed to have curves less than 30’, which is suitable for 180-220 mph operations. Interstate vertical geometry in non-mountainous areas is also generally consistent with 180-220 mph electrified operations. The interstate highway routes in the southern and coastal areas of Georgia were found to be particularly desirable geometrically. The study also concluded that the interstate highway corridors would be appropriate for higher speed Maglev operations in the Atlanta-Chattanooga-Nashville-Louisville Corridor. This route was chosen to maintain consistency with the Atlanta-Chattanooga Tier I EIS. Although this study is not yet finalized, the report indicates that the I-75 corridor was selected for both an electrified 180-220 mph and 220+ mph Maglev operations.

The study assumed that viable high-speed rail operations along interstate highway corridors are to be on one of three basic routes: within the highway median, alongside the outside highway lane within the highway right-of-way, or in purchased right-of-way adjacent to the highway right-of-way. Where selected interstate highway curves were greater than 30', the high-speed rail route was adjusted to leave the immediate highway corridor if justified by travel time savings.

3.1.5 Step 2: Alternative Screening and Representative Route Selection

3.1.5.1 90-110 mph Shared Use

For the Shared Use corridor operations, the second step of the screening process involved the application and comparison of the following data for each evaluated alternative as identified in Step One above:

1. Length of Route – Miles of Track as
    a. A measure of connectivity; and
    b. A measure of direction/indirection;

2. Ownership – Class I, Regional or Shortline, Abandoned or Recreation as
    a. A measure of ability to purchase the corridor for passenger rail; and
    b. A measure of potential to control the dispatch of passenger trains.

3. Class of Track as
    a. A measure of current improvement levels; and
    b. A measure of potential incremental track up-grade costs.

4. Predominant Track Configuration – Single, Single with sidings, double or triple track, etc. as a measure of existing capacity and density.

5. Degree of Curvature – 1 degree 30 minutes (1° 30') maximum curvature generally consistent with 110 mph operations. Expressed in number of curves greater than 1° 30' and percent miles greater than 1° 30' as
    a. A measure of limitation on achievable top speeds; and
    b. A measure of maximum curvature generally consistent with 110 mph operations.

6. Million Gross Tons of Freight per year as
    a. A measure of current freight activity and potential freight conflicts;
    b. A measure of congestion; and
    c. A measure of competing freight demand for a given route.

7. Number of Trains per day (converted from million gross tons or from freight railroad information) as
    a. A measure of current freight activity and potential freight conflicts;
    b. A measure of congestions; and
    c. A measure of competing freight demand for a given route.

8. 90-110 mph travel time – Calculated based on mileage and track class as a measure of comparative mobility.

9. 90-110 mph average speed as a measure of comparative mobility.

A comparison matrix of all evaluated corridors and the technical characteristics can be seen in Appendix C of this report. Additionally, more detailed information including stakeholder insight for each of the evaluated corridors is located in subsequent section (Sections II, III, and IV).

3.1.5.2 180-220 mph Dedicated Use

The interstate highway routes for 180-220 mph Dedicated Use operations were further evaluated a high level using the following criteria:

1. Miles of Interstate Highway as
    a. A measure of connectivity; and
    b. A measure of direction/indirection.

2. Degree of Curvature – 30 minute (30') maximum curvature generally consistent with 180-220 mph operations. Expressed in numbers of curves greater than 30' and percent miles greater than 30' as
    a. A measure of limitations on achievable top speeds; and
    b. A measure of maximum curvature generally consistent with 180-220 mph operations.

3. Auto travel times as a measure of comparative measure of mobility.

4. 180-220 mph high-speed rail travel time as a measure of comparative measure of mobility.

5. 180-220 mph high-speed rail average speed as a measure of comparative measure of mobility.

A comparison matrix of the 180-220 mph corridors and the associated technical characteristics can be seen in Appendix C of this report. Additionally, more detailed information including stakeholder insight for each of the interstate corridors is located in subsequent section (Sections II, III, and IV).

3.1.6 STEP 3: REFINEMENT OF REPRESENTATIVE ROUTES

The third step in the development of representative route for further evaluation was to refine the representative route based on accessibility, operating considerations and travel time improvements. In particular, this involved refining route routes to optimize station accessibility and operating characteristics in and out of the major cities including: Atlanta, Birmingham, Macon, Savannah, Jacksonville, Chattanooga, Nashville and Louisville.

3.1.7 Step 4: Evaluate Feasibility of Each Representative Corridor

The final step in the evaluation process was to develop more detailed information on each representative route and technology alternative which can be used to assess the comparative feasibility of the corridor for future high-speed rail service.

The study utilized operating ratios and benefit-cost calculations as well as other factors to evaluate the three study corridors following the methodology used in the FRA 1997 Commercial Feasibility Report to Congress: “High Speed Ground Transportation in America”.

Forecast ridership, revenue and operating cost data was used to determine the degree to which annual operating revenues can cover operating costs. This can be expressed as an operating ratio of revenues divided by operating costs. A ratio greater than one (>1.0), indicates an operating surplus. Operating ratios are also an indicator of whether there may be an opportunity for private sector investment. The operating ratio is typically seen as a comparative measure of the economic efficiency of high-speed rail service in one corridor versus another.

Information on ridership, revenues and operating and capital costs over time as also used to calculate a benefit-cost ratio for each given level of high-speed rail service. Here, benefits, as measured by revenues and other user and societal benefits, are compared to costs including capital, operating and maintenance costs over time, as well as other societal costs expressed in dollar terms. A discount rate is used to express benefits and costs in net present value (NPV) terms and a benefit-cost ratio greater than one implies a net value (or benefit) to society. The benefit-cost ratio can be seen as a comparative measure of the societal rate of return of a public investment in high speed rail in one corridor versus another. A more technical discussion of benefit-cost analysis is found later in Section 3.4.4.

This same information on ridership and revenues and operating and capital costs can also be used individually to assess a high-speed rail project’s feasibility in terms of other measures such as: a project’s impact on state budget priorities, project impact on state credit ratings, viability of private sector contributions, eligibility for various federal grant and loan program, and state and local economic impact in terms of jobs, incomes and property values. However, for the purposes of this study, the corridor feasibility primarily focuses on operating and benefit-cost ratios.

3.2 Capital Cost Methodology

Capital cost estimates for this study were completed at the conceptual engineering level (5-10 percent) with a +/- 30 percent level of accuracy. Table 3-7 illustrates the level of accuracy of engineering cost estimates associated with various levels of project development.

Table 3-7: Level of Accuracy vs. Project Development

Project Development Phase	Engineering Design Level	Approximate Level of Accuracy[9]
Conceptual Engineering	5-10 percent	+/- 30 percent
Preliminary Engineering	30 percent	+/- 15 percent
Final Design	100 percent	+/- 10 percent or better

3.2.1 FRA Standard Cost Categories (SCC)

To achieve a consistent costing methodology, the study used the FRA Standard Cost Categories (SCC) in developing all capital cost estimates for the three corridors. Preparing the capital cost estimate according to current FRA SCC allows the easy transition and preparation for future funding applications. This approach will greatly reduce the need to re-evaluate quantities, unit costs and individual items for future application. FRA SCC is separated into ten categories for capital projects/programs. The categories are broad enough to be applied to all three corridors and each of the different technology considerations (refer back to Section 1.2). The ten major categories are shown below in Table 3-8.

[9] Level of Accuracy is implied and is based on typical industry practice

Table 3-8: FRA Standard Cost Categories

FRA Standard Cost Categories for Capital Projects/Programs
10 Track Structures & Track
20 Stations, Terminals, Intermodal
30 Support Facilities: Yards, Shops, Administration Buildings
40 Sitework, Right-of-Way, Land, Existing Improvements
50 Communications & Signaling
60 Electric Traction
70 Vehicles
80 Professional Services
90 Unallocated Contingencies
100 Finance Charges

Each category is broken down into subcategory items that expand the capital cost estimate of each major category. The study only utilized categories 10 through 80 because categories 90 and 100 do not apply to the current Feasibility Study. The values for these categories will be determined in later evaluations. Below (Table 3-9) is a list of all FRA subcategories and definitions for category 10 Track Structures & Track through 80 Professional Services.

Table 3-9: FRA Cost Items

10 Track Structures and Track		
	Item	**Definition**
10.01	Track Structure: Viaduct	Include elevated track structure of significant length consisting of multiple spans of generally equal length.
10.02	Track Structure: Major/Movable Bridge	Include all elevated track structures with a movable span, and/or with a span of significant length (generally of approximately 400’ or longer)
10.03	Track Structure: Under-grade Brides	Include elevated track structure of greater than 20 feet that does not fall into 10.01 and 10.02
10.04	Track Structure: Culvert & Drainage Structure	Include all minor undergrade passageways (generally of 20 feet or less in width)
10.05	Track Structure: Cut & Fill (> 4’ height/depth)	Include grading and subgrade stabilization of roadbed

	Item	Definition
10.06	Track Structure: At-grade (grading and sub-grade stabilization)	All grading and subgrade stabilization of roadbed not included under cost categories 10.01 through 10.05 and 10.07
10.07	Track Structure: Tunnel	Definition self-explanatory
10.08	Track Structure: Retaining Walls & Systems	Definition self-explanatory
10.09	Track New Construction: Conventional Ballasted	Include all ballasted track construction on prepared subgrade, on new or existing rights-of-way
10.10	Track New Construction: Non-Ballasted	Include all slab, direct fixation, embedded, and other non-ballasted track construction on prepared subgrade, on new or existing rights-of-way
10.11	Track Rehabilitation: Ballast and Surfacing	Include undercutting, ballast cleaning, tamping, and surfacing not associated with new track construction
10.12	Track Rehabilitation: Ditching & Drainage	Definition self-explanatory
10.13	Track Rehabilitation: Component Replacement (Rails, ties, etc.)	Definition self-explanatory
10.14	Track: Special Track Work (Switches, turnouts, insulated joints)	Include minor turnouts and interlocking, such as crossovers and turnouts at the ends of passing tracks
10.15	Track: Major Interlockings	Significant interlockings at major stations and where routes converge from three or more directions
10.16	Track: Switch Heaters (with power & control)	Include cost of power distribution equipment from commercial power source to interlocking location
10.17	Track: Vibration & Noise Dampening	Definition self-explanatory
10.18	Other Linear Structures (including fence, sound walls, crash barrier, etc.)	Definition self-explanatory
20 Stations, Terminals, Intermodal		
20.01	Station Buildings: Intercity Passenger Rail Only	Definition self-explanatory
20.02	Station Buildings: Joint use (commuter rail, intercity bus)	Definition self-explanatory

	Item	Definition
20.03	Platforms	Definition self-explanatory
20.04	Elevators, Escalators	Definition self-explanatory
20.05	Joint Commercial Development	Construction at station sites intended to support non-transportation commercial activities (shopping, restaurants, residential, office space). Do not include cost of incidental commercial use of station space intended for use by passengers (newsstands, snack bar, etc.). Costs may not be allowable for Federal reimbursement
20.06	Pedestrian/Bike access and accommodation, landscaping, parking lots	Include sidewalks, paths, plazas, landscape, site and station furniture, site lighting, signage, public artwork, bike facilities, permanent fencing
20.07	Automobile, Bus, Van Accessways including roads	Include all on-grade paving
20.08	Fare Collection Systems and Equipment	Include fare sales and swipe machines, fare counting equipment
20.09	Station Security	Definition self-explanatory
30 Support Facilities: Yards, Shops, Administration Buildings		
30.01	Administration Buildings: Office, Sales, Storage, Revenue Counting	Definition self-explanatory
30.02	Light Maintenance Facility	Include service, inspection, and storage facilities and equipment
30.03	Heavy Maintenance Facility	Include heavy maintenance and overhaul facilities and equipment
30.04	Storage or Maintenance-of-Way Building	Definition self-explanatory
30.05	Yard and Yard Track	Include yard construction and track associated with yard
40 Sitework, Right-of-Way, Land, Existing Improvements		
40.01	Demolition, Clearing, Site Preparation	Include project/program-wide clearing, demolition and fine grading
40.02	Site utilities, utility relocation	Include all site utilities-storm, sewer, water, gas, electric
40.03	Hazardous Material, contaminated soil, removal/mitigation, ground water treatments	Include underground storage tanks, fuel tanks, other hazardous materials and treatments, etc.
40.04	Environmental mitigation: wetlands, historic/archeology, parks	Include other environmental mitigation not listed

	Item	Definition
40.05	Site structures including retaining walls, sound walls	Definition self-explanatory
40.06	Temporary facilities and other indirect costs during construction	Definition self-explanatory
40.07	Purchase or lease of real estate	If the value of right-of-way, land and existing improvements is to be used as in-kind local match to the Federal funding of the project/program, include the total cost on this line item. In backup documentation, separate cost for land from cost for improvements. Identify whether items are leased, purchased or acquired through payment or for free. Include the costs for permanent surface and subsurface easements, trackage rights, etc.
40.08	Highway/pedestrian overpass/grade separation	Other than the grade separations included in this line item, highway-rail grade crossing safety enhancements generally fall under 50.06
40.09	Relocation of existing households and businesses	In compliance with Uniform Relocation Act
50 Communications & Signaling		
50.01	Wayside signaling equipment	Definition self-explanatory
50.02	Signal power access and distribution	Definition self-explanatory
50.03	On-board signaling equipment	Include on-board cab signal, Automatic Train Control (ATC), and Positive Train Control (PTC) related equipment
50.04	Traffic control and dispatching systems	Definition self-explanatory
50.05	Communications	Definition self-explanatory
50.06	Grade crossing protection	Includes all types of highway-rail grade crossing safety enhancements expect for grade separation projects, which fall under 40.08
50.07	Hazard detectors: dragging equipment high water, slide, etc.	Definition self-explanatory
50.08	Station train approach warning system	Definition self-explanatory

	Item	Definition
60 Electric Traction		
60.01	Traction Power Transmission: High Voltage	Definition self-explanatory
60.02	Traction Power Supply: Substations	Definition self-explanatory
60.03	Traction Power Distribution: Catenary and third rail	Definition self-explanatory
60.04	Traction Power Control	Definition self-explanatory
70 Vehicles		
70.00	Vehicle Acquisition: Electric Locomotive	Definition self-explanatory
70.01	Vehicle Acquisition: Non-Electric Locomotive	Definition self-explanatory
70.02	Vehicle Acquisition: Electric Multiple Unit	Definition self-explanatory
70.03	Vehicle Acquisition: Diesel Multiple Unit	Definition self-explanatory
70.04	Vehicle Acquisition: Loco-hauled passenger cars with ticketed space	Include cars with coach space, sleeping compartments, etc.
70.05	Vehicle Acquisition: Loco-hauled passenger cars without ticketed space	Include dedicated food service, lounge, baggage and other service support cars
70.06	Vehicle Acquisition: Maintenance of Way Vehicles	Definition self-explanatory
70.07	Vehicle Acquisition: Non-railroad support vehicles	Definition self-explanatory
70.08	Vehicle Refurbishment: Electric Locomotive	Definition self-explanatory
70.09	Vehicle Refurbishment: Non-Electric Locomotive	Definition self-explanatory
70.10	Vehicle Refurbishment: Electric Multiple Unit	Definition self-explanatory
70.11	Vehicle Refurbishment: Diesel Multiple Unit	Definition self-explanatory
70.12	Vehicle Refurbishment: Loco-hauled passenger cars with ticketed space	Include coaches, sleeping cars, etc.
70.13	Vehicle Refurbishment: Non-passenger Loco-hauled car without ticketed space	Include food service, lounge, baggage and other service support cars
70.14	Vehicle Refurbishment: Maintenance of Way Vehicles	Definition self-explanatory
70.15	Spare Parts	Definition self-explanatory

	Item	Definition
80 Professional Services		
80.01	Service Development/Service Environmental	Definition self-explanatory
80.02	Preliminary Engineering/Project Environmental	Definition self-explanatory
80.03	Final Design	Definition self-explanatory
80.04	Project Management for Design and Construction	Definition self-explanatory
80.05	Construction Administration & Management	Definition self-explanatory
80.06	Professional Liability and other Non-Construction Insurance	Definition self-explanatory
80.07	Legal; Permits; Review Fees by Other Agencies, Cities, etc.	Definition self-explanatory
80.08	Surveys, testing, investigation	Definition self-explanatory
80.09	Engineering Inspection	Definition self-explanatory
80.10	Start Up	Definition self-explanatory

The study expanded several subcategory cost items to capture more detail for the cost items. Items requiring expansion were decided during the data gathering and capital cost estimate activities of the feasibility study. The subcategory expansions include:

Table 3-10: FRA Cost Item Expansion

10.09	Track New Construction: Conventional Ballasted	
	10.09.01	Track New Construction: 136LB CWR w/ Concrete Ties
	10.09.02	Track New Construction : 136LB CWR w/ Wood Ties

3.2.2 Unit Cost Development Method

The study developed all unit costs in 2010 dollars for the design and construction of high-speed passenger rail and maglev infrastructure. Unit costs were derived from various sources and publications. The unit costs for each of the items included cost of material, labor, overhead and profit. Refer to Section 3.2.3 for detailed unit cost developments. Below is a list of resources that was referenced in developing the unit costs:

- Published construction documents such as "RSMeans Heavy Construction Cost Data", current edition;
- GDOT and other State Transportation agencies weighted unit cost;
- Federal Transit Authority (FTA) website for typical elements cost;

- California and Florida High-Speed Rail feasibility Studies and Preliminary Design documents;
- Wisconsin and Illinois Planning and Design Documents;
- Various Class I railroad cost estimates for similar sized projects; and
- Estimating experience and historical costs for similar projects.

Unit costs needed adjustments from previous years to 2010 base year dollars. Escalating these unit costs to 2010 dollars was done by utilizing the *Engineering News Record* Construction Cost Index (CCI) for Atlanta, GA. The CCI uses local prices for Portland cement and 2x4 lumber and the national average price for structural steel. The CCI also uses local union wages, plus fringes, for carpenters, bricklayers and iron workers. The following formula was used to escalate unit costs to 2010 dollars:

$$Unit\ Cost_{2010} = (Unit\ Cost_{Year\ X}) \times \frac{(December\ 2010\ Index) - (Prior\ year\ Index)}{(Prior\ Year\ Index)}$$

The feasibility study was based on U.S. Customary Units defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the U.S., and are also known in the U.S. as “English” of “Imperial” units. Actual units of measure for each of the items were determined during the capital cost estimations.

3.2.2.1 Quantities

From the various data sources in the data collection process, the study developed conceptual take-off quantities for several of FRA cost categories. These quantities are related to earthwork, structures, track roadbed, rail, track materials, turnouts, stations, support facilities, site work, right-of-way, communication & signaling, electric traction, and vehicles.

Take off quantities were made from maps, drawings, typical sections and sketches created during the feasibility study for each corridor and level of service. Take-off quantities were (+/-) 30 percent of actual quantities.

3.2.2.2 Unit Costs

Table 3-11 outlines the unit costs for each FRA SCC sub-category. Because this study is at the feasibility level, the study did not estimate costs for Section 90 (Unallocated Contingencies) and 100 (Finance Charges). The values for these categories will be determined in later evaluations. These unit costs, again, were developed based on regional and national references.

HNTB

Table 3-11: SCC Sub-Category Unit Costs

10 Track Structures and Track				
	Item	Unit	Shared Use	Dedicated Use
10.01	Track Structure: Viaduct	Corridor Mile	$47,000,000	$47,000,000
10.02	Track Structure: Major/Movable Bridge	Lump Sum	Varies	Varies
10.03	Track Structure: Undergrade Brides	Lump Sum	Varies	Varies
10.04	Track Structure: Culvert & Drainage Structure	Each	$57,000	$57,000
10.05	Track Structure: Cut & Fill (> 4' height/depth)			
10.05.01	Rolling Terrain	Corridor Mile	$1,073,000	$1,073,000
10.05.02	Mountainous Terrain	Corridor Mile	$2,145,000	$2,145,000
10.06	Track Structure: At-grade (grading and subgrade stabilization)	Corridor Mile	$715,000	$715,000
10.07	Track Structure: Tunnel	Corridor Mile	$116,000,000	$116,000,000
10.08	Track Structure: Retaining Walls & Systems	Track Mile	$1,281,000	$1,281,000
10.09	Track New Construction: Conventional Ballasted			
10.09.01	136 lb. CWR on Concrete Ties	Track Mile	$894,000	$894,000
10.09.02	136 lb. CR on Wood Ties	Track Mile	$1,010,000	$1,010,000
10.10	Track New Construction: Non-Ballasted	Track Mile	N/A	N/A
10.11	Track Rehabilitation: Ballast and Surfacing	Track Mile	$132,000	$132,000
10.12	Track Rehabilitation: Ditching & Drainage	Track Mile	$38,000	$38,000
10.13	Track Rehabilitation: Component Replacement (Rails, ties, etc.)			
10.13.01	30% Track Rehabilitation	Track Mile	$427,000	$427,000
10.13.02	60% Track Rehabilitation	Track Mile	$491,000	$491,000
10.13.03	100% Track Rehabilitation	Track Mile	$966,000	$966,000

	Item	Unit	Shared Use	Dedicated Use
10.14	Track: Special Track Work (Switches, turnouts, insulated joints)			
10.14.01	Turnout; No. 11	Each	$150,000	$150,000
10.14.02	Turnout; No. 20	Each	$200,000	$200,000
10.14.03	Turnout; No. 24	Each	$475,000	$475,000
10.15	Track: Major Interlockings	Each	N/A	N/A
10.16	Track: Switch Heaters (with power & control)	Each	$45,000	$45,000
10.17	Track: Vibration & Noise Dampening	Track Mile	N/A	N/A
10.18	Other Linear Structures (including fence, sound walls, crash barrier, etc.)	Corridor Mile	$122,000	$122,000
20 Stations, Terminal, Intermodal				
20.01	Station Buildings: Intercity Passenger Rail Only	Each	$5,610,000	$5,610,000
20.02	Station Buildings: Joint use (commuter rail, intercity bus)			
20.02.01	Atlanta MMPT	Lump Sum	$217,121,588	$217,121,588
20.02.02	H-JAIA	Lump Sum	$62,034,739	$62,034,739
20.02.03	Birmingham Transit Station	Lump Sum	$18,610,422	$18,610,422
20.02.04	Jacksonville Multimodal	Lump Sum	$43,424,318	$43,424,318
20.03	Platforms	Linear Feet	$1,080	$1,080
20.04	Elevators, Escalators	Each	$350,000	$350,000
20.05	Joint Commercial Development	Square Foot	$150	$150
20.06	Pedestrian/Bike access and accommodation, landscaping, parking lots	Lump Sum	N/A	N/A
20.07	Automobile, Bus, Van Accessways including roads	Lump Sum	N/A	N/A
20.08	Fare Collection Systems and Equipment	Each	$250,000	$250,000
20.09	Station Security	N/A	N/A	N/A
30 Support Facilities: Yards, Shops, Administration Buildings				
30.01	Administration Buildings: Office, Sales, Storage, Revenue Counting	N/A	N/A	N/A
30.02	Light Maintenance Facility	N/A	$6,203,473	$6,203,473

	Item	Unit	Shared Use	Dedicated Use
30.03	Heavy Maintenance Facility	Lump Sum	$29,776,674	$37,220,844
30.04	Storage or Maintenance-of-Way Building	N/A	N/A	N/A
30.05	Yard and Yard Track	Lump Sum	N/A	N/A
40 Sitework, Right-of-Way, Land, Existing Improvements				
40.01	Demolition, Clearing, Site Preparation	Lump Sum	Varies	Varies
40.02	Site utilities, utility relocation	Corridor Mile	$59,000	$59,000
40.03	Hazardous Material, contaminated soil, removal/mitigation, ground water treatments	N/A	N/A	N/A
40.04	Environmental mitigation: wetlands, historic/archeology, parks	Acre	N/A	N/A
40.05	Site structures including retaining walls, sound walls	Track Mile	$2,561,000	$2,561,000
40.06	Temporary facilities and other indirect costs during construction	Lump Sum	N/A	N/A
40.07	Purchase or lease of real estate	Lump Sum	Varies	Varies
40.08	Highway/pedestrian overpass/grade separation	Lump Sum	Varies	Varies
40.09	Relocation of existing households and businesses	Lump Sum	Varies	Varies
50 Communications & Signaling				
50.01	Wayside signaling equipment	Corridor Mile	$970,000	$970,000
50.02	Signal power access and distribution	Corridor Mile	$5,500	$5,500
50.03	On-board signaling equipment	Each	$400,000	$400,000
50.04	Traffic control and dispatching systems	Each	$9,000,000	$9,000,000
50.05	Communications	Corridor Mile	$555,000	$555,000
50.06	Grade crossing protection			
50.06.01	Public At-Grade	Each	$411,000	$411,000
50.06.02	Private At-Grade	Each	$293,000	$293,000

	Item	Unit	Shared Use	Dedicated Use
50.07	Hazard detectors: dragging equipment high water, slide, etc.	Corridor Mile	$7,500	$7,500
50.08	Station train approach warning system	Each	$137,500	$137,500
60 Electric Traction				
60.01	Traction Power Transmission: High Voltage	Corridor Mile	$60,400	$60,400
60.02	Traction Power Supply: Substations	Corridor Mile	$1,800,000	$1,800,000
60.03	Traction Power Distribution: Catenary and third rail	Track Mile	$3,600,000	$3,600,000
60.04	Traction Power Control	Corridor Mile	$1,625,000	$1,625,000
70 Vehicles				
70.00	Vehicle Acquisition: Electric Locomotive	N/A	N/A	N/A
70.01	Vehicle Acquisition: Non-Electric Locomotive	N/A	N/A	N/A
70.02	Vehicle Acquisition: Electric Multiple Unit			
70.02.01	Electric Multiple Unit (EMU)	Each	N/A	$43,450,000
70.02.02	Maglev Unit	Each	N/A	$79,290,000
70.03	Vehicle Acquisition: Diesel Multiple Unit	Each	$32,500,000	N/A
70.04	Vehicle Acquisition: Loco-hauled passenger cars with ticketed space	N/A	N/A	N/A
70.05	Vehicle Acquisition: Loco-hauled passenger cars without ticketed space	N/A	N/A	N/A
70.06	Vehicle Acquisition: Maintenance of Way Vehicles	N/A	N/A	N/A
70.07	Vehicle Acquisition: Non-railroad support vehicles	N/A	N/A	N/A
70.08	Vehicle Refurbishment: Electric Locomotive	N/A	N/A	N/A
70.09	Vehicle Refurbishment: Non-Electric Locomotive	N/A	N/A	N/A

HNTB

	Item	Unit	Shared Use	Dedicated Use
70.10	Vehicle Refurbishment: Electric Multiple Unit	N/A	N/A	N/A
70.11	Vehicle Refurbishment: Diesel Multiple Unit	N/A	N/A	N/A
70.12	Vehicle Refurbishment: Loco-hauled passenger cars with ticketed space	N/A	N/A	N/A
70.13	Vehicle Refurbishment: Non-passenger Loco-hauled car without ticketed space	N/A	N/A	N/A
70.14	Vehicle Refurbishment: Maintenance of Way Vehicles	N/A	N/A	N/A
70.15	Spare Parts	Lump Sum	N/A	N/A
80 Professional Services				
80.01	Service Development/Service Environmental	2% of Total Cost	Varies	Varies
80.02	Preliminary Engineering/Project Environmental	4% of Total Cost	Varies	Varies
80.03	Final Design	4% of Total Cost	Varies	Varies
80.04	Project Management for Design and Construction	4% of Total Cost	Varies	Varies
80.05	Construction Administration & Management	6% of Total Cost	Varies	Varies
80.06	Professional Liability and other Non-Construction Insurance	N/A	Varies	Varies
80.07	Legal; Permits; Review Fees by Other Agencies, Cities, etc.	N/A	Varies	Varies
80.08	Surveys, testing, investigation	2% of Total Cost	Varies	Varies
80.09	Engineering Inspection	2% of Total Cost	Varies	Varies
80.10	Start Up	N/A	Varies	Varies

3.2.3 DETAILED METHODOLOGIES

3.2.3.1 Shared Use and Dedicated Use Track

Shared Use

In Shared Use corridors, the passenger operation involves passenger trains operating on existing freight routes and tracks. This requires coordination with freight train volumes. This study uses the assumption that passenger trains will not restrict the current or future freight operations and schedules.

Below are assumed values for current freight densities for the various freight segments that could have future passenger service. The density values are daily weighted averages for the entire route and can be seen in Table 3-12. Daily weighted average is defined as the average density over the entire route and is determined by multiplying the density by the distance over which it operates. Summing these values over the route and dividing by the total length provides the "weighted "average of density on the entire route. For the purposes of calculation, the study assumes that a typical carload is 60 gross tons, in which typical trains consist of two locomotives and 70 cars. Therefore, the following formula was used to calculate the average trains per day for a particular segment length:

$$Daily\ Weighted\ Density\ (trains\ per\ day) = \left(Annual\ Million\ Gross\ Tons\ * \left(\frac{1}{60}\right) * \left(\frac{1}{70}\right) * \left(\frac{1}{365}\right)\right) * Route\ Length.$$

These daily weighted densities were then summed and divided by the total corridor length to equal the corridor weighted average.

Table 3-12 Current Corridor Freight Densities

Corridor	Railroad Owner	Density (trains/day)
Atlanta – Birmingham	NS	26.3
Atlanta – Jacksonville	NS S-Line	2.5
	NS H-Line	43.4
	Georgia Central Railroad	0.8
	CSXT S-Line (Savannah to Richmond Hill)	9.5
	CSXT S-Line (Richmond Hill to Kingsland)	0.3
	CSXT (Callahan to Jacksonville)	65.2
Atlanta – Louisville	CSXT (Atlanta to Chattanooga)	29.0
	NS (Atlanta to Chattanooga)	45.0
	CSXT (Chattanooga to Nashville)	22.5
	CSXT (Nashville to Louisville)	22.5
	Private (Chattanooga to Harriman)	45.0
	Nashville & Eastern	12.0
	NS (Chattanooga to Danville)	45.0
	NS (Danville to Louisville)	25.0

For the purposes of this feasibility study, the study assumed current freight operations will grow by the percentages outlined in Table 3-13. This percentage reflects the growth through 2035 and is taken from the *National Rail Freight Infrastructure Capacity and Investment Study* (September 2007).

Table 3-13: Future Freight Density Increases

Corridor	Railroad Owner	Density Increase (through 2035)	2035 Freight Density (trains/day)	2040 Freight Density Estimate[10]
Atlanta – Birmingham	NS	100%	52.6	52.9
Atlanta – Jacksonville	NS S-Line	50%	3.6	3.9
	NS H-Line	100%	86.8	87.1
	Georgia Central Railroad	50%	1.2	1.4
	CSXT S-Line (Savannah to Richmond Hill)	50%	14.2	14.4
	CSXT S-Line (Richmond Hill to Kingsland)	50%	0.5	0.6
	CSXT (Callahan to Jacksonville)	100%	130.4	130.7
Atlanta – Louisville	CSXT (Atlanta to Chattanooga)	100%	58.0	58.3
	NS (Atlanta to Chattanooga)	100%	90.0	90.3
	CSXT (Chattanooga to Nashville)	100%	45.0	45.3
	CSXT (Nashville to Louisville)	100%	45.0	45.3
	Private (Chattanooga to Harriman)	50%	67.5	67.7
	Nashville & Eastern	50%	18.0	18.2
	NS (Chattanooga to Danville)	100%	90.0	90.3
	NS (Danville to Louisville)	50%	37.5	37.7

Chapter 3.4 explains the calculations behind estimating passenger train frequency. However, as a rule, higher ridership associated with faster options support more train frequencies, along with larger, more efficient trains. Train size and frequency are increased together to accommodate the ridership increase. Therefore, an

[10] 2040 Freight Density Estimates were extrapolated using the Average Annual Growth Rate (AAGR) between 2010 and 2035.

iterative approach was used to identify the optimal investment and operating strategy for each of the three corridors.

As will be seen in Section II-IV, the corridors have unique characteristics and ridership patterns that lead to estimating corridor frequencies. This study optimizes ridership and frequencies based on these unique characteristics. The passenger train frequency estimates below illustrate the preliminary train frequency estimates that were then used to help calculate the necessary capacity improvements along each corridor.

- Atlanta – Birmingham Corridor: 6 round trips (12 trains/day)
- Atlanta – Macon – Jacksonville: 8 round trips (16 trains/day)
- Atlanta – Chattanooga: 16 round trips (32 trains/day)
- Chattanooga – Nashville: 10 round trips (20 trains/day)
- Nashville – Louisville: 5 round trips (10 trains/day)

Based on these passenger rail densities in combination with the projected freight densities, the density values in Table 3-14 were used to develop the necessary capacity improvements.

Table 3-14: Evaluated Corridor Densities

Corridor	Railroad Owner	Evaluated Density
Atlanta – Birmingham	NS Crescent	64.6
Atlanta – Jacksonville	NS S-Line	21.0
	NS H-Line	102.8
	Georgia Central Railroad	13.6
	CSXT S-Line (Savannah to Richmond Hill)	31.0
	CSXT S-Line (Richmond Hill to Kingsland)	16.6
	CSXT A-Line (Callahan to Jacksonville)	142.4
Atlanta – Louisville	CSXT (Atlanta to Chattanooga)	74.0
	NS (Atlanta to Chattanooga)	106.0
	CSXT (Chattanooga to Nashville)	57.0
	CSXT (Nashville to Louisville)	53.0
	Private (Chattanooga to Harriman)	79.5
	Nashville & Eastern	30.0
	NS (Chattanooga to Danville)	102.0
	NS (Danville to Louisville)	45.5

In developing a capital cost estimate, the study made the following assumptions and took the following approach to increasing track capacity to accommodate current and future freight operations and proposed passenger service:

- Freight railroads will require access to any track infrastructure the proposed passenger service builds on private railroad property;
- Existing mainline and siding tracks will be completely replaced with 136-pound CWR and concrete ties;
- All mainline turnouts will be replaced with power turnouts and passing sidings will require No. 20/24[11] power turnouts;
- Minimum freight sidings are two miles and passenger sidings are 10 miles;
- Universal crossovers should be No. 20/24; and
- Proposed track centers are 20-feet.

Table 3-15 illustrates the methodology for increasing track capacity on the various existing track corridors based on the evaluated densities outline in Table 3-14.

[11]No. 20/No. 24 refers to the specific angle of the diversion of the train movement. Larger turnouts reflect higher traveling speeds.

Table 3-15: Capacity Improvement Methodology

Average Trains/Day[12]	Existing # of Main tracks	New Signal System	Track Improvement
≤ 30	1	PTC	Upgrade existing mainline track to Class 6 standards
			Upgrade and extend all sidings to lengths of 2 miles
			Maintain a minimum siding spacing of 8-10 miles
			Add 10 mile passenger siding every 50 miles
			Upgrade all mainline turnouts to power turnouts
30 < x ≤ 75	1	PTC	Upgrade existing mainline track to Class 6 standards
			Connect all sidings creating a double track system
			Space double crossovers every 12 miles
			Upgrade all mainline turnouts to power turnouts
75 < x ≤ 100	2	PTC	Upgrade existing mainline tracks to Class 6 standards
			Space double crossovers every 8 miles
			Upgrade all mainline turnouts to power turnouts
100 < x ≤ 135	2	PTC	Upgrade existing mainline tracks to Class 6 standards
			Add third track
			Space double crossovers every 12 miles
			Upgrade all mainline turnouts to power turnouts

[12] Average trains/day based on future freight density plus proposed passenger service trains

Dedicated Use

In Dedicated Use corridors, the passenger operation involves passenger trains operating on dedicated routes and tracks. This separates passenger service from existing and future freight operations.

However, in "last mile" situations where passenger trains enter and exits city stations such as Atlanta, Macon, Savannah, Jacksonville, Birmingham, Chattanooga, Nashville and Louisville, the study assumed passenger trains will operate on sealed corridors at reduced speeds (110 mph). A sealed corridor does allow for at-grade crossings. Typically, the passenger rail will utilize an existing freight corridor route and purchase additional right-of-way to approach the destination station. For the purposes of this feasibility study, the study assumed that the dedicated technology cannot operate on existing freight tracks and vice versa.

Again based on the iterative approach and taking into consideration the unique characteristics and ridership patterns of each of the three study corridors, the passenger train frequency estimates for the three corridors follows:

- Atlanta – Birmingham: 10 round trips (20 trains/day)
- Atlanta – Macon – Jacksonville: 14 round trips (28 trains/day)
- Atlanta – Chattanooga: 28 round trips (56 trains/day)
- Chattanooga – Nashville: 20 round trips (40 trains/day)
- Nashville – Louisville: 12 round trips (24 trains/day)

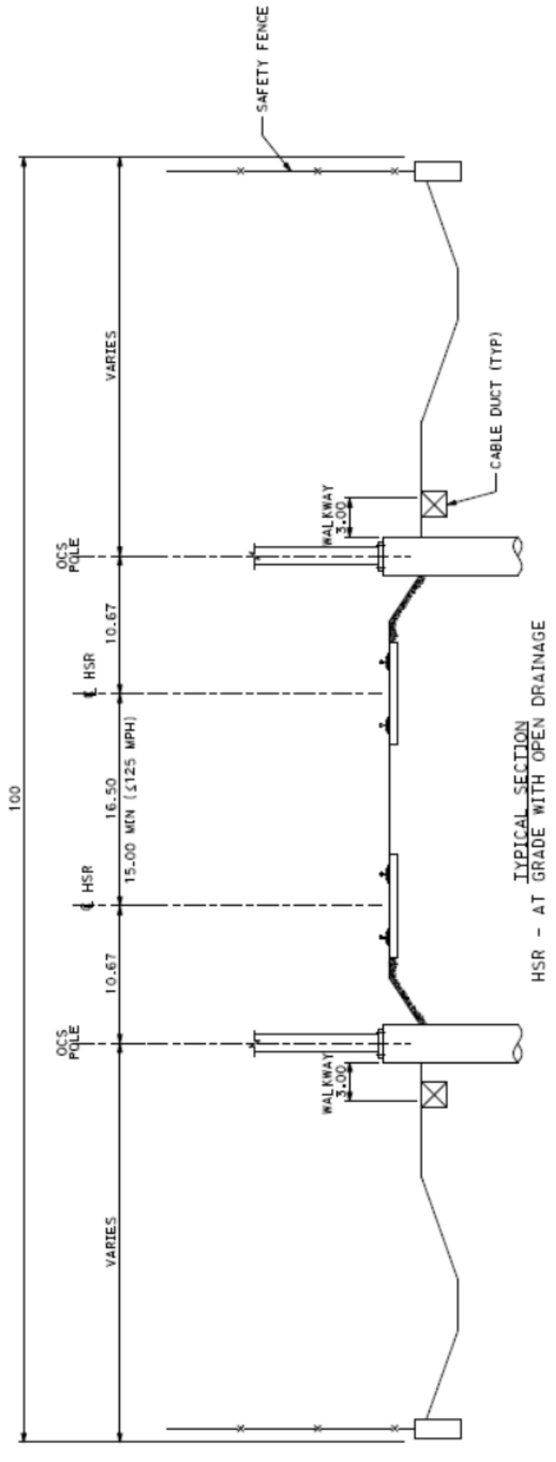
To develop a capital cost estimate, the study made the following assumptions and took the following approach for constructing dedicated track infrastructure:

- Double track corridors for bi-directional operation;
- Build track to FRA Class 9 standards;
- Track will be 136-pound CWR on concrete ties;
- Universal crossovers should be No. 24 or greater and spaced every 25 miles for the purpose of maintenance; and
- Proposed track centers are 16.5 feet with a minimum of 15 feet in segments[13] where speed is reduced to less than 125 mph.

Figure 3-1 through Figure 3-4 demonstrate the various types of typical sections applied to various segments along the dedicated corridors.

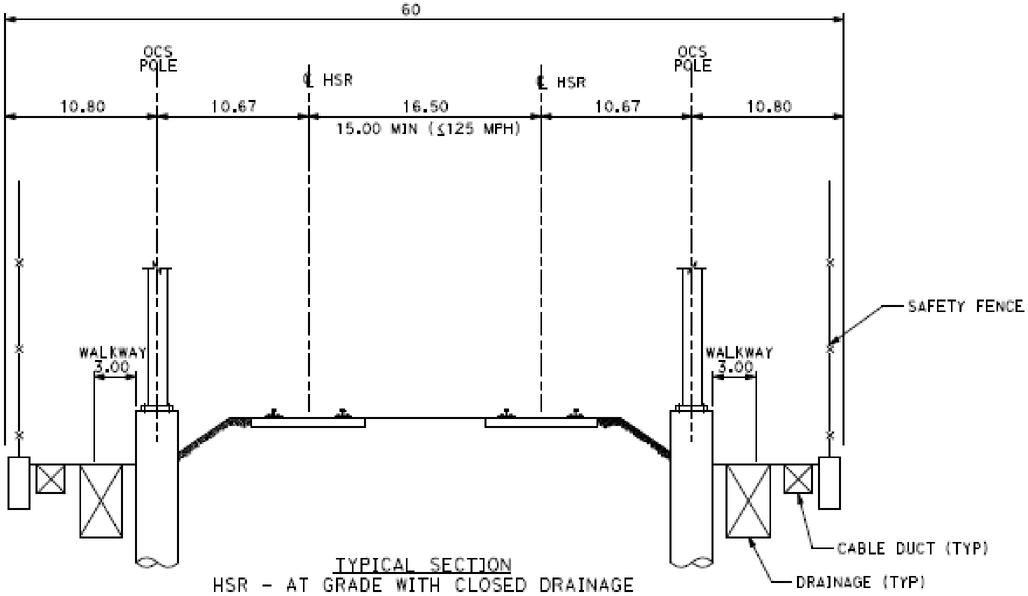
[13] This is not an industry standard and is not required by FRA

Figure 3-1: At-Grade, Open Drainage Typical Section



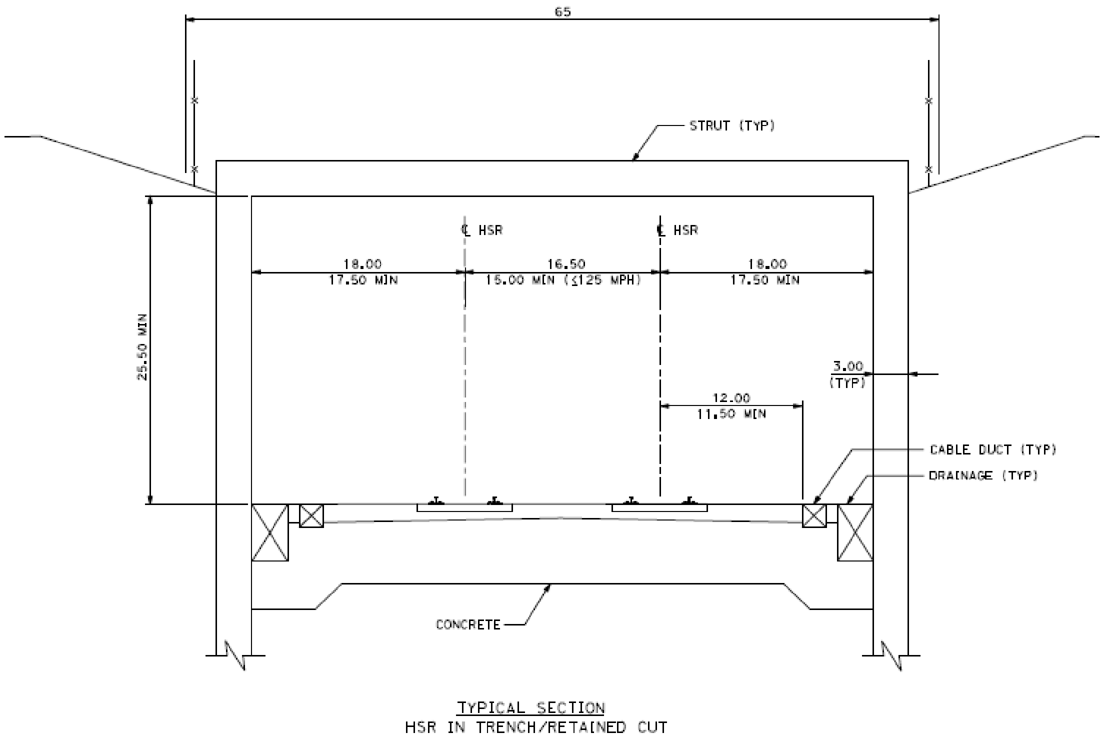
Source: California High-Speed Train: Project Environmental Impact Report (2010)

Figure 3-2: At-Grade, Closed Drainage Typical Section



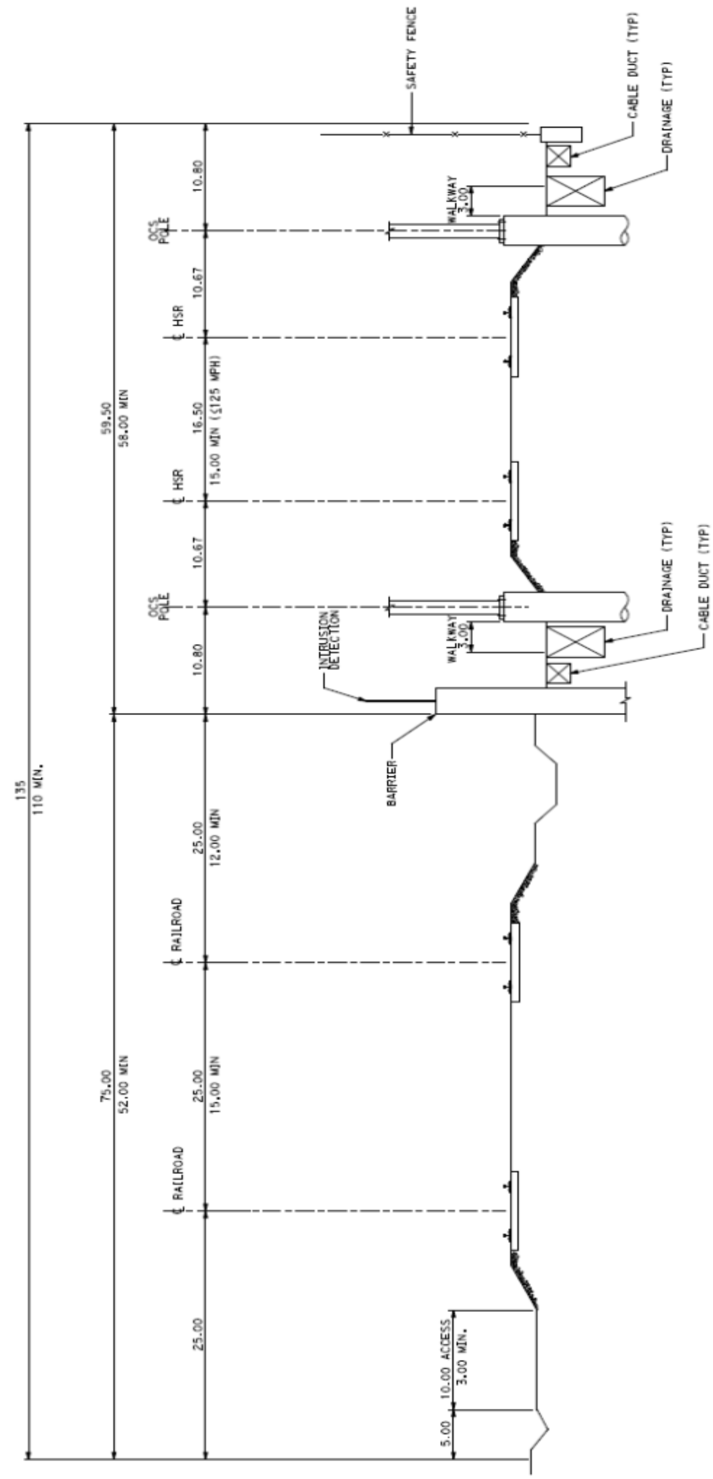
Source: California High-Speed Train: Project Environmental Impact Report (2010)

Figure 3-3: Trench/Retained Cut Typical Section



Source: California High-Speed Train: Project Environmental Impact Report (2010)

Figure 3-4: Dedicated Track within Existing Freight Corridor Typical Section



Source: California High-Speed Train: Project Environmental Impact Report (2010)

3.2.3.2 Track Geometry

The general basis of the route design was to follow best practices of the current high-speed rail liens (i.e., Japanese and European) as well as the guidance of the International Union of Railways (UIC) and the Manual of Railway Engineering of the American Railway Engineering and Maintenance Association (AREMA). The study also utilized the current American projects in California and Florida.

Shared Use

Shared Use geometry will be limited to the existing track horizontal and vertical geometry. For this feasibility study, the study did not perform any analysis associated with easing curves for better travel times, as this would have been too involved for this level study.

It is recommended that this be looked at further as a part of future detailed studies if the corridors are determined feasible for further analysis. Future engineering can study a number of factors to increase the travel times on the existing freight corridors including decreasing the degree of curvature, lengthening spirals, and increasing super-elevation.

Dedicated Use

Dedicated Use geometry was more in-depth due to greater design speeds (125 mph < 200 mph). Again, it was not within the scope of the feasibility study to create a detailed horizontal route. However, for this study, the study utilized the following geometry characteristics:

- Maximum degree of curve is 0°30’00”;
- Maximum super-elevation is six (6) inches *(Applied super-elevation plus under balance)*;
- Maximum length of spiral is 1,500 feet (*based on* $1.63*E_a*V$ *and* E_a*=4”, V=220 mph);* and
- Minimum length of a segment is 600 feet.

It should be noted that the spiral length stated above is stated as information only. Length of spiral is individually calculated for each curve based on type of spiral, design speed, applied super-elevation and degree of curve. It is outside the scope of the feasibility study to design each curve and determine an acceptable spiral length. This exercise will be required at a later phase of design.

For vertical grade, the only factor that was considered at the feasibility level was the corridor grade. The desirable ruling grade should be 1.25 percent with a maximum of 2.5 percent.

3.2.3.3 Interstate Interchanges

The vertical routes of intercity passenger rail, high-speed rail, and Maglev are usually less flexible in their rate of change and maximum percent grades than local roads and interstate highways. For example, intercity passenger rail systems typically have a maximum grade of two percent, compared to interstate highways with a maximum grade of four percent (with exceptions). Preferred operating grades for high-speed rail also do not exceed two percent, although current systems do have instances of grades up to six percent with lower operating speeds.

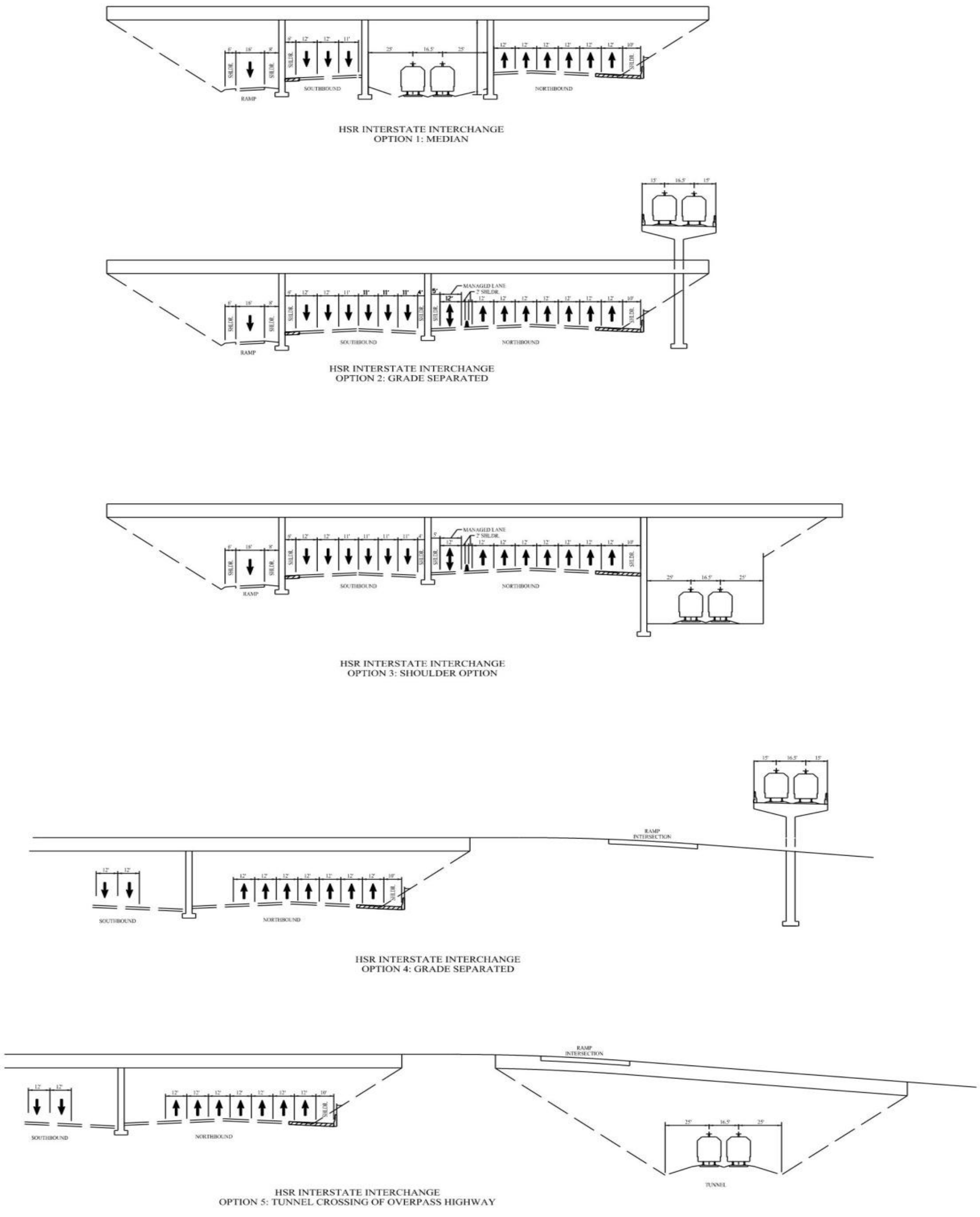
Costs for interstate interchanges can reach $100 million per grade separation, depending upon the characteristics of the interchange and the incoming route of the high-speed rail system. This large range in cost is due to the minimal percent vertical grades that allow high-speed rail systems to achieve their top speeds as mentioned previously. The minimal vertical change in route results in lengthy retaining walls and other approach structures and lengthy overpasses. Therefore, in most interchange scenarios, it is proposed that the highways and interstates are elevated over the high-speed rail route.

The Atlanta-Chattanooga-Nashville-Louisville and Atlanta-Birmingham Corridors both locate routes in rolling hills, eroded plateaus, and mountainous terrain resulting in a combination of interchange types. For this feasibility study, Table 3-16 and Figure 3-5 outline the interchange details and costs that were used based on the scenario.

Table 3-16: High-Speed Rail Interchange Options

Option	Description	Cost (in millions)
Flyover Structures	High-speed rail flyover shoulder to half multi-lane into interstate median	$95
	High-speed rail flyover half multi-lane into median to shoulder	$95
	High-speed rail flyover shoulder across entire multi-lane to shoulder	$150
Bridge	High-speed rail bridge over an interchange	$23
	High-speed rail bridge over and away from interchange	$23
Grade Under	High-speed rail grade under interchange	$93
	High-speed rail grade under intersecting roadway/ramp	$3

Figure 3-5: High-Speed Rail Interchange Option Details



Source: California High-Speed Train: Project Environmental Impact Report (2010)

3.2.3.4 At-Grade Crossings

Shared Use

In Shared Use corridors, the passenger operation involves passenger trains operating in sealed corridors. Sealed corridors affect every public and private at-grade crossing in order to maintain a specific level of protection.

For the purpose of this feasibility study, all public at-grade crossings will be upgraded to quad gates, flashing lights, and audible bells activated by constant warning time system that adjusts for different train speeds. All private crossings will be upgraded to single gates, flashing lights, and audible bells activated by the constant warning system.

This feasibility study assumes all at-grade crossings will remain open and that all crossings will need to be upgraded to the proposed audible bell warning system.

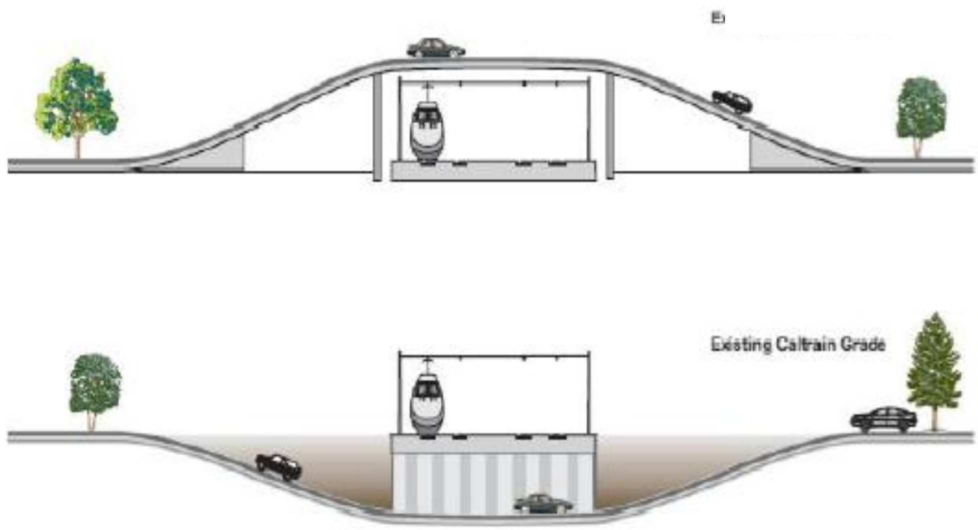
Dedicated Use

In Dedicated Use corridors, the passenger train operates within a corridor that has no at-grade crossings, eliminating any potential risk for interference between roadways and rail operations. The corridor will require every public and private at-grade crossing to be grade separated (or closed).

For the purposes of this feasibility study, all public at-grade crossings will remain open and will be grade-separated. Approach and various types of grade separations are discussed in Section 3.2.3.6. All private crossings will be closed and access will need to be realigned. It was determined at the beginning of the study that grade separating private crossings would not be cost effective.

This feasibility study assumes that all public crossings will be road over rail (Figure 3-6). This is primarily based on the fact that roadway horizontal and vertical geometry standards are much more flexible than typical railroad geometry standards. In addition, typical highways structures have lower associated costs than railroad structures.

Figure 3-6: Typical Grade Separations (Overpass and Underpass)



Source: California High-Speed Train: Project Environmental Impact Report(2010)

3.2.3.5 Earthwork

In Shared Use routes, where passenger trains share track with freight operations, the existing corridors may or may not have been graded for additional track infrastructure. Therefore, the standards for earthwork will vary along the corridor depending on the time period of the work. In Dedicated Use routes, the passenger operations will commence on new infrastructure where no previous earthwork (in most cases) has been completed.

Due to the variables and requirements of doing field investigations and evaluating terrain information, the study relied solely on information developed by Federal and State agencies to classify terrain. The following categories and definitions were used for all three corridors as outline by the Geometric Design Projects for Highways (ASCE Press, 2000):

- **Flat:** conditions where sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expense;
- **Coastal:** conditions similar to Flat Terrain with the addition of wetland and marsh areas that may require frequent elevation;
- **Rolling:** conditions where the natural slopes consistently rise above and fall below the rail grade and where occasional steep slopes offer some restriction to normal horizontal and vertical route; and
- **Mountainous:** conditions where longitudinal and transverse changes in the elevation of the group with respect to rail are abrupt and where benching

and side hill excavation is frequently required to obtain acceptable horizontal and vertical route.

Unit Costs

The unit cost for each classification was based on the Coastal and Flat terrain types. These two types of terrains pose the least amount of earthwork challenges and are the basis of an ideal condition. Coastal and Flat terrain classifications will be considered FRA Standard Cost Category Item 10.06 Track Structure: At-Grade (grading and subgrade stabilization). Refer to Section 3.2.3 for detailed unit cost development.

At the feasibility study level, the study had limited information on existing elevations, existing and proposed vertical track routes, soils and several other variables related to earthwork. Therefore, the study used a factor approach for Rolling and Mountainous terrain classifications. The following factors were applied:

- Rolling: Factor of 1.5
- Mountainous: Factor of 3

These terrain locations will be classified under FRA SSC 10.05 Track Structure: Cut and Fill (>4 feet height/depth) as 10.05.01 Rolling and 10.05.02 Mountainous.

3.2.3.6 Structures

Table 3-17 outlines the structural costs along each corridor. All costs, except the viaduct, are calculated based on Cost/Linear Foot of Track. Bridges built for double tracks should multiply by two to account for the second track.

Table 3-17: Structure Costs

Structure	Assumption	Unit Cost (in millions)
Rail over Interstate	196-foot span with a center pier, using Deck Plate Girders	$1.76
Rail over major roadway	156-foot span with a center pier, using Deck Plate Girders	$1.40
Rail over minor roadway	72-foot clear span, using Deck Plate Girders	$0.68
Rail over major waterway	120-foot clear span, using Deck Plate Girders. If waterway can be traversed with 120-foot span, enter as multiple bridges placed end to end	$1.10
Rail over major water way (greater than 120-foot spans)	120-150 foot span using Through-Plate Girders	$0.012/Linear Foot of Track
	150-350 foot span using Through Truss	$0.025/Linear Foot of Track
Rail over minor waterway	24-foot clear span using Concrete Slab Bridge. If waterway can be traversed with 24-foot spans, enter as multiple bridges placed end to end.	$0.11
Viaduct Guideway	All viaducts will be built 50-feet wide to accommodate two tracks, for either immediate or future use	$0.009/Linear Foot of Track

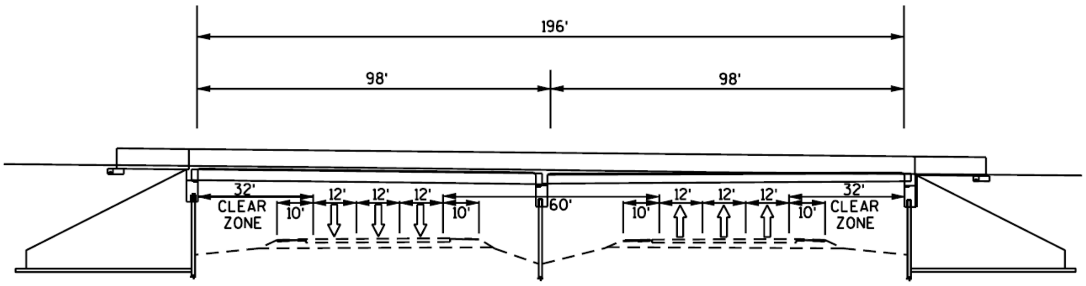
Costs were developed using the following planning-level unit costs by structure type in Table 3-18. Costs are by linear foot of single track. For bridges containing two tracks, costs should be doubled to calculate a cost for the linear foot of the bridge.

Table 3-18: Unit Cost by Structure Type

Structure Type	Maximum Span (feet)	Cost/Foot of Track
Concrete Slab	24	$4,500
30" Double Cell Box Beam	35	$5,500
42" Double Cell Box Beam	49	$6,000
Wide Flange Deck Girder	65	$7,000
Deck Plate Girder	120	$9,000
Through Plate Girder	150	$12,000
Truss	350	$25,000

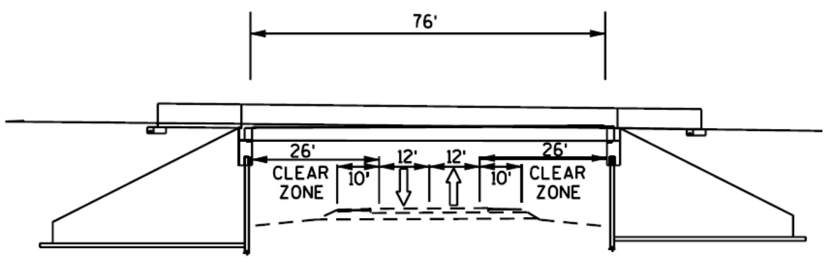
For bridges crossing roadways, the structures are sized to span the roadway and the roadside Clear Zone. This is specified as the desired practice whenever practical, in the GDOT *Bridge and Structures Design Policy Manual*, Section 2.3.2, and the AASHTO's *Roadside Design Guide* and is detailed in Figure 3-7 through Figure 3-11.

Figure 3-7: Interstate Crossing



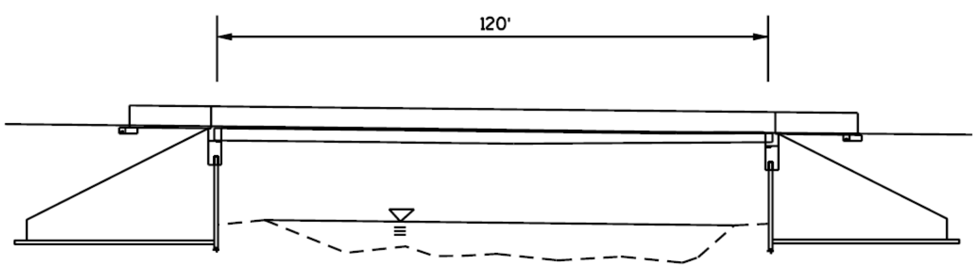
- Uses a 156-foot span with a center pier, using Deck Plate Girders
- $9,000/linear Foot of Track
- 156' X $9,000/FT of Track = $1,404,000

Figure 3-8: Minor Roadway



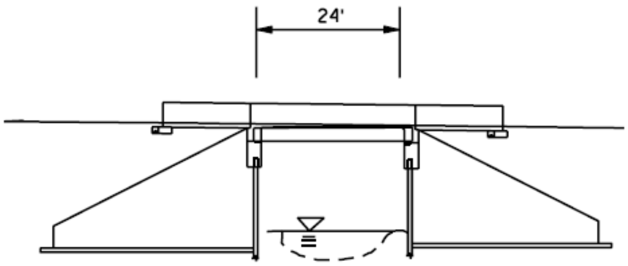
- Uses a 76-foot clear span, using Deck Plate Girders
- $9,000/Linear Foot of Track
- 76' X $9,000/FT of Track = $684,000

Figure 3-9: Major Waterway



- Uses a 120-foot clear span, using Deck Plate Girders
- $9,000/Linear Foot of Track
- 120' X $9,000/FT of Track = $1,080,000

Figure 3-10: Minor Waterway

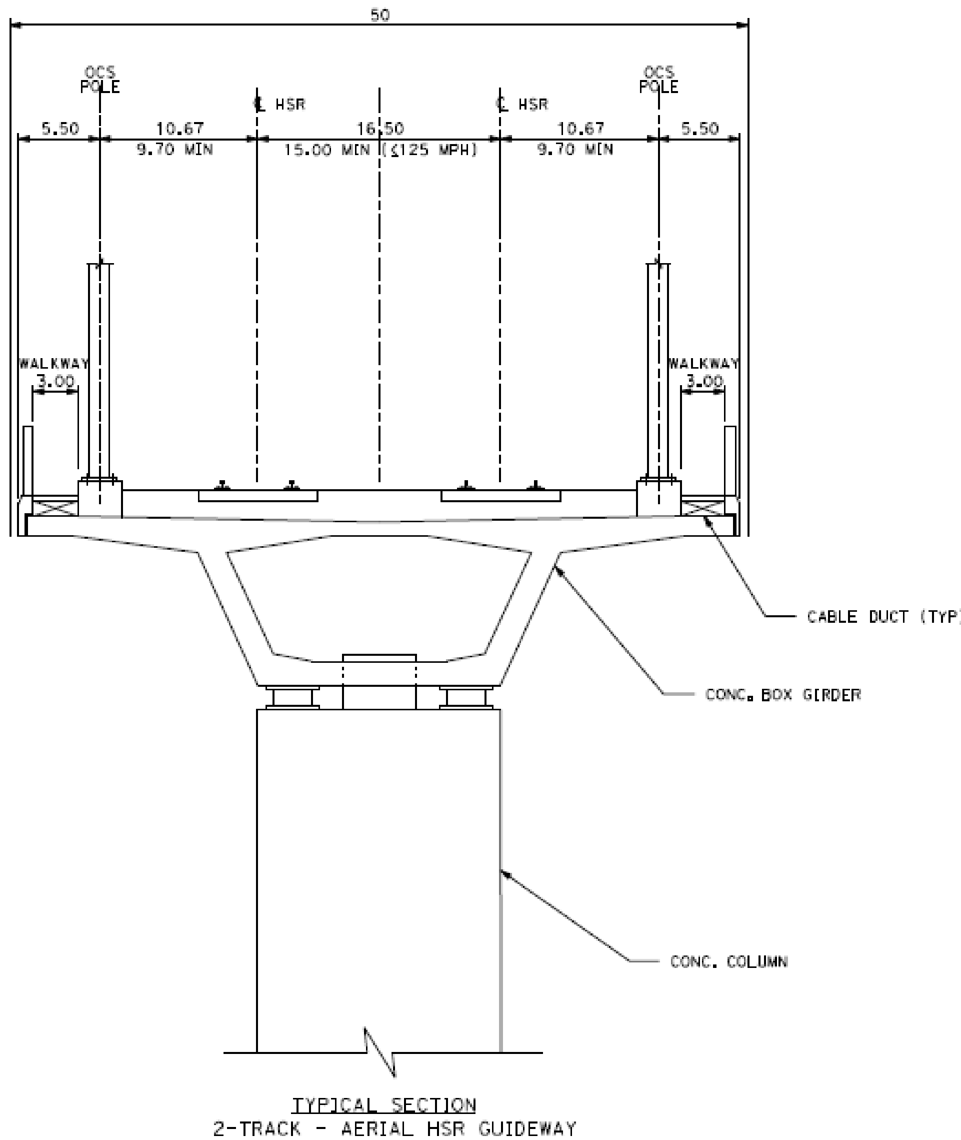


- Uses a 24-foot clear span, using Concrete Slab Bridge
- $4,500/Linear Foot of Track
- 24' X $4,500/FT of Track = $108,000

If spans are required that are greater than 120 feet, use the following:

- Spans 120-150 feet, Through-Plate Girders: $12,000/Linear Foot of Track
- Spans 150-350 feet, Through Truss: $25,000/Linear Foot of Track

Figure 3-11: Viaduct Guideway



Source: California High-Speed Train: Project Environmental Impact Report (2010)

For the purposes of this planning level effort, viaducts are considered to be structures that consist of many short spans that are typically the same length, built over land, in easily accessible urban areas. Structures of this type have receptive spans and substructures. Because of this, viaducts offer a significant cost savings due to economies of scale for bridge components and efficiencies for construction.

- Uses a 60-foot span with Concrete Box Girder
- $4,418/Linear Foot of Track
- All viaducts can accommodate two tracks
- 2 Tracks X $4,418/FT of Track = $8,828/Linear Foot of Bridge

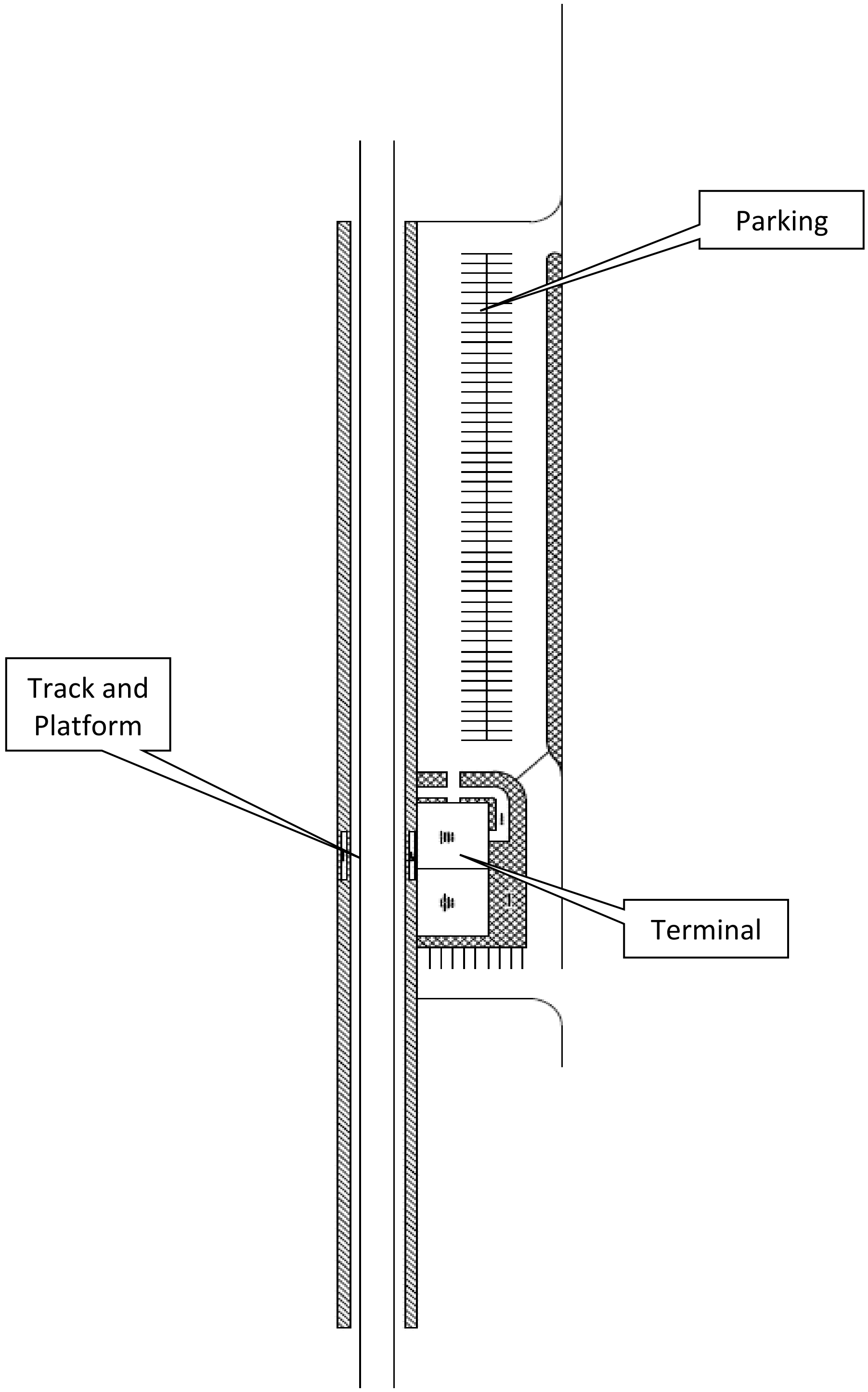
3.2.3.7 Stations

The study assumes that unless plans are underway for a proposed station, the station buildings will be based on a typical Intermediate footprint. Unit of measure was based on square foot of the proposed building and covers the construction of the station. Additionally, costs were generated for elevators, platforms, fare collections and other miscellaneous items. For larger stations that are proposed under alternative plans, the total cost will be assumed for this feasibility study. These stations include:

- MMPT;
- H-JAIA
- Birmingham Multimodal Terminal; and
- Jacksonville Multimodal Terminal.

For the purposes of this feasibility study, the study has assumed all Intermediate stations (those not already under current plans) will be classified as Amtrak "Medium" stations and will be approximately 6,600 sq. ft. buildings. Based on other studies and sources for typical building construction costs, the unit cost for stations was $215/sq. ft. It should be noted, that this cost was considered Conservative in nature. At this time, no elevators or escalators and overhead bridges above the track are included in the station base cost. If the Intermediate station requires any of these items, they will need to be added into the correct categories in subsequent studies. Figure 3-12 illustrates a typical Intermediate station cost.

Figure 3-12: Intermediate Station Footprint



3.2.3.8 Right-of-Way/Real Estate

The feasibility study evaluated five uses of property; existing railroad rights-of-way, highway rights-of-way, the GRIP network in Georgia, power and other utility corridors and "greenfield" routes.

The costing approach for Shared Use situations involved determining the property value of the existing railroad right-of-way based on adjacent land values. This land value was included in corridor cost estimates to address the public use of the privately-owned railroad right-of-way. The study assumed construction of new passenger tracks can generally occur inside existing railroad right-of-way. For situations where new passenger track does not fit inside the railroad right-of-way, an assumed additional 50-ft of property was added. In isolated situations where more detailed engineering will be done at the feasibility level, this approach was modified to better reflect the specific area.

The use of state-owned highway rights-of-way will generally have no cost impact. The costing methodology assumes that right-of-way or air rights will be granted by the various state transportation agencies at no cost to the passenger rail system.

The costing approach for existing utility rights-of-way will also be based on adjacent property values. A right-of-way width of 100 feet was assumed for passenger rail service. Ultimate compensation will be determined during negotiations with the host utility company.

Right-of-way cost approach for Dedicated Use (greenfield) situations will be based on existing property values. A right-of-way width of 100 feet was assumed for passenger rail service. For "last-mile" situations, the study used engineering judgment to decide if two new dedicated tracks can be constructed parallel to the existing freight tracks. The assumption is that an agreement can be obtained with the existing freight railroads to build proposed future capacity improvements. The general approach will be to parallel the existing freight centerline of track at a specified distance.

The study utilized the GDOT Office of Planning right-of-way value database and other similar databases in neighbor states as appropriate to determine property values. The use of property was separated into the following categories in Table 3-19.

Table 3-19: Real Estate Cost Items

40.07	Purchase or Lease of Real Estate		
	Subcategory	Item	Definition
	40.07.01	Railroad Owned – Urban	Corridor route on urban railroad owned property
	40.07.02	Railroad Owned – Rural	Corridor route on rural railroad owned property
	40.07.03	Utility Owned – Urban	Corridor route on urban utility owned property
	40.07.04	Utility Owned – Rural	Corridor route on rural utility owned property
	40.07.05	State Owned	Existing interstate, highway and GRIP rights-of-way
	40.07.06	Land Acquisition – Urban	Purchase of urban designated property
	40.07.07	Land Acquisition – Rural	Purchase of rural designated property

3.2.3.9 Signaling and Communication

Shared Use

The existing freight corridors already have signaling and communications in place. These systems could be Track Warranted Control (TWC), Automatic Block Signals (ABS), or Centralized Traffic Control (CTC).

FRA requires all signaling and communications for passenger service to have Positive Train Control (PTC) signal and communication network. Currently, no existing freight railroad has implemented PTC. Therefore, all existing railroad signaling and communications along the three corridors will require upgraded or replacement equipment in order to implement the Shared Use passenger service.

Upgrading or replacing existing signaling will involve new signals, signal houses, relays, cable, pull boxes, track circuits, etc. The following assumptions were used to determine the required signal improvements:

- Any existing freight line with ABS or TWC will receive a complete new signaling system;
- Even in areas where there is an existing CTC system in place, the communications will need to be fully upgraded to handle a new full PTC system.

Most failures of PTC systems have been caused by the communication network and not the signals. Therefore, for the purpose of this feasibility study, the study assumed that new communications will be required regardless of the existing communication system.

Dedicated Use

Since the Dedicated Use routes are primarily greenfield corridors, the study assumed new PTC signaling and communication will be required for the entire route.

3.2.3.10 Cost of Vehicles

Vehicle unit cost estimates, based on developed service plans, was prepared for three generic vehicle technologies: 1) 90-110 mph diesel-electric locomotive and tilt coach technology; 2) 150-220 mph electric multiple unit (EMU) technology; and 3) 250-300 mph Maglev technology.

The diesel-electric technology used in shared-use passenger and freight corridors will be FRA Tier I compliant. Other technologies will operate on dedicated right-of-ways and meet European crashworthiness standards. Vehicle purchase costs (including design) will be included in FRA standard cost category 70 on a cost-per-train set basis. The train set seating capacity was based on the service plan developed for each corridor (typically 400 to 500 seats) and the train set will be ADA accessible including restrooms. Each train set will include a dining/bistro car. All train sets will feature standard amenities including 2x2 seating, video displays, automated station announcement/displays, audio entertainment availability, Wi-Fi internet access and 110 volt power at each seat. Costs for an appropriate number of spare cars and replacement parts will also be included in the estimate.

Costs were blended from several sources as appropriate, and escalated to 2010 dollars using *Engineering News Record* Cost Indices. Sources for the cost estimates include study vehicle experience on the Wisconsin DOT Milwaukee-Madison Corridor Project, the Illinois Chicago to St. Louis Corridor; the California High-Speed Rail Authority Program; the Florida DOT Tampa to Orlando HSR Corridor Program; and other public and proprietary sources.

Representative Train Technologies

1. *90-110 mph Single Level Diesel Electric Tilt Technology*

Figure 3-13: Talgo Series 8

- Talgo Series 8 tilt coaches and two push-pull "Next Generation" 3,000 horsepower, lightweight locomotives
- 184 meters in length, 397 passenger capacity

2. *150-220 mph Single Level Electrified Tilt Technology*

Figure 3-14: Alston AGV and Siemens Velaro EMU (left to right)

- Alstom AGV EMU, 196 meters in length, 450-500 passenger capacity
- Siemens Velaro E EMU, 200 meters in length, 400-600 passenger capacity

3. <u>250-340 mph Transrapid Maglev Technology</u>

Figure 3-15 Transrapid Maglev

- 153 meters in length, 600-650 passenger capacity

3.2.3.11 Professional Services

The costing approach for professional services was based on percentages of the construction cost for categories 10 through 60. Cost category 70: Vehicles will be excluded because professional services for vehicle procurement, design, and manufacturing will be included in the cost of the vehicles.

These percentages are common practice percentages for a feasibility study. The following table (Table 3-20) shows the assumed percentage values that were used for the feasibility study:

Table 3-20: Professional Services Percentages

80 Professional Services		
	Item	Percentage
80.01	Service Development/Service Environmental	2%
80.02	Preliminary Engineering/Project Environmental	4%
80.03	Final Design	4%
80.04	Project Management for Design and Construction	4%
80.05	Construction Administration & Management	6%
80.06	Professional Liability and other non-construction insurance	0%, negligible
80.07	Legal; Permits; Review Fees by other agencies, cities, etc.	2%
80.08	Surveys, testing, investigation	2%
80.10	Start Up	Not applicable

3.2.3.12Contingencies

The study approached contingencies the same way the FRA grant applications approach contingencies during the funding application process. The FRA process allows for different contingencies applied to different cost categories. For the purpose of this feasibility study, the study applied a constant contingency (30 percent) value to the various categories. However, for future refinements and investigations the contingencies for each of the categories can adjust with this type of methodology.

The contingency factor will be large at the conceptual engineering level (generally 30 percent with allowances for special cases). This is primarily based on the fact that average unit costs were used and detailed design analysis was not done.

3.2.3.13Phasing Scenarios for Capital Costs

Once capital costs estimates were complete, the study examined phasing scenarios for the capital costs in order to reduce the initial public investment into the construction and delivery of high-speed rail. Other operational characteristics were not included in these phasing scenarios; therefore, there are no details that support the phases. Detailed capital cost and delivery of service phasing will be more appropriate during the NEPA process, but an introduction to the concept of phasing is included as a part of this feasibility analysis.

3.3 Ridership and Revenue Methodology

This section presents the ridership and revenue forecasting methodology. The key feature of the methodology is the use of binary diversion models to calculate high-speed rail ridership. Each diversion model computes, for each combination of trip purpose, market segment and current model, the probability that a traveler would choose high-speed rail over its current model of travel as a function of the respective modes' service attributes. These probabilities are then multiplied by the trip volumes of the existing modes to predict the volume of travel that will divert to high-speed rail. Induced (new) travel on the high-speed rail mode is also calculated using a generalized cost based on travel utility function directly related to the diversion model. Total high-speed rail ridership is obtained by summing the diverted and induced demand volumes for the individual market segments.

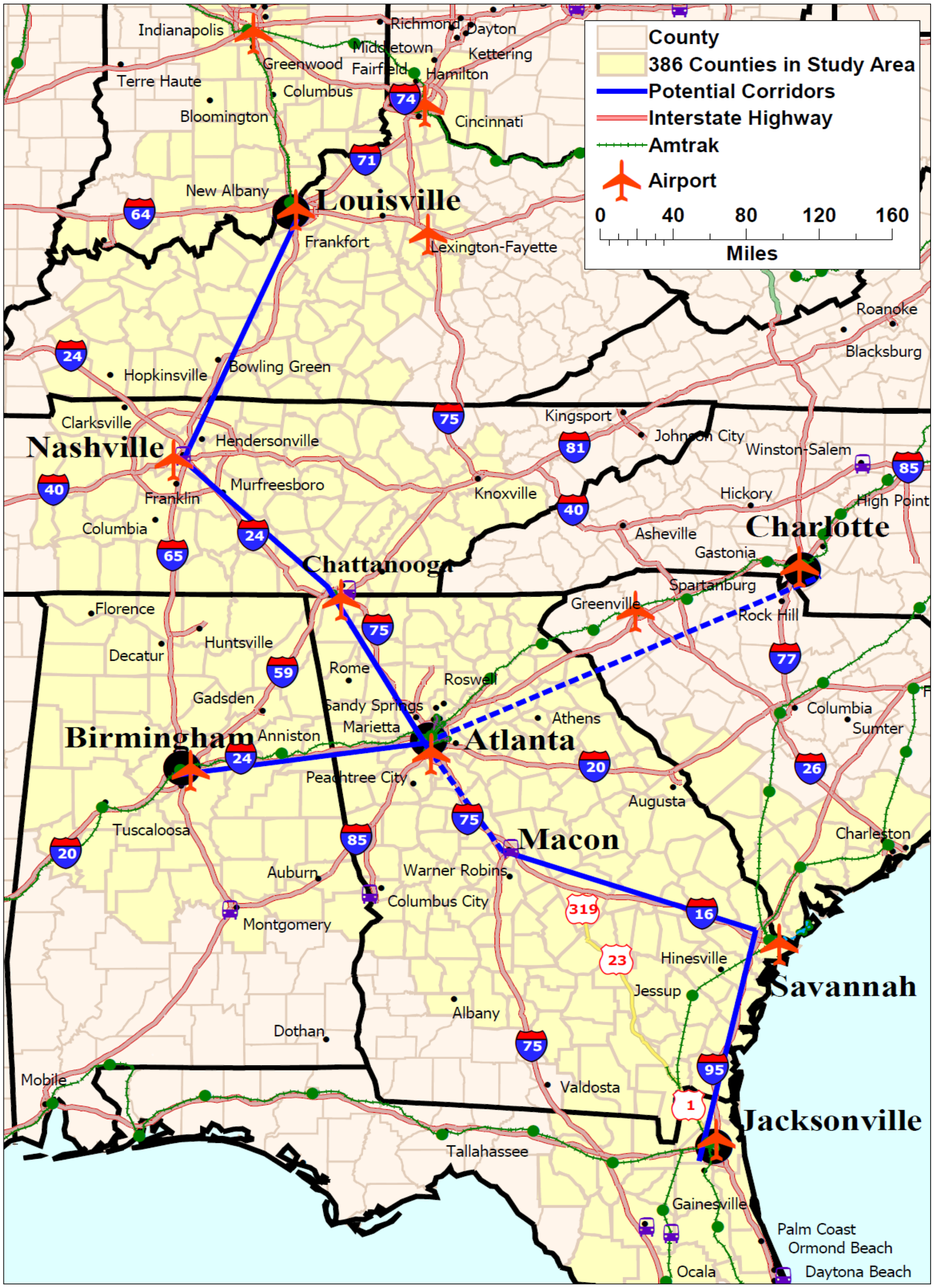
This section begins with a brief description of the geographic scope and the zoning structure used for the demand forecasting, followed by an analysis of the potential markets considered and ending with a presentation of the demand forecasting modeling methodology.

3.3.1 Geographic Scope and Zoning Structure

The demand forecasting task covers a geographic area that follows the three corridors and extends approximately 50 miles on either side of the proposed routes, which is a typical planning assumption for access catchment for high-speed rail services. However, the 50-mile distance is indicative rather than absolute, and was adjusted as appropriate in specific instances to accommodate, for example, important population centers located just outside the 50-mile cut-off.

The area within the geographic boundary created by the process described above was split into a number of zones. Given the size of the study area and the multiple corridors, the zoning structure was at the county level. The total number of counties (zones) including within the study area for all three corridors was 386 zones. This definition of zone provided a good balance between having sufficient granularity to reflect the differences in level of service characteristics for residents of adjacent areas, and the need to model a large area for a feasibility study. The counties included within the study area formed the geographic basis for all subsequent travel demand forecasting analysis performed as a part of this feasibility study. Figure 3-16 shows the straight line routes for the three corridors and counties included as a part of the study area.

Figure 3-16: Geographic Study Area



3.3.2 MARKET ANALYSIS

The first step in forecasting the potential ridership and revenue of the proposed rail service is to estimate the current in-scope travel markets inside the study area. The in-scope travel markets are the key travel markets competing with the proposed high-speed rail service. The three main travel markets have been identified as:

- The inter-urban travel markets;
- The local travel markets; and
- The connect air market.

3.3.2.1 Inter-Urban Travel Market

Inter-urban travel is longer distance travel between major metropolitan areas within the study area (e.g., travel between the counties of the Atlanta urban area and the counties of the Chattanooga urban area). There are three travel markets from which the proposed high-speed rail services my draw their patronage from:

- Automobile travel;
- Bus service; and
- Air service.

Each of these travel markets are described in more detail. However, the quantitative estimates for these markets are presented in each subsequent section describing the corridor-specific results, later in this report.

Automobile Travel

Automobile is the dominate travel mode in the three study corridors. Unfortunately, up to date and reliable inter-urban travel volume data is not available anywhere for the U.S. unless original new data collection efforts are undertaken. Therefore, this study depends on existing sources for quantifying the automobile travel market. Some information exists on specific aspects of inter-urban travel (such as journey-to-word data from the 2000 U.S. Census and 2006-2008 American Community Survey). In the absence of original data collection, the best source of information on inter-urban automobile volumes within these rail corridors is still the 1995 Automobile Travel Survey (ATS). In addition, up-to-date traffic count data are available on major roadways and interstate, which the study used to validate automobile travel volumes calculated from the ATS.

Bus Service

There are a variety of bus services that operate in the corridors. Commercial bus operators are generally reluctant to release ridership numbers. Nevertheless, in the absence of any information from the operators, approximate ridership estimates based on bus capacity and load factors were prepared for this study. It should be noted that charter bus operators have been excluded from the analysis.

Direct Air Service

The study area is served by a number of large airports including Atlanta, Chattanooga, Birmingham, Jacksonville and Nashville. Of particular importance is the large airport hub, H-JAIA, the busiest airport in the U.S., and a major hub for Delta and AirTran airlines. This airport services as a gateway for passengers throughout the southeastern U.S. to connect to numerous domestic and international destinations, as well as a connection point for many longer-distance trips.

The other airports in the study area are primarily served by feeder flights to hubs that serve various carriers; this obliges passenger traveling to other destinations to make a connection. Services between these airports are provided by both mainline and regional aircrafts.

It is evident that the largest air markets are those that include H-JAIA. Other significant travel markets include direct air service between Jacksonville, FL and Nashville, TN, Jacksonville, FL and Birmingham, AL and Birmingham, AL and Louisville, KY, each with more than 20,000 passengers in each direction as seen from Q4 2009 to Q3 2010 air volumes.

The point-to-point air markets between the major airports in the study area are presented in subsequent sections describing the corridor-specific travel patterns later in this report.

3.3.2.2 Local Travel Market

Local travel is shorter-distance travel within the different urban areas of the study area. For the Atlanta urban area, this includes travel within the 20-county metropolitan area (ARC area). For the rest of the study area, local travel is defined as travel within a 30-mile radius of each of the proposed rail stations. There are three main types of local trips considered for this feasibility study:

- Journeys to work (most likely to originate in the suburbs and terminate in the city centers);
- Local trips for leisure purposes; and
- Local trips to access the airport.

3.3.2.3 Connect Air Market

There are a number of airports in the study area where it may be possible that a new high-speed rail service may change the purpose of the airport, and allow for passenger to start their air journey at these airports. To establish the potential size of these markets, the study examined data on the number of total passengers traveling between the key city pairs. This differs from the direct air market presented earlier which shows just eh passengers traveling between original and destination airports (both located within the study area), and does not include connections to flights to other national and international destinations.

Of all of the key airport pairs in the study area, most include H-JAIA, which reflects the importance of H-JAIA as a hub to air travel in the region. Comparing total passenger counts on the air routes in the study area with the true origin-destination traffic on the same airport pairs demonstrates how many of the passengers are connecting. This comparison shows that much of the connecting traffic involving H-JAIA (particularly the short-haul routes such has H-JAIA-Chattanooga and H-JAIA-Birmingham) and that the connections are significantly lower for airport pairs not involving the H-JAIA hub.

With proposed rail stations at H-JAIA and other study area airports, high-speed rail will be available option to attract air trips between these airports which are then ultimately connection to/from airports outside the study area. Out demand forecasting methodology incorporates the possible diversion of these trips to the proposed rail modes.

3.3.3 DEMAND ESTIMATION MODEL

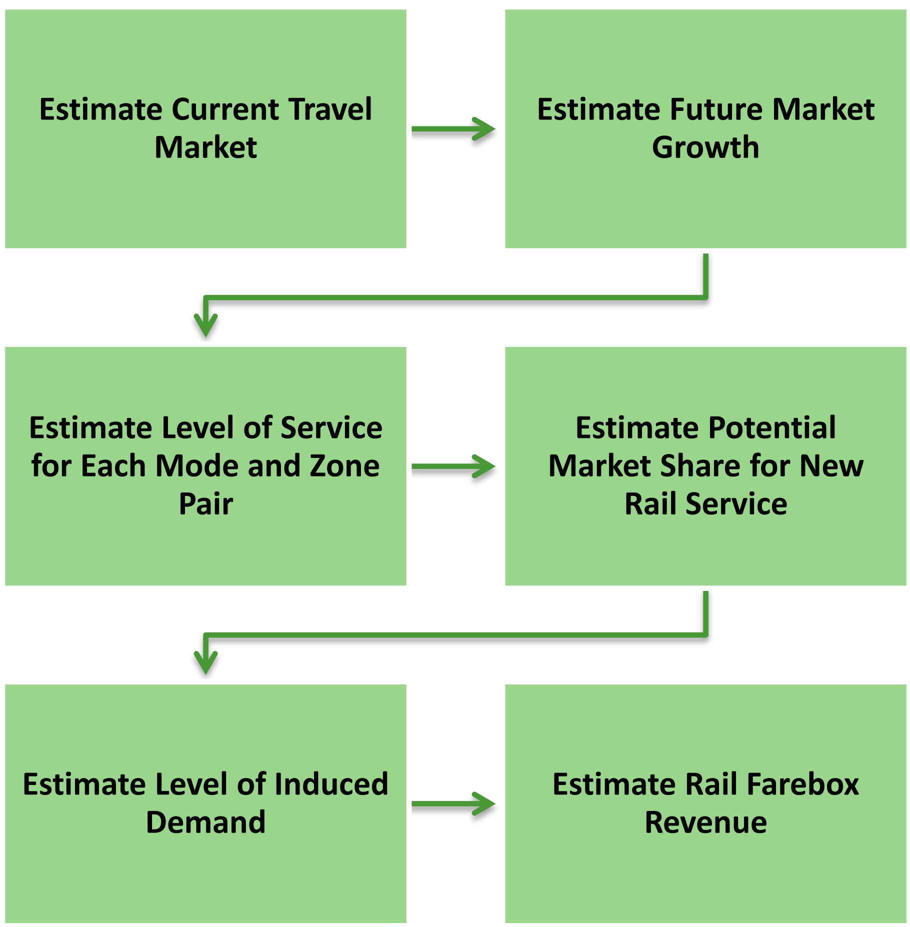
The study used the following approach to forecast the potential ridership and revenue of the proposed high-speed rail services through six broad steps:

1. Estimate the current in-scope travel market (including trips by air, bus, train, and automobile). These estimates are developed on a zone-to-zone basis as outlined in the next section. They are also disaggregated by trip purpose.
2. Estimate how this market will grow in the future. These estimates will reflect forecast socio-economic trends (such as changes in population and employment) and assumptions regarding the sensitivity of changes in trip making behavior to these trends.
3. Estimate the Level of Service (LOS) characteristics for each mode and each zone pair. For a trip by common carrier (including the proposed rail service), this takes into account the in-vehicle time, frequency of service, fare, and time/cost needed to access and egress the mode's station from the trip's actual origin and destination respectively (e.g., the traveler's home, place of work or leisure destination). For a trip by automobile, this takes into

account the origin-destination travel time (including any delays due to road congestion) and vehicle operating costs (largely fuel cost).

4. Estimate the potential market share that the new service will capture (i.e., the ridership). This is estimated using the LOS characteristics calculated in the previous step and the established mode choice models and modeling methodology.
5. Estimate the level of induced demand. These are new inter-urban trips that are not made in the no-project situation, but that occur as a result of the improved service provided by the proposed project.
6. Estimate the rail farebox revenue. This is calculated using the ridership calculated in the previous two steps and the fare assumptions used for the new rail service from Step 3 above. Note that the level of ridership is sensitive to the level of fare.

Figure 3-17: Demand Estimation Model Process



These forecasting steps pre-suppose a number of additional tasks that the study carried out. These include collecting and analyzing data; preparing input assumptions and tables; specifying, building and testing the forecasting model; producing and reviewing forecasts; and running sensitivity tests.

3.3.3.1 Step 1: In-Scope Travel Market

The first step in the high-speed rail ridership forecasting process was to forecast total intercity air, automobile and bus travel between the major metropolitan areas making up each corridor.

Intercity Auto

There is no standard up-to-date source of information about inter-city auto trip making in the U.S. that is sufficiently detailed to be used in the project-level forecasting; however, the accuracy of the auto trip tables strongly influences the accuracy of the ridership and revenue forecasts for the new high-speed rail services. Conducting new original data collection efforts including survey work to establish inter-city automobile travel patterns and levels was not within the scope of this feasibility study.

For this study, the study adopted a direct demand modeling approach to calculate automobile travel-related data within the study area. While the accuracy of trip tables created in this manner was likely lower than that of trip tables prepared from original data collection, the accuracy is nonetheless expected to be suitable for a feasibility-level study. The study developed econometric travel demand models which forecast total county-to-county auto trips based on changes in the underlying socioeconomic and level of service characteristics (both are important drivers of travel) of and between the counties.

Auto travel was estimated with the help of linear regression analysis using historical auto volumes between the largest Metropolitan Statistical Areas (MSAs) as the dependent variable, and socioeconomic and level of service measures as the independent or explanatory variables. The general specification of the model is:

The model was estimated using historical auto trip data for trips to and from the major MSAs from the latest 1995 ATS. The Woods and Poole economic forecasts provided historical and future forecasts of socioeconomic variable such as population and employment. Travel distance information was obtained from the network geographic using a network based model.

Bus Service

Commercial bus operators are generally reluctant to release ridership numbers. However, in the absence of any information from the operators, approximate ridership estimates based on bus capacity and load factors were prepared. In order to calculate bus travel volumes from the supply side data in the study area, a seating capacity of 50 seats per bus and a 50 percent load factor were assumed.

Local Air and Connect Air

The Bureau of Transportation Statistics (BTS) website publishes U.S. air carrier statistics, monthly data reported by certified U.S. air carriers. The data contains information on passengers transported with both origin and destination airports are located within the U.S. and its territories. Local air and connect air volume data were prepared using the DB1B market and T-100 Segment database from the BTS. The airline origin and destination survey (DB1B) is a 10 percent sample of airline tickets from reporting carriers[14]. The market data provides information on origin and destination airports, true origin-destination passenger volumes and fares. The T-100 segment data includes data on passenger volume, total available seats and scheduled flight departures for all air trip segments. Airport-to-airport volumes were then allocated to the county pair level using socioeconomic information. The trip purpose (business vs. non-business) distribution was estimated using data on trip-making characteristics from the U.S. Census Bureau, county business patterns, and Woods and Poole data.

Local Trips

Local trips were estimated based on two sources. For the Atlanta-metro area, the study based the analysis on results of the Atlanta-Chattanooga Tier I EIS completed in 2010. This was done to make the best use of significantly more detailed modeling of the local trips in response to similar proposed high-speed rail service in the Atlanta-Chattanooga EIS[15]. For all other areas, the 2000 U.S. Census Journey to Work data was scaled accordingly based on Woods and Poole employment growth. The typical ratio of commuting trips to leisure trips was used to size the overall local trip markets within each major urban area.

---

[14] http://www.transtats.bts.gov/databases.asp?Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0

[15] The EIS involved the use of the Atlanta Regional Commission (ARC) model and the associated input data to predict local high-speed rail ridership in the Atlanta metro area.

3.3.3.2 Step 2: Market Future Growth

Auto

Future auto travel was predicted using the econometric auto total travel demand models described earlier. Future travel was forecasted through the application of these models, adjusted to match historical traffic growths in the region.

Air Travel (Direct and Connect Air)

Air trips (both direct and connect) were assumed to increase at the rate of enplanement growths at the study area airports as forecasted by the Federal Aviation Administration (FAA) Terminal Area Forecast.

Bus Travel

Bus trips were assumed to increase at the rate of population growth of the metropolitan area served by the high-speed rail system.

3.3.3.3 Step 3: Level of Service Characteristics

To estimate the entire highway based travel times including county to county auto travel time and access and egress times to/from the airports and stations (both rail and bus), the study used a combination of two common approaches in travel demand forecasting. The first was to prepare (code) a representation of the networking using network modeling software (i.e., Cube Voyager) and use the highway network to estimate free flow travel times. The second approach was the estimate the times using actual travel time data sources from commercial trip planning software (e.g., MapQuest and Google Maps) supplemented with real time travel alert websites (e.g., www.sigalert.com, www.beathetraffic.com). These two techniques were combined with other assumptions (regarding vehicle operating costs, running times, fares or service frequencies) to estimate various mode specific levels of service (LOS) characteristics between all relevant county pairs. In addition, travel times calculated from commercial trip planning software were used to check the travel times obtained through network modeling software.

Irrespective of the method used to calculate the LOS characteristics, the Cube Voyager network modeling software was used to develop the study forecast, as it offers the capability to hold and manipulate the large volumes of data created in preparing demand forecast, and has other useful functionality.

Following is a brief summary of the LOS characteristics for the various mods that were used to estimate rail ridership forecasts for this study.

Intercity Auto

Auto travel times between county pairs were estimated using a combination of network based and real-time traffic data as mentioned above. Automobile travel distances and times between the counties from commercial trip planning software were also used as supporting information in order to better reflect speed limits and representative congestion levels on each route. Highway congestion was measured using the Texas Transportation Institute (TTI) index and congestion growth into the future yeas was based on historical TTI trends. Automobile operating costs of 15 cents/mile for non-business and 55 cents/mile for business travelers were used.

Local Air and Connect Air

Airport to airport journey times and frequencies were estimated based on individual airport pair statistics from flight search engines. A terminal processing time of 45 minutes was used to represent the total time spend (including security delays) at the airport terminals before boarding a flight. Access/egress times to/from the nearest airport to the origin/destination county were calculated based on highway access using network models as described above. Airport to airport airfares were calculated based on data from BTS's DB1B segment database.

Rail

High-speed rail characteristics such as proposed stops, station to station running times and frequencies were based on the assumptions adopted by the engineering study which were the results of research on rail services and stops in other similar studies, detailed stakeholder feedback, terrain analysis and simulation of train operations, etc. Distance based rail fares (separate for Shared Use and Dedicated Use services) were used with a fixed boarding fee based on research of several existing Amtrak corridor services and a few other international high-speed rail systems. For the Shared Use and Dedicated Use high-speed rail services, distance based fares of $0.28 per mile and $0.40 per mile (with a $5.00 boarding fee) were used, respectively as the base fares for the three corridors.

Bus

Bus level of services such as frequency, travel time and fares were obtained from the bus operator websites.

Service frequencies are generally low, although services between the major metropolitan areas are more frequent. Fares are, broadly speaking, between $30 and $70 and correlated with the trip duration. Travel times are highly variable and reflect stopping patterns and/or transfer times.

Local Trips

Diversions of local trips to high-speed rail were estimated based on using diversion percentages calculated for the intercity markets. Hence, no LOS characteristic was needed for this market segment.

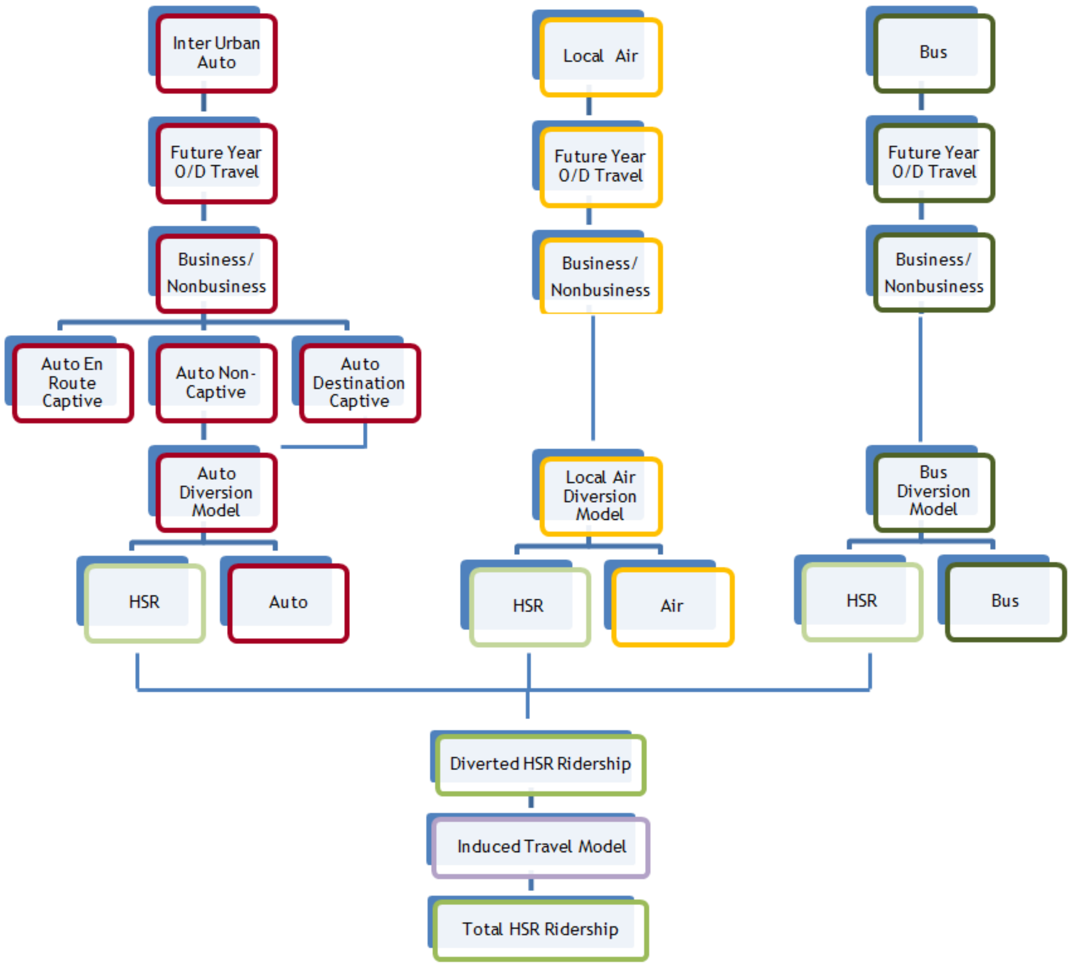
3.3.3.4 Step 4: Mode Choice

The study's well-tested high-speed rail forecasting methodology was applied to this feasibility study. The key feature of the ridership and revenue forecasting methodology is its use of binary diversion models to calculate high-speed rail ridership. This methodology is practical, transparent and easily evaluated for the reasonableness and accuracy of its relationships, and it reflects a theoretically satisfying choice structure. The approach is similar to that adopted in the recent Atlanta-Chattanooga study, in the Volpe Center's Charlotte-Atlanta-Macon study, and in many other studies. Forecasts produced using this methodology has been benchmarked to Amtrak's Acela Express and Northeast Direct ridership and revenue in the Northeast Corridor.

The model uses separate binary (two mode) logit relationships to predict traveler diversions from each existing mode to the new high-speed rail service. This forecasting approach is graphically shown in Figure 3-18 below. Travel market segments are carefully defined based on a combination of current mode, trip purpose and other traveler and trip characteristics. Market segments include:

- Inter-urban auto travel (business and non-business);
- Local air travel (business and non-business); and
- Inter-urban bus travel (business and non-business).

Figure 3-18: Diversion Model



Inter-Urban Auto, Local Air and Bus Mode Choice Model Estimation

Each model is a binary choice model, which predicts the probability that a traveler would choose high-speed rail over their existing mode given the respective attributes of the two modes.

These three market segments are all shown in Figure 3-18 above. The auto travel market is further segmented into three groups: 1) those who do not need a vehicle at their final destination ("non-captive"); 2) those who need a vehicle at their final destination ("destination-captive"); and 3) those who need to make automobile trips at Intermediate stops during their trip ("en-route-captive"). The likelihood of selecting high-speed rail for intercity-travel will be very different for the three groups. Empirical work suggests that many auto travelers are, in fact, both en-route and destination-captive.

Each diversion model shown in Figure 3-18 computes, for each combination of trip purpose, market segment and current mode, the probably that a traveler would choose high-speed rail over his / her current mode of travel as a function of each mode's service attributes. These probabilities are then multiplied by the trip volumes of the existing modes to predict the volume of travel that will divert to high-speed rail. Induced (new) travel on the high-speed rail mode is separately forecast (described later) using models based on generalized costs. Total high-speed rail ridership is obtained by summing the predictions for the individual market segments.

Modal service attributes include time, cost, frequency, reliability and quality of service with time and cost disaggregated into their access, egress, terminal and line haul components. Mode-specific constants account for the effects of other (non-explicitly modeled) characteristics of high-speed rail relative to other modes.

The models relate to overall "utility" experienced by travelers in each market segment to the respective price and service levels of their respective modes. The general specification for each model is as follows:

$$U = \alpha + \beta_1 * Cost + \beta_2 * Travel\ Time + \beta_3 * Access/Egress\ Time + \beta_4 * Waiting\ Time$$

Where α represents the modal constant (the inherent preference for the mode with all other attributes being equal), β_1, β_2, β_3 and β_4 are modal coefficients, and waiting time represents a transformation of service frequency.

These model parameters are usually estimated and calibrated using travel behavior data from new stated and revealed preference surveys conducted locally for study area under consideration. However, it was beyond the scope of this study to conduct primary travel survey data collection. Rather, the study drew heavily on the recent Household Travel Survey conducted by the study in 2009 as part of the Atlanta-Chattanooga HSGT EIS study. This survey sampled approximately 1,000 households in the Atlanta-Chattanooga corridor. Indeed, similar inter-urban binary mode choice models (as described above) were estimated for travel between Atlanta and Chattanooga using the survey data. The study used those models as starting points for this feasibility study. However, the study then adapted and modified the models as required to reflect the specificity of the other current study corridors, using readily-available data and information developed in other studies in the study area and experience in other high-speed rail corridors.

This is a very plausible demand forecasting approach because it allows for different intercity market segments to exhibit realistic differences in their tradeoffs among time, cost comfort, etc., and so accounts explicitly for the actual diversity of travel behavior in the study corridor. The approach also makes it easy to carry out a wide range of sensitivity analyses to determine the effects of various changes on competitiveness, financial viability and benefits.

The advantages of this approach included its economy in avoiding original data collection, and some confidence derived from the adoption of a model that has already demonstrated its utility and applicability in studies elsewhere including within the study area (Atlanta to Chattanooga). Its robustness and reasonableness in these other applications provide considerable assurance that it is a useful and credible tool for the present feasibility study.

The values of time of travelers in each market segment calculated from the model coefficients of the diversion models used for this study are presented below in Table 3-21 for the various components of travel time (and the terminal transfer penalty for connecting air passengers). These values of time strongly support our findings in previous high-speed rail studies. First, as expected, the values of line-haul time for air travelers are higher than for private vehicle travelers, and both are much higher in general than for bus travelers. Line-haul time savings on high-speed rail are much more important to air travelers than private vehicle travelers, and more important in both cases (except for short non-business private vehicle trips) than they are to bus travelers. This means that bus travelers are much more sensitive to price differences between modes than they are to time differences. Also as expected, the values of line-haul time for business travelers are higher than for non-business travelers traveling on the same mode.

Table 3-21: Values of Time

Value in 2010 dollars	Air		Auto		Bus	
	Business	Non business	Business	Non business	Business	Non business
In-vehicle value of time ($)	$27	$15	$19	$12	$10	$5

<u>Connect Air Model</u>

The connect air model estimates the share of current air travelers that connect at H-JAIA from one of the six major airports in the study area that will be using the proposed high-speed rail mode to complete the connecting leg of their journey within the study area. The six major airports in the study area with connection at H-JAIA are: Savannah (SAV), Jacksonville (JAX), Birmingham (BHM), Chattanooga (CHA), Nashville (BNA) and Louisville (LOU).

The study estimated a connect air model for this study by using representative (not average or composite) destinations and routes from each of the six major airports with connection at H-JAIA. The connect air model then uses an air route choice model to predict the percentage of connect air travelers that will switch to the proposed high-speed rail mode from the air mode for the connecting leg of their trip inside the study area.

The representative destinations were selected first. The top 10 destinations from each of the six airports were analyzed. Based on the distribution, the study combined the destination into representative geographic areas and then selected one city/airport within each to act as a representative destination. The four representative areas and destinations used are: Florida, U.S. Northeast quadrant, west of the Mississippi River and International.

Next, the study selected representative routes based on the markets and carriers on each representative destination. The study did not estimate the average or composite level of service characteristics, but used the actual services to these destinations, as this is more transparent and representative of actual experiences on a given route.

After selecting representative destinations and routes, the study estimated an ordinary least square regression-based route choice model based on the market shares and volumes along each route for each destination. Once the model was estimated, the study applied it to the introduction of a new route between each of the six airports and the final destination through H-JAIA. These new routes would connect each of the six airports with H-JAIA by the proposed high-speed rail service.

Local Trips

Local trips diverted to high-speed rail were estimated based on already observed/calculated diversion percentages to the potential rail service from the inter-urban markets. For the Atlanta metropolitan area, the study used results of the local markets with proper modification as appropriate from the Atlanta-Chattanooga HSGT Tier I EIS.

3.3.3.5 Step 5: Induced Demand

Most transportation planners recognize that the introduction of new transportation facilities typically generate new or induced traffic (trips that would not be made at all if the new facility was not built). The final step in the inter-urban high-speed rail ridership forecasting process is, therefore, to forecast the amount of induced travel on the high-speed rail mode.

Total ridership is obtained by summing the induced demand and the diverted rail trips described above for the individual market segments. The study defines new travel induced by the introduction of the high-speed rail system in the market as follows:

Induced Travel = Total Travel with High-Speed rail – Total Travel before High-Speed Rail

The number of induced trips will be a function of the change in the overall "impedance" to travel in the corridor; by providing another transportation option. Total travel on all modes is related to a composite generalized cost computed overall of the modes, as follows:

$$\text{Total Travel all modes} = (S / E)^{a} x\ GC_{ccomposite}^{q}$$

Where:

Total travel all modes = Total travel volume between Origin/Destination on all modes;

S / E = Socioeconomic factors for Origin and Destination;

$GC_{composite}$= Generalized cost of travel between Origin and Destination; and

A, q = estimation coefficients.

This composite generalized cost is known as the logsum and is calculated using the utility estimates for each mode form the diversion models:

$$GC_{composite} = ln(e^{Uprivatevehicle}+e^{Uair}+e^{Ubus}+e^{UHSR})$$

Consequently:

Total travel before high-speed rail: Ta = $(S / E)\ x\ (GCa)^{q}$

Total travel after high-speed rail: Tb = $(S / E)\ x\ (GCb)^{q}$

And, the percent increase in total travel becomes:

Induced Demand % = $[Ta-Tb] / Tb = [GCa^{q}-GCb^{q}] / GCb^{q}$

Induced demand was considered for the inter-urban market, where it is reasonable to assume that improved access in the corridor would lead to some trips that would not have occurred without the existence of the high-speed rail system. Using the behavioral survey results from the Atlanta-Chattanooga HSGT Tier I EIS, the study estimated induced demand parameter for the various intercity markets.

This calculation was done for each market segment. Total high-speed rail trips were then computed as the sum of the trips diverted from the existing modes and these new trips induced by the introduction of the high-speed rail system.

The study developed specific ridership forecasts for two years, 2015 and 2035. In order to illustrate annual ridership forecasts between 2021 and 2040, the study interpolated ridership between 2015 and 2035 and extrapolated ridership from 2036 to 2040.

3.3.3.6 Step 6: Rail Farebox Revenue

The farebox revenue was calculated using the ridership calculated in the previous two steps and the fare assumptions used for the new high-speed rail service from Step 3 above. Note that the level of ridership is sensitive to the level of fare.

Detailed ridership and revenue results are presented for each of the Atlanta-Birmingham, Atlanta-Macon-Jacksonville and Atlanta-Chattanooga-Nashville-Louisville Corridors separately in the corridor-specific sections of the report.

3.4 OPERATING AND MAINTENANCE METHODOLOGY

A key requirement for developing an operating plan and costs is to work in tandem with ridership and revenue forecasts to adjust train sizes and frequencies levels to appropriately match demand, for providing enough capacity while still producing acceptable load factors. In addition, there is a need to respect financial constraints on the operation of the system (e.g., the FRA's requirement for high-speed rail systems to produce a positive operation ration). The results of this interactive analysis are then used to identify the system operating costs.

As a rule, higher ridership associated with faster options can also support more train frequencies, along with larger, more efficient trains. Train size and frequencies will be increased together, in a balanced way, to accommodate the ridership increase. Train frequency increases the ridership and revenue impact of an initial speed improvement. At the same time, ridership increases associated with higher speed options often allow the use of larger, more efficient trains. This is why an iterative approach was needed to identify the optimal investment and operating strategy for each of the three corridors.

3.4.1 OPERATING PLAN DEVELOPMENT

3.4.1.1 Train Service and Operating Assumptions

Train timetables were developed for both Shared Use and Dedicated Use speed options and route combinations identified for each corridor. Schedules were designed to maximize utilization of the train sets, while also ensuring that any scheduled meetings between passenger trains occur in stations or double track, while respecting constraints on minimum turn time at route endpoint stations, and required schedule buffer guidelines. In addition to this, trains were scheduled at convenient times for capturing a portion of the daily peak-hour commuter traffic while providing an effective all-day intercity service for business travelers as well as recreational and leisure travelers with convenient off-peak travel options. Clearly, the higher the frequency of service, the easier it was to meet these conflicting needs.

A second consideration for the service is the quality of travel offered. Quality of service can have a significant impact on ridership levels and it is critical that any new rail service offers a modern transportation environment that is comfortable, convenient, economical and safe. It was assumed in this analysis that the quality of service offered by the rail system would reflect all of these critical attributes.

3.4.1.2 Potential Station Locations

Based on an assessment of the prospective rail demand, the study identified the general locations for potential stations along each corridor. On average, station spacing on the corridors was limited to one stop every 30-60 miles, with exception to the Atlanta-Chattanooga segment in order to reflect the proposed operating plan in the Atlanta-Chattanooga HSGT Tier I EIS. More station stops increase travel times, decrease average train speed and cause high-speed rail service to become less competitive. Slower-speed systems can accommodate more stops and if traffic volumes are high enough, the stopping patterns at smaller, Intermediate stations can be “thinned” to develop express local service patterns. This can be done while providing at least a minimum base line level of service to each station. The study developed a set of station locations that are compatible with each proposed route option, and the operating plan reflects the frequency of service that was determined as most appropriate to the needs of each station.

Specific station site planning is beyond the scope of this study and sites will likely be finalized in future project development phases. Local governments, business interests and citizens groups would be involved in the station location planning and design process. However, for the purposes of the current study, prospective station sites were selected by the study and the operational assessment will be consistent with the assumptions made in the capital cost development and with the ridership and revenue forecasts.

3.4.1.3 Train Technology Assumptions

As outlined in Section 1.2, there are three technology considerations for this feasibility study. In the Atlanta-Birmingham and Atlanta-Macon-Jacksonville Corridor, the study is considering a 90-110 mph Shared Use Emerging High-Speed Rail and 180-220 mph Dedicated Use Express High-Speed Rail. Along the Atlanta-Chattanooga-Nashville-Louisville Corridor, the study is also considering at 220+ Maglev option.

A key study assumption that determines transit time is a passenger car’s “tilt” or “non-tilt” design. The track in curves is typically banked (super-elevated) up to six degrees (6°), which results in designation of a balance speed for each curve (at which speed a vehicle occupant would feel no sideways force in the curve). However, up to four degrees (4°) of imbalance (cant deficiency) is acceptable for passenger comfort. Beyond this, onboard hydraulic systems (active tilt) or car suspension designs (passive tilt) can permit even higher speeds, by lowering the centrifugal forces felt inside cars.

Another key issue for determining the suitability of train technology for the three study corridors is compliance with FRA safety requirements. The FRA has Tier I 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 with speeds 125-150 mph. For the dedicated and Maglev corridors, safety regulations will follow European standards since no FRA standards are currently in place.

3.4.1.4 Other Rolling Stock and Operational Requirements

Consistent with the assumptions customarily made in feasibility-level planning studies, the following general assumptions are proposed regarding operating requirements for the rolling stock:

- Trains will be reversible for easy push-pull operations (able to operate in either direction without turning the equipment at the terminal stations);
- Trains will be accessible from low-level station platforms for passenger access and egress, which is required to ensure compatibility with freight operations;
- Trains will have expandable capacity for seasonal fluctuations and will allow for coupling two or more trains together to double or trip 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 the entire trip;
- On-board space is required for stowage of small, but significant, quantities of mail and express packages, and also to provide for an optional checked baggage service for pre-arranged tour groups;
- Each end of the train will be equipped with a standard North American coupler that will allow for easy recovery of a disabled train by conventional locomotives;
- Trains will not require mid-route servicing, with the exception of food top-off. Refueling, potable water top-off, interior cleaning, required train inspections and other requirements will be conducted at night, at the layover facilities located at or near the terminal stations. Trains would be stored overnight on the station tracks, or they would be moved to a separate train layover facility. Ideally, overnight layover facilities should be located close to the passenger stations and in the outbound direction so a

train can continue, without reversing direction, after its final station stop; and

- Trains must meet all applicable regulatory requirements including:
    - FRA safety requirements for crash-worthiness,
    - Requirements for accessibility for disabled persons,
    - Material standards for rail components for high-speed operations, and
    - Environmental regulations for waste disposal and power unit emissions.

3.4.2 Operating Plan Model

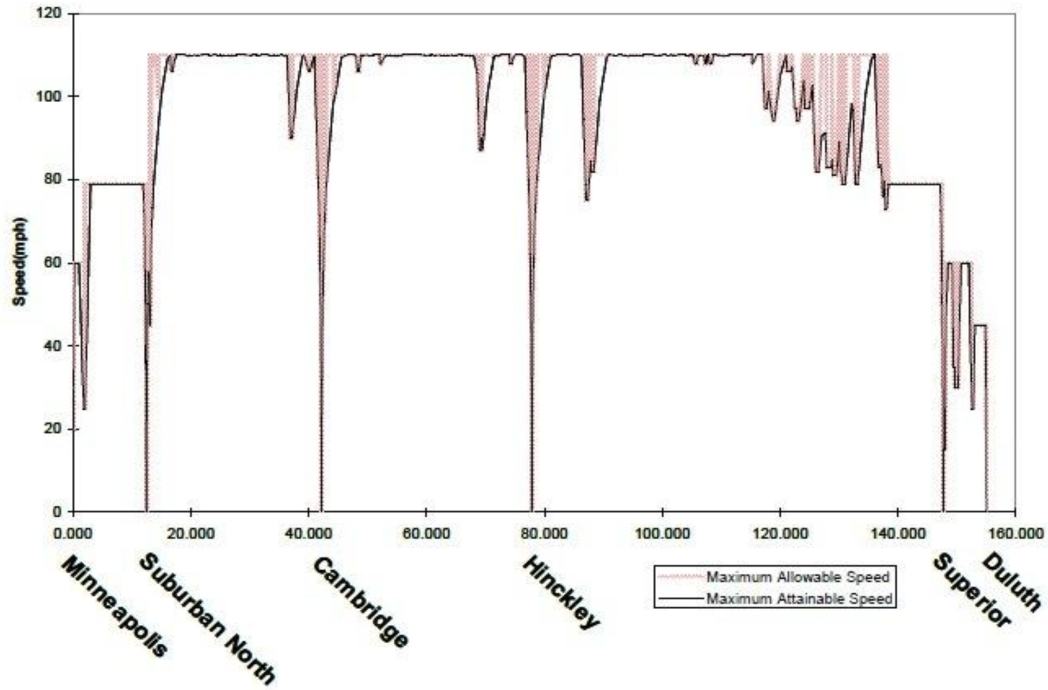
3.4.2.1 Train Performance

The study used the TEMS LOCOMOTION™ Train Performance Calculator to estimate train-running times for each operating scenario. For each route and train technology, this program uses route geometry and infrastructure, together with train performance characteristics to estimate running times and levels of service. The study added recovery time into the schedules to remain consistent with FRA guidelines and 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. For the purposes of this study, the study used eight percent recovery time as this represents an Intermediate level of schedule slack that is appropriate for the Shared-Use option that includes substantial capacity improvements, but which continues to co-mingle freight and passenger services together on the same tracks.

Higher acceleration as well as tilt can result in a substantial reduction in end-to-end running times. However, if the train is mismatched to the infrastructure (a high-speed train on low quality infrastructure, or a conventional train on high-speed infrastructure) these benefits will not be achieved. Using the wrong equipment can result in a flawed evaluation of the potential for upgrading a rail line. For this feasibility study, the study avoided making this common mistake by ensuring an appropriate match of the train technology to the infrastructure of each route.

The TEMS LOCOMOTION™ program developed the train speed profiles by mile as well as the overall running time calculation. For example, Figure 3-19 shows an example speed profile that was developed for a 110 mph operating over a Midwestern corridor. The speed limits applicable to each segment of the route, as well as the impact of curve speed limits and station stops, can clearly be seen on the graphic.

Figure 3-19: Example 110 mph Speed Profile



For the three study corridors, a similar detailed running time assessment was developed for the Shared Use, Dedicated Use and Maglev (Atlanta-Chattanooga-Nashville-Louisville Corridor only). In addition, the operational analysis assessed the impact of raising or lowering speeds, easing curves or skipping stops to help prioritize the capital investment strategy for each corridor. With the addition of appropriate schedule pad, this process developed the point-to-point running times needed to develop detailed train schedules for each corridor.

3.4.2.2 Train Scheduling and Fleet Requirements

The study calculated the number of train sets required for day-to-day operations for each corridor and technology. These train sets must be large enough to cover all assignments in the operating plan with sufficient spares for maintenance, yet, without excess equipment sitting idle. Typically, intercity corridor weekday services will face a stronger demand than weekends.

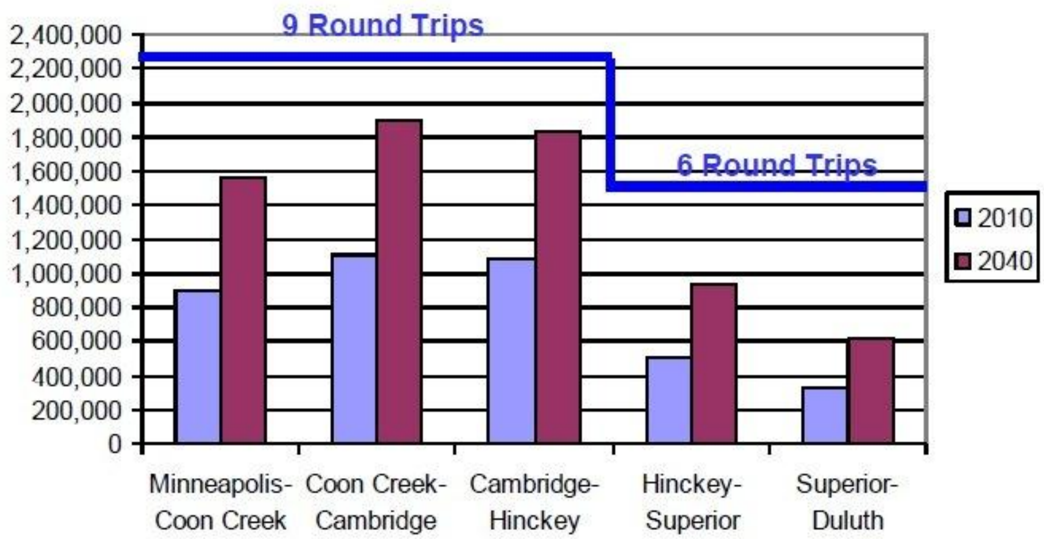
While it is typical to assume reduced weekend operations for high-speed rail corridors, sometimes this assumption is modified for special circumstances. Each corridor was studied to determine if there were strong tourist attractions and if it may be appropriate to employ a different weekend train scheduling assumption. None of the corridors presented a strong case for an alternative weekend schedule.

The operational analysis for each of the three study corridors was developed in concert with the engineering assessment of proposed passing siding locations for each corridor. A specific analysis of train scheduling was developed for each of the three study corridors to ensure that the proposed passenger train schedules are operationally feasible with respect to the passing and station infrastructure provided.

3.4.2.3 Train Size, Frequency and Load Factors

In addition to timing trains to meet the anticipated needs of the market, the operational assessment determined what size the trains need to be and over what portion of the route they need to run. Whatever combination of train sizes and frequencies are chosen for each corridor and technology pairs, the operating plan must ensure there are enough seats to carry all of the passengers over the peak load segment; beyond this, it is desirable to minimize empty seat-miles, for matching supply to forecasted demand as closely as possible. A segment-loading chart, similar to that shown in, is useful tool for this purpose. This chart shows the number of passenger forecast over every segment of the route enabling the study to determine both the peak load segment as well as for forecasting average load factors across the entire route.

Figure 3-20: Example Segment Loading Chart



3.4.3 Operating and Maintenance Costs

In addition to assessing the physical feasibility of the operating plan, the study assessed the level of operating costs for supporting the needs of the financial and economic analysis. This section describes the build-up of the unit operating costs that were used in conjunction with the operating plans, to assess the total operating cost of each corridor for Shared-Use and Dedicated-Use. Because there are a number of corridor and technology considerations in place, it was essential to maintain consistency of the costing basis across all options. For developing a fair comparison:

- Costs that depend on the propulsion/speed should reflect legitimate differences between technologies and routes; and
- Costs that do not depend on propulsion/speed should remain the same across all technologies and routes.

For developing operating and maintenance costs for this study, the study adapted the bottom-up costing framework that was originally developed for the MWRRS and Ohio Hub studies. This enabled the direct development of costs based on directly-controllable and route-specific factors, and allowed sensitivity analyses to be performed on the impact of specific cost drivers. It also enabled direct and explicit treatment of overhead cost allocations, to ensure that costs which do not belong to a corridor are not inappropriately allocated to the corridor, as would be inherent in a simple average cost-per-train mile approach. This also allows benchmarking and direct comparability of Georgia costs with those developed by other high-speed rail studies across the nation, including those in which the proposed corridor route would connect.

As background, the MWRRS costing framework was developed in conjunction with nine states that comprised the MWRRS steering committee and with Amtrak. In addition, freight railroads, equipment manufacturers and others provided input into the development of the costs. This methodology has been most recently validated with recent operating experience based on public data available from other sources, particularly the Northern New England Passenger Rail Authority's (NNEPRA) Down-easter costs and data on Illinois and Oklahoma operations that was provided by Amtrak. These costs were brought to a 2010 costing basis and included additional cost categories, such as electrification and Maglev technologies, which have been added into the MWRRS framework.

Following the MWRRS methodology as outline in Table 3-22, nine specific costs were used for this study. Variable costs include:

- Equipment maintenance;
- Energy and fuel;
- Train and onboard service (OBS) crews; and
- Insurance liability.

Additionally, ridership influences marketing and sales. Fixed costs include:

- Administrative costs;
- Station costs; and

- Track and right-of-way maintenance costs (includes signals, communication and power supply).

Table 3-22: Operating Cost Categories and Primary Cost Drivers

Drivers	Cost Categories
Train Miles	Equipment Maintenance
	Energy and Fuel
	Train and Engine Crews
	Onboard Service (OBS) Crews
Passenger Miles	Insurance Liability
Ridership and Revenue	Sales and Marketing
Fixed Costs	Service Administration
	Track and ROW Maintenance
	Station Costs

Operating costs developed for this study were benchmarked to be consistent with unit operating costs from other recent studies. These costs were fine-tuned and updated to current 2010 dollars consistent with the ridership and revenue and capital cost projects. The costs were then applied to the train-miles, number of station, passenger volumes and other cost factors developed specifically for this study. Cost factors that vary by train technology, such as fuel usage and equipment maintenance, were developed from discussions with manufacturers and/or users of the technology and/or by cost benchmarking from both public and confidential sources. A cost development approach was used to fine-tune those items with the greatest potential impact on the bottom line. The study forecasted operating and maintenance costs for three years: 2021, 2030, and 2040. The study interpolated annual operating and maintenance costs between 2021 and 2030 and also between 2030 and 2040.

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

- **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 was identified and used to determine the total cost of that operating variable. An increase or decrease in any of these will directly drive operating costs higher or lower.
- **Fixed Costs:** generally predetermined, but may be influenced by external factors, such as the volume of freight tonnage, or may include a relatively small component of activity-driven costs. As a rule, costs identified as fixed

remained stable across a broad range of service intensities. Within fixed costs are two sub-categories:

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

Operating costs were developed based on the following premises:

- Based on results of recent studies, a variety of sources including suppliers, current operators' histories, testing programs and prior internal analysis from other passenger corridors were used to develop the base-line cost data. Actual costs will be subject to negotiation between the passenger rail authority and contract rail operator(s).
- Freight railroads will maintain the track and right-of-way that they own, but ultimately, the actual cost of track maintenance will be resolved through negotiations with the railroads. For this study, a track maintenance cost model was used that reflects actual freight railroad cost data. The costs for maintaining the Dedicated Use and Maglev Guideway were directly assessed.
- Maintenance of train equipment will be contracted out to the equipment supplier.
- Train operating practices follow existing work rules for crew staffing and hors of service. Operating expenses for train operations, crews, management and supervision were developed through a bottom-up staffing approach based on typical passenger rail organizational needs.

Table 3-23 outlines the unit costs for each of the three corridor based on the technology considerations.

Table 3-23: Unit Operating and Maintenance Costs

Annual Costs	Shared Use	Dedicated Use	Maglev
Variable per Train Mile			
Train Crew	$4.66	$3.20	$2.13
On Board Services	$1.81	$1.60	$1.07
Equipment Maintenance	$11.67	$12.94	$7.73
Fuel or Energy	$3.94	$7.63	$7.74
Variable per Other			
Insurance (per messenger mile)	$0.02	$0.02	$0.02
Call center (per passenger)	$0.66	$0.66	$0.66
Credit Card/Travel Agency Commissions	2.8%	2.8%	2.8%
Fixed Costs			
Stations	Specific	Specific	Specific
Track and Electrification Maintenance (per track mile)	$50,000	$75,000	$65,000
Administration and Management (fixed)	$13,029,600	$13,029,600	$13,029,600
Administration and Management (per track mile)	$1.53	$1.53	$1.53

3.4.4 Public-Private Benefit Analysis

The Public-Private Benefits Analysis is designed to identify the benefit-cost returns to both the public and private sector. The benefit-cost analysis is designed to show whether a project is good for local and regional communities as well as states and countries, and how the benefits are distributed between the public and private sectors. In developing the benefit-cost analysis, the study used the methodology set out in the FRA *High-Speed Ground Transportation for America*, September 1997, and the *Maglev Deployment Program*, July 1999.

Given the uncertainties associated with the ridership and revenue and capital costs for each corridor, the Public-private Benefits analysis used a range of values to reflect the likely potential outcomes. These range from Conservative estimates with low revenue and high costs incorporated, to an aggressive, or Optimistic, estimate based on higher revenue and lower costs incorporated. Further, the study developed an Intermediate estimate that is a "middle of the road" estimate which takes into account slightly higher ridership and slightly lower costs than that of the Conservative estimates.

In estimating the benefits for the different passenger rail options, the study had to make high-level assumptions regarding the operating plan. For example, the study assumed to have 325 days per year operation, in line with the original Atlanta-Chattanooga HSGT EIS study. This suggests a five day per week operation along with a high-level of service; Saturday morning and Sunday afternoon/evening, with only a skeletal operation on Saturday afternoon/evening, and Sunday morning. More corridor specific assumptions regarding the operating plan are outlined in subsequent sections.

3.4.4.1 Benefit-Cost Analysis

This feasibility analysis will determine if the three study corridors provide a wide range of benefits. The methodology used to estimated economic benefits and costs is based on the approach of the FRA and its analysis of the feasibility of implementing high-speed passenger rail service in selected travel corridors throughout the country[16]. In that study, revenues and benefits were quantified as shown in Table 3-24.

Table 3-24: Key Elements of the Benefit-Cost Analysis

Types of Benefits	Types of Costs	Measures of Economic Benefits
• Benefits to Users ○ Consumer Surplus ○ System Revenues ○ Ancillary Revenues ○ OBS • Benefits for Public at Large ○ Airport Congestion Delay Savings ○ Airport Reduced Emissions ○ Highway Congestion Delay Savings ○ Highway Congestion Fuel Savings ○ Highway Reduced Emissions	• Capital Investment Needs • Operations and Maintenance Expenses	• Benefit-Cost Ratio • Net Present Value

Two measures of economic benefits were used to evaluate each corridor's Net Present Value (NPV) and benefit-cost ratios, which are defined as follows:

[16] FRA, *High-Speed Ground Transportation for America,* pp. 3-7 and 3-8, September 1997

$$Net\ Present\ Value = \\ Present\ Value\ of\ Total\ Benefits - Present\ Value\ of\ Total\ Cost$$

and

$$Cost - Benefit\ Ratio = \frac{Present\ Value\ of\ Benefits}{Present\ Value\ of\ Costs}$$

Present values are calculated using the standard financial discounting formula:

$$PV = \sum C_t / (I + r)^t$$

Where:

PV	=	Present value of the project benefits or costs (e.g., revenue)
C_t	=	Cash flow for t years
R	=	Interest Rate reflecting opportunity cost of capital
T	=	Time

For a feasibility analysis, revenues and cost cash flows for the three study corridors were discounted to the 2010 base year using a three percent (3%) real discount rate. The three percent discount rate intended to reflect the real cost of money in the market as reflected by the long-term bond markets.

3.4.4.2 Estimate of Economic Benefits

Benefit-cost analysis takes a social perspective by attributing economic values to resource efficiency and environmental factors, such as reduced infrastructure, congestion, time savings, and emissions reduction. These benefits accrue to both users and non-users of the system:

- ***Users*** of the system enjoy a consumer surplus benefit that reflects the additional fare value that the individual would be willing to pay for riding the train, as a result not only of time savings, but other aspects of the service (quality, frequency reliability) as measured by the Generalized Cost framework. Benefit-cost analysis recognizes consumer surplus and places that value on parity with the revenues of the system. This is because revenues are merely consumer surplus that is transformed into revenue by charging a fare. Thus, the analysis is only concerned with the overall value of economic benefits, not the distribution of those benefits between the producer and consumer. The portion of economic benefit that is transferred to the producer shows up as farebox revenue. The share of benefit that is allowed to remain with the consumer is called consumer surplus.

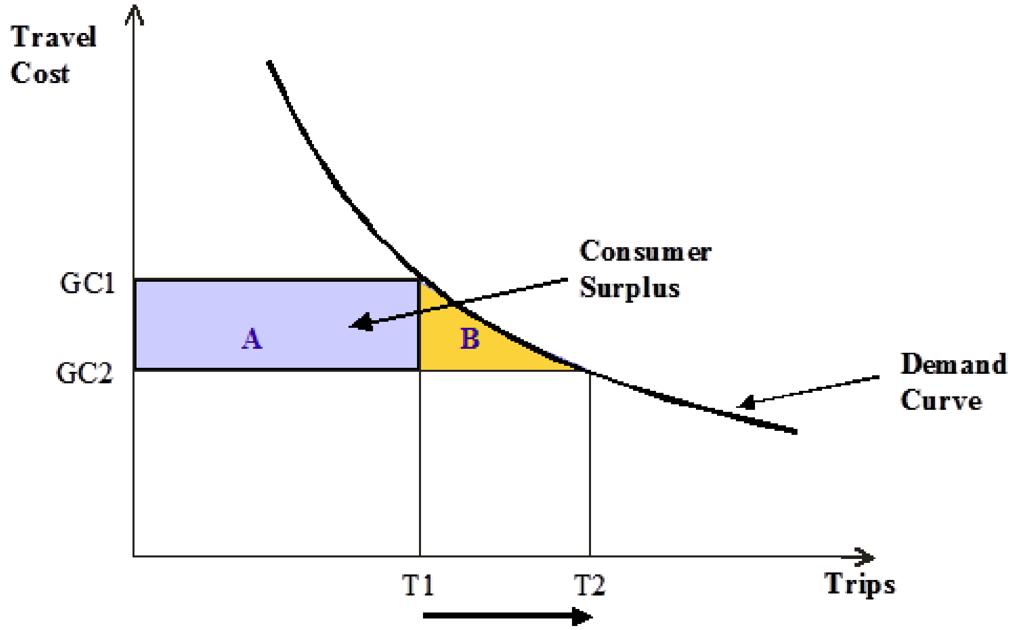
- ***Non-User*** benefits are for people who continue to drive their cars or fly, but who benefit from reduced congestion and improved air quality as a result of diversion from the higher and air to rail. The analysis measures benefits to the motoring public from decongestion that is a product of travelers diverted from the highway and air to the rail, and benefits to society as a whole resulting from reduction of air pollution from reduced emissions.

The following sections describes the calculations of these additional non-cash benefits and merges the results of these calculations together with the cash benefits to develop an overall benefit-cost assessment. Following Office of Management and Budget (OMB) guidelines, the results are aggregated over a 30-year system life using net present values at real interest rates of three percent (3%).

3.4.4.3 User Benefits – Consumer Surplus

Consumer surpluses are realized when a user obtains more value from the rail trip, such as greater convenience, greater reliability or reduced travel time, than was actually represented (and paid for) in the fare. Classically, consumer surplus can also be considered the difference (or delta Δ) between the maximum fare the rider would be willing to pay to use the service and the fare that was actually charged. Figure 3-21illustrates the concept of Consumer Surplus as typically used in transportation analyses. A demand curve is represented in terms of generalized cost of travel, which includes the fare, but also other important attributes such as travel time, reliability, frequency, etc. This ensures consistency between the behavioral characteristics of the demand model and the evaluation of the economic benefit of travel to individuals.

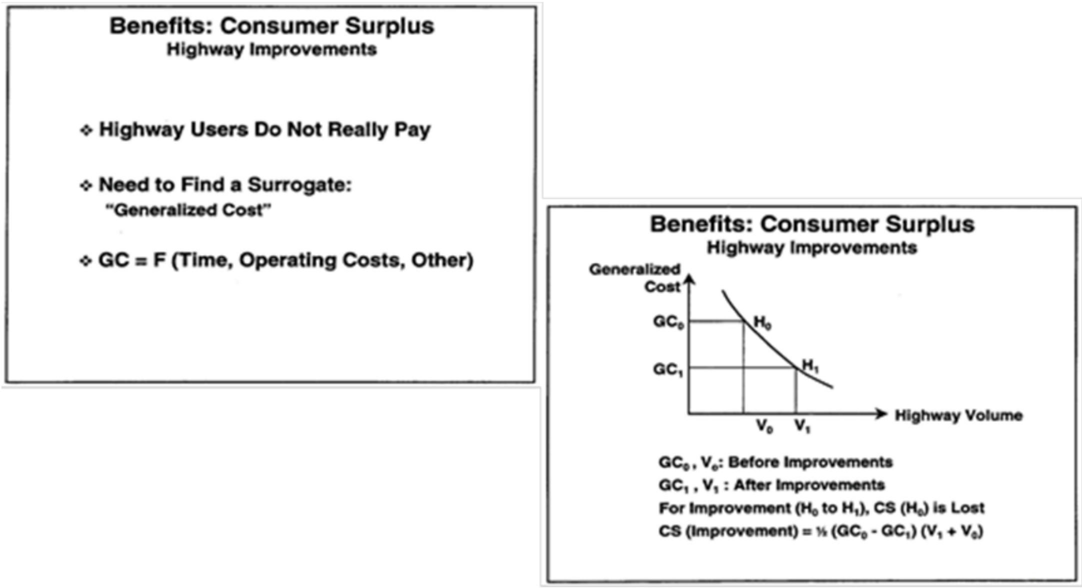
Figure 3-21: Economic Measure of Consumer Surplus



Consumer Surplus = A + B

As can be seen from Figure 3-22, when an improvement is made to the transportation system that reduces the generalized cost of travel (from GC1 to GC2), demand responds by increasing travel from T1 to T2. In economic terms, this results in a definition of Consumer Surplus, as being the sum of these two areas (area A and area B) under the demand curve. Area A reflects the economic benefit of the service improvement to existing users; whereas Area B represents the benefit to new users attracted to the system. This definition of the demand curve in terms of generalized cost is well documented in the transportation planning literatures. The FRA 2005 Maglev Deployment Program recognized this as a legitimate methodology for streamlining the Consumer Surplus calculation (refer to Figure 3-22).

Figure 3-22: Consumer Surplus Calculation as shown in the Maglev Deployment Program



Source: USDOT/FRA Maglev Deployment Program, 1999

3.4.4.4 Non-User Benefits

Non-user benefits include highway and airport non-user benefits. Two major categories of highway non-user benefits that were assessed were emissions savings and congestions reduction. The assessment for airport non-user benefits includes airport congestion savings and emission savings.

Emissions Reduction

Highway congestion and emission benefits were estimated using data on auto trips diverted to rail from their feasibility-level forecast. Tons of emissions savings were calculated by multiplying diverted vehicle miles traveled (VMT) with emission rates as shown in Appendix B. The VMT were then multiplied by cost per ton of emissions as shown below in Table 3-25. Several critical pollutants were included for evaluation in estimating the potential emissions saving value. The dollar amounts applied for the reduced pollutant volume resulting from the VMT reduction were obtained from the Corporate Average Fuel Economy for MY2011 Passenger Cars and Light Trucks (March 2009) and were inflated to a 2010 equivalent to obtain an estimated monetary value for the pollutants. A summary of the estimated diverted vehicle miles, tons of auto emissions saved and cost of emissions saved due to auto trips diverted to the rail system is provided in Appendix B.

Table 3-25: Cost per Ton of Pollutant (VOC, CO, NO_x, PM10 and SO_x)

Pollutants	Cost per Ton (2010$)[17]
VOC	$1,785
CO	$510.33
NO_x	$4,200
PM-10	$176,400
CO_2	$27.60

Highway Congestion Time Savings

The highway congestion delay savings consists of the time savings to the remaining highway users that result from diversion of auto users to the rail system.

The assumption is that less congestion leads to improved operating speeds for the remaining road uses, which results in shorter overall travel times. Applying an average regional value of time to the remaining highway automobile occupants monetizes the time savings. The time savings were estimated using the volume-capacity, speed and time profile analysis that evaluated the expected change in average travel times along highway corridors parallel to the rail system using the Bureau of Public Roads (BPR) time adjustment factor equation (as shown in Appendix B). The following outlines the main assumptions used for all three technologies to develop the highway congestion delay benefits:

- Average vehicle occupancy rates of 1.2 for business users and 1.5 for non-business users;
- Average freeway capacity of 2,000 vehicles per lane;
- Major corridors include I-16, I-20, I-65, I-75 and I-95; and
- Highway growth patterns are based on State Highway Authority projects.

Highway Congestion Fuel Savings

Another component due to reduction in overall congestion on the highway system is reduction excess fuel expenditure. The excess fuel component is used instead of actual fuel consumed component because the base fuel cost is already included in the generalized cost components and is embedded in the consumer surplus results.

[17] Corporate Average Fuel Economy for MY2011 Passenger Cars and Light Trucks (March 2009), page VIII-60,Table VIII-5 “Economic Values for Benefits Computations (2007$)

As such, only the excess congestion fuel over and above the normally consumed fuel levels for a trip can be considered an added benefit of the system.

The excess fuel consumed refers to the fuel consumed while sitting in traffic congestion and is unrelated to the actual fuel consumed by each traveler. The assumption is that less congestion leads to improved operating speeds for the remaining road users, which results in shorter overall travel times and less fuel consumption.

The excess fuel savings resulting from diverting vehicular travel to the rail system was estimated using average excess fuel consumption values generated by using the fuel economy and vehicle speed relationship. The total cost savings from the reduced excess fuel consumption were then estimated by applying an average fuel cost for the study corridors.

Airport Congestion and Emissions Reduction

Airport congestion and emissions reduction benefits were based on the 1997 FRA *Commercial Feasibility Study*. Air congestion projections were estimated using passenger air trips and air trips diverted to rail (refer to each corridor's Ridership and Revenue section of this report for additional details). The FRA study calculated travel time saved by air passengers (those not diverted to rail) due to reduced congestions, deviations from scheduled flight arrival and departure times, and additional time spent on the taxiway or en route.

Air passenger delay benefits per diverted air trip were estimated at $24.60 (2010$), based on the Southeast corridor from the 1997 FRA study. This value, multiplied by the relevant option air trips (in millions) diverted to rail each year yields the 30-year discount benefit.

Benefits to air carriers in terms of operating costs savings resulting from reduced congestion at airports are calculated the same way as the time savings benefit to air travelers. For its study corridors, the FRA study estimated the benefits to air carriers by multiplying the projected reduction in the number of aircraft hours of delay by the average cost to the airlines for each hour of delay. For this study, the calculate air carrier benefits per diverted air trip were $13.40 (2010$). This value, multiplied by the number of air trips diverted to rail each year yields the 30-year discount benefit.

The diversion of travelers to rail from air also generates emissions savings estimated as $5.38 per diverted air trip. This value, multiplied by the relevant option air trips diverted to rail each year yields the 30-year discount benefit.

3.4.4.5 Public and Private Benefit Estimations

A key element of the FRA public-private partnership analysis is the assessment of both public and private benefits. To test the "franchisability" of a corridor, the FRA uses the "operating ratio" of revenues divided by operating costs. A service with a positive operating ratio greater than 1.0 generates an operating surplus. A positive operating ratio gives evidence of a strong, self-supporting operating system that is less likely to need operating subsidies and reduces the operating risk for the owner, investor and operator. The following equation was used in this analysis to determine the operating ratios for each corridor and evaluation range:

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

With respect to the public benefit of a project, a benefit-cost analysis was performed to show how the overall public benefits relate to the overall costs of the project. The FRA benefit-cost methodology identifies costs (capital, operating and maintenance) and benefits (fare revenues, on-board service revenue, consumer surplus and external resources) that can be monetized and then calculates a benefit cost ratio. Similar to the operating ratio, a benefit-cost ration greater than 1.0 is desirable and the ratio can be used to compare the relative social desirability of multiple high-speed rail projects. In order to capture the benefits and costs over time with a three percent (3%) discount rate for NPV, the benefit-cost analysis was based on forecasts from 2021 to 2050 (a 30-year discounting period).

$$Benefit\ Cost\ Ratio = \frac{Total\ Public\ Benefits}{Total\ Project\ Costs}$$

3.4.5 EVALUATION RANGES

In setting up the evaluation, three scenarios were developed to show the impact of a range of ridership, revenue, capital and operating cost estimates typically encountered in a feasibility-level analysis. Unadjusted base forecasts for ridership, revenue, capital and operating costs were used for the Conservative Scenario. Base ridership and revenue estimates were increased for Dedicated Use corridors to establish the Intermediate and Optimistic Scenarios.[18] Operating costs were

[18] Ridership adjustments for Intermediate and Optimistic Scenarios were only made for Dedicated Use corridor 180-220 mph electrified, steel-wheel and Maglev technologies (Maglev in Atlanta-Louisville corridor only) based on a peer review of regional and national high speed rail corridor studies. No scenario ridership adjustment was made for Shared Use corridor diesel-electric technology results based on a peer review of other shared-use corridor studies.

adjusted by the appropriate ridership drivers. Capital cost estimates were adjusted downward in the Intermediate and Optimistic Scenarios for all technologies.

The three scenarios are intended to capture and illustrate the relatively wide range of estimates at the feasibility-level of study. As corridors are deemed feasible for further evaluation, future studies will provide greater detail in the analysis of ridership, revenues and costs, narrowing the range of estimates.

3.4.5.1 Conservative Scenario

- Ridership/Revenue = Direct estimates based on travel demand model which include a county based market assessment and demographic forecasts along with assumptions for increased fuel costs and congestion.
- Operating and Maintenance Costs = Direct estimates based on unit costs and scenario drivers
- Capital costs = Direct estimates based on unit costs including a 30 percent contingency

3.4.5.2 Intermediate Scenario

- Ridership/Revenue = An "intermediate" 75 percent increase from the Conservative Scenario for Dedicated Use corridors only. Based on a peer review of national and regional high-speed rail studies that employed more detailed and sophisticated ridership forecasts.
- Operating and Maintenance Costs = Direct estimates based on unit costs and scenario drivers
- Capital Costs = Direct estimates based on unit costs including a 15 percent contingency

3.4.5.3 Optimistic Scenario

- Ridership/Revenue = An "optimistic" 100 percent increase from the Conservative Scenario for Dedicated-Use corridors only. Again, based on a peer review of national and regional high-speed rail studies that employed more detailed and sophisticated ridership forecasts.
- Operating and Maintenance Costs = Direct estimates based on unit costs and scenario drivers
- Capital Costs = Direct estimates based on unit costs without a contingency

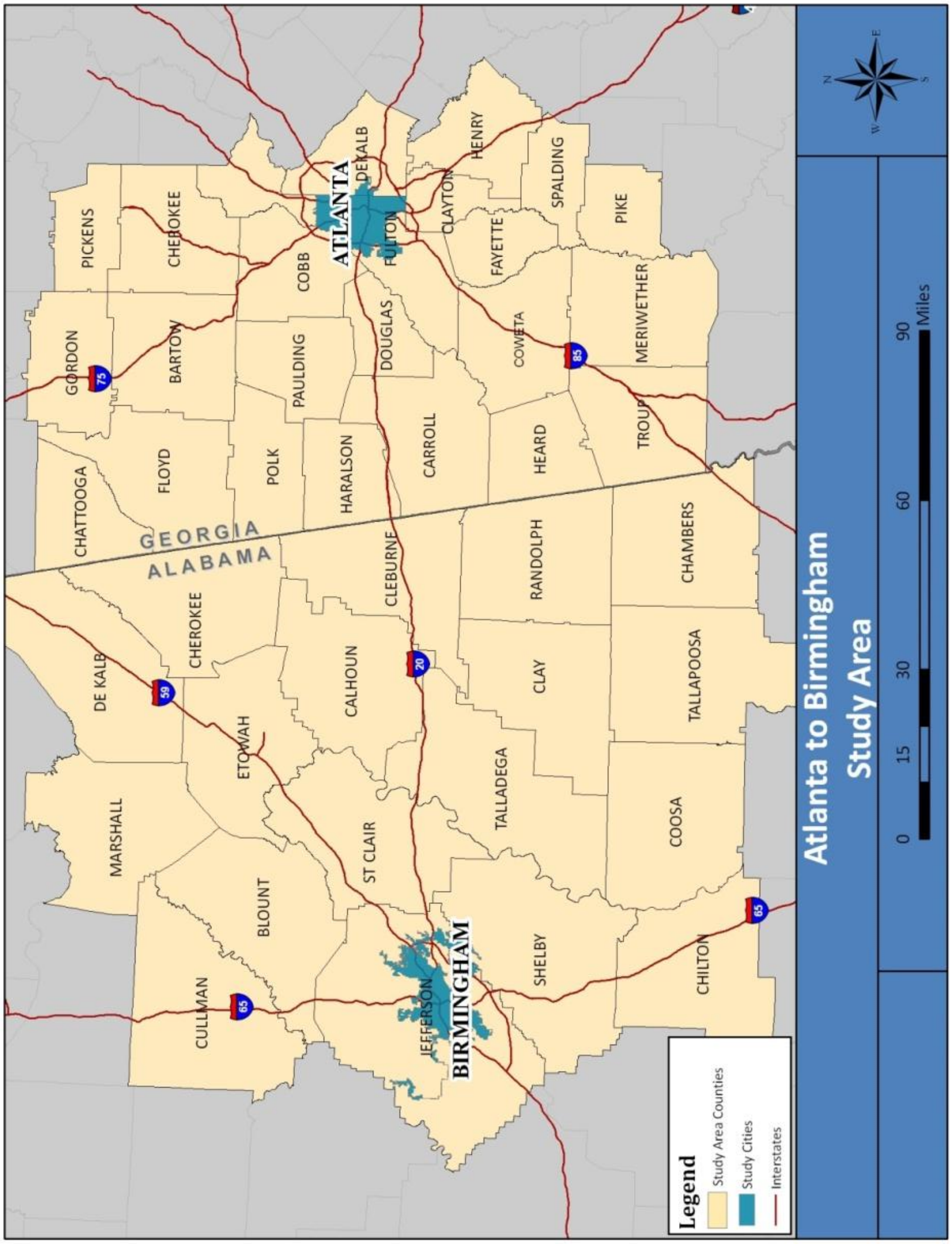
SECTION II:
ATLANTA TO BIRMINGHAM

1 EXISTING CONDITIONS AND BACKGROUND

In order to estimate the improvements that high-speed rail will bring to the Atlanta-Birmingham Corridor, a baseline of existing conditions was established. Existing conditions can include a variety of factors and characteristics; however, for the purposes of this feasibility study, the existing conditions include population demographics and socioeconomic characteristics, employment patterns, land use patterns, transportation systems, and environmentally critical areas.

A 100-mile wide study area was established around three Shared Use and one Dedicated Use evaluated routes. The basis of the existing conditions assessment is based on this study area and the counties within. This size study area was chosen to be consistent with the ridership and revenue forecasting catchment area. Further, a 100-mile corridor allows for connecting opportunity areas that high-speed rail will benefit. A map of all Georgia and Alabama counties included in the study area can be seen in Figure 1-1, below.

Figure 1-1: Atlanta-Birmingham Study Area



1.1 Evaluated Alternatives

The study evaluated a number of potential route alternatives for both Shared Use and Dedicated Use technologies to determine the best representative route to utilize throughout the study analyses. It should be noted that this route is not a preferred route for the corridor, but rather, is a route that can represent the overall feasibility of the corridor. If this corridor is determined feasible from this representative route, it will be necessary, in the future, to conduct an alternatives analysis to determine a preferred route through the NEPA process.

1.1.1 90-110 mph Shared Use Corridors

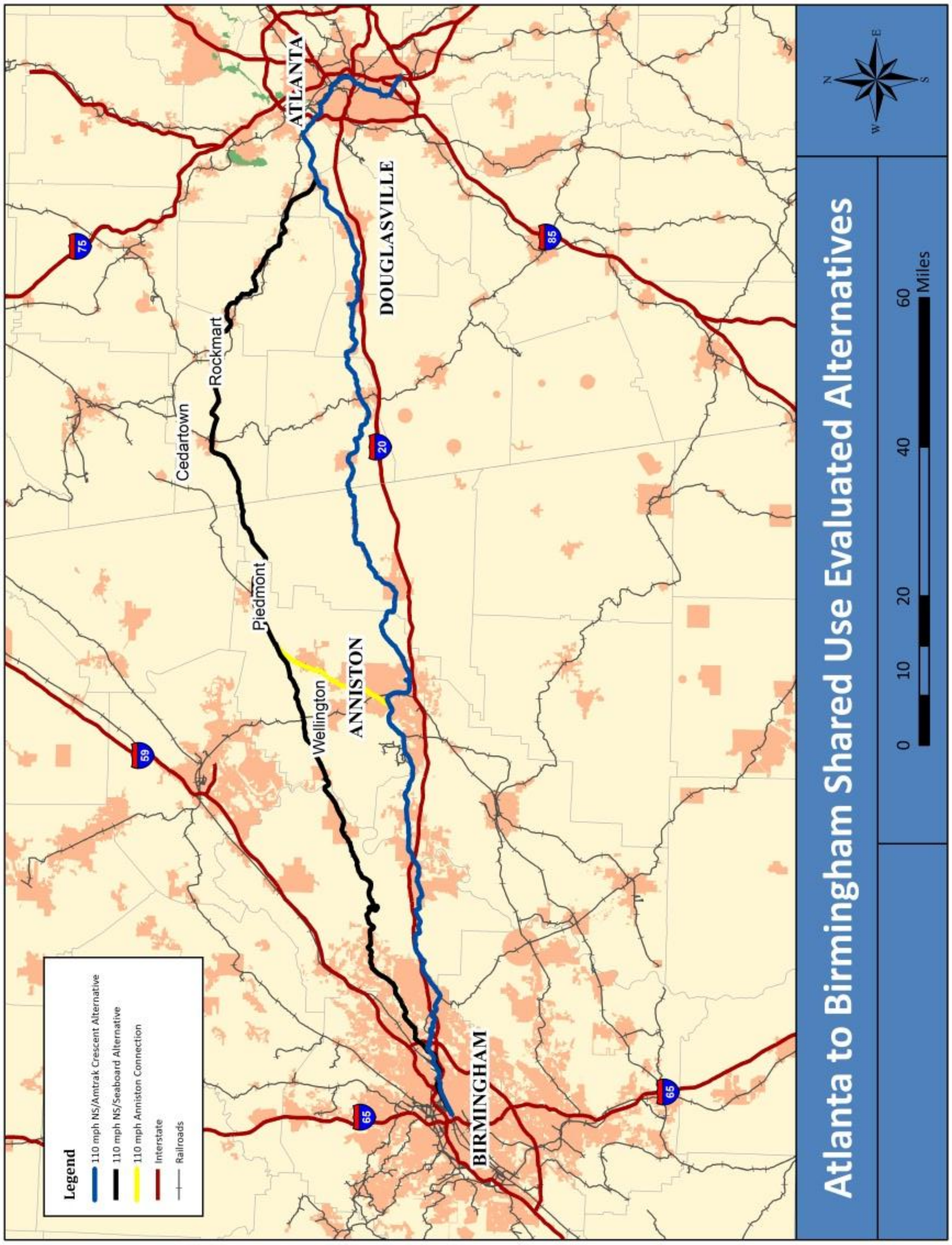
There are three rail routes that were considered for the Atlanta to Birmingham for 90-110 mph technology. These routes use a combination of existing and abandoned freight and passenger rail infrastructure. All three options can be seen in Figure 1-2. Additionally, the characteristics for these corridors can be seen in Appendix C. Each of these proposed routes was subject to a technical review by the project study as well as input from key local stakeholders to determine the representative route for the corridor.

The first alternative follows the NS and Amtrak crescent corridor. The route is approximately 176 miles and is a single Class 4 track with sidings. A preliminary analysis reveals that there are 355 curves that exceed a radius of one degree, 30 minutes. This equates to 67.5 miles or 41 percent of the corridor. This information was gathered by measuring the radius of each individual curve along the existing freight corridors using GIS and AutoCAD software. In addition to the two passenger trains per day, a daily weighted average density of 26.3 freight trains per day uses the corridor. The estimated passenger travel time based on the track geometry for this corridor is about 166 minutes with an average speed of 64 mph.

The second alternative in consideration is the Seaboard Route; this route consists of the NS route for Atlanta to Rockmart and the CSXT Seaboard from Rockmart to Birmingham. This route is 169 miles and consists of a single track with sections of Class 1, 3, 4 with some abandoned sections. There are 306 curves that exceed the limit the one degree, 30 minute curvature, for a total of 49 miles (29 percent of the route). This track carries an average of 17.5 trains per day, most of which can be found between Atlanta, GA and Austell, GA. The estimated travel time is 169 minutes with an average speed of 60 mph. A large portion of the route was abandoned by CSXT in the 1980s and has since been converted to the Chief Ladiga bike trails.

There is opportunity in Anniston, AL to move the service from the Seaboard to the NS Crescent route via an abandoned track beginning in Jacksonville, AL through Anniston and connecting with the NS line in Piedmont, AL. Using this route, the total route is 174 miles with a combination of abandoned and Class 1, 3, and 4 tracks. The connection is approximately 25 miles and encompasses 14 curves with a radius greater than one degree, 30 minutes (2.86 miles or 11 percent of the total miles). The estimated travel time is 174 minutes with an average speed of 60 mph.

Figure 1-2: Atlanta-Birmingham Shared Use Evaluated Alternatives



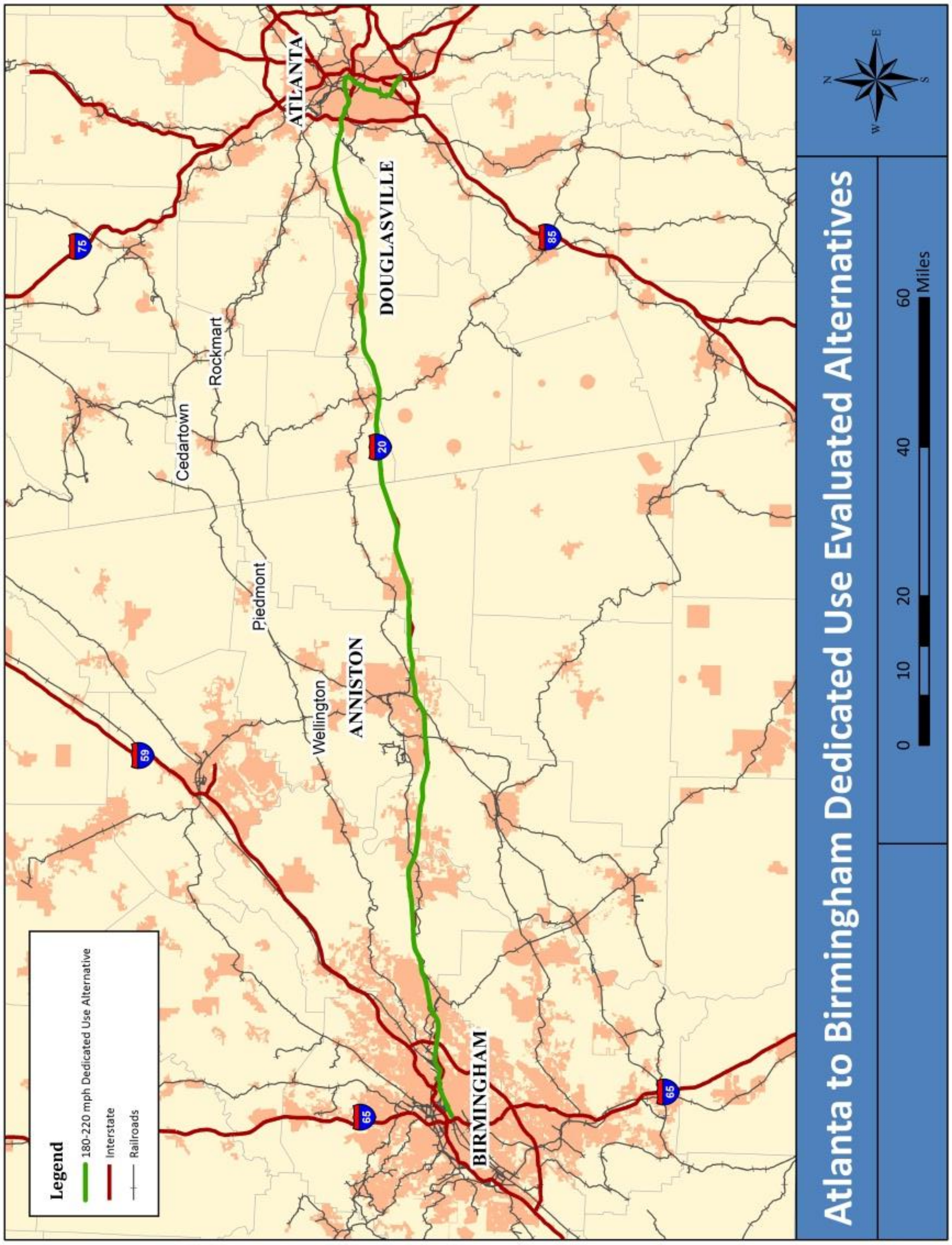
1.1.2 180-220 MPH DEDICATED USE CORRIDORS

The study assumed that viable high-speed rail operations along interstate highway corridors are to be on one of three basic routes: within the highway median, alongside the outside highway lane within the highway right-of-way, or in purchased right-of-way adjacent to the highway right-of-way. Where selected interstate highway curves were greater than 30’, the high-speed rail route was adjusted to leave the immediate highway corridor if justified by travel time savings. It should be noted that while there is not a preferred alignment alternative as a part of the feasibility study, but variations in these basic routes will have an impact on cost and environmental considerations.

The proposed Dedicated Use route generally follows the Interstate 20 (I-20) corridor. For 180-220 mph high-speed rail, to maintain top speeds, the track cannot exceed a curvature of greater than 30 minutes. For most of the Dedicated Use route, the interstate is a four- lane, rural facility with a 70 mile-per-hour speed limit and at least a 45-foot median, allowing for the trains to use the interstate median. The corridor transitions to a 6-lane facility with speed limits varying between 55 and 65 miles per hour with urban cross-sections both east of Birmingham and also near Douglasville, GA just west of Atlanta. In these areas, it will be necessary to use the shoulder of the interstate route to construct the high-speed rail track. In some instances, the route utilizes a true greenfield route in areas where the interstate right-of-way corridor geometry cannot be eased to the extent necessary for the high-speed train technology. Near downtown Atlanta (within the I-285 perimeter) the Dedicated Use route transitions from the interstate corridor to the NS corridor to connect to the proposed MMPT.

This route is approximately 151 miles with 24 curves that exceed the 30 minute curvature radius. This is equal to about seven miles (five percent) of the corridor. The estimated travel time is approximately 78 minutes with an average speed of 117 mph. Figure 1-3 illustrates this representative Dedicated Use corridor route.

Figure 1-3: Atlanta-Birmingham Dedicated Use Evaluated Alternative



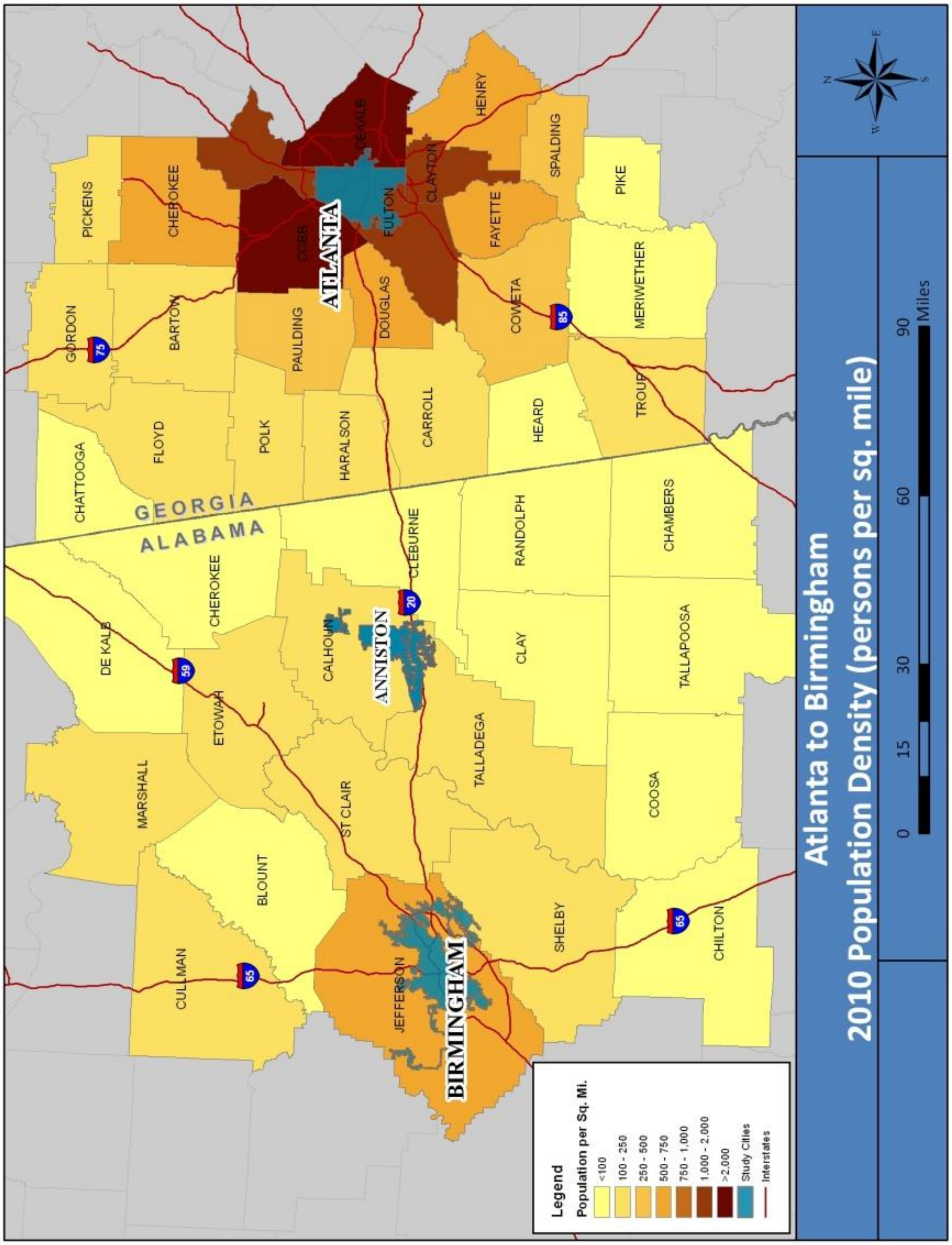
1.2 Demographics and Socioeconomics

1.2.1 Total Population, Density, Race and Age

In order for high-speed rail to be feasible, it must serve areas of high population and employment density in order to produce a market for high-speed rail service. Other characteristics, such as age and race must be considered as this can impact the population's propensity to ride transit.

For the purpose of assessing population, data was reviewed and aggregated from a county level from the 2010 U.S. Census. The total existing (2010) population of the 41 counties in the 100 mile study corridor area is 5,913,667. Despite the fact that most of the study area lies within Alabama, a majority of this population (70%) is located in Georgia. As illustrated in Figure 1-4, population densities vary along the corridor, but are generally higher in Georgia. These densities range from above 2,000 persons per square mile in DeKalb County, GA (2,580) and Cobb (2,023) County, GA to under 50 persons per square mile in many of the rural Alabama Counties, including Cherokee (47), Clay (28), Cleburne (27), Coosa (18), and Randolph (39) Counties. This indicates that much of the corridor is rural and exhibits a potential need for high-speed travel between the major origin and destinations of Atlanta and Birmingham. Appendix D provides 2010 total populations and population density by county.

Figure 1-4: Atlanta-Birmingham Population Density



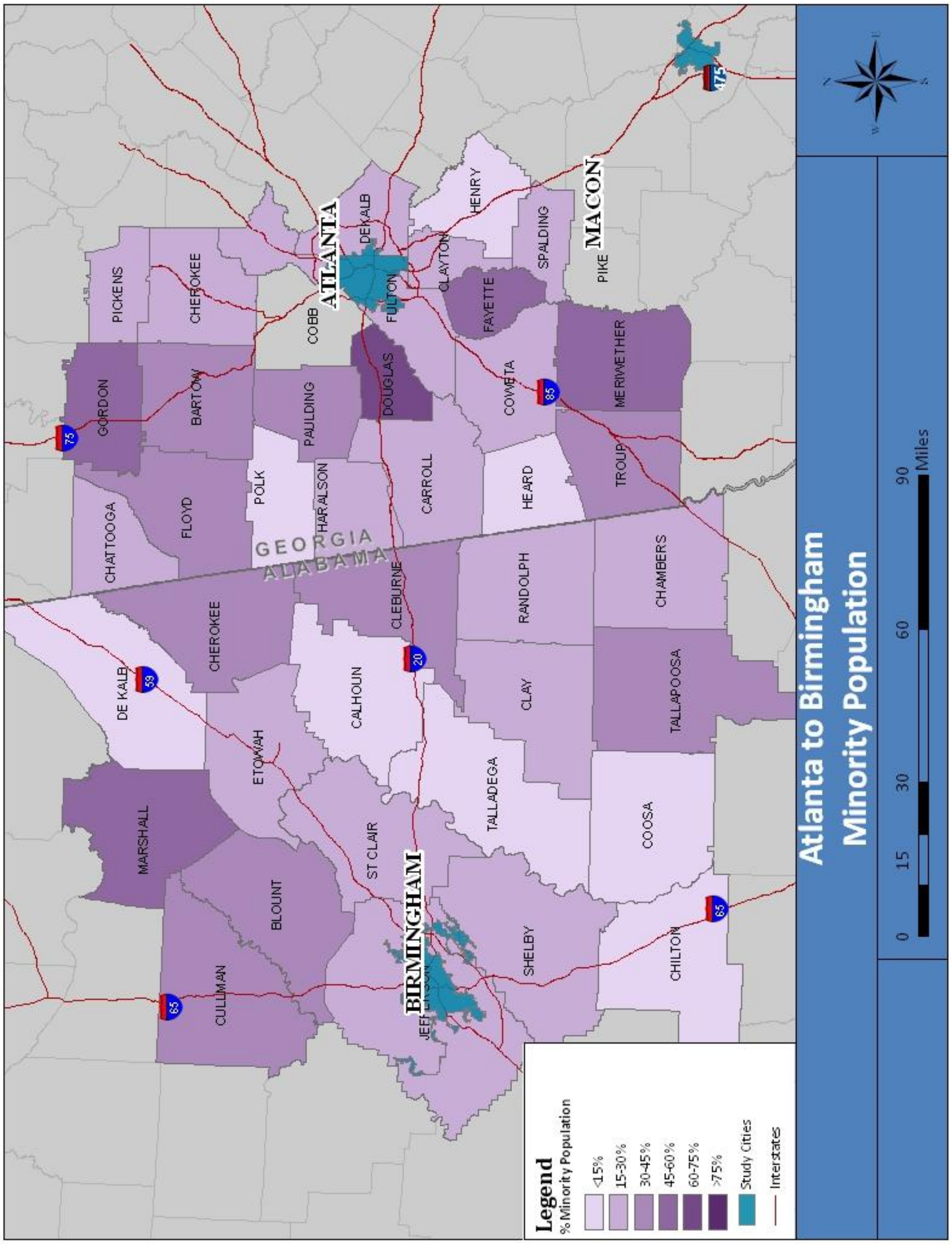
The distribution of race along the corridor is shown in Table 1-1. Most counties along the corridor follow a general trend of majority Caucasian populations, followed by smaller African American and Hispanic populations. Compared to state levels, the distribution of race and ethnicity along the corridor reflect similar patterns to Georgia and slightly lower Caucasian population than Alabama, as illustrated in Table 1-1. However, most of the counties in Georgia, with the exception of Clayton County, DeKalb County and Fulton County, African Americans are the minority. Figure 1-5 illustrates the distribution of minority. Appendix D provides the 2010 racial and ethnic distribution by county.

Table 1-1: Atlanta-Birmingham Race of Study Area Population

Race	Percent of Total Population (2010)	Statewide Georgia – Percent of Total Population (2010)	Statewide Alabama – Percent of Total Population (2010)
White	56.4%	59.7%	68.5%
Black/African American	30.9%	30.5%	26.2%
Hispanic or Latino	7.7%	8.8%	3.9%
American Indian	0.2%	0.3%	0.6%
Asian/Pacific Native	2.9%	3.2%	1.1%
Other	1.7%	2.2%	3.6%

Source: U.S. Census Bureau (2010)

Figure 1-5: Atlanta-Birmingham Minority Populations

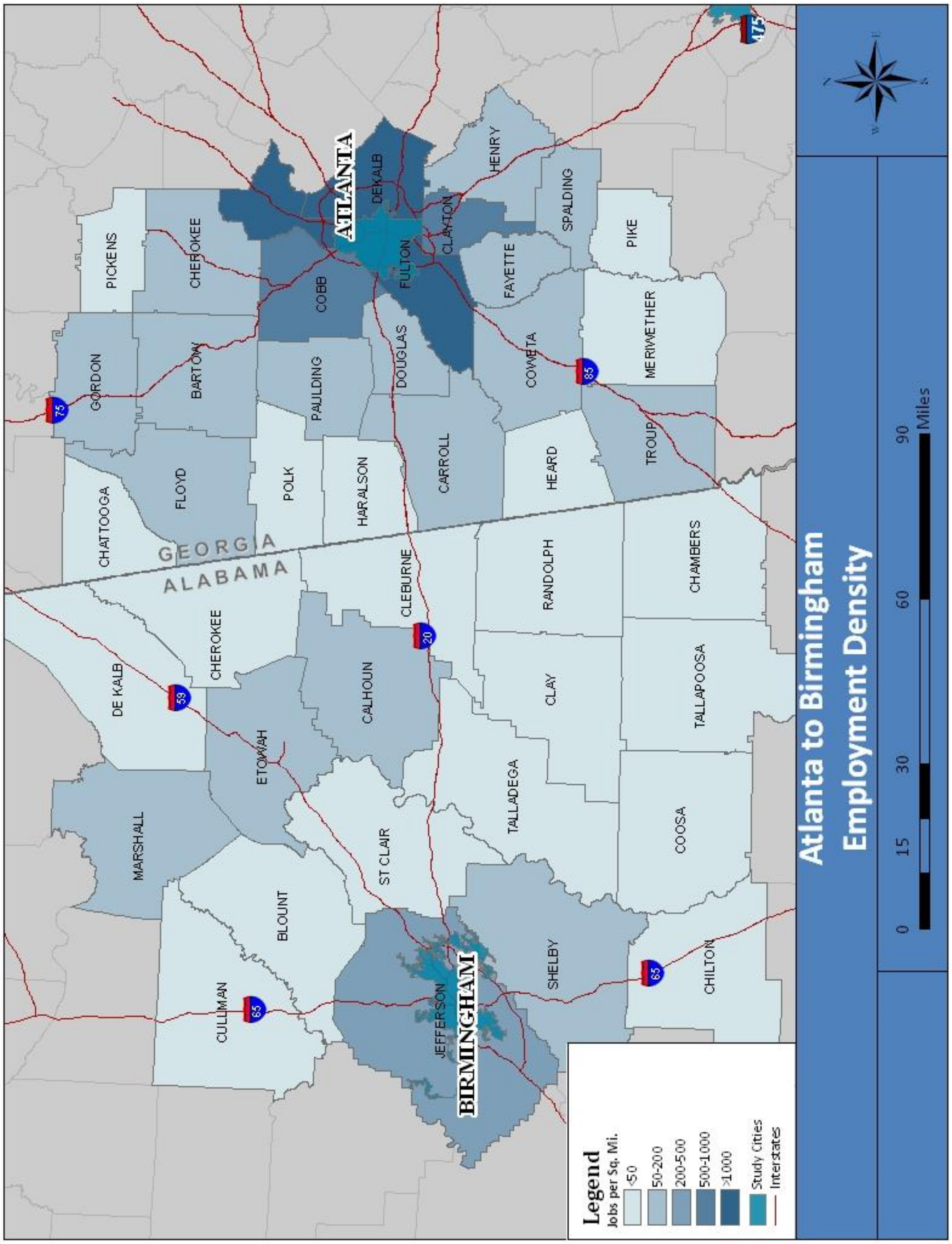


As seen with similar aging trends across the United States, the 2010 senior populations (ages 65 and older) in Alabama and Georgia make up approximately seven percent and six percent of the total population, respectively. However, in the 41-county study area of the Atlanta to Birmingham corridor, the senior population is slightly higher at eight and half percent. Seniors can play a major role in ridership for many transportation alternatives. Many of these seniors are transit dependent and would potentially rely on this high-speed rail corridor for their travels between the two cities, or perhaps from a more rural area to a major city for services such as medical treatment and shopping. Appendix D provides the 2010 aging population by county.

1.2.2 EMPLOYMENT AND EMPLOYMENT CENTERS

Employment distribution is important to understand potential trip patterns since employment centers serve as the destination for most trips whether they are work trips, school trips, shopping trips, or medical trips. Employment densities vary significantly along the study corridor, as illustrated in Figure 1-6. The distributions range from over 1,000 jobs per square mile in Fulton County and DeKalb County, GA to less than 10 jobs per square mile in some of the rural counties in Georgia and Alabama. Over half (55 percent) of the total employment in the corridor is located in the metropolitan Atlanta counties of Cobb, Clayton, DeKalb and Fulton, GA. Another 16 percent of the corridor's employment is located within the Birmingham area, in Jefferson and Shelby Counties. Appendix D provides employment data by county for 2009.

Figure 1-6: Atlanta-Birmingham Employment Density



Major employment centers include hospitals, large office parks, universities, shopping malls, military bases and other activity centers. High-speed rail offers an advantage to populations by offering more reliable, quicker commutes to major employment centers. As previously mentioned, there is opportunity to reach average speed of 117 miles per hour, yielding travel times between the two destinations of just over one hour. This is similar to the automobile commutes workers currently make from suburbs to inner cities. Opening the opportunity for greater distances can potentially increase the economic activity and viability on a regional scale and it may, in turn, enhance the attractiveness of the cities to major industries and businesses.

In general, there are a number of major employment centers within both cities. In Atlanta, there are major universities such as, Georgia Institute of Technology, Georgia State University, Emory University and the Atlanta University System; four major hospitals: Grady Hospital, Piedmont Hospital, Emory Midtown Hospital, and Children's Hospital of Atlanta. Atlanta is home to Fortune 500 companies including, but not limited to The Home Depot (#30), UPS (#48), Coca-Cola Company/Enterprises (#70), Delta Airlines (#88), Southern Company (#147), Genuine Parts (#215), First Data (#236), SunTrust Bank (#244), AGCO (#340), Newell-Rubbermaid (#397), and Mohawk Industries (#427). Further, there is a multitude of small companies and branches of major national and international firms represented in Atlanta. Finally, Atlanta is home to the busiest international airport in the United States, H-JAIA, which accommodates almost 90 million passengers annually (H-JAIA, 2010).

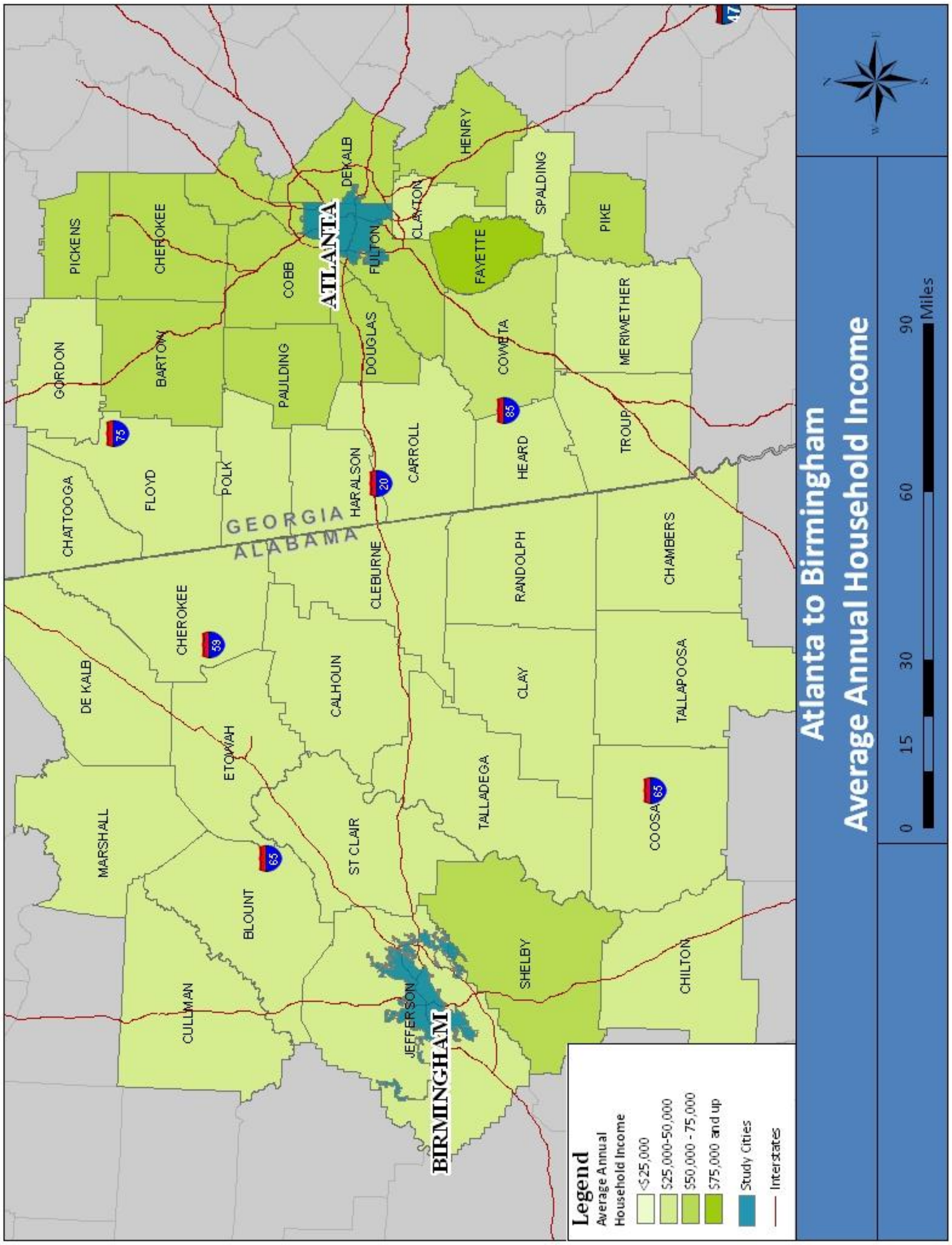
In Birmingham, University of Alabama Birmingham and Stamford University have a large presence. There are two major hospitals including the University of Alabama Hospital and Children's Hospital of Birmingham. Regions Financial Corporation (Fortune 500 #293) houses its headquarters in Birmingham. Other corporations such as Alabama Power, Belk, Books-A-Million, CVS Caremark Corporation, EBSCO Industries, Hibbett Sports, Inc., and State Farm Insurance Companies all have a major presence in Birmingham. Finally, Birmingham-Shuttlesworth International Airport served nearly three million passengers in 2010, making it one of the largest international airports in the southeastern United States.

1.2.3 Socioeconomic Characteristics - Income

Similar to age, income is often a good indicator of an individual's propensity to ride transit. Figure 1-7 shows the average annual household income for counties within the study area. Average incomes for Georgia counties within the study area are similar to that of the nation ($51,833 compared to $51,425 nationally) while those in Alabama are significantly lower (averaging $46,152). Several counties far exceed this average (30 percent or more), including Fayette ($82,678), Cobb ($69,728), Cherokee ($68,627) in Georgia and Shelby ($71,785) in Alabama. Similarly, several counties have average annual household incomes which are more than 30 percent lower than the national average, including Chattooga ($34,249) and Meriwether ($35,566) in Georgia and Chambers ($35,614), Randolph ($34,185) and Talladega ($35,487) in Alabama. Appendix D provides the income distribution by county for 2009.

HNTB

Figure 1-7: Atlanta-Birmingham Average Annual Household Income 2009



1.2.4 ENVIRONMENTAL JUSTICE

A full environmental analysis will be necessary for a Tier I NEPA study. However, the feasibility study can begin to identify areas where environmental justice (EJ) issues may surface along the corridor. Minority populations were identified along the Atlanta-Birmingham corridor. The percentage of minority populations within each county along the corridor was compared to the state percentages of minority populations. Those counties whose minority populations exceeded the state average are considered potential EJ counties. Additionally, the county median household income was compared to the statewide median household income. Counties that showed a lower median income than the state are considered potential EJ counties. Table 1-2 illustrates the potential EJ counties and the thresholds met. The detailed demographics for each county are in Appendix D.

Table 1-2: Atlanta-Birmingham Potential EJ by County

County	Thresholds	
	Race/Ethnicity	Household Income
Georgia		
Carroll		✓
Chattooga		✓
Clayton	✓	✓
DeKalb	✓	
Douglas	✓	
Floyd		
Fulton	✓	
Floyd		✓
Gordon		✓
Haralson		✓
Heard		✓
Henry	✓	
Meriwether		✓
Polk		✓
Spalding		✓
Troup		✓
Alabama		
Calhoun		✓
Chambers	✓	✓
Cherokee		✓
Chilton		✓
Clay		✓
Cleburne		✓
Coosa	✓	✓
Cullman		✓
DeKalb		✓
Etowah		✓
Jefferson	✓	
Marshall		✓
Randolph		✓
Talladega	✓	✓
Tallapoosa		✓

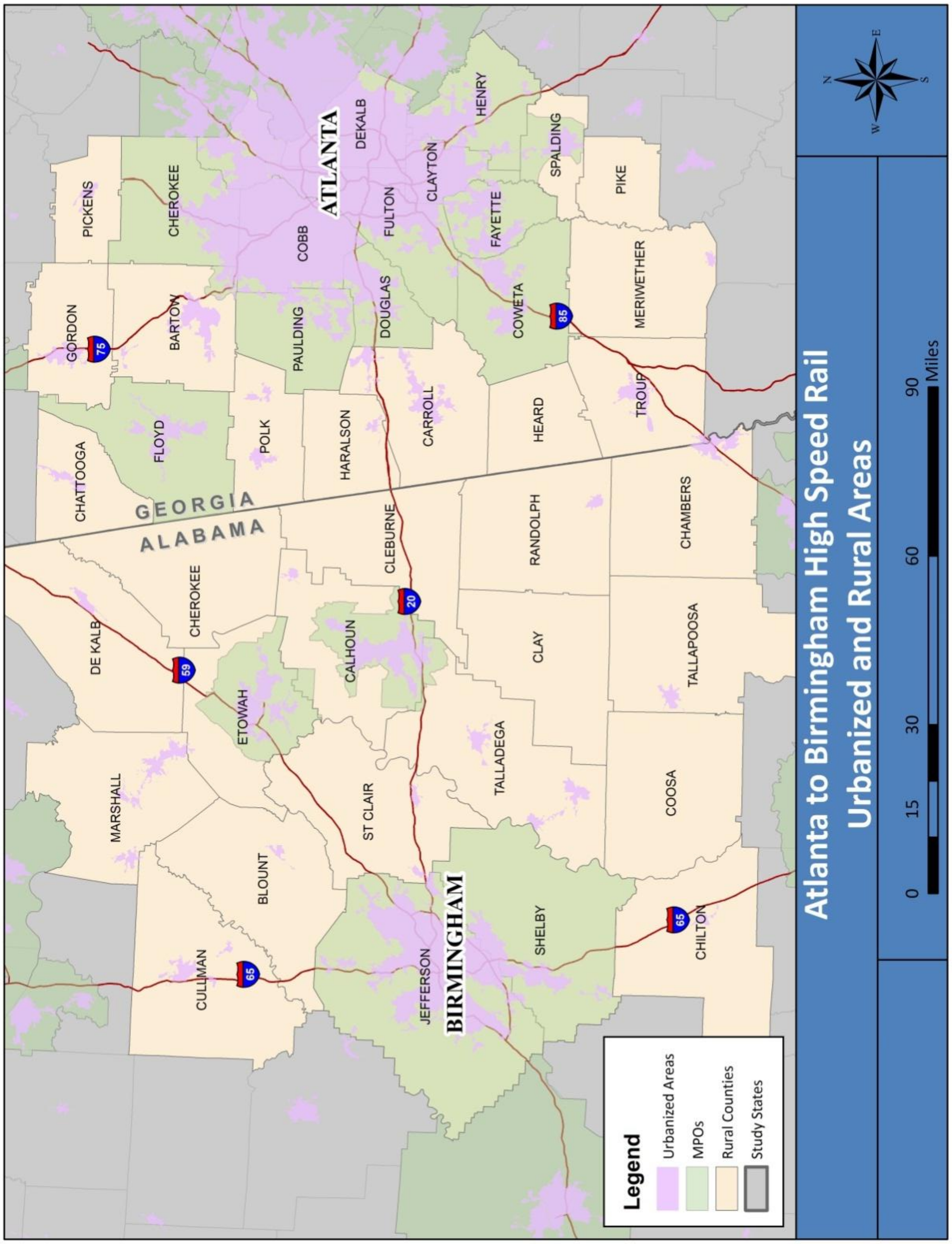
Source: U.S. Census Bureau, 2010

1.3 LAND USE – URBAN VS. RURAL

The study area consists of both urban and rural areas. According to the U.S. Census, urban areas are defined as “densely settled territory, which consist of core census block groups or blocks that have a population density of at least 1,000 people per square mile and surrounding census blocks that have an overall density of at least 500 people per square mile (U.S. Census, 2000). The two terminal points, Atlanta and Birmingham, are major cities with dense commercial, office and residential development near the city centers. Between these two major cities, Anniston serves as an employment and residential center for central Alabama. Between these cities along the corridor, there is a mix of suburban and rural communities and areas.

Figure 1-8 illustrates the location of census-defined urban areas along the study corridor. From Birmingham, traveling east, land uses transition from urban to rural just outside the Jefferson County, AL border and remains rural for much of the route through Alabama with the exception of Calhoun County, AL (City of Anniston). As the route continues east into Georgia, the surrounding land uses remain rural until I-20 reaches the suburbs of metropolitan Atlanta, specifically Paulding County, GA. The study area encompasses a majority of the metro Atlanta region, as it is expected to attract trips from the Atlanta and its surrounding suburbs.

Figure 1-8: Atlanta-Birmingham Urbanized Areas



1.4 TRAVEL PATTERNS

High-speed rail feasibility is partially determined by the success of other modes of travel between major cities. High-speed rail competes with both air and automotive travel, and will therefore, be more successful in corridors where air and auto travel have consistently moderate to high travel between the major cities.

1.4.1 AUTOMOTIVE TRAVEL

The ridership and revenue forecasting methodology utilizes annual auto round-trip estimation from the 1995 ATS conducted by the BTS. This is the most recent intercity travel survey data available. The survey found that there were over one million (1,174,715) vehicular roundtrips between Atlanta and Birmingham annually. The roundtrips between cities can be seen in Table 1-3.

Table 1-3: Atlanta-Birmingham Intercity Auto Trip Table (ATS 1995)

Originating City	Annual Person Trips (Round Trips)
Atlanta	479,181
Birmingham	695,534

Source: ATS, 1995

Traffic counts were also observed between 1995 and 2010 to understand total volumes along the interstates. It should be noted that traffic counts can be misleading because they include both long-distance travel and local travel. Therefore, while traffic counts can give an indication on the demand between the major cities, these are not definitive figures intercity travel. On average, the traffic has increased by 1.71 percent per year between Atlanta and Birmingham (from 25,963 to 33,460, daily).

1.4.2 AIR TRAVEL

Local air travel refers to air passenger volumes on direct flights between the major airports within the study corridor. The Federal Highway Administration (FHWA) Airline DB1B provided volumes for 2010. It should be noted that these figures do not include transfers at either end of corridor, only trips originating in and destined for one of the study cities. The survey determined that there were 7,310 air passengers travelling between Atlanta and Birmingham in 2010. These total volumes can be seen in Table 1-4.

Table 1-4: Local Air Trips in 2010

Originating City	Annual Person Trip (Round Trips)
Atlanta	3,960
Birmingham	3,350

Source: FHWA Airline Origin and Destination Survey Database, 2010 (Q1-Q4)

Air connections are also an important comparison to high-speed rail travel. In many cases along the corridor, connecting flights play an important role in the airport's function. These passengers should be taken into consideration as high-speed rail could potentially serve to replace a flight connection link to another airport. Table 1-5 shows segment-level traffic information for the H-JAIA and Birmingham-Shuttlesworth Airport pair which provides a reliable estimate for the connect air market under consideration. The table includes total passengers, scheduled seats, scheduled departures, average daily frequency, average sets per flight, and average passenger per flight for Q4 2009 to Q3 2010.

Table 1-5: Atlanta-Birmingham Air Services Summary

City Pair	Passengers	Seats	Scheduled Departures	Flights/ Day	Seats/ Flight	Passengers / Flight
ATL-BHM	257,423	324,154	4,745	13	68	54

Source: FHWA Airline Origin and Destination Survey Database, 2010 (Q1-Q4)

1.5 Environmental Issues

Environmentally sensitive areas for the purposes of this study include those that potentially contain threatened and endangered species and/or cultural resources such as properties listed on the NRHP or that are outlined in Section 4(f) of the USDOT Act of 1966. FRA must comply with Section 4(f) guidelines for the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refugees, or public and private historical sites unless the following conditions apply: 1) there is no feasible and prudent alternative to the use of the land; and 2) the actions includes all possible planning to minimize harm to the property resulting from use.

As previously mentioned there are additional environmental aspects that should be considered in future studies, but given the high-level analysis if this feasibility analysis, these aspects are more appropriate during the NEPA process.

1.5.1 Threatened and Endangered Species

Threatened and endangered species lists are maintained by the U.S. FWS. The four corridors were reviewed for the potential of threatened and endangered species on a county basis. The county reports "contain species that are known to or are believed to occur in the county" (U.S. FWS). These counties include Carroll, Cobb, Douglas, Fulton, Haralson, Paulding and Polk in Georgia and Calhoun, Cleburne, Jefferson, Shelby, St. Clair, and Talladega counties in Alabama. A full list of species can be found in Appendix E. There are currently 27 species within study area counties (displayed in Table 1-6) that are listed as endangered, 13 species that are considered threatened, three species are candidates, and one is potentially endangered.

Table 1-6: Atlanta-Birmingham Study Area Counties Known Endangered and Threatened Species

Species	Status	Species	Status
Red-cockaded woodpecker	Endangered	Goldline darter	Threatened
Southern acornshell	Endangered	Vermilion darter	Endangered
Upland comb shell	Endangered	Rush darter	Potentially Endangered
Finelined pocketbook	Threatened	Etowah darter	Endangered
Ovate clubshell	Endangered	Mohr's Barbara button	Threatened
Southern clubshell	Endangered	Green pitcher-plant	Endangered
Triangular kidneyshell	Endangered	White fringeless orchid	Considered
Coosa moccasinshell	Endangered	Tennessee yellow-eyed grass	Endangered
Southern pigtoe	Endangered	Michaux's sumac	Endangered
Gulf moccasin shinyrayed pocketbook	Endangered	Little amphiantus	Threatened
Orangeacre mucket	Threatened	Georgia rockcress	Considered
Alabama moccasinshell	Threatened	Gentian pinkroot	Endangered
Dark pigtoe	Endangered	Georgia aster	Considered
Pygmy sculpin	Threatened	Alabama leather flower	Endangered
Blue shiner	Threatened	Indiana bat	Endangered
Cherokee darter	Threatened	Gray bat	Endangered
Watercress darter	Endangered	Painted rocksnail	Threatened
Cahaba shiner	Endangered	Cylindrical lioplax	Endangered
Plicate rocksnail	Endangered	Round rocksnail	Threatened
Tulotoma snail	Endangered	Rough hornsnail	Endangered
Flat pebblesnail	Endangered	Lacy elimia	Threatened
Flattened mush turtle	Threatened		

Source: U.S. FWS, 2011

1.5.2 CULTURAL RESOURCES

Using the same counties as the endangered species screening, the study looks at the NRHP to understand the magnitude of historic resources within the corridor. Within the study area, there are a total of 573 places that are listed on the NRHP. While only some of these properties will be located within a close proximity to representative routes, additional resources could potentially be identified during a field survey that are considered eligible for inclusion if the project moves forward into further environmental review. Properties that intersect the high-speed rail route will need further exploration to determine if there are any adverse impacts before making a preferred route recommendation. A list of the National Register for these counties can be found in Appendix E.

1.6 Issues and Opportunities

As noted in the previous sections, each of the high-speed rail alternatives has potential benefits as well as obstacles to implementation. Issues include environmental impacts, operational barriers, and political concerns. Opportunities for success include the potential to serve key facilities and populations, travel time savings and benefits to freight services operating on these lines. These issues and opportunities, described in Table 1-7, were identified through technical analysis as well as through stakeholder interviews (refer to Chapter 2).

Table 1-7: Issues and Opportunities

Alternative	Opportunities	Issues
110 mph Shared Use Corridors		
NS/Amtrak Crescent	• Utilizes existing NS right-of-way • Could directly serve Anniston/Fort McClellan/ Jacksonville State University • Direct route resulting in shorter travel times • Existing Amtrak route	• High percentage of miles with curvature greater than 1 degree, 30 minutes (41%/68 miles) • Relatively long travel time (166 minutes at 60 mph) due to high number of curves • High train volumes (averages 26 trains/day) • Development of NS Crescent Corridor will result in increased freight traffic in the future • High freight volumes could cause increased passenger train delay • Will require major capacity improvements on NS line from Atlanta to Austell to accommodate passenger service • Route would not serve planned Anniston multimodal center
Seaboard Route (NS Atlanta to Rockmart, Seaboard Rockmart to Birmingham)	• Utilizes existing right-of-way • Potential to serve Anniston/Fort McClellan/Oxford/ Jacksonville University via station in or near Piedmont • Low train volumes because much of route is abandoned or operated by shortlines	• Relatively indirect route resulting in longer travel times • Would require capacity improvements on NS line from Atlanta to Rockmart • Major improvements/track replacement needed to upgrade corridor to Class 6, especially on

Alternative	Opportunities	Issues
	(averages 18 trains/day which is mainly from Atlanta to Rockmart) • Less potential for passenger train delay • Lower percentage of miles with curvature greater than 1 degree, 30 minutes (30%/49 miles) compared to the NS/Amtrak route • Opportunity to benefit NS freight capacity by rerouting Amtrak • Opportunity to benefit Amtrak by reducing train delays due to reduced freight traffic on the Seaboard route	the abandoned corridor from Cedartown to Wellington • May require the relocation of existing bike trails (Silver Comet and Chief Ladiga Trails) • Does not directly serve Anniston area
Seaboard/ NS Route (Anniston Sub-Alternative)	• Serves Anniston area (including Fort McClellan) • Directly passes Jacksonville State University • Utilizes existing right-of-way • Low train volumes on Seaboard segment (averages less than 5 trains per mile on segment between Rockmart and Piedmont) • Opportunity to benefit NS freight capacity by rerouting Amtrak (on NS Corridor between Anniston and Atlanta) • Opportunity to benefit Amtrak by reducing train delays (on NS Corridor between Anniston and Atlanta)	• Current Anniston Amtrak station is not accessible by the connection between the Seaboard and NS routes • Additional miles and stop in Anniston make the travel time between endpoints longer (adds an additional 25 miles and an overall travel time from Atlanta to Birmingham 174 minutes) • More potential for passenger train delay due to higher traffic volumes (averages between 18 and 26 trains/day) between Anniston and Birmingham • The Anniston connection has an additional 2.86 miles of curves exceeding 1 degree, 30 minutes (11% of miles) • Increased travel time due to the increase in freight volumes and a potential stop in Anniston • Seaboard portion of track would require major improvements to be upgraded to a Class 6 facility • May require the relocation of existing bike trails (Silver Comet and Chief Ladiga Trails)

Alternative	Opportunities	Issues
		• Reduced speeds due to curves required through Anniston
220 mph Dedicated Use Corridor		
Interstate 20/NS Greenfield	• Direct route (150 miles) resulting in shorter travel times • Travel time is 60% that of Shared Use routes • Less than 5% of miles (7 miles) exceed curve limit of 30 minutes • Potential to serve Anniston/Fort McClellan/Oxford/Jacksonville State University via station in or near Oxford	• Significantly higher cost than Shared Use alternative • Limited available right-of-way in some areas especially in the urban areas of Atlanta, Anniston and Birmingham • Will require significant land takings and associated social and environmental impacts

2 STAKEHOLDER OUTREACH

As a part of the High-Speed Rail Feasibility Study effort, the study developed a Public Involvement Plan identifying targeted stakeholders as well as outreach techniques designed to encourage two-way communication for the duration of the study effort. Refer to Appendix A for the Public Involvement Plan in its entirety. The purpose of the outreach effort was to keep key stakeholders along the Atlanta-Birmingham Corridor informed of the study process and results, and to identify local issues and opportunities for consideration in the development of alternative routes. In some cases, the study received local input on methodologies for the corridor to determine the best representative routes for the corridor (subsequent sections outline the major input of the stakeholders). Input from local stakeholders also ensured that the study reflects the most recent and accurate data available to determine high-speed rail feasibility.

For the Atlanta-Birmingham Corridor, the study worked with the following stakeholder organizations:

- Alabama Department of Economic and Community Affairs (ADECA);
- Alabama Department of Transportation (ALDOT);
- The Atlanta Regional Commission (ARC);
- Birmingham-Jefferson County Transit Authority (BJCTA);
- City of Anniston;
- City of Birmingham;
- East Alabama Regional Planning Commission (EARPC); and
- Regional Planning Commission of Greater Birmingham (RPCGB).

The study held three rounds of stakeholder involvement activities throughout the study process. Table 2-1 shows the three rounds of meetings and the details of each meeting for the Atlanta-Birmingham Corridor. The first round of meetings took place in May 2011 in which the study met with representatives of each of the stakeholders to introduce them to the study project scope and schedule. The study described the study corridor and the potential alternatives that were under a technical review to determine the best alternative to represent a Shared Use and Dedicated Use routes. The study also presented corridor maps outlining all identified strengths, weaknesses, issues and opportunities along each of the potential alternatives (Figure 2-1). The study gathered input from the stakeholders to combine with technical data to develop the Issues and Opportunities table (refer back to Table 1-6) and, ultimately, the representative routes. Refer to Appendix A for the stakeholder agenda and handout packet presented at each of these meetings.

Table 2-1: Stakeholder Outreach Meetings

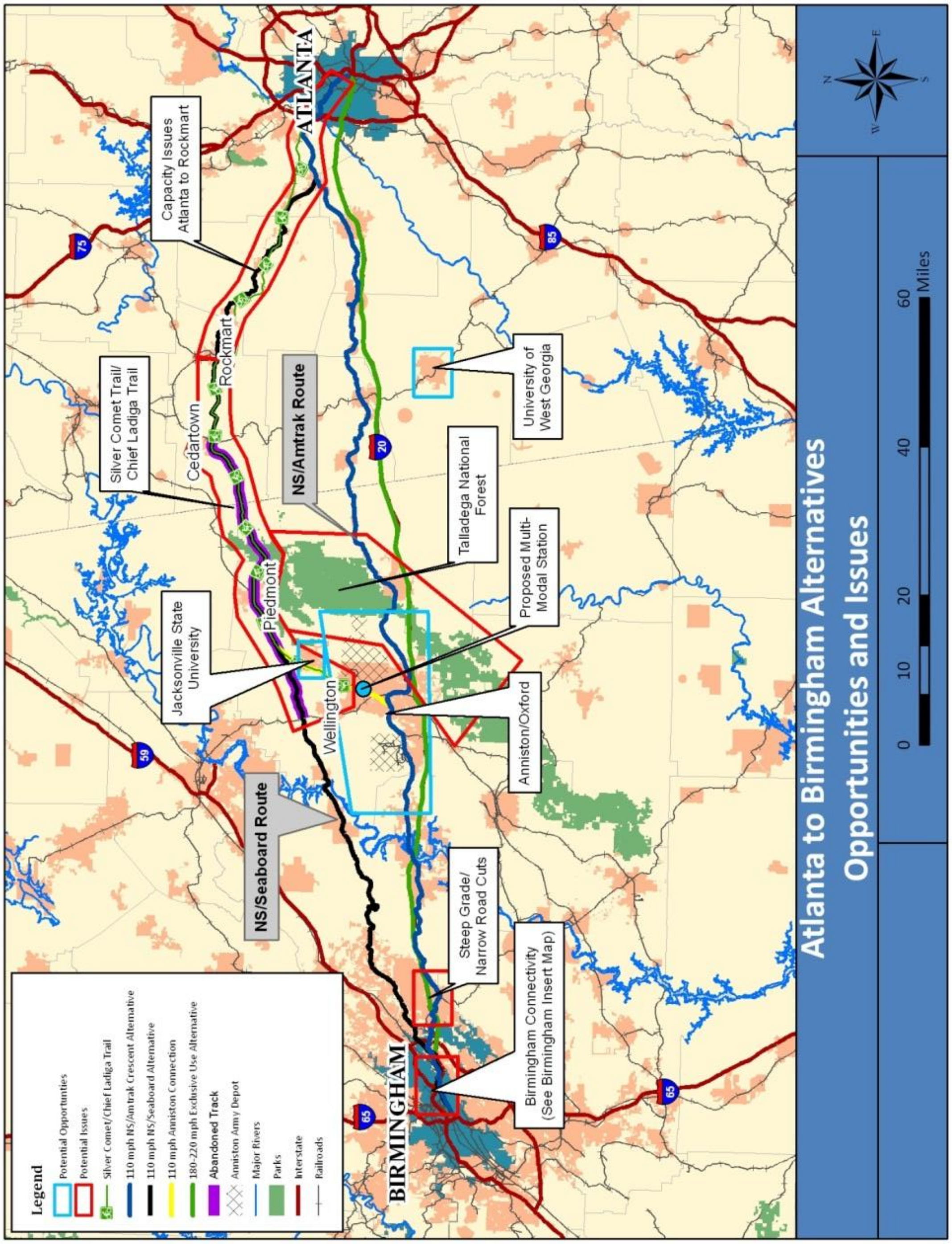
Stakeholder	Date	Time (EST)	Location
Round One, Stakeholder Meetings			
City of Anniston / EARPC	May 16, 2011	8:00-9:45 AM	Anniston, AL
BJCTA	May 16, 2011	10:15-11:00AM	Birmingham, AL
RPCGB	May 16, 2011	11:00 AM-12:00 PM	Birmingham, AL
ADECA	May 16, 2011	2:30-3:30 PM	Montgomery, AL
ALDOT	May 16, 2011	4:00-5:00 PM	Montgomery, AL
ARC	May 27, 2011	11:00 AM-12:00 PM	Atlanta, GA
Round Two, Corridor Webinar			
All Stakeholders	September 8, 2011	3:00-4:00 PM	On-Line
Round Three, Stakeholder Meetings			
BJCTA	November 14, 2011	10:00-11:00 AM	Birmingham, AL
RPCGB	November 14, 2011	11:00 AM-12:00 PM	Birmingham, AL
ADECA	November 14, 2011	2:00-3:00 PM	Montgomery, AL
ALDOT	November 14, 2011	3:30-4:30 PM	Montgomery, AL
ARC	November 30, 2011	9:00-10:00 AM	Atlanta, GA
City of Anniston / EARPC	December 13, 2011	1:30-2:30 PM	Anniston, AL
City of Birmingham	December 13, 2011	4:30-5:30 PM	Birmingham, AL

Major Stakeholder Input

Stakeholders provided valuable insight into issues and opportunities along the corridor to assist the study in developing the representative routes for the Shared Use and Dedicated Use services. Outlined below, are a few of the main feedback comments heard across the corridor.

- The Chief Ladiga Trail is an important rails to trails project in Alabama, and it will be difficult with public involvement and environmentally to use this corridor for passenger rail.
- The Talladega National Forest is a major environmental concern that will be an important obstacle moving forward in environmental studies.
- There is potential for a multi-modal station along the Anniston connection line that Anniston would be interested in pursuing further if this study determines that connection line to be feasible.
- There is no longer an active military base in Anniston (this opportunity area was eliminated from Figure 2-1).
- Anniston could generate a good portion of ridership for commuting to and from Birmingham.

Figure 2-1: Atlanta-Birmingham Issues and Opportunities



The second round of meetings was a virtual webinar and conference call held in September 2011 to provide an update on the corridor progress and present preliminary results on capital costs, operating and maintenance costs, and ridership and revenue for both the Shared Use and Dedicated Use representative routes. Additionally, the study presented a variety of technology considerations for the corridor and gave an update on the federal funding options and strategies moving forward. Refer to Appendix A for the webinar agenda and presentation.

Major Stakeholder Input

- Stakeholders participants in the webinar session showed an overall interest in development of the capital cost estimates and technology alternatives.
- Stakeholders inquired about freight railroad agreements and whether the railroad owners would allow higher speeds on the freight corridors. The study stated that worked with railroad owners, and agreements would need to be in place for speeds greater than 79 mph.

The third and final round of meetings was held in November 2011 in which the study presented the final estimates for capital costs, operating and maintenance costs and ridership and revenue. Additionally, the study ran operating ratio and consumer surplus analyses to determine the overall feasibility of the Atlanta-Birmingham Corridor and made final observations and recommendations for the corridor moving forward. Refer to Appendix A for the meeting agenda and presentation.

Major Stakeholder Input

- Stakeholders agreed that a Dedicated Use alternative would be the better option for the corridor.
- Stakeholders were pleased with the cost and ridership estimates, understanding that a feasibility-level study would produce high-level estimates.
- Stakeholders were generally encouraged with the results, and showed interest in next steps.

3 Representative Routes

Representative Shared Use and Dedicated Use routes were identified in the Atlanta-Birmingham Corridor to provide a basis for developing ridership and revenue forecasts, capital costs, and operating and maintenance costs to assess the feasibility of the corridor for high-speed rail service. The representative routes were selected based on an analysis of physical, cost and service factors as well as stakeholder input. Each is an illustrative route for the corridor for purposes of determining feasibility, and is not intended to represent a locally preferred route. Final decisions on routes and specific alignments will be made in future environmental study phases if the corridor is determined to be feasible.

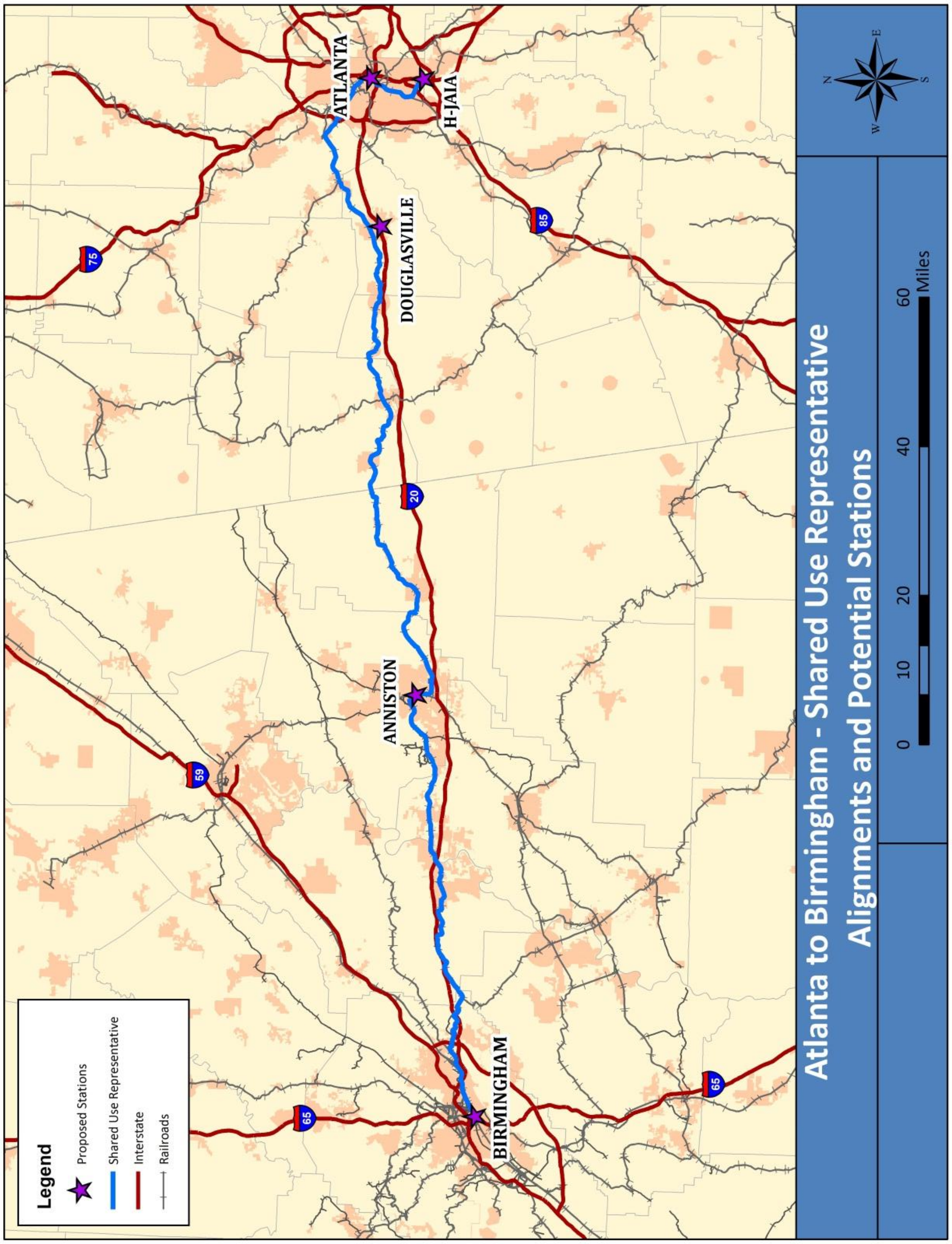
3.1 90-110 mph Emerging High-Speed Rail (Shared Use)

In identifying capacity improvements required for 90-110 mph Shared Use operations in the Atlanta-Birmingham Corridor, the study assumed that all infrastructure improvements could be made within the existing freight right-of-way (assumed at 100 feet). All segment corridors are currently single track with passing sidings. The proposed Shared Use Corridor was assumed to be double track for each of the segments in order to accommodate new passenger service as well as the existing and forecasted freight operations. Table 3-1 describes the Shared Use route in detail. Figure 3-1 illustrates the Shared Use representative route.

Table 3-1: Atlanta-Birmingham Shared Use route Characteristics

Atlanta-Birmingham	
Train Capacity	Class 4 - Single track with Sidings
Train Frequency	Existing: 26.3 freight trains per day (average)
	Future: 52.6 freight trains per day (average)
	Proposed passenger frequency: 6 round trips per day
Track Geometry and Capacity	Total Corridor: 176.0 route miles
	41% of corridor / 67.5 miles exceed 1 degree, 30 minute curves
Travel Time Estimations (Schedule Time Including Station Stops)	2 hours, 46 minutes

Figure 3-1: Atlanta-Birmingham Shared Use Representative Route and Stations



In developing the station locations, the study took into consideration airports, transit connections, major downtown areas and minor cities and suburbs. Refer to Chapter 4 for station details as they pertain the operating plan and schedule

Two types of stations were evaluated as a part of the operating plan schedule and also capital costs. Major stations refer to major city stations in which the study assumes locations, costs and designs as outlined by previous studies and plans. The source of the capital costs for each of these stations is documented below. Additionally, the study developed an Intermediate station plan and an associated lump sum cost estimate that was used for all other, smaller-scale stations (refer to Section I: Chapter 3 for details).

Table 3-2: Atlanta-Macon-Jacksonville Shared Use Proposed Stations

Potential Stations	Estimated Cost	Source of Cost Estimate
H-JAIA, Atlanta GA	$100 million	Feasibility Study Estimate
MMPT, Atlanta GA	$350 million	Feasibility Study Estimate[19]
Douglasville, GA	$7.2 million	Feasibility Study Estimate
Anniston, AL	$7.2 million	Feasibility Study Estimate
Birmingham, AL	$30 million	BJCTA

3.1.1.1 Major Terminal Stations

There are three major terminal stations along the Atlanta-Birmingham Corridor:

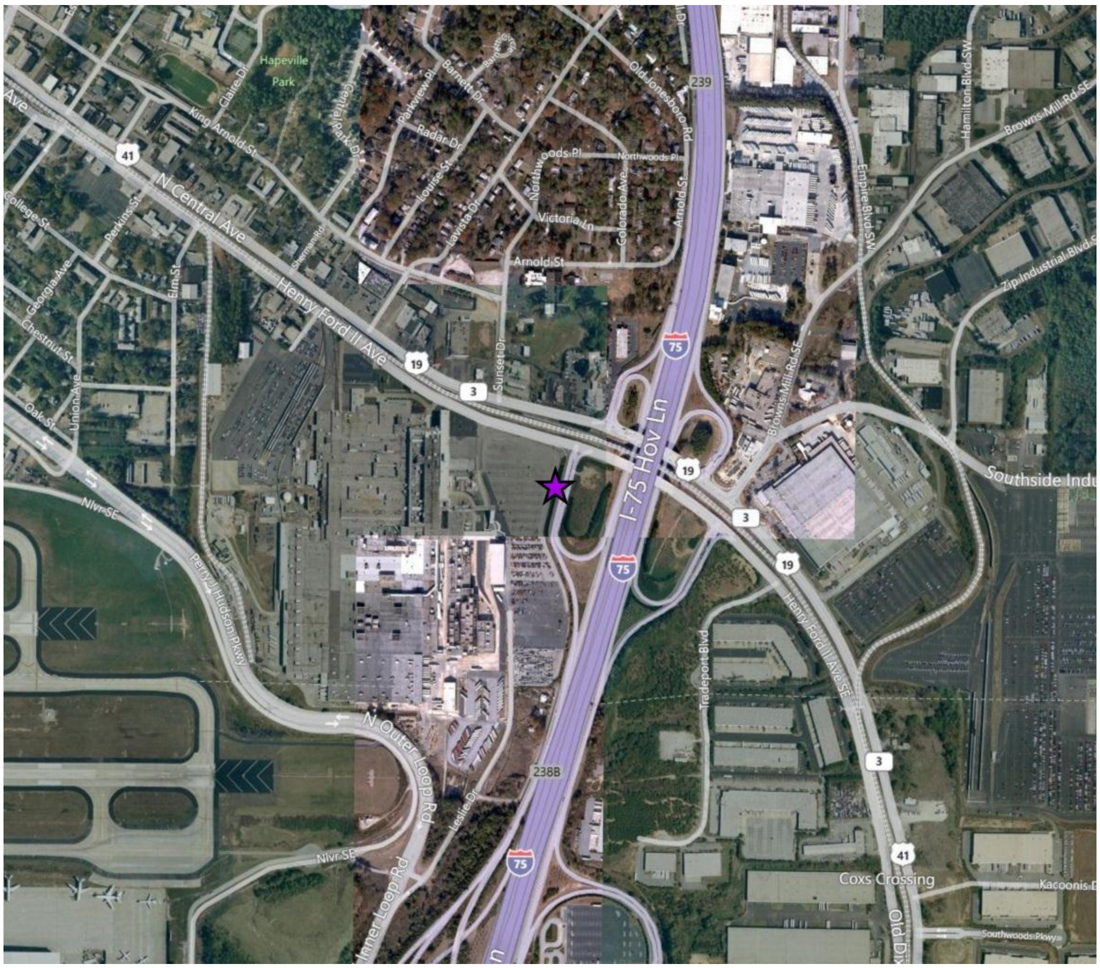
- H-JAIA;
- Atlanta MMPT; and
- Birmingham Multimodal Station.

[19] MMPT Cost estimates are based on Central Atlanta Progress 1992 estimates of $165,650,000. This was elevated to 2011 dollars using the Consumer Price Index (CPI), and added a 30 percent contingency.

Hartsfield-Jackson Atlanta International Airport

The H-JAIA station is proposed on a site adjacent to the airport in which intermodal connections could potentially be constructed between the rail terminal and the airport terminals. This site, located at the southwest corner of the intersection I-75 and Henry Ford II Avenue (US Highway 19/41) and the NS Jackson rail line as illustrated in Figure 3-2. The cost of this station is estimated at approximately $100 million.

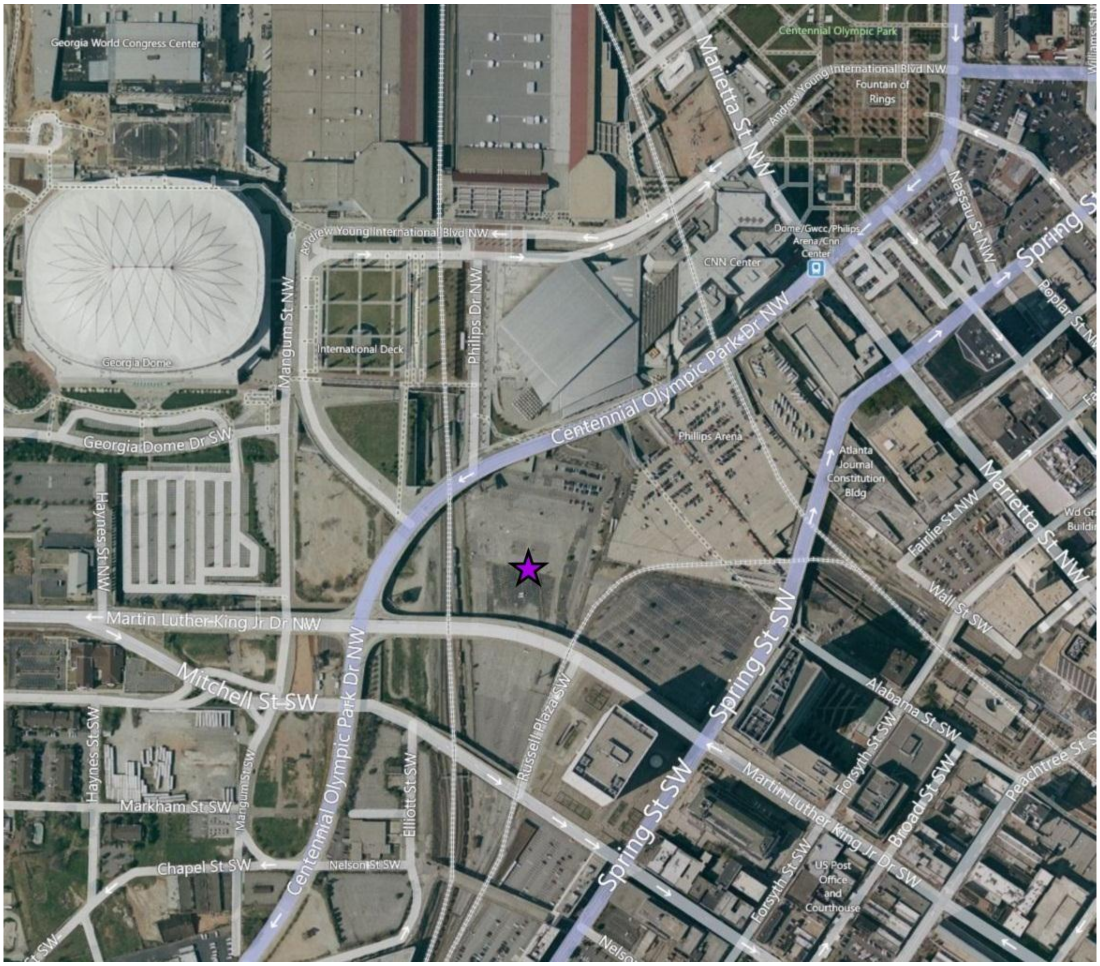
Figure 3-2: H-JAIA Station Location



<u>Atlanta Multi-Modal Passenger Terminal</u>

The AMMPT is an on-going public private partnership initiative in downtown Atlanta. The MMPT is proposed as a major high-speed, commuter rail and transit hub for the Atlanta metropolitan area. Although the exact location of the MMPT is not yet determined, Figure 3-3 displays the study area for the MMPT that was used for the purposes of this study. The estimated cost for the station and track infrastructure that was incorporated into the capital cost estimates for this feasibility study are $350 million based on estimates from Central Atlanta Progress, elevated costs to 2011 dollars and added contingency.

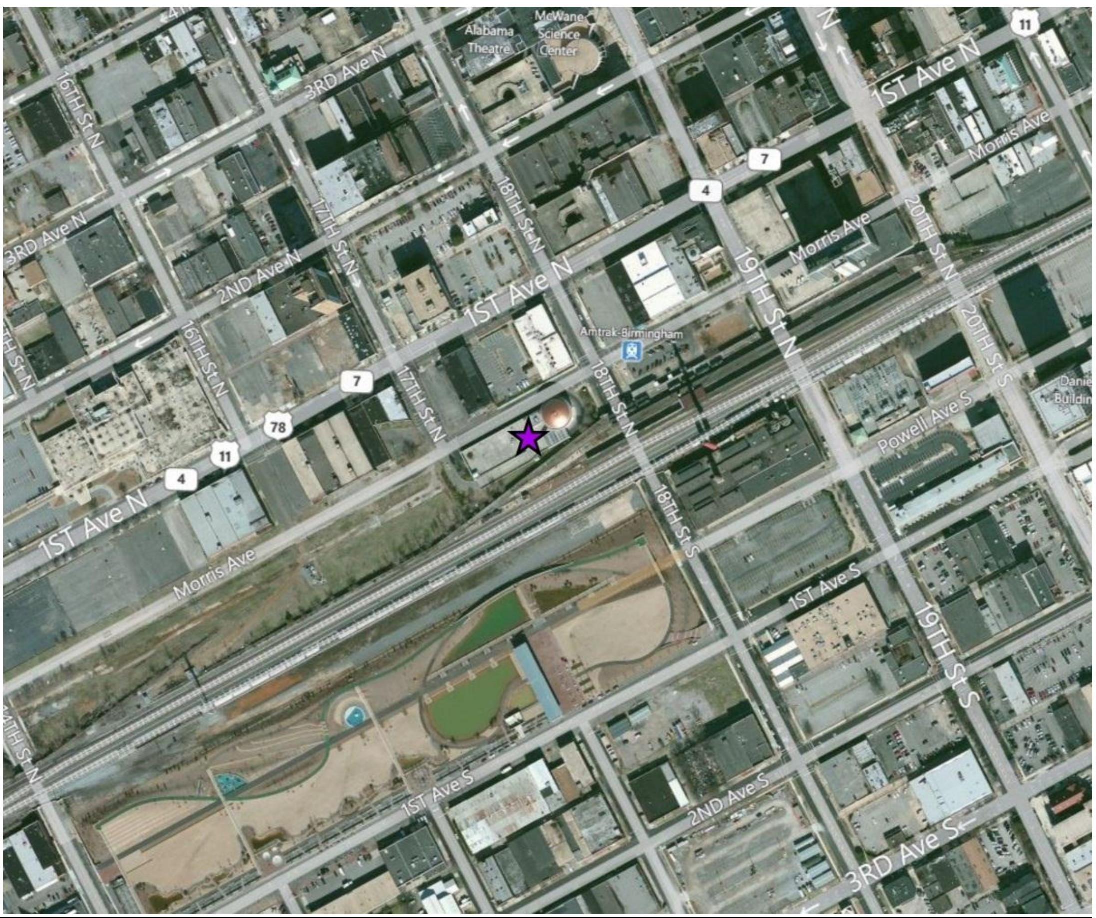
Figure 3-3: Atlanta MMPT Station Location



Birmingham Intermodal Transportation Facility

The City of Birmingham along with BJCTA is working with private consulting firms to design and build a new intermodal facility for the City. This facility will house BJCTA as well as provide a transportation hub for various modes of ground transportation including bus, taxis and the current Amtrak rail service. The facility will replace the existing BJCTA station in downtown. As of now, construction is estimated to begin in 2012 and be completed in 2014 and has an estimated cost of $30 million. Figure 3-4 outlines the proposed location of the new intermodal transportation facility

Figure 3-4: Birmingham Intermodal Transportation Facility



3.1.1.2 Intermediate Stations

Intermediate stations are located between major city destinations along the Atlanta-Birmingham Corridor. These stations serve smaller city and suburban populations and are not as large as major destination terminals. As outlined in Section I: Chapter 3, the Intermediate stations are characterized as Amtrak "medium" stations with a 6,600 square foot station building and 2,000 linear foot platform. The estimated cost for these Intermediate stations is approximately $7.3 million per station with an added 30 percent contingency. For the Atlanta-Birmingham Corridor, the study identified two potential small city and/or suburban Intermediate stations:

- Douglasville, GA and
- Anniston, AL.

Douglasville, Georgia

A station was located in Douglasville, GA to capture the western Atlanta suburbs as well as a portion of the southern and northern Atlanta suburbs for those that would rather travel to this station than the Atlanta MMPT site in downtown. Additionally, this station would capture a portion of western Georgia travelling to either Alabama or Atlanta. Figure 3-5 illustrates the proposed station location for the purposes of developing the operating plan and estimating ridership for the corridor.

Figure 3-5: Douglasville Intermediate Station

Anniston, Alabama

Similar to Douglasville, the study proposed a station in Anniston, AL to capture ridership from Anniston and the surrounding areas. Anniston is located between Birmingham and the Georgia state line providing a good area for a centrally station. In addition, Anniston currently houses an Amtrak station for the Crescent corridor service. Therefore, the study upgraded the existing station to the Intermediate station specifications. Figure 3-6 shows the location of the existing Amtrak station and proposed Intermediate high-speed rail station.

Figure 3-6: Anniston Intermediate Station

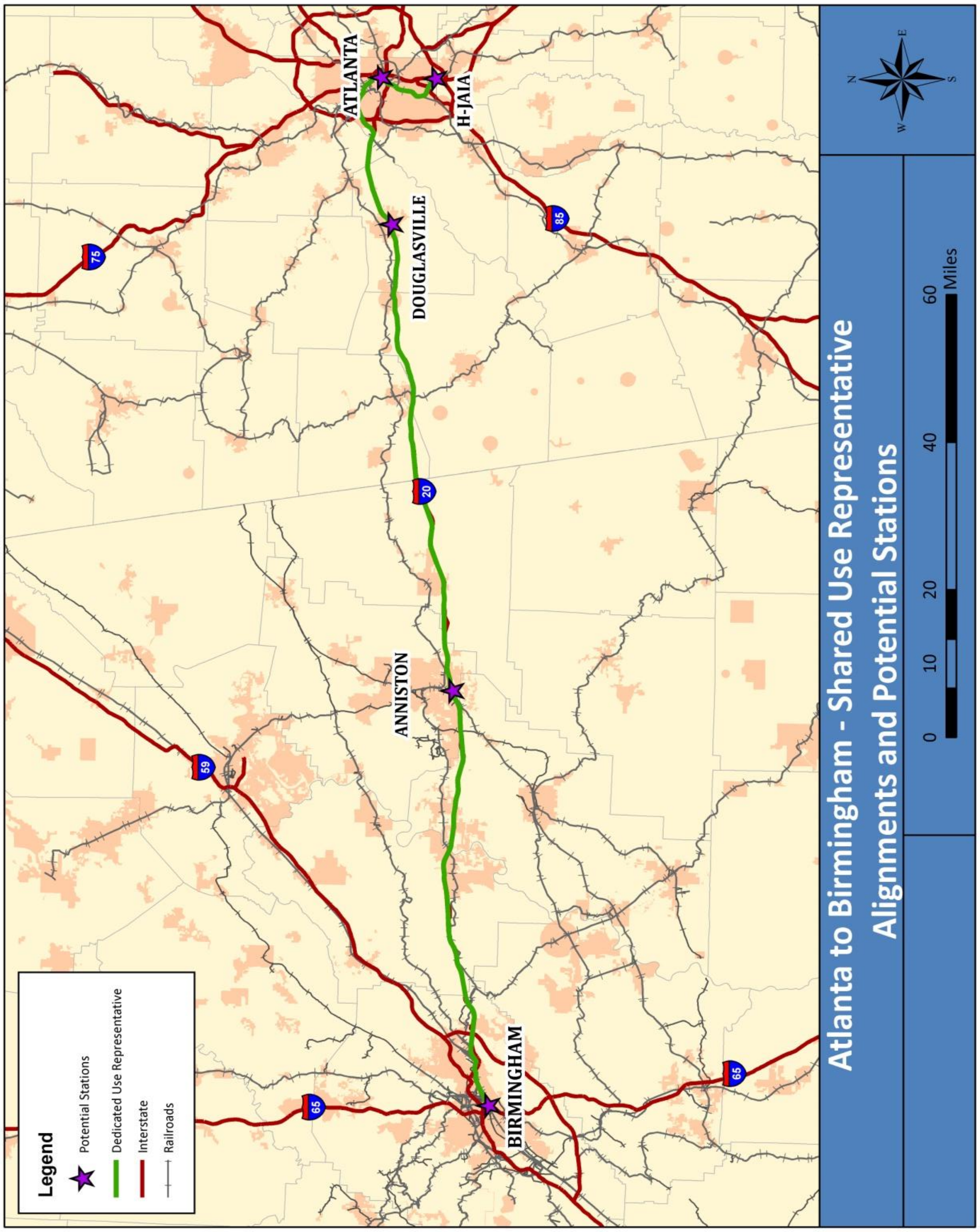
3.2 180-220 MPH EXPRESS HIGH-SPEED RAIL (DEDICATED USE)

The Atlanta-Birmingham 180-220 mph Dedicated Use alternative is a greenfield interstate highway route that utilizes existing freight corridor right-of-way for the last few miles into each major city (Atlanta, GA and Birmingham, AL). The shared “last mile” corridors still fully separate passenger and freight operations to maximize system efficiency. The Dedicated Use alternative is an electrified, steel-wheel, double-track system. The required right-of-way is assumed to be 60-feet in urban areas and 100-feet in rural areas. Table 3-3 and Figure 3-7 outlines the Dedicated Use track characteristics.

Table 3-3: Atlanta-Birmingham Dedicated Use Characteristics

Atlanta-Birmingham	
Train Capacity	Double track with universal crossover every 50 miles
Train Frequency	Proposed Frequency: 10 round trips per day
Track Geometry and Capacity	Total Corridor: 150.7 route miles
	4.9% of corridor / 7.0 miles exceed 30 minute curves
Travel Time Estimations (Schedule Time Including Station Stops)	1 hour, 18 minutes

Figure 3-7: Atlanta-Birmingham Dedicated Use Representative Route and Stations



3.2.1 PROPOSED STATIONS

For the Atlanta-Birmingham Corridor, the study utilized an identical set of station locations for the Dedicated Use route with the exception of the Anniston station. The existing Amtrak station in Anniston is approximately 3.2 miles north of the Dedicated Use representative route; therefore, for the Dedicated Use, the study assumed a new Intermediate station just south of the existing Amtrak station, as illustrated in Figure 3-8.

Figure 3-8: Anniston, AL Dedicated Use Station Location

The other station locations were each designed to maximized accessibility to existing freight rail right-of-way as the routes entered urban areas. Table 3-2 (in section 3.2.1) outlines the potential station and their associated costs.

4 OPERATING PLAN AND SCHEDULE

Timetables were developed for each of the speed options and each of the routes identified for the corridor. As discussed in Section I of the report, for the Shared Use option, tilting diesel-electric trains with a maximum speed limit of 110 mph were simulated over the existing NS rail route. For the Dedicated Use option, 220 mph electric trains were simulated. A five percent (5%) slack time allowance was added to the simulated running times to produce the suggested train schedules.

4.1 90-110 MPH SHARED USE

4.1.1 SPEED PROFILE AND TIMETABLE

The study ran a speed profile for the Atlanta-Birmingham Shared Use as illustrated in Figure 4-1. The average speed along the 176-mile corridor was approximately 64 mph, with peaks near or above 100 mph.

Figure 4-1: Atlanta-Birmingham Shared Use Speed Profile

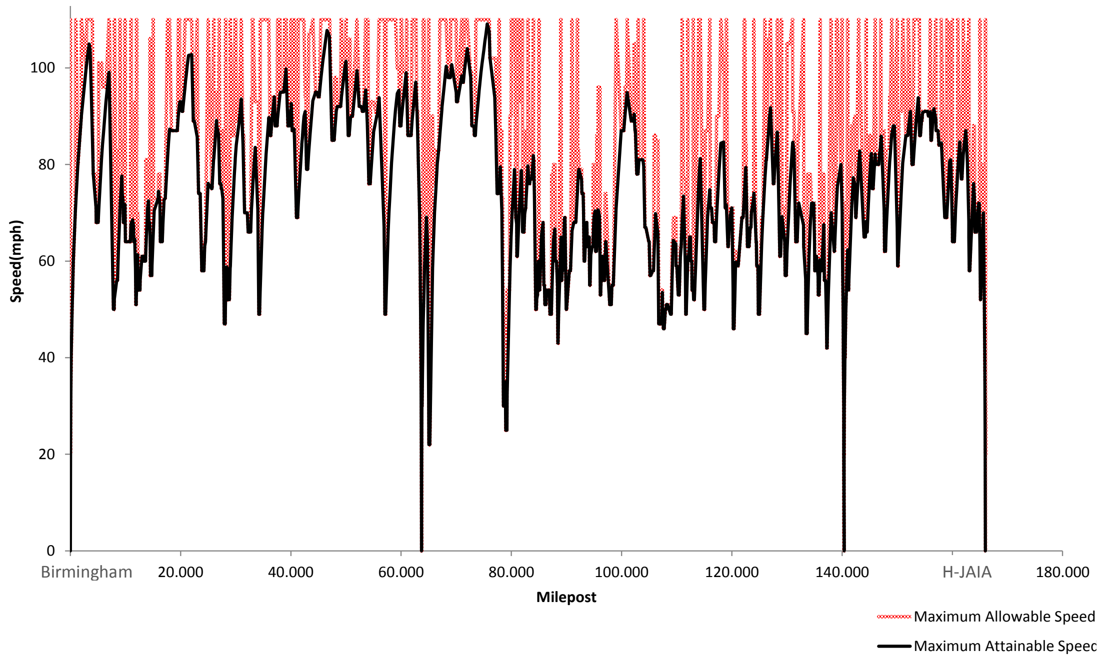


Table 4-1 illustrates a typical travel time table outlining the route station segments, rail distance, scheduled travel time, cumulative travel time and average speed for the Atlanta-Birmingham Shared Use corridor.

Table 4-1: Atlanta-Birmingham Shared Use Speed and Travel Time Table

Shared Use				
Segment	Rail Distance	Travel Time	Cumulative Travel Time	Average Speed (mph)
Birmingham	0.0	0:00	0:00	0
Anniston	63.7	0:56	0:56	68
Douglasville	76.4	1:19	2:15	58
Atlanta MMPT	26.7	0:23	2:38	67
Atlanta Airport	9.0	0:08	2:47	65
Total	**176.0**	**2:46**	**2:46**	**64**

As seen in the above Figure 4-1 and Table 4-1, although the tilting diesel-electric train would be capable of operating at 110 mph or better, curves on the existing NS rail line would restrict the train to 79 mph or less, even taking the train's tilt capability into account. The table indicates a travel time of 2 hours and 46 minutes, slower than the average auto driving time (2 hours 26 minutes) between the two end destinations.

4.1.2 Operating Plan

The running times were used in conjunction with the prospective train frequencies to develop an initial assessment of the ridership forecast for the Atlanta-Birmingham Shared Use Corridor. In addition, the results of the three corridors were compared to one another, resulting in frequency adjustments so that each corridor could utilize the same train size, for corridor compatibility. As a result, the train frequencies and train sizes were adjusted after initial ridership and revenue results to balance planned train capacity against ridership for the corridor. The Shared Use operations are projected to run six round trips per day, with 250 seats per train. Given the combination of train frequencies and running times, four train-sets would be required to cover the Shared Use equipment rotation.

Table 4-2: Atlanta-Birmingham Shared Use Train Frequency and Size

Scenario	Round Trips per Day	# of Seats per Train	# of Train-Sets
Shared Use	6	250	4

4.2 180-220 MPH DEDICATED USE

4.2.1 SPEED PROFILE AND TIMETABLE

The study developed a speed profile for the Atlanta-Birmingham Dedicated Use route as illustrated in Figure 4-2. The average speed along the 151-mile corridor was approximately 117 mph, with consistent segments near or above 150 mph.

Figure 4-2: Atlanta-Birmingham Dedicated Use Speed Profile

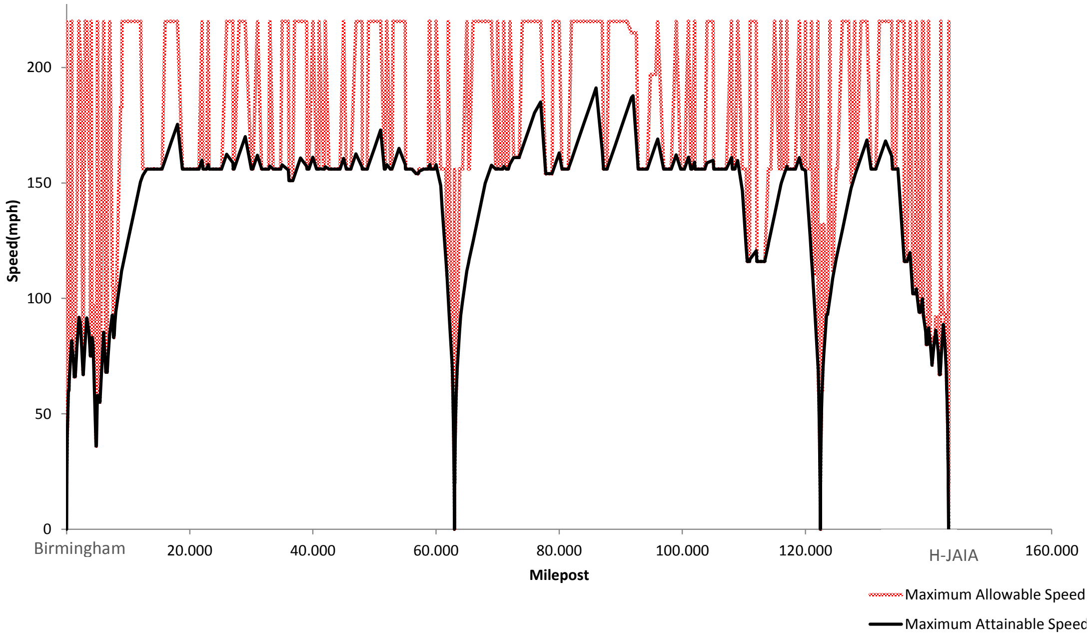


Table 4-3 illustrates a typical travel time table outlining the route station segments, rail distance, scheduled travel time, cumulative travel time and average speed for the Atlanta-Birmingham Dedicated Use corridor.

Table 4-3: Atlanta-Birmingham Dedicated Use Speed and Travel Time Table

Dedicated Use				
Segment	Rail Distance	Travel Time	Cumulative Travel Time	Average Speed (mph)
Birmingham	0.0	0:00	0:00	0
Anniston	63.0	0:32	0:32	116
Douglasville	59.4	0:28	1:00	126
Atlanta MMPT	20.8	0:12	1:12	101
Atlanta Airport	7.4	0:06	1:18	76
Total	**150.7**	**1:18**	**1:18**	**117**

As seen in the above Table 4-2 and Table 4-3 the proposed Dedicated Use route following I-20 would achieve higher speeds, although as the speed profile shows, curvature on the route would allow maximum speeds of 150 mph. However, the running time comparison with the automobile is favorable with an average travel time of 1 hour, 18 minutes, compared to auto travel at 2 hours, 26 minutes.

4.2.2 Operating Plan

Similar to Shared Use, the running times were used in conjunction with the prospective train frequencies to develop an initial assessment of the ridership forecast for the Atlanta-Birmingham Dedicated Use Corridor. In addition, the results of the three corridors were compared to one another, resulting in frequency adjustments so that each corridor could utilize the same train size, for corridor compatibility. The train frequencies and train sizes were adjusted after initial ridership and revenue results to balance planned train capacity against ridership for the corridor. As a result, the Dedicated Use operations are projected to run ten round trips per day, with 265 seats per train. Given the combination of train frequencies and running times, five train-sets would be needed for the Dedicated Use option.

Table 4-4: Atlanta-Birmingham Dedicated Use Train Frequency and Size

Scenario	Round Trips per Day	# of Seats per Train	# of Train-Sets
Dedicated Use	10	265	5

5 RIDERSHIP AND REVENUE

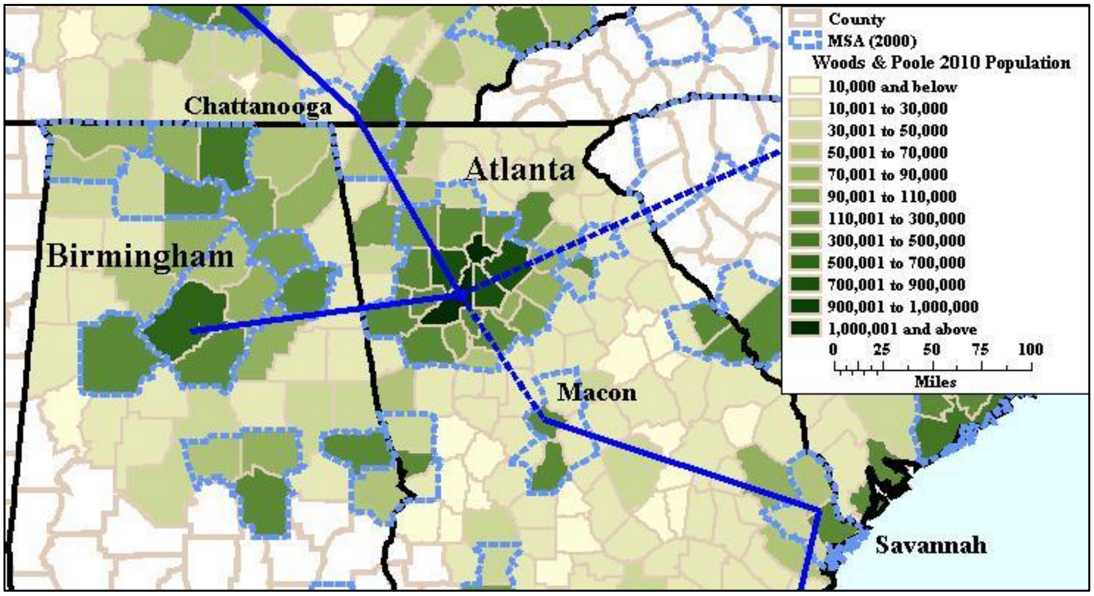
5.1 CORRIDOR DEMOGRAPHICS

This chapter presents information on the demographic characteristics and builds upon the existing conditions section (refer back to Chapter 1). For the purposes of ridership and revenue, information on corridor population and employment is presented for both the base (2010) and future years (2020-2040). All of the historical demographic information presented in Section 5.1.1 was obtained from Woods and Poole Economic Forecasts 2011 which are based on U.S. Census Bureau data. Similarly, Woods and Poole also produce future year forecasts on demographics. Refer back to Section I: Chapter 3 for detailed ridership and revenue methodologies.

EXISTING (2010)

The Atlanta-Birmingham Corridor has two main centers of population, located at each end of the corridor (Atlanta and Birmingham), with areas of low density in between the cities. Figure 5-1 presents a county-level population map focused on the Atlanta-Birmingham Corridor.

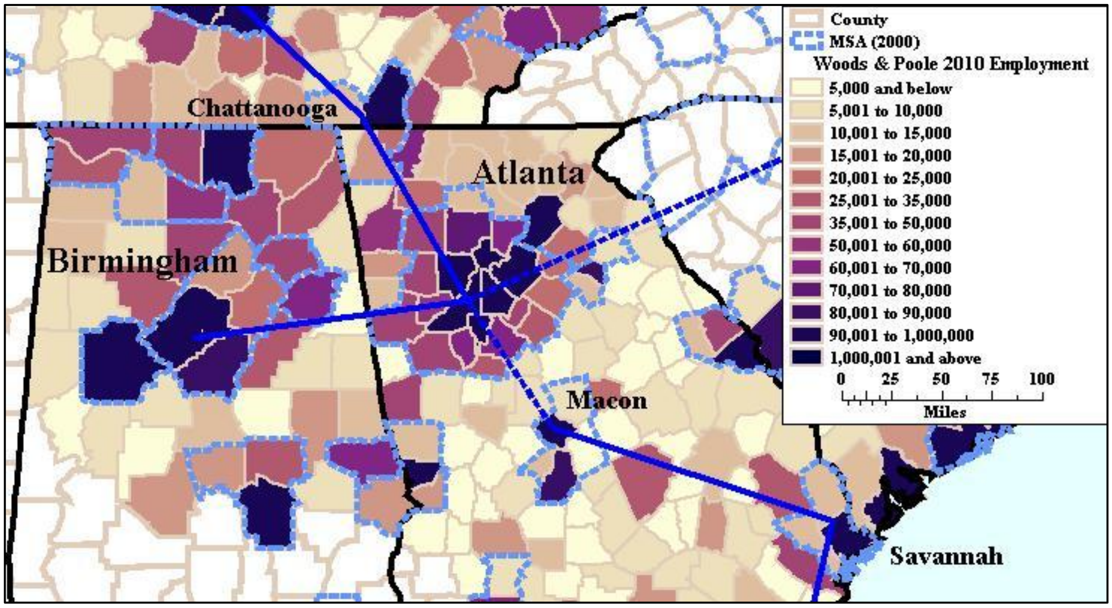
Figure 5-1: Atlanta-Birmingham Base Year (2010) Population Map



Source: Woods and Poole Economic Forecasts, 2011

Similarly, as shown in Figure 5-2, the two metropolitan statistical areas (MSA) (Atlanta and Birmingham) are also the major centers of employment, with Atlanta being the dominant employment hub in the corridor.

Figure 5-2: Atlanta-Birmingham Base Year (2010) Employment Map



Source: Woods and Poole Economic Forecasts, 2011

Table 5-1 Table 5-2 show the historical population and employment trends for the Metropolitan Planning Organization (MPO) coverage areas for the ARC and RPCGB. Atlanta has experienced rapid population growth over the past five years, while the population growth in Birmingham has been more modest. However, the recent economic downturn has hit the employment sector of both regions significantly with Atlanta observing almost no increase in employment and Birmingham experiencing negative employment growth over the last five years.

Table 5-1: Historical Population Trend for MPO Coverage Areas

MPO	2005 Population	2010 Population	05-10 CAGR[20]
ARC	4,934,314	5,566,062	2.44%
RPCGB	831,393	865,070	0.80%

Source: Woods and Poole Economic Forecasts, 2011

[20] Compound Annual Growth Rate (CAGR)

Table 5-2: Historical Employment Trend for MPO Coverage Areas

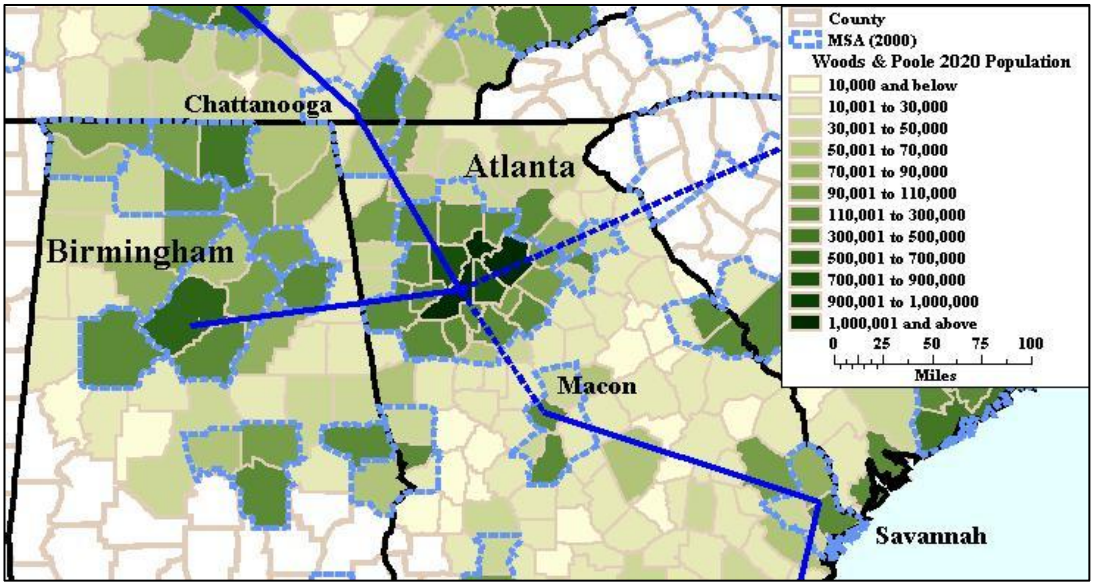
MPO	2005 Population	2010 Population	05-10 CAGR
ARC	3,013,970	3,012,811	-0.01%
RPCGB	558,737	518,476	-1.48%

Source: Woods and Poole Economic Forecasts, 2011

5.1.1 Future Year (2020-2035) Demographics

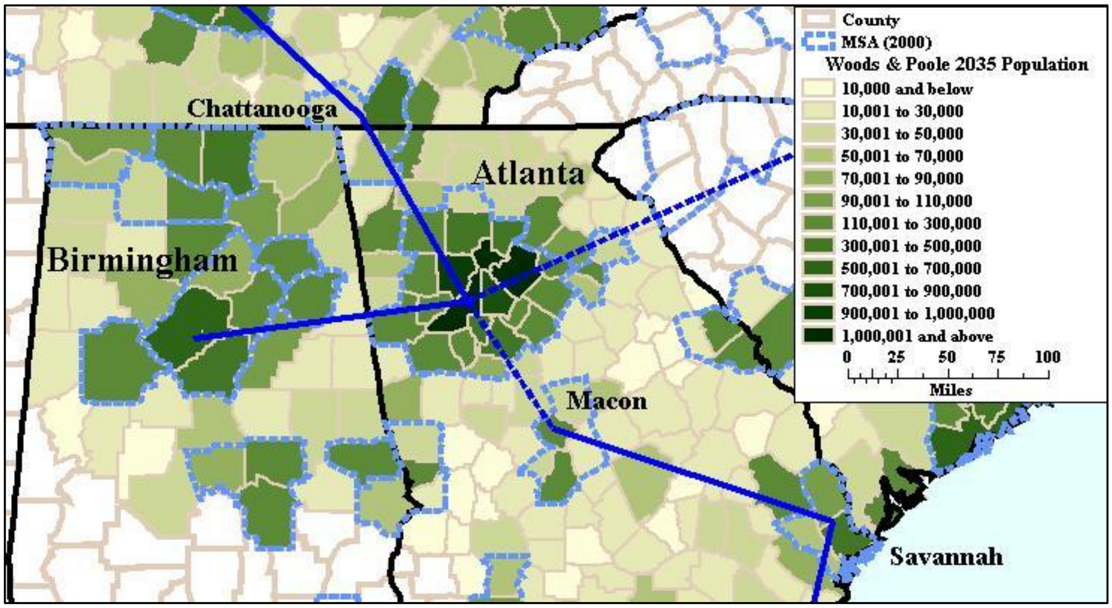
The 2020 and 2035 (Figure 5-3 and Figure 5-4, respectively) geographic distribution of population at the county level will remain essentially similar compared to 2010 populations. The highest projected population growths in the region are observed in the suburban areas surrounding Atlanta and Birmingham as seen in Figure 5-5.

Figure 5-3: Atlanta-Birmingham 2020 Population



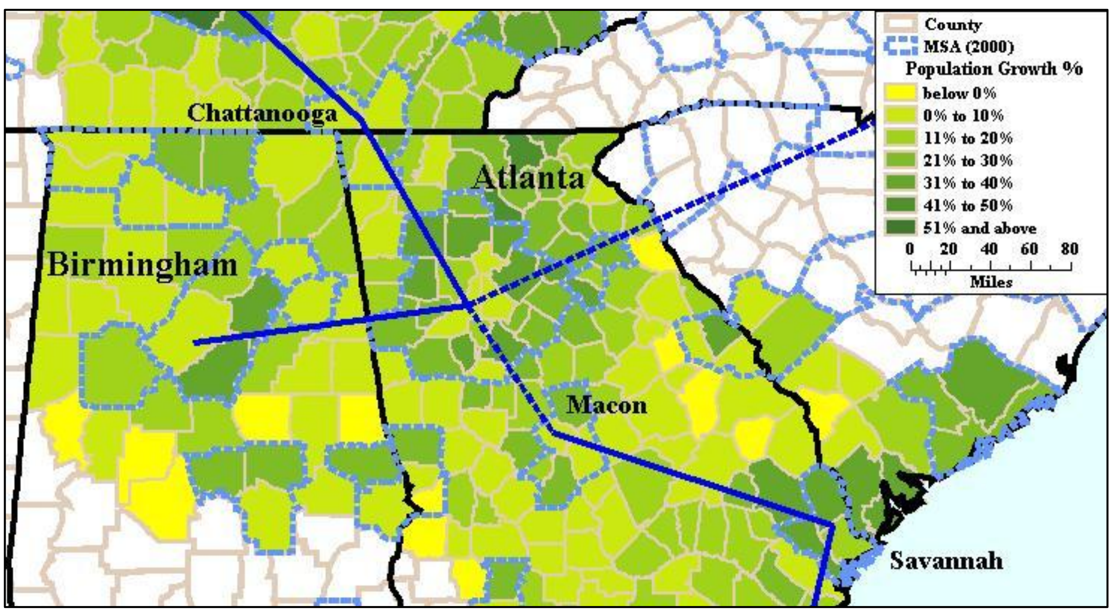
Source: Woods and Poole Economic Forecasts, 2011

Figure 5-4: Atlanta-Birmingham 2035 Population



Source: Woods and Poole Economic Forecasts, 2011

Figure 5-5: Atlanta-Birmingham 2020-2035 Population Growth



Source: Woods and Poole Economic Forecasts, 2011

The population growth forecast follow the latest trends observed in the region and nationwide, predicting a slower annual population growth in future years as compared to the rapid population growth observed over the past decade. Table 5-3 shows that the areas covered by both the ARC and RPCGB are expected to experience healthy population growths until 2035.

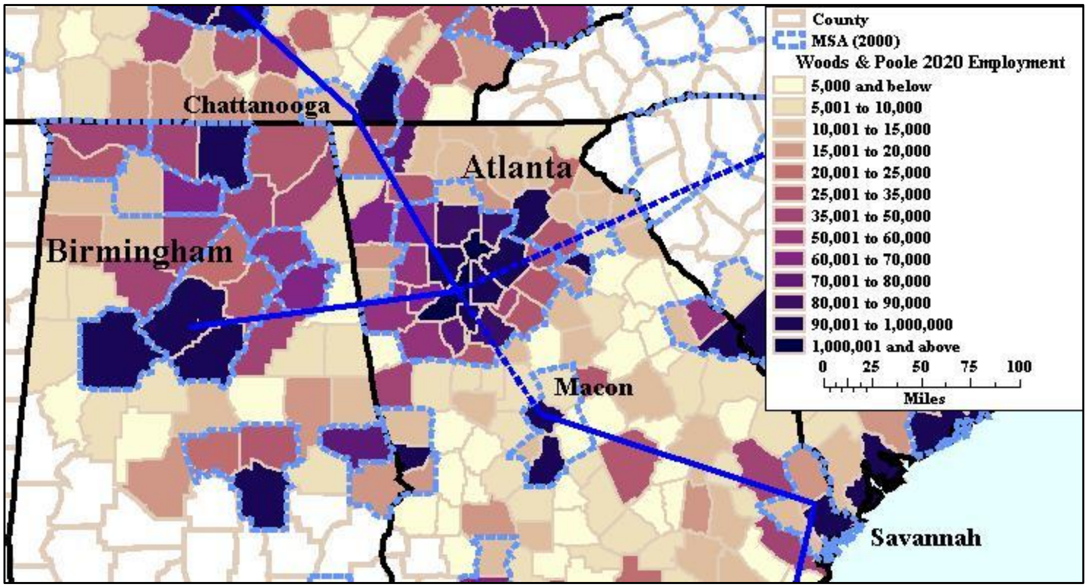
Table 5-3: Population forecasts for MPO Coverage Areas

MPO	2005 Population	2010 Population	2020 Population	2035 Population	05-10 CAGR	20-35 CAGR
ARC	4,934,314	5,566,062	6,523,568	7,997,611	2.44%	1.37%
RPCGB	831,393	865,070	943,910	1,067,896	0.80%	0.83%

Source: woods and Poole Economic Forecasts, 2011

Figure 5-6 and Figure 5-7 show the county level employment for the years 2020 and 2035, respectively; while Figure 5-8 and Table 5-4 present the employment growths between 2020 and 2035. The employment growth forecasts are following similar trends to what is observed at the population level, with a slower population growth observed in Birmingham compared to Atlanta.

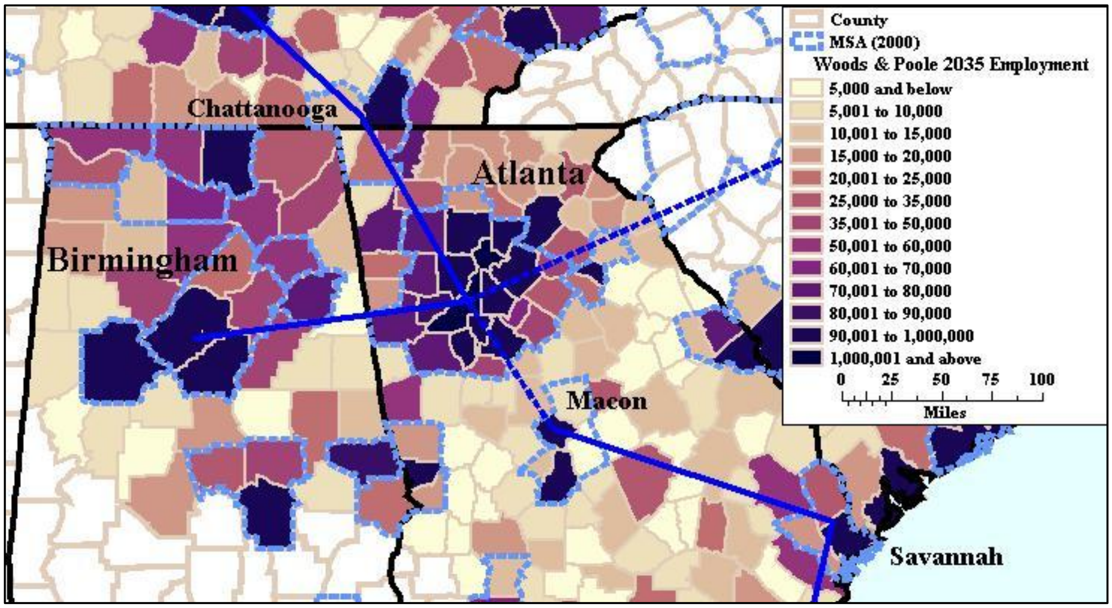
Figure 5-6: Atlanta-Birmingham 2020 Employment



Source: Woods and Poole Economic Forecasts, 2011

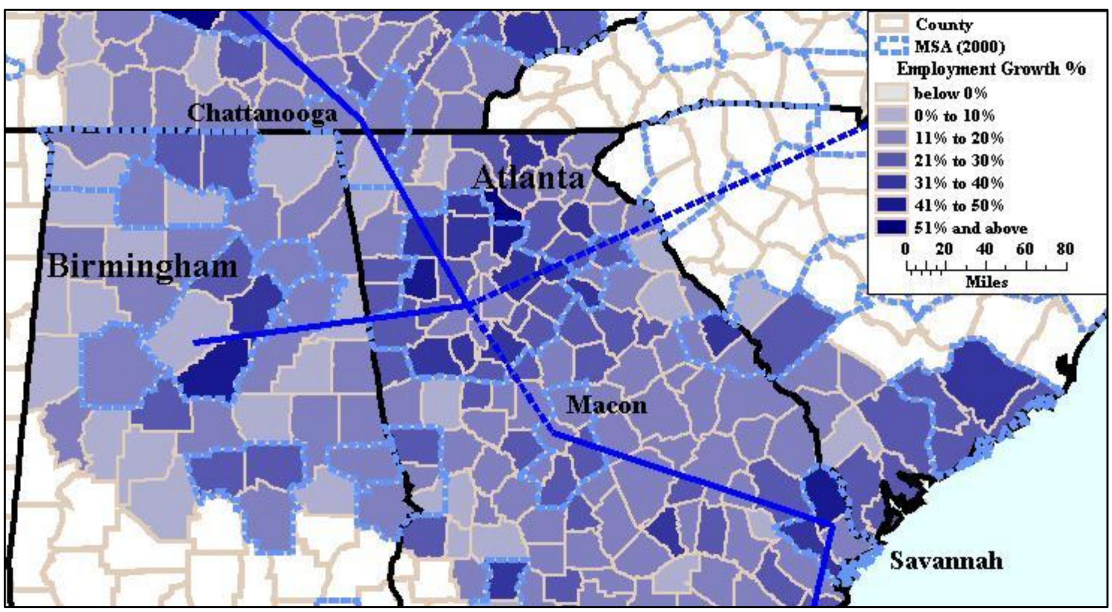
HNTB

Figure 5-7: Atlanta-Birmingham 2035 Employment



Source: Woods and Poole Economic Forecasts, 2011

Figure 5-8: Atlanta-Birmingham 2020-2035 Employment Growth



Source: Woods and Poole Economic Forecasts, 2011

Section II: Atlanta-Birmingham Corridor

Table 5-4: Employment Forecasts for MPO Coverage Areas

MPO	2005 Emp.	2010 Emp.	2020 Emp.	2035 Emp.	05-10 CAGR	20-35 CAGR
ARC	3,013,970	3,012,811	3,545,633	4,425,027	-0.01%	1.49%
RPCGB	558,737	518,476	585,062	681,173	-1.48%	1.02%

Source: Woods and Poole Economic Forecasts, 2011

5.2 Market Analysis

As discussed in Section I: Chapter 3, three main travel markets have been identified in this corridor – the inter-urban travel market; the local travel market; and the connect air market.

5.2.1 The Inter-Urban Market

There are four travel modes by which inter-urban trips can currently be made between Atlanta and Birmingham:

- Automobile travel;
- Bus service;
- Air service; and
- Rail service.

5.2.1.1 Automobile Travel

Automobile is the predominant mode of transportation utilized between Atlanta and Birmingham. Traffic count data is available on major roadways and interstates connecting these cities. Table 5-5 sets out some recent relevant traffic count data (annual average daily traffic [AADT]) on I-20, the main intercity highway between Atlanta and Birmingham. It is important to note that these represent total traffic volumes on the designated road section, and not the origin-destination demand from one section endpoint to the other.

Table 5-5: Atlanta-Birmingham Selected Traffic Counts

Location	AADT[21]	Year and Count Site Reference
I-20 between Atlanta and Birmingham	30,000	2011, I20 @ Alabama line 143-0126-1

Source: http://aldotgis.dot.state.al.us/atd/default.aspx

[21]The traffic counts should not be interpreted as the volume of trips between these cities. AADTs are rounded to the nearest thousand vehicles

Table 5-6 shows end to end automobile travel distances and travel times in the corridor. The data is sourced from commercial journey planning software (Mapquest.com) and reflects speed limits and representative congestion levels on each route.

Table 5-6: Travel Times and Distances between City Pairs

Route	Distance (miles)	Time (min)
Atlanta - Birmingham	147	151

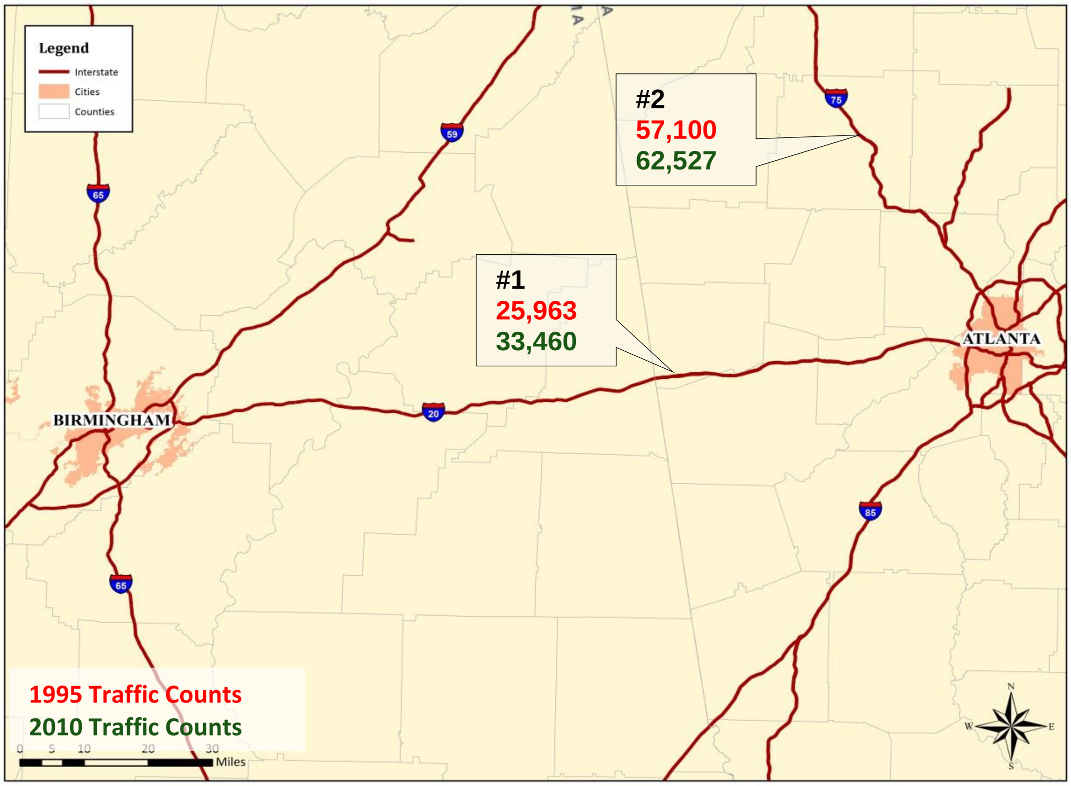
Source: Mapquest.com

The historical traffic counts data show an average annual growth of 1.71 percent between Atlanta and Birmingham since 1995 (as seen in Table 5-7 and Figure 5-9).

Table 5-7: Observed Auto Traffic Growth (in AADT) between 1995 and 2010

Corridor	Location	Traffic Count 1995	Traffic Count 2010	CAGR 95-10
Within the Birmingham to Atlanta Corridor:				
Atlanta - Birmingham	I-20	25,963	33,460	1.71%
Outside the Birmingham to Atlanta Corridor (for comparison purposes):				
Louisville – Atlanta	I-75	57,100	62,527	0.61%

Figure 5-9: Atlanta-Birmingham Observed Auto Traffic (in AADT) in 1995 and 2010



Source: http://aldotgis.dot.state.al.us/atd/default.aspx

5.2.1.2 Bus Service

A summary of the bus services between Atlanta and Birmingham is presented in Table 5-8.

Table 5-8: Atlanta-Birmingham Bus Service Summary

City Pair	Route	Operator	Travel time	Frequency	Full fare[22]
Atlanta – Birmingham	Airport to Airport	Airport Express	3h 30m	M-F 3x/day S-S 2x/day	$9
Atlanta – Birmingham	City to city	Greyhound	2h 30m (direct) 2h 55m (w/stops)	5x/day	$35-$39
Atlanta – Birmingham	Airport to city	Greyhound	5h 10m-7h 20m	2x/day	$35-$39

Source: www.grehound.com, www.amtrak.com, www.theairportexpress.com

[22] Full or standard weekday and weekend fares, Rounded to nearest dollar

The table shows that there are a variety of bus services operating in the corridors. Service frequencies are generally low. Travel times are highly variable and reflect stopping patterns, congestion and/or transfer times.

Commercial bus operators are generally reluctant to release ridership numbers. Nevertheless, in the absence of any information from these operators, approximate ridership estimates based on bus capacity and load factors were prepared. Based on the service frequencies set out in the table above, and assumptions of 50 seats per bus and load factors of 50 percent, there are potentially 45,000 one-way trips being made per year (in each direction), which is substantially smaller than the potential auto market.

There may also be some charter bus operators; however, these operations have been excluded from the analysis.

5.2.1.3 Direct Air Service

The study area is served by two large airports. Table 5-9 presents the key characteristics of these airports. The table includes the airport's ranking among U.S. airports in terms of 2010 domestic passenger enplanements, scheduled departures, passenger carriers operating at the airport, and enplanements per departure.

Of particular importance is the large hub airport in the study area, H-JAIA, the world's busiest airport and a major hub for Delta and AirTran airlines. This airport serves as a gateway for passengers throughout the southeast to connect to flights to numerous domestic and international destinations, as well as a connection point for many longer-distance trips.

Table 5-9: Atlanta-Birmingham Major Airport Characteristics

Code	Airport	Rank	2010 Passenger Enplanements	2010 Scheduled Departures	2010 Passenger Carriers	Enplanements per Departure
ATL	H-JAIA	1	38,362,000	429,258	31	89
BHM	Birmingham-Shuttlesworth Airport	73	1,434,000	24,794	21	58

Source: Airport Snapshots from www.bts.gov

Table 5-10 shows the total number of true origin-destination trips between each pair of study area airports by direction, with outbound passenger volumes shown to the left of the diagonal and inbound passenger volumes shown to the right of the diagonal. Given the relatively short distance between these two airports, there are not too many true origin-destination air trip made in this corridor. As seen in the table, there is only about 8,000 point to point air trips between Atlanta and

Birmingham annually. However, given the presence of H-JAIA as a major hub, there are a significant number of connect air trips (described later under Chapter 5.2.3) between the two corridor airports.

Table 5-10: Origin-Destination Air Trips by Direction (Q4 2009-Q3 2010)

Destination / Origin	ATL	BHM
ATL		4,330
BHM	3,790	

Source: DB1B Market Data (www.bts.gov)

5.2.1.4 Rail Service

Amtrak's Crescent service currently services the Atlanta to Birmingham corridor. The Crescent service includes a daily train in each direction between New York City, New York and New Orleans, Louisiana. The schedule running time for this service between Atlanta and Birmingham is approximately 4 hours, 10 minutes. The adult one-way fare quoted on the Amtrak website is $32. The service offers the typical facilities provided on Amtrak's long-distance trains and the online journey planner suggests reservations.

Given the significant travel time disadvantage of Amtrak's Crescent service compared to the auto mode, the low frequency of service and likely focus of Amtrak's marketing for this service towards longer-distance (or even end-to-end) trips, the study estimated the mode of share of conventional rail for trips between Atlanta and Birmingham to be negligible.

5.2.2 Local Travel Market

There are three main types of local trips:

- Journeys to work (most likely to originate in the suburbs and terminate in the city centers);
- Local trips for leisure purposes; and
- Local trips to access the airport, as part of a longer trip (where the ultimate destination is outside the study corridor and where the longer trip itself is not expected to shift the new high-speed rail service).

Local trips were estimated using the U.S. Census 2000 Journey to Work data and the Atlanta-Chattanooga HSGT Tier I EIS study. In the Atlanta-Birmingham Corridor, 149,000 communing trips were estimated to have been made in 2015 between Birmingham and Anniston, AL, and Douglasville and Atlanta, GA. This was calculated using information from the 2000 Census Journey to Work data and forecasting using Woods and Poole socio-economic and demographic forecasts. The total number of local trips was then calculated as multiples of the communing trips identified in the 2000 Census. Local trips to access H-JAIA and other local trips for the Atlanta metro area were taken directly with appropriate adjustments form the Atlanta-Chattanooga HSGT Tier I EIS study.

5.2.3 Connect Air Market

The proposed high-speed rail service may provide a viable service between H-JAIA and the Birmingham-Shuttlesworth Airport, which may result in attracting current connect air travelers between the two airports. The connect air travel market differs from the data shown in Table 5-10 on page 2-55 shows just the passenger traveling between Atlanta and Birmingham, and does not include connecting flights to other destinations.

Table 5-11 shows segment-level traffic information for the H-JAIA and Birmingham-Shuttlesworth Airport pair which provides a reliable estimate for the connect air market under consideration. The table includes total passengers, scheduled seats, scheduled departures, average daily frequency, average sets per flight, and average passenger per flight for Q4 2009 to Q3 2010.

Table 5-11: Air Services Summary

City Pair	Passengers	Seats	Scheduled Departures	Flights/ Day	Seats/ Flight	Passengers / Flight
ATL-BHM	257,423	324,154	4,745	13	68	54

Source: T-100 segment data for scheduled passengers in corridor from/to ATL for Q4 2009 to Q3 2010, www.bts.gov

As illustrated by the relatively small average aircraft sizes for Atlanta-Birmingham, many of the flights are operated using regional aircraft, which typically provides service on short-haul routes between medium-sized cities and large hubs.

Comparing passenger counts on these routes with the true origin-destination traffic on the same airport pairs presented in Table 5-10, Table 5-11 above demonstrates that almost all of the air travelers in this market are connecting. Given the high share of connecting traffic and relatively shorter distance (ATL-BHM: 150 miles) between the airports, it is plausible for air travelers in Birmingham to consider H-JAIA as a possible alternate origin/destination of their air trips as long as they can get to/from H-JAIA in a relatively quick time using the proposed high-speed rail system.

5.3 FORECASTS

This section presents the ridership and revenue forecasts for the base case fare scenarios[23] (refer back to Section I: Chapter 3) for both the proposed Shared Use and Dedicated Use high-speed rail services. A fare sensitivity analysis is also presented later in this chapter.

The demand forecasting methodology uses binary diversion models to calculate high-speed rail ridership. Each diversion model computes, for each combination of trip purposes, market segment and current model, the probability that a traveler would choose high-speed rail over its current mode of travel as a function of each mode's level of service attributes. The probabilities are then multiplied by the future year mode-specific travel volumes to calculate the diverted volumes from the existing modes to the new high-speed rail system. The inclusion of each mode's level of service attributes in the diversion models enables the study to test several high-speed rail service frequencies and to accordingly adjust them to the ridership level. The forecasting approach is explained in more detail in Section 1, Chapter 3 within section 3.3 and also graphically in Figure 3-18.

In the subsequent sections, the study presents the base case ridership and revenue forecasts for both the proposed Shared Use and Dedicated Use rail services. Based on benchmarks against other regional high-speed ground transportation studies and the broad estimates of a feasibility study, it was decided to use the doubling of auto operating costs and the four percent increase in highway congestion between 2015 and 2035 as a part of the bases cases for a total of 28 percent increase (in addition to the fare and other base case assumptions) for both service levels.

In order to account for unforeseen increases in factors that contribute directly towards ridership and revenue, the study studied the following:

- Effect of higher auto operating costs (e.g., higher fuel prices);
- Effect of higher-socioeconomic forecast between 2015 and 2035; and
- Effect of higher congestion.

The results of these sensitivity analyses are presented in Table 5-12 below:

[23] $0.28/mile with $5 boarding fee for Shared Use and $0.40/mile with $5 boarding fee for Dedicated Use.

Table 5-12: External Factor Analyses

Scenario Tested	% Increase in Ridership
Doubling auto operating costs	+24%
Higher population growth (additional 0.5% annually above W&P forecasts)	+10%
Higher congestion (additional 14% between 2015 and 2035 above SDG forecasts)	+4%

- **Doubling Auto Operating Costs:** Higher increases in fuel prices could be possible, but coupled with continuing fuel efficiency advances, increasing operating costs by a factor of two is a plausible scenario. This scenario would add as much as a 24 percent increase in ridership and revenue. This is compared to the base case where average auto costs were $0.10/mile and $0.55/mile for non-business and business travel purposes, respectively. The impact of higher operating costs is more prominent in Atlanta due to the relatively higher sensitivity to cost in that metropolitan region.
- **Higher Population Growth:** The study tested a scenario that increases population by an additional 0.5 percent above the Woods and Poole forecast, annually, between 2015 and 2035. This would result in an additional 10 percent increase.
- **Higher Congestion Growth:** For the base case, the study used historical trends in congestion growth in Atlanta and reported by the TTI. This translated to an 11 percent increase in the travel time from the base case scenarios between 2015 and 2035. Then, the study assumed that travel times would increase by an additional 14 percent increase from the base case assumption of 11 percent growth for a total growth of 25 percent. The resulting impact of congestion on ridership would result in an approximate increase of four percent in ridership and revenue.

5.3.1 90-110 MPH SHARED USE RIDERSHIP AND REVENUE FORECASTS (2021-2040)

During the assumed first year of operation in 2021, the proposed Shared Use rail service ridership will be 1.6 million with an associated ticket revenue figure of $46.1 million. By 2040, 2.1 million riders and $61.7 million ticket revenue (annually) are expected during steady state operation. Table 5-13 illustrates the annual ridership and revenue for 2021, 2030 and 2040 as well as total ridership and revenue (2021-2040), rounded to the nearest thousand, expected for the Atlanta-Birmingham Corridor.

Table 5-13: 90-110 mph Shared Use Base Annual Ridership and Revenue (2021-2040 in 2010$)

Year	Ridership	Revenue
2021	1,613,000	$46,054,000
2030	1,847,000	$53,480,000
2040	2,087,000	$61,731,000
Total	**37,177,000**	**$1,077,851,000**

Table 5-14 presents the projected bi-directional station boardings and segment volumes for the shared use high-speed rail in the corridor in 2035. It is evident from the table that the majority of the boardings take place at the three larger city stations H-JAIA, Atlanta MMPT and Birmingham Terminal Station. Additionally, most of the ridership flows are end to end or H-JAIA airport access trips from downtown Atlanta MMPT.

Table 5-14: Shared Use Base 2035 Annual Station Boardings and Segment Volumes (Bi-Directional)

Station	2035 Boardings	2035 Segment Volumes
Birmingham	476,253	952,627
Anniston	62,799	995,880
Douglas	94,704	940,663
Atlanta MMPT	888,210	889,706
Atlanta Airport	444,853	-
Total Annual Boardings	**1,966,819**	

5.3.2 180-220 MPH DEDICATED USE RIDERSHIP AND REVENUE FORECASTS (2021-2040)

With a base fare assumption of $0.40/mile with $5 boarding fee, the Atlanta-Birmingham Corridor would attract approximately 1.9 million riders in the first year of operation (2021) and ticket revenue of $83.8 million. By 2040, 2.5 million riders are expected on an annual basis during steady state operation, with ticket revenue of $96.7 million.

The proposed Dedicated Use high-speed rail service operating plan assumes a higher frequency and lower running times between all station pairs compared to those of the Shared Use service. Hence, the Dedicated Use service would naturally attract significantly more riders than the shared use service. But, the base case fare assumption for the Dedicated Use service is also significantly higher compared to that of the Shared Use service ($0.40/mile as opposed to $0.28/mile). This increased fare has offset the frequency and travel time advantage of the Dedicated Use service over the Shared Use serviced a large extent. This can be seen in Table 5-15 that the ridership advantages of the Dedicated Use service over the Shared Use service for all years are only in the order of 16 percent. However, the higher base fare assumption for the Dedicated Use service has resulted in significant higher ticket revenue figures. The ticket revenue advantages of the Dedicated Use service over the Shared use service are more than 36 percent (considerably higher than the ridership advantage) for all years as presented in Table 5-15.

Table 5-15: 180-220 mph Dedicated Use Base Ridership and Revenue (2021-2040 in 2010$)

Year	Ridership	Revenue
2021	1,946,000	$83,791,000
2030	2,199,000	$84,113,000
2040	2,481,000	$96,693,000
Total	**44,270,000**	**$1,694,837,000**

Table 5-16 shows that the station boardings and ridership flows (in 2035) for various segments between the station pairs for the Dedicated Use service follow the same trend as those of the Shard Use service.

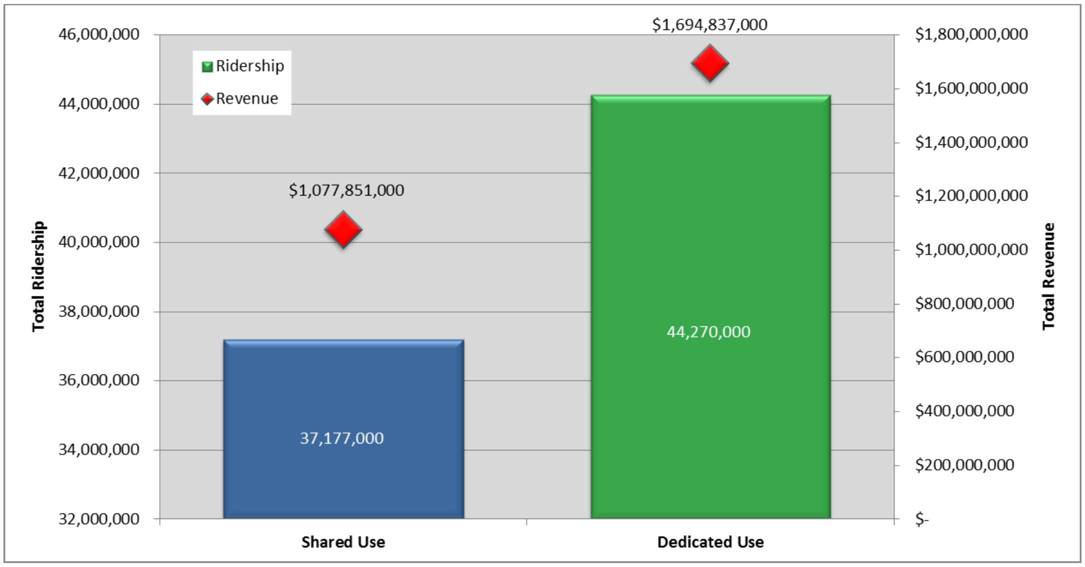
Table 5-16: Dedicated Use Base Case 2035 Annual Station Boardings and Segment Volumes (bi-directional)

Station	2035 Boardings	2035 Segment Volumes
Birmingham	650,917	1,301,940
Anniston	59,549	1,303,883
Douglas	114,782	1,265,197
Atlanta MMPT	964,474	1,100,590
Atlanta Airport	550,295	-
Total Annual Boardings	**2,340,017**	

5.3.3 Ridership and Revenue Forecast Comparison (2021-2040)

Figure 5-10 presents total ridership and revenue for the base case scenario for both the proposed Shared Use and Dedicated Use high-speed rail services between 2021 and 2040. Over these 20 years of operation, the ridership (and revenue) accrual for the Shared Use and Dedicated Use services are expected to be about 38.7 million riders (and $1.1 billion) and 46.2 million riders (and $1.8 billion), respectively.

Figure 5-10: Atlanta-Birmingham Corridor Total Ridership and Revenue Forecasts (2021-2040 in 2010$)



5.4 Sensitivity Analysis

In addition to the base case and earlier sensitivity analyses discussed in Section I: Chapter 3, additional sensitivity tests on the effects of fares was performed. The following sections present the results of the sensitivity analysis. The effect of fares on ridership and revenue is presented first for both the Shared and Dedicated Use high-speed rail services.

5.4.1 Shared Use Fare Sensitivity

Table 5-17 presents the total ridership and revenue (rounded to the nearest thousand) numbers for the Atlanta-Birmingham Corridor for two fare scenarios ($0.20/mile and $0.40/mile both with $5 boarding fees) in addition to the base case ($0.28/mile with $5 boarding fee) for the Shared Use high-speed rail service for three separate years (2021, 2030 and 2040). It is evident from the table that increasing fares to even $0.40/mile generates revenue increases compared to lower fare scenarios including the base case. This suggests that the base fare of $0.28/mile for the Shared Use service is below the revenue maximizing fare. However, the $0.28/mile fare generates higher ridership levels, thus increasing Consumer Surplus, which is described in detail in Section I: Chapter 3. It is important to maximize both ridership and revenue in order to not only receive farebox revenues, but also provide a valuable service to consumers. Additionally, passenger rail service can have positive impact on non-users such as auto motorists and those flying that are also important to capture.

Table 5-17: Fare Sensitivity for Shared Use High-Speed Rail Service (2021-2040 in 2010$)

Year	Annual Volume and Revenue		
	Scenario 1 - $0.20/mile	**Scenario 2 - $0.28/mile**	**Scenario 3 - $0.40/mile**
2021	1,840,000	1,613,000	1,375,000
	$40.0 M	**$46.1 M**	**$51.9 M**
2030	2,083,000	1,847,000	1,558,000
	$46.3 M	**$53.5 M**	**$60.5 M**
2040	2,353,000	2,087,000	1,760,000
	$53.3 M	**$61.7 M**	**$70.0 M**

5.4.2 DEDICATED USE FARE SENSITIVITY

Table 5-18 presents the total ridership and revenue (rounded to nearest thousand) numbers for the Atlanta-Birmingham Corridor for two fare scenarios ($0.55/mile and $0.70/mile both with $5 boarding fees) in addition to the base case ($0.40/mile with $5 boarding fee) for the Dedicated Use high-speed rail service for three separate years. Similar to the Shared Use service sensitivity, increasing fares above the base fare of $0.40/mile generates higher revenues for the Dedicated Use service indicating that the base fares are lower than the revenue maximizing levels. In fact, substantial additional ticket revenue (in the order of 20 percent additional revenue) can be generated with the $0.70/mile fare level compared with the base case. However, the higher fare levels are also associated with significant ridership loss and consequently public benefits loss.

Table 5-18: Fare Sensitivity for Dedicated Use High-Speed Rail Service

Year	Annual Volume and Revenue		
	Scenario 1 - $0.40/mile	**Scenario 2 - $0.55/mile**	**Scenario 3 - $0.70/mile**
2021	1,946,000	1,647,000	1,427,000
	$72.8 M	**$82.2 M**	**$87.8 M**
2030	2,199,000	1,862,000	1,612,000
	$84.1 M	**$95.1 M**	**$101.7 M**
2040	2,481,000	2,102,000	1,818,000
	$96.7 M	**$109.5 M**	**$117.0 M**

5.4.3 Shared and Dedicated Use Total Ridership and Revenue Summary

Table 5-19 and Table 5-20 below summarize the total number of passengers and revenue that will be accrued over 20 years of operations starting in the assumed opening year of 2021 for the Shared Use and Dedicated Use services, respectively.

Table 5-19: Shared Use Total Ridership and Revenue Summary (2021-2040)

Years 2021-2040	Ridership	Revenue (2010$)
Scenario 1 - $0.20/mile	41,928,000	$932.8 million
Scenario 2 - $0.28/mile	38,792,000	$1.1 billion
Scenario 3 - $0.40/mile	31,353,000	$1.2 billion

Table 5-20: Dedicated Use Total Ridership and Revenue Summary (2021-2040)

Years 2021-2040	Ridership	Revenue (2010$)
Scenario 1 - $0.40/mile	46,188,000	$1.8 billion
Scenario 2 - $0.55/mile	37,487,000	$1.9 billion
Scenario 3 - $0.70/mile	32,448,000	$2.1 billion

5.4.4 Evaluation Scenarios

In setting up the evaluation, three scenarios were developed to show the impact of a range of ridership, revenue, capital and operating cost estimates typically encountered in a feasibility-level analysis. Unadjusted base forecasts for ridership, revenue, capital and operating costs were used for the Conservative Scenario. Base ridership and revenue estimates were increased for Dedicated Use corridors to establish the Intermediate and Optimistic Scenarios.[24] Operating costs were adjusted by the appropriate ridership drivers. Capital cost estimates were adjusted downward in the Intermediate and Optimistic Scenarios for all technologies.

---

[24] Ridership adjustments for Intermediate and Optimistic Scenarios were only made for Dedicated Use corridor 180-220 mph electrified, steel-wheel and Maglev technologies (Maglev in Atlanta-Louisville corridor only) based on a peer review of regional and national high speed rail corridor studies. No scenario ridership adjustment was made for Shared Use corridor diesel-electric technology results based on a peer review of other shared-use corridor studies.

The three scenarios are intended to capture and illustrate the relatively wide range of estimates at the feasibility-level of study. As corridors are deemed feasible for further evaluation, future studies will provide greater detail in the analysis of ridership, revenues and costs, narrowing the range of estimates.

5.4.4.1 Conservative Scenario Estimates

Conservative scenario estimates use base case ridership and revenue forecast and capital cost estimates for the operating ratio and benefit-cost analysis. Refer back to Section I: Chapter 3 for additional details on the Conservative estimate methodology. Table 5-15 on page 2-60 summarizes base case ridership and revenue forecasts.

5.4.4.2 Intermediate Scenario Estimates

The Intermediate scenario represents a balance between Conservative and Optimistic scenarios, balancing both ridership and cost risks. The ridership and revenue estimates are approximately 75 percent higher than the Conservative estimates. Table 5-22 outlines the Intermediate scenario ridership and revenue estimates for 2021, 2030 and 2040 as well as total (2021-2040) rounded to the nearest thousand.

Table 5-21: Intermediate Scenario Annual Ridership and Revenue Estimates (2021-2040 in 2010$)

Year	Dedicated Use	
	Ridership	Revenue
2021	3,406,000	$127,384,000
2030	3,849,000	$147,198,000
2040	4,341,000	$169,213,000
Total	**77,473,000**	**$2,965,965,000**

These ridership and revenue levels, in conjunction with forecast operating and maintenance costs and capital costs (refer to Chapter 6), were used to calculate scenario-based operating ratios and benefit-cost ratios (refer to Chapter 7) for use in the feasibility evaluation.

5.4.4.3 Optimistic Scenario Estimates

This scenario uses higher ridership and revenue and a lower capital cost estimates for the Atlanta-Birmingham Corridor. The ridership and revenue estimates are increased by 100 percent to become comparable to other peer studies within the southeast region and nationally. Table 5-21 outlines the ridership and revenue estimates (to the nearest thousand) for the Optimistic scenario.

Table 5-22: Optimistic Scenario Annual Ridership and Revenue Estimates (2021-2040 in 2010$)

Year	Dedicated Use	
	Ridership	Revenue
2021	3,893,000	$145,582,000
2030	4,399,000	$168,226,000
2040	4,961,000	$193,386,000
Total	**88,540,000**	**$3,532,740,000**

6 FORECASTED COSTS

The study gathered regional and national infrastructure and equipment capital costs data to estimate total design and construction costs for the Atlanta-Birmingham high-speed rail corridor. As aforementioned in Section I: Chapter 3, the study prepared capital costs at the conceptual engineering level (5-10 percent design level) with a +/- 30 percent level of accuracy. The study used FRA standard cost categories (SCC) as required by FRA grant applications. To recap, the Table 6-1 illustrates these FRA SCC.

Table 6-1: FRA Standard Cost Categories

FRA Standard Cost Categories for Capital Projects/Programs
10 Track Structures & Track
20 Stations, Terminals, Intermodal
30 Support Facilities: Yards, Shops, Administration Buildings
40 Sitework, Right-of-Way, Land, Existing Improvements
50 Communications & Signaling
60 Electric Traction
70 Vehicles
80 Professional Services
90 Unallocated Contingencies
100 Finance Charges

This chapter outlines the total capital costs for the Atlanta-Birmingham high-speed rail corridor for both 90-110 mph Shared Use and 180-220 mph Dedicated Use routes and technologies. It should be noted that these unit costs are only preliminary costs, and actual costs for the corridor will be dependent upon a preferred route and technology, which this study does not determine.

6.1.1 90-110 MPH SHARED USE

The 90-100 mph Shared Use, as outlined in previous chapters, will use diesel-electric operating equipment and will share existing freight railroad right-of-way and track infrastructure. Therefore, the overall capital costs are less than the 180-220 mph Dedicated Use technology, which is on a dedicated route and is a fully electrified system. Table 6-2 provides the overall Atlanta-Birmingham corridor capital costs by major SCC category. For a more detailed breakdown of capital costs by sub-category, refer to Appendix F at the end of this report.

Table 6-2: Atlanta-Birmingham Total Shared Use Capital Cost by SCC Category (2010$)

Costing Category		Allocated Cost	Contingency (30%)	Total Cost
10	Track Structures & Track	$755,913,000	$226,774,000	$982,687,000
20	Stations, Terminals, Intermodal	$308,987,000	$92,696,000	$401,683,000
30	Support Facilities: Yards, Shops, Administration Buildings	$35,980,000	$10,794,000	$46,774,000
40	Sitework, Right-of-Way, Land, Existing Improvements	$276,874,000	$83,062,000	$359,936,000
50	Communications & Signaling	$339,569,000	$101,871,000	$441,440,000
60	Electric Traction	N/A	N/A	N/A
70	Vehicles	$130,000,000	$39,000,000	$169,000,000
80	Professional Services	$535,805,000	N/A	$535,805,000
90	Unallocated Contingencies	N/A	N/A	N/A
100	Finance Charges	N/A	N/A	N/A
	TOTAL COST	**$2,383,128,000**	**$554,197,000**	**$2,937,324,000**
TOTAL COST PER MILE (174.6 MILES)				**$16,821,000**

To further understand the detailed SCC costs of the Atlanta-Birmingham Corridor, Figure 6-1 through Figure 6-5 and Table 6-3 through Table 6-7 illustrates the capital costs by segment. Segments were developed based on station location and natural breaks in the corridor such as state boundaries. It should be noted that station and maintenance facility costs were only accounted for in the segment in which the station and/or maintenance facility is located. Additionally, vehicle costs were only accounted for in the total corridor capital costs, and were not included in the segment costs.

Figure 6-1: Atlanta-Birmingham Shared Use Segment One

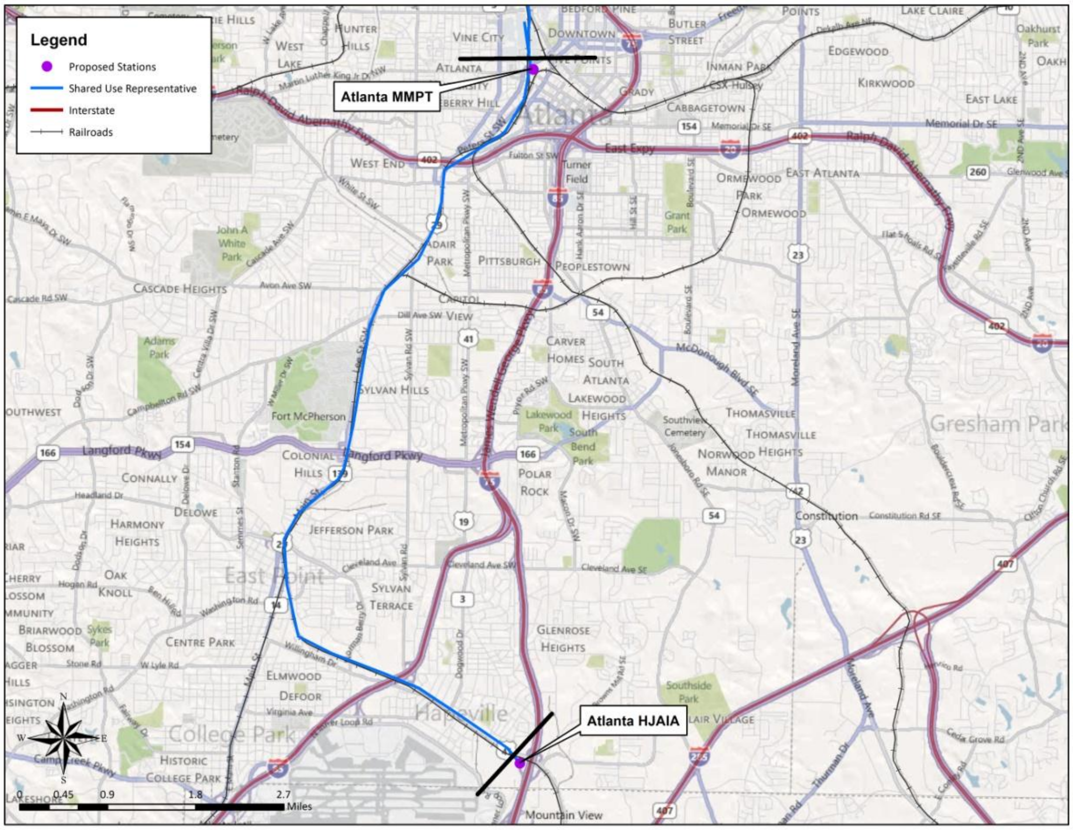


Table 6-3: Atlanta-Birmingham Total Shared Use Capital Cost Segment One

Segment 1: 90-110 mph Shared Use – Atlanta Airport (H-JAIA) to Atlanta MMPT			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$25,819,000	$7,746,000	$33,565,000
Stations, Terminals, Intermodal	$279,156,000	$83,747,000	$362,903,000
Support Facilities: Yards, Shops, Administration Buildings	$29,777,000	$8,933,000	$38,710,000
Sitework, R/W, Land	-	-	-
Communications & Signaling	$18,005,000	$5,402,000	$23,407,000
Electric Traction	-	-	-
Vehicles	-	-	-
Professional Services	$110,060,000	N/A	$110,060,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$462,817,000**	**$105,828,000**	**$568,645,000**
Cost Per Mile (8.5 Miles)			**$66,899,000**

Figure 6-2: Atlanta-Birmingham Shared Use Segment Two

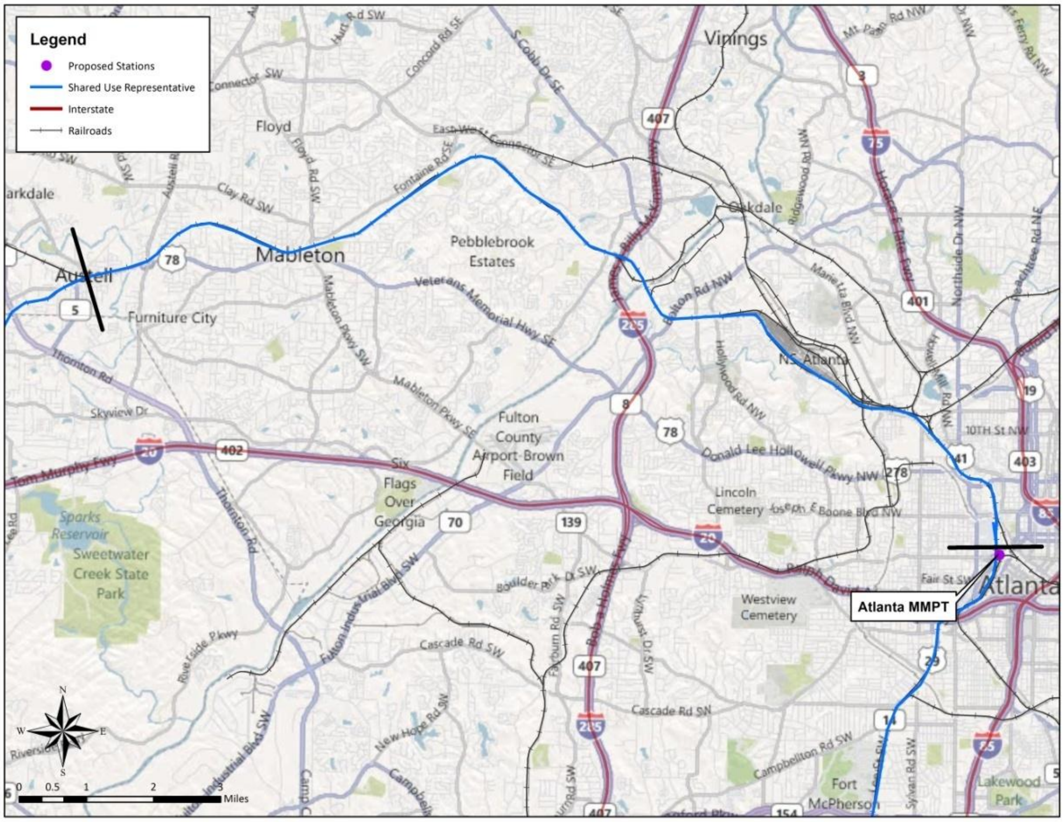


Table 6-4: Atlanta-Birmingham Total Shared Use Capital Cost Segment Two

Segment 2: 90-110 mph Shared Use – Atlanta MMPT to Austell, GA			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$79,603,000	$23,881,000	$103,485,000
Stations, Terminals, Intermodal	-	-	-
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$90,237,000	$27,071,000	$117,308,000
Communications & Signaling	$29,106,000	$8,732,000	$37,838,000
Electric Traction	-	-	-
Vehicles	-	-	-
Professional Services	$62,071,000	-	$62,072,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$261,017,000**	**$59,684,000**	**$320,703,000**
Cost Per Mile (17.9 Miles)			**$17,916,000**

Figure 6-3: Atlanta-Birmingham Shared Use Segment Three

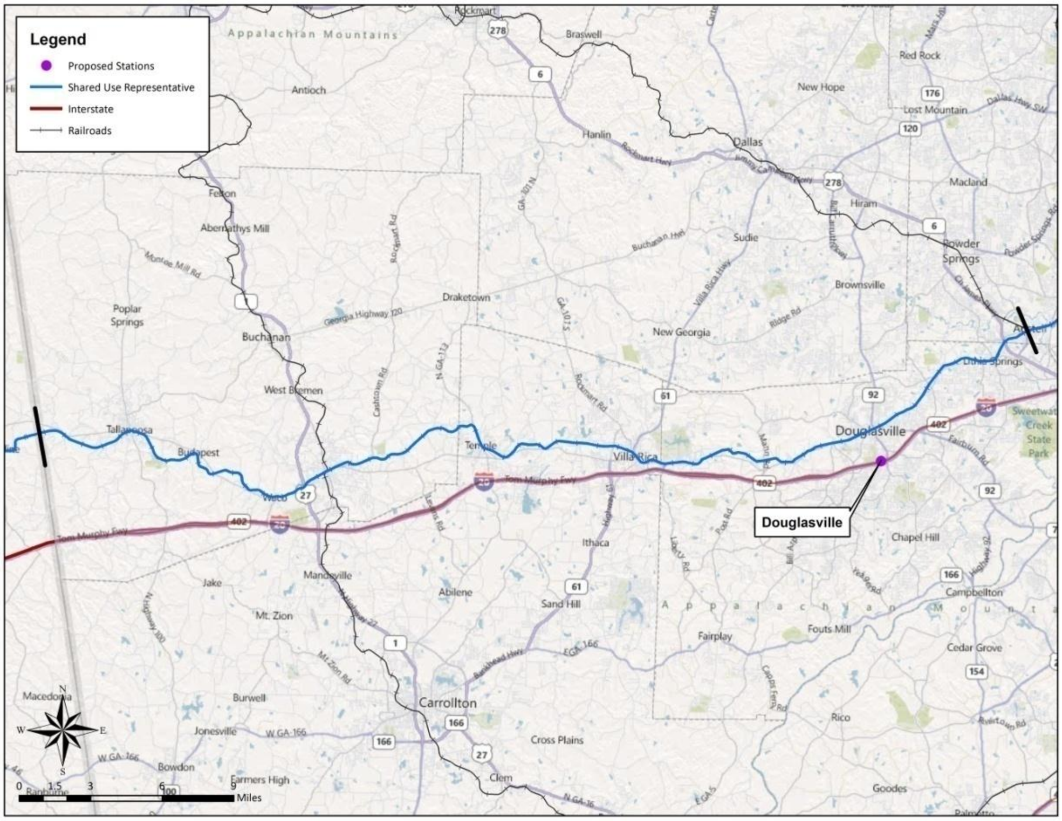


Table 6-5: Atlanta-Birmingham Total Shared Use Capital Cost Segment Three

Segment 3: 90-110 mph Shared Use – Austell, GA to GA/AL State Line			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$168,615,000	$50,584,000	$219,199,000
Stations, Terminals, Intermodal	$5,610,000	$1,683,000	$7,293,000
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W Land	$22,560,000	$6,768,000	$29,328,000
Communications & Signaling	$105,043,000	$31,513,000	$136,556,000
Electric Traction	-	-	-
Vehicles	-	-	-
Professional Services	$94,170,000	-	$94,170,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$395,998,000**	**$90,548,000**	**$486,546,000**
Cost Per Mile (49.9 Miles)			**$9,750,000**

Figure 6-4: Atlanta-Birmingham Shared Use Segment Four

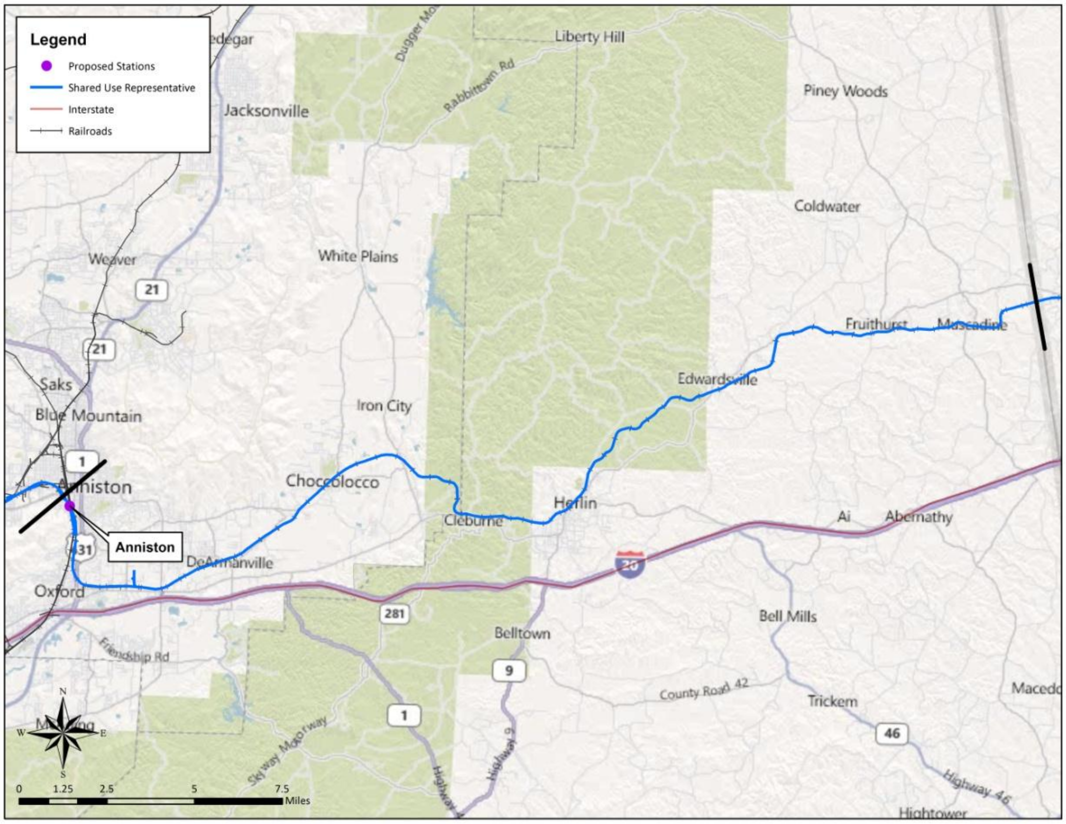


Table 6-6: Atlanta-Birmingham Total Shared Use Capital Cost Segment Four

Segment 4: 90-110 mph Shared Use –GA/AL State Line to Anniston, AL			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$152,176,000	$45,653,000	$197,829,000
Stations, Terminals, Intermodal	$5,610,000	$1,683,000	$7,293,000
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$21,410,000	$6,423,000	$27,833,000
Communications & Signaling	$69,730,000	$20,919,000	$90,650,000
Electric Traction	-	-	-
Vehicles	-	-	-
Professional Services	$77,665,000	-	$77,665,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$326,591,000**	**$74,678,000**	**$401,270,000**
Cost Per Mile (37.2 Miles)			**$10,786,000**

Figure 6-5: Atlanta-Birmingham Shared Use Segment Five

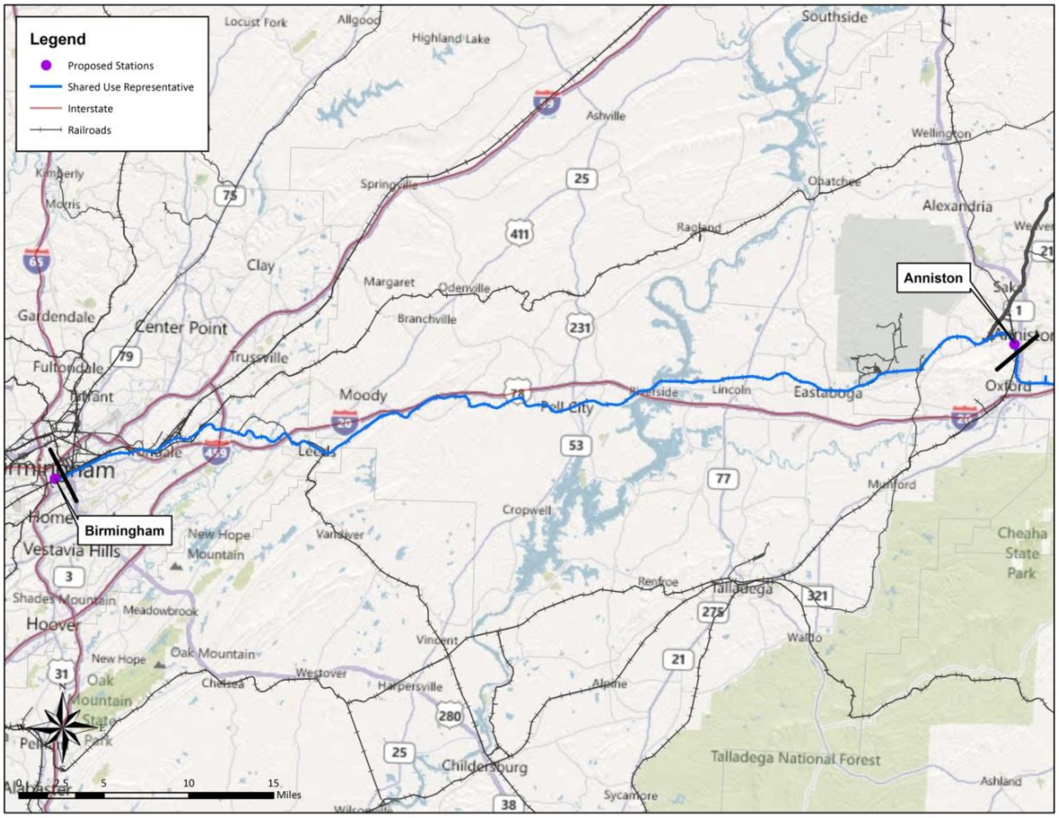


Table 6-7: Atlanta-Birmingham Total Shared Use Capital Cost Segment Five

Segment 5: 90-110 mph Shared Use – Anniston, AL to Birmingham, AL			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$329,700,000	$98,910,000	$428,610,000
Stations, Terminals, Intermodal	$18,610,000	$5,583,000	$24,194,000
Support Facilities: Yards, Shops, Administration Buildings	$6,204,000	$1,861,000	$8,065,000
Sitework, R/W, Land	$142,667,000	$42,800,000	$185,467,000
Communications & Signaling	$117,684,000	$35,305,000	$152,989,000
Electric Traction	-	-	-
Vehicles	-	-	-
Professional Services	$191,838,000	-	$191,838,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$806,703,000**	**$184,459,000**	**$991,163,000**
Cost Per Mile (61.2 Miles)			**$16,195,000**

6.1.2 180-220 MPH DEDICATED USE

The 180-220 mph Dedicated Use route on a fully separated, dedicated route utilizing interstate, rail line and greenfield right-of-way. Within urban corridors, the route is shared with freight right-of-way. The track will be separated from freight operations and will not interfere with freight traffic. The total capital costs for Dedicated Use are higher than Shared Use due to the electrification of the track, electrified vehicles, land acquisition and relocations. Table 6-8 outlines the total Atlanta-Birmingham Dedicated Use corridor costs by SCC.

Table 6-8: Atlanta-Birmingham Total Dedicated Use Capital Cost (2010$)

Costing Category	Allocated Cost	Contingency (30%)	Total Cost
Track Structures & Track	$1,906,481,000	$571,944,000	$2,478,425,000
Stations, Terminals, Intermodal	$308,987,000	$92,696,000	$401,683,000
Support Facilities: Yards, Shops, Administration Buildings	$43,424,000	$13,027,000	$56,452,000
Sitework, R/W, Land	$828,647,000	$248,594,000	$1,077,240,000
Communications & Signaling	$257,181,000	$77,154,000	$334,336,000
Electric Traction	$1,643,166,000	$492,980,000	$2,136,116,000
Vehicles	$217,250,000	$65,175,000	$282,425,000
Professional Services	$1,564,369,000	N/A	$1,556,220
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$6,796,505,000**	**$1,569,570,000**	**$8,322,896,000**
Total Cost Per Mile (153.8 Miles)			**$54,126,000**

To further understand the detailed SCC costs of the Atlanta-Birmingham Dedicated Use corridor, Figure 6-6 through Figure 6-11 and Table 6-9 through Table 6-14 illustrates the capital costs by segment. Segments were developed based on station location and natural breaks in the corridor such as state boundaries. Again, similar to the Shared Use segment costs, it should be noted that station and maintenance facility costs were only accounted for in the segment in which the station and/or maintenance facility is located. Additionally, vehicle costs were only accounted for in the total corridor capital costs, and were not included in the segment costs.

Figure 6-6: Atlanta-Birmingham Dedicated Use Segment One

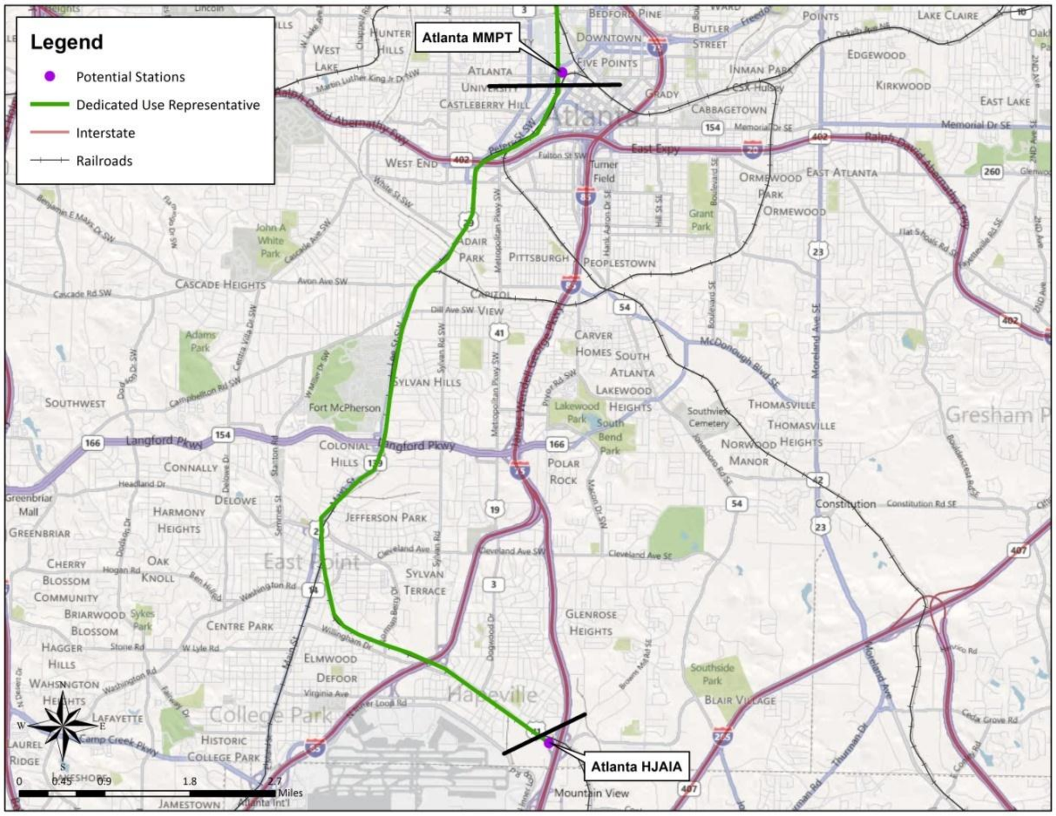


Table 6-9: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment One

Segment 1: 90-110 mph Shared Use – Atlanta Airport (H-JAIA) to Atlanta MMPT			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$61,249,000	$18,375,000	$79,624,000
Stations, Terminals, Intermodal	$279,156,000	$83,747,000	$362,903,000
Support Facilities: Yards, Shops, Administration Buildings	$37,221,000	$11,166,000	$48,387,000
Sitework, R/W, Land	$195,601,000	$58,680,000	$254,281,000
Communications & Signaling	$16,711,000	$5,013,000	$21,724,000
Electric Traction	$90,399,000	$27,120,000	$117,518,000
Vehicles	-	-	-
Professional Services	$212,265,000	-	$212,265,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$892,602,000**	**$204,101,000**	**$1,096,701,000**
Cost Per Mile (8.5 Miles)			**$129,023,000**

Figure 6-7: Atlanta-Birmingham Dedicated Use Segment Two

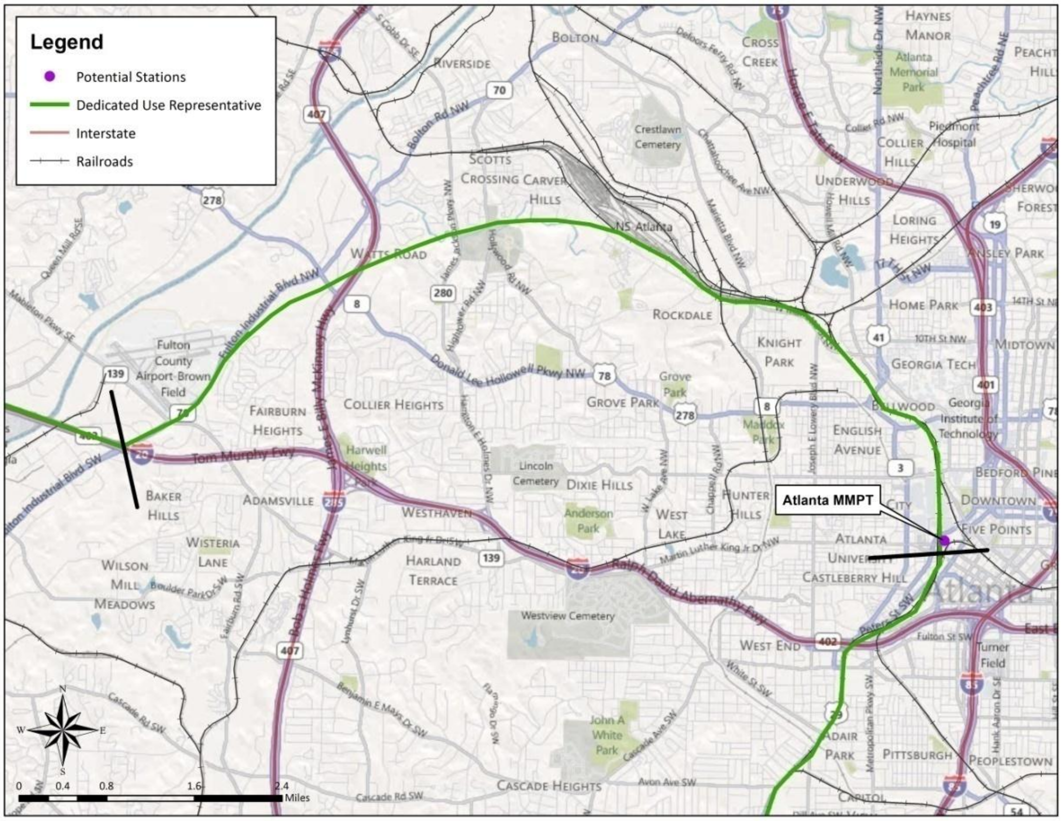


Table 6-10: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Two

Segment 2: 90-110 mph Shared Use – Atlanta MMPT to Fulton Industrial Blvd Interchange			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$172,767,000	$51,830,000	$224,597,000
Stations, Terminals, Intermodal	-	-	-
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$254,611,000	$76,383,000	$330,995,000
Communications & Signaling	$24,642,000	$7,392,000	$32,034,000
Electric Traction	$108,671,000	$32,601,000	$141,272,000
Vehicles	-	-	-
Professional Services	$174,935,000	-	$174,935,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$735,626,000**	**$168,206,000**	**$903,833,000**
Cost Per Mile (10.2 Miles)			**$88,611,000**

Figure 6-8: Atlanta-Birmingham Dedicated Use Segment Three

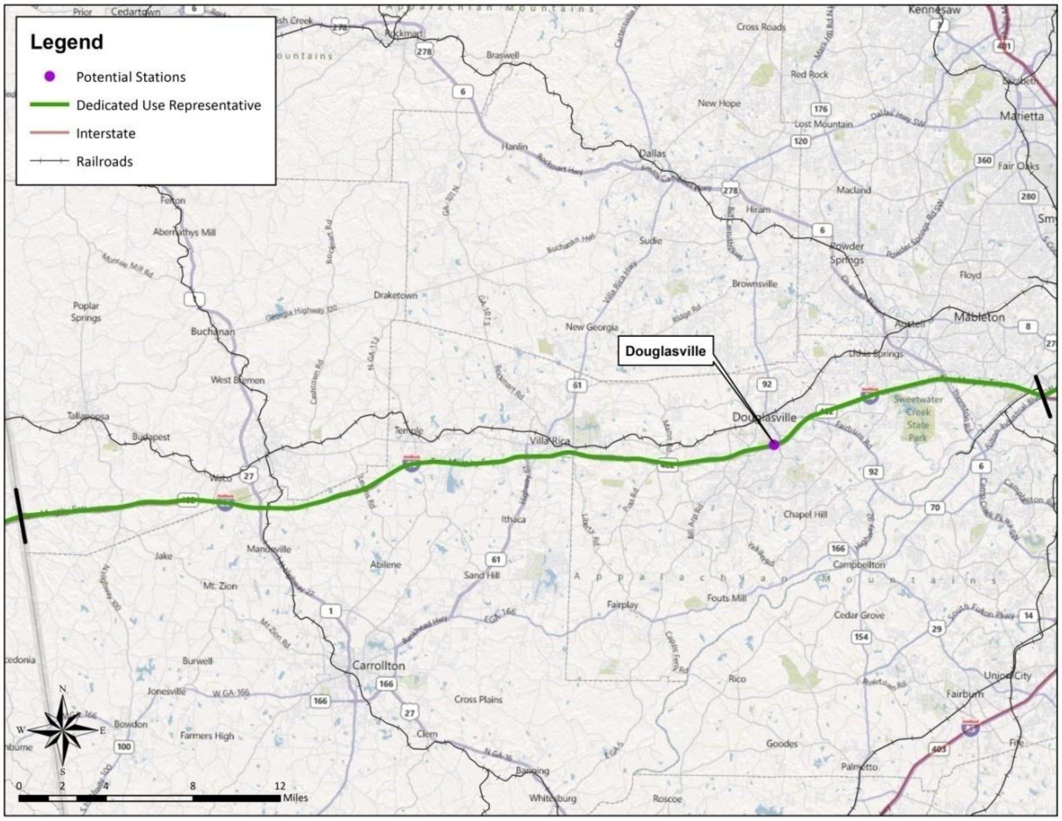


Table 6-11: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Three

Segment 3: 90-110 mph Shared Use – Fulton Industrial Blvd to GA/AL State Line			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$501,341,000	$150,402,000	$651,744,000
Stations, Terminals, Intermodal	$5,610,000	$1,683,000	$7,293,000
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$138,352,000	$41,506,000	$161,576,000
Communications & Signaling	$74,578,000	$22,373,000	$96,951,000
Electric Traction	$518,135,000	$155,441,000	$673,576,000
Vehicles	-	-	-
Professional Services	$386,261,000	-	$381,873,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$1,624,277,000**	**$371,405,000**	**$1,973,013,000**
Cost Per Mile (48.5 Miles)			**$40,689,000**

Figure 6-9: Atlanta-Birmingham Dedicated Use Segment Four

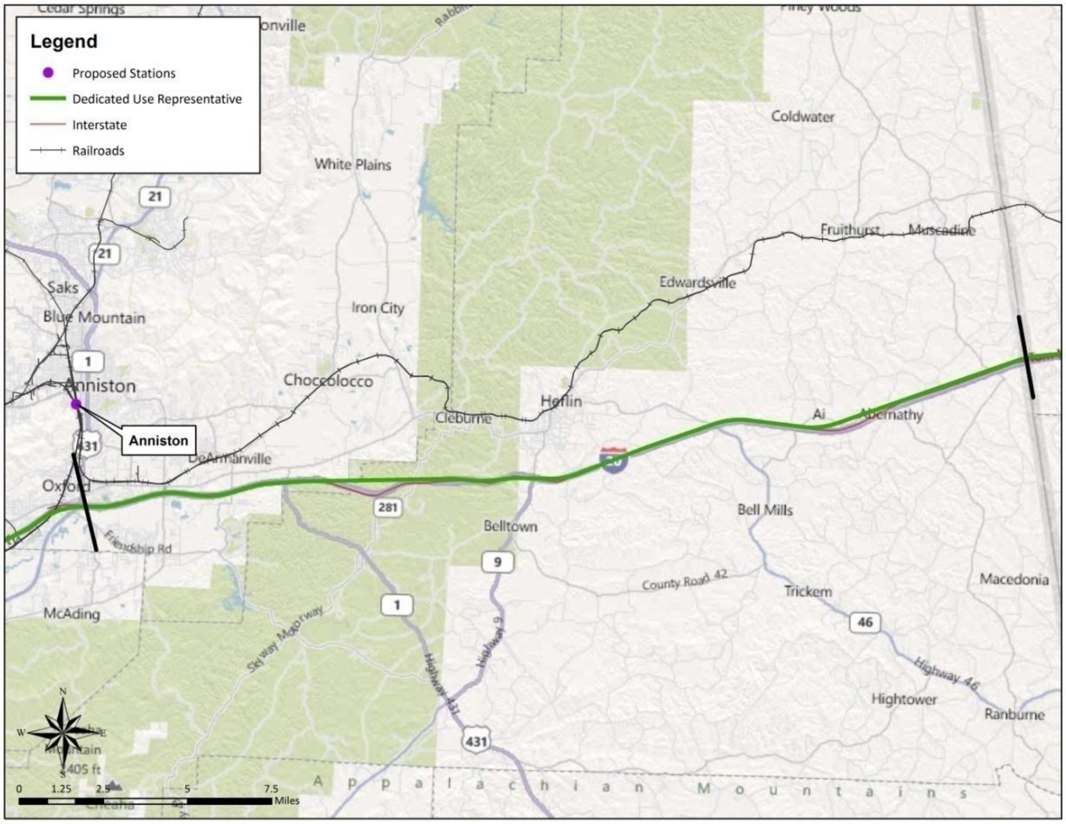


Table 6-12: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Four

Segment 4: 90-110 mph Shared Use –GA/AL State Line to Anniston, AL			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$310,769,000	$93,231,000	$403,999,000
Stations, Terminals, Intermodal	$5,610,000	$1,683,000	$7,293,000
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$55,384,000	$16,615,000	$66,776,000
Communications & Signaling	$47,186,000	$14,156,000	$61,342,000
Electric Traction	$327,864,000	$98,359,000	$426,223,000
Vehicles	-	-	-
Professional Services	$233,006,000	-	$231,752,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$979,819,000**	**$224,044,000**	**$1,197,385,000**
Cost Per Mile (30.7 Miles)			**$39,028,000**

Figure 6-10: Atlanta-Birmingham Dedicated Use Segment Five

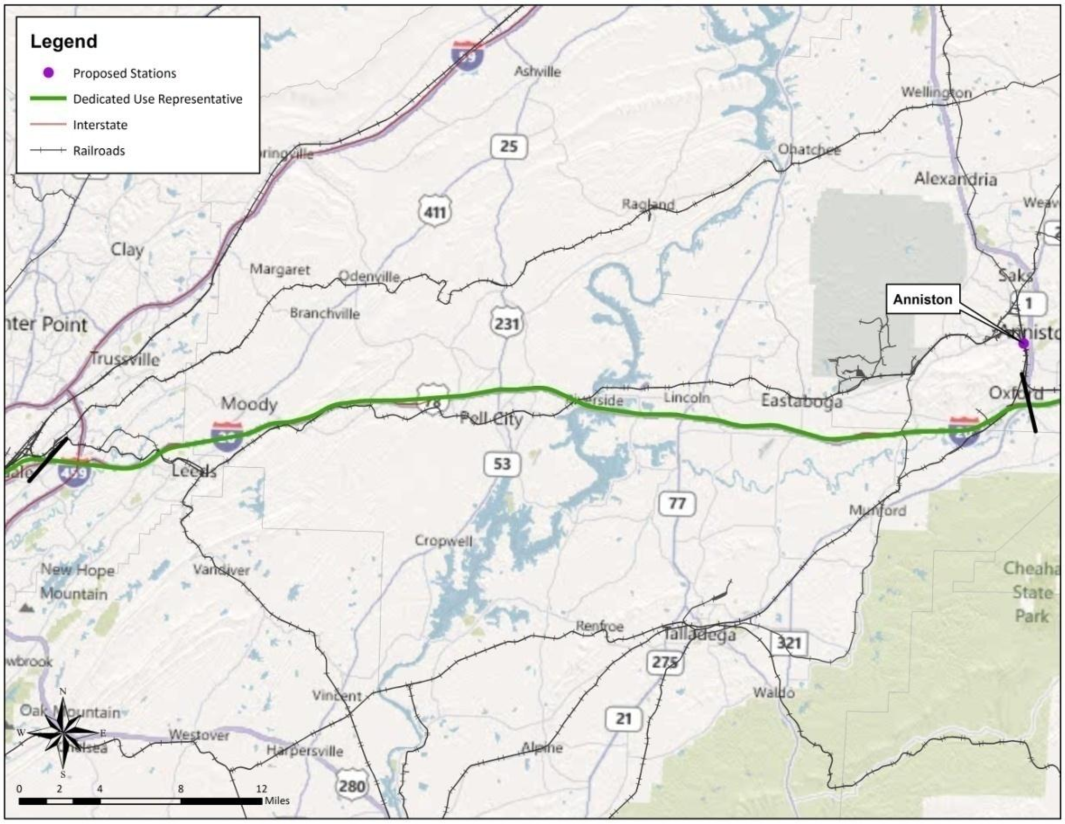


Table 6-13: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Five

Segment 5: 90-110 mph Shared Use – Anniston, AL to Birmingham Shared Use			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$803,275,000	$240,982,000	$1,044,257,000
Stations, Terminals, Intermodal	-	-	-
Support Facilities: Yards, Shops, Administration Buildings	-	-	-
Sitework, R/W, Land	$100,117,000	$30,035,000	$119,706,000
Communications & Signaling	$74,362,000	$22,309,000	$96,671,000
Electric Traction	$516,675,000	$155,003,000	$671,678,000
Vehicles	-	-	-
Professional Services	$466,262,000	-	$463,755,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$1,960,693,000**	**$448,329,000**	**$2,396,066,000**
Cost Per Mile (48.3 Miles)			**$49,557,000**

Figure 6-11: Atlanta-Birmingham Dedicated Use Segment Six

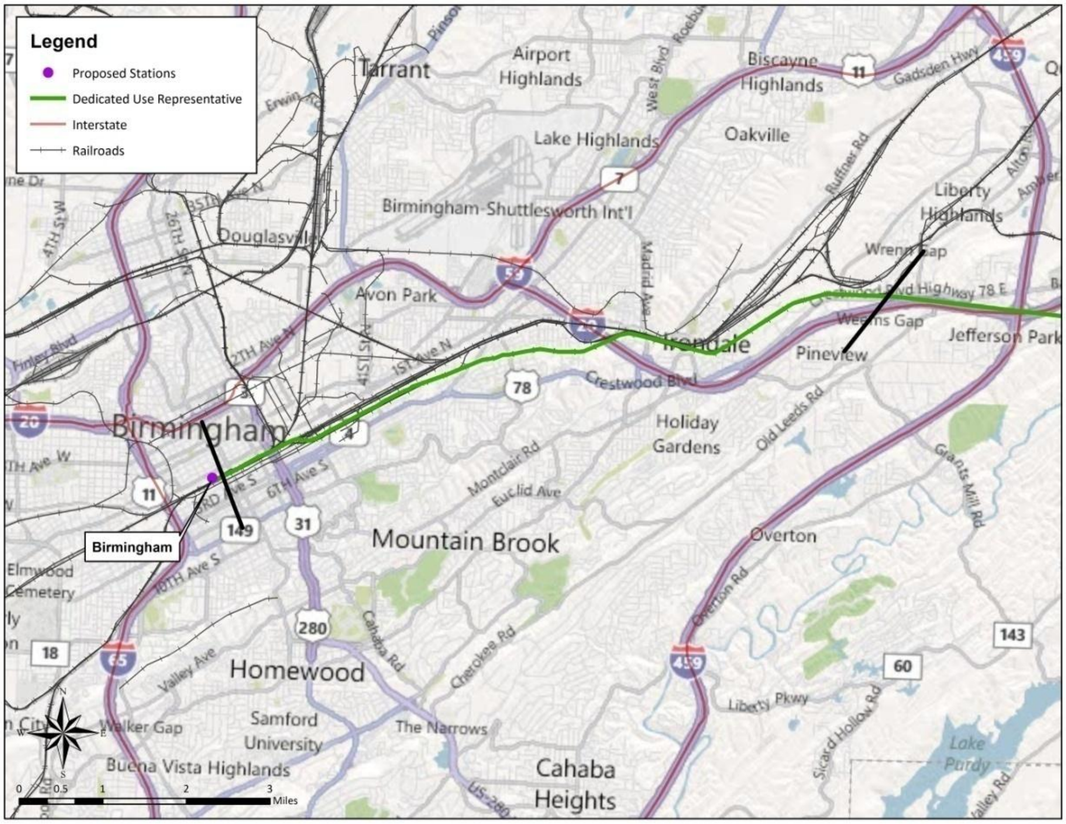


Table 6-14: Atlanta-Birmingham Total Dedicated Use Capital Cost Segment Six

Segment 6: 90-110 mph Shared Use –Birmingham Shared Use to Birmingham Station			
	Allocated	**Contingency (30%)**	**Total Cost**
Track Structures & Track	$57,080,000	$17,124,000	$74,205,000
Stations, Terminals, Intermodal	$18,610,000	$5,583,000	$24,194,000
Support Facilities: Yards, Shops, Administration Buildings	$6,203,000	$1,861,000	$8,065,000
Sitework, R/W, Land	$110,698,000	$33,209,000	$143,907,000
Communications & Signaling	$19,704,000	$5,911,000	$25,615,000
Electric Traction	$81,423,000	$24,427,000	$105,850,000
Vehicles	-	-	-
Professional Services	$91,640,000	-	$91,640,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
Total Cost	**$385,358,000**	**$88,115,000**	**$473,475,000**
Cost Per Mile (7.6 Miles)			**$62,299,000**

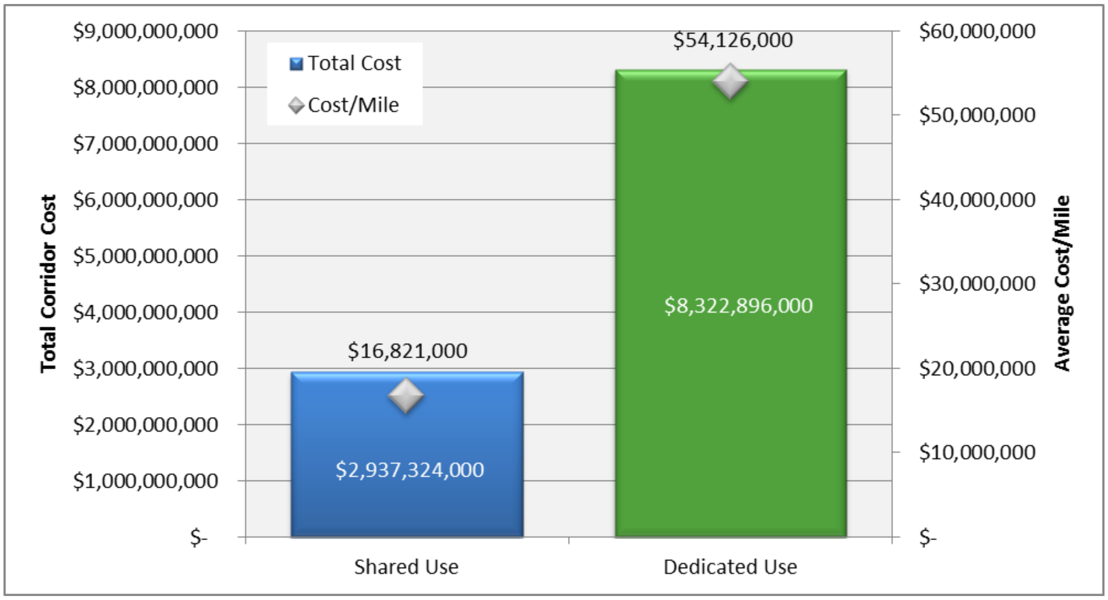
6.1.3 COMPARING CAPITAL COSTS

Table 6-15 and Figure 6-12 illustrate the total capital cost differences between Shared Use and Dedicated Use technologies. While it is evident that Shared Use total cost is far less than Dedicated Use, the Dedicated Use ridership and revenue (refer back to Chapter 5) is substantially higher.

Table 6-15: Total Capital Cost by Route/Technology

	Shared Use	Dedicated Use
Total Cost	$2,937,324,000	$8,322,896,332
Cost per Mile	$16,821,000	$54,125,618

Figure 6-12: Total Capital Cost by Technology



The last item that will determine the feasibility of the capital cost will be funding and financing opportunities. Section V, Chapter 3 outlines some potential funding and financing sources; however, additional funding analysis will be necessary in the future to understand realistic funding levels at the federal, state and local levels.

6.2 OPERATING AND MAINTENANCE COSTS

Operating and Maintenance costs were separated into fixed costs and variable costs. Table 6-16 outlines the fixed and variable cost categories used for this feasibility analysis.

Table 6-16: Atlanta-Birmingham Fixed and Variable Cost Categories

Fixed Cost Categories	Variable Cost Categories
• Stations • Track and Electrification Maintenance • Administration and Management	• Train Crew • On Board Services • Equipment Maintenance • Fuel/Energy • Insurance • Call Center • Credit Card/Travel Agency Commissions

6.2.1 90-110 MPH SHARED USE

The fixed and variable costs for the Shared Use Corridor are substantially less than Dedicated Use due to less required inspection, maintenance and repair on track and lower ridership levels (thus creating lower variable costs). Table 6-17 provides operating and maintenance cost estimates for 20201 (start up), 2030 and 2040 (feasibility planning horizon).

Table 6-17: Atlanta-Birmingham Shared Use O&M Costs (2010$ millions)

	2021	2030	2040	Total (2021-2040)
Variable O&M Costs	$20.9	$21.8	$22.7	$457.8
Fixed O&M Costs	$22.5	$22.5	$22.5	$472.5
Total O&M Costs	**$43.4**	**$44.3**	**$45.2**	**$930.3**

6.2.2 180-220 MPH DEDICATED USE

The Dedicated Use operating and maintenance costs are higher than Shared Use due to the track electrification maintenance as well as higher ridership. Table 6-18 provides the operating and maintenance costs for 2021, 2030 and 2040.

Table 6-18: Atlanta-Birmingham Dedicated Use O&M Costs (2010$ millions)

	2021	2030	2040	Total (2021-2040)
Variable O&M Costs	$35.0	$36.6	$38.1	$767.9
Fixed O&M Costs	$44.4	$44.4	$44.4	$932.4
Total O&M Costs	**$79.4**	**$81.0**	**$82.5**	**$1,700**

7.1 FEASIBILITY MEASUREMENTS

The study utilized two feasibility measurements for the Atlanta-Birmingham Corridor (operating ratios and benefit-cost calculations). The feasibility analysis was done for both Shared Use and Dedicated Use routes. Refer back to Section I: Chapter 3 for detailed methodology information on these measures.

A key element of the feasibility analysis is an assessment of both public and private benefits. To test the "franchisability" of a corridor as a public-private partnership, the analysis uses the "operating ratio" of revenues divided by operating costs. A service with a positive operating ratio greater than 1.0 generates an operating surplus. A positive operating ratio gives evidence of a strong, self-supporting operating system that is less likely to need operating subsidies and reduces the operating risk for the owner, investor and operator.

The benefit-cost analysis identifies all costs (capital, operating and maintenance) and all benefits (fare revenues, on-board service revenue, consumer surplus and external resources) and monetizes the value of each to determine a benefit-cost ratio. Similar to the operating ratio, a benefit-cost ratio of greater than 1.0 is desirable.

It should be mentioned that for both operating ratios and benefit-cost analyses, the standard period for assessing discounted cash flows is 25 to 30 years. Therefore, for the purposes of the feasibility analyses, the horizon year was extended from 2040 to 2050 to account for the three (3%) percent discount rate.

In setting up the feasibility evaluation, three scenarios were developed to show the impact of a range of ridership, revenue, capital and operating cost estimates typically encountered in a feasibility-level analysis. Unadjusted base forecasts for ridership, revenue, capital and operating costs were used for the Conservative Scenario. Base ridership and revenue estimates were increased for Dedicated Use corridors to establish the Intermediate and Optimistic Scenarios.[25] Operating costs

[25] Ridership adjustments for Intermediate and Optimistic Scenarios were only made for Dedicated Use corridor 180-220 mph electrified, steel-wheel and Maglev technologies (Maglev in Atlanta-Louisville corridor only) based on a peer review of regional and national high speed rail corridor studies. No scenario ridership adjustment was made for Shared Use corridor diesel-electric technology results based on a peer review of other shared-use corridor studies.

were adjusted by the appropriate ridership drivers. Capital cost estimates were adjusted downward in the Intermediate and Optimistic Scenarios for all technologies.

The three scenarios are intended to capture and illustrate the relatively wide range of estimates at the feasibility-level of study. As corridors are deemed feasible for further evaluation, future studies will provide greater detail in the analysis of ridership, revenues and costs, narrowing the range of estimates. Refer back to Section I: Chapter 3 for more detailed information on the development of these evaluation scenarios.

7.1.1 90-110 MPH SHARED USE

7.1.1.1 Operating Ratio

Table 7-1 provides the operating ratio for the Atlanta-Birmingham Shared Use route. Operating revenues include both farebox revenue and on board service revenue. Operating and maintenance costs include both fixed and variable costs (refer back to Chapter 6). Separate ridership and revenue scenarios were not developed for the Shared Use route. Therefore, Table 7-1 only presents the "Conservative" scenario using base-case ridership and revenue forecasts. Revenues, costs, operating surplus/deficits and operating ratio are estimated for 2021, 2030 and 2040 to understand the overall performance of the Shared Use route. The 110 mph Shared Use route generates an operating ratio greater than 1.0 providing a revenue surplus for all forecast years.

Table 7-1: Atlanta-Birmingham Shared Use Operating Ratio (2010$ millions)

	2021	2030	2040
Total Operating Revenue	**$50.1**	**$58.3**	**$67.3**
Farebox Revenues	$46.0	$53.5	$61.7
Ancillary Revenues	$0.5	$0.5	$0.6
On-Board Services	$3.6	$4.3	$4.9
Total Operating Costs	**$43.4**	**$44.3**	**$45.2**
Fixed Operating Costs	$22.5	$22.5	$22.5
Variable Operating Costs	$20.9	$21.8	$22.7
Operating Surplus (Deficit)	**$6.7**	**$14.0**	**$22.1**
Operating Ratio	**1.15**	**1.32**	**1.49**

7.1.1.2 Benefit-Cost

The study includes Shared Use route capital cost scenarios for use in the benefit-cost analysis, since base-case capital costs are substantial and include a 30 percent contingency. Table 7-2 outlines the benefit-cost results for each scenario. More details are included in Appendix G. The first scenario includes the Conservative (base) ridership and revenue as well as capital costs with the 30 percent contingency. The Intermediate scenario the capital cost contingency is reduced to 15 percent, and the Optimistic scenario removes the contingency completely from the capital cost estimates.

Table 7-2: Atlanta-Birmingham Shared Use Benefit-Cost Analysis (2021-2050)

	Conservative	Intermediate	Optimistic
Shared Use	0.80	0.88	0.95

The Shared Use service alternative has a benefit-cost ratio between 0.80 and 0.95, with an Intermediate value of 0.88. The Shared Use route did not generate a benefit-cost ratio above 1.0. However, if the Atlanta-Birmingham Corridor were operated as a part of a larger Atlanta Hub System the benefit-cost ratio will improve. Refer to Section V: Chapter 2 for more detailed information on the feasibility of an integrated high-speed rail system.

7.1.2 180-220 MPH DEDICATED USE

7.1.2.1 Operating Ratio

Table 7-3 displays operating ratios for the Atlanta-Birmingham Dedicated Use route. Ridership, revenue, and capital cost scenarios were developed for all Dedicated Use routes. Refer back to Section I: Chapter 3 for detailed methodologies for the Conservative, Intermediate and Optimistic sensitivity scenarios.

The Conservative scenario uses base-case ridership and revenue forecasts and operating and maintenance costs. The Intermediate scenario includes moderately increasing revenue and operating costs; and Optimistic illustrates aggressive revenues and their associated operating costs. The Intermediate and Optimistic scenarios were developed based on benchmarking this feasibility study with other high-speed ground transportation studies both within the region and nationally.

Table 7-3: Atlanta-Birmingham Dedicated Use Operating Ratio

	Conservative	Intermediate	Optimistic
Dedicated Use			
2021	1.10	1.72	1.87
2030	1.25	1.86	2.00
2040	1.41	2.00	2.12

Similar to the Shared Use route, the Dedicated Use route produces operating ratios greater than 1.0 for all scenarios and forecast years.

7.1.2.2 Benefit-Cost

Table 7-4 outlines the three benefit-cost scenarios for the Dedicated Use route and the three scenarios outlined in section 7.1.2.1. Variations in capital costs were also included in the calculations. The Conservative scenario uses base-case ridership and revenue as well as base-case capital and operating and maintenance costs. The Intermediate scenario is based on a 75 percent increase in ridership and revenues and a capital cost contingency of 15 percent rather than 30 percent. The Optimistic scenario increases ridership and revenue by 100 percent over the Conservative scenario and eliminates the capital cost contingency.

Table 7-4: Atlanta-Birmingham Dedicated Use Benefit-Cost Analysis 2021-2050

	Conservative	Intermediate	Optimistic
Dedicated Use	0.48	0.92	1.13

The Dedicated Use route produces benefit-cost ratios between 0.48 and 1.13, with an Intermediate value of 0.92. This indicates that high-speed rail service is potentially feasible in the Optimistic case, which suggests that the Atlanta-Birmingham Corridor should continue to be evaluated in future environmental and engineering studies. Future studies should also consider the benefits of an integrated Atlanta-Hub System. Refer to Section V: Chapter 2 for more details on the potential for an Atlanta-hub high-speed rail system.

7.1.3 KEY FINDINGS

The Shared Use and Dedicated Use route and technology alternatives perform well under the operating ratio analysis, resulting in ratios well above 1.0 for all three scenarios. This indicates strong operations with lower associated risks to owners and operators. Positive operating ratios indicate an ability to pay down debt services and bonds, and can lead to reduced reliability on public investment subsidies. Additionally, operating surpluses on an annual basis may finance a “rail maintenance fund”, requiring less investment in future years for capital maintenance costs. Positive operating ratios will likely spark private sector investment interest in the corridor, providing additional funding opportunities.

The benefit-cost results do not exceed 1.0 for any of the representative routes, with the exception of the Dedicated Use 180-220 mph technology option, which shows a benefit-cost ratio of 1.13 for the Optimistic scenario.

It should be noted that this feasibility study includes very high-level data and estimates. A more detailed corridor analysis with more definitive study boundaries, travel demand models, and cost estimates, could yield a better benefit-cost evaluation with a narrow range of estimates.

Taking into account the operating ratios and benefit-cost ratios, the study recommends that the results of this analysis be used to set priorities for future state planning and corridor development activities In particular, this study finds that high speed rail service is feasible in the Atlanta-Birmingham Corridor.

The study developed an additional "Hybrid" High Performance scenario, discussed in detail in Chapter 8 that further supports the above conclusions. This alternative has the potential to reduce initial capital costs and positively impact the benefit-cost analysis while maintaining the ability to achieve higher speeds along the corridor.

8 HYBRID HIGH PERFORMANCE SCENARIO

One of the results from the Shared Use and Dedicated Use analyses was the introduction of a “hybrid” scenario to offset a portion of the initial capital costs (compared to the Dedicated Use) while improving the travel speeds (compared to the Shared Use), thus positively impacting the operating ratio and benefit-cost analysis. While some analyses were completed for the Hybrid High Performance scenario, there was insufficient data available for a full analysis to be completed. Therefore, more performance and financial details regarding the Hybrid High Performance scenario will need to be explored through the NEPA process. This feasibility study intends to introduce the concept of the Hybrid High Performance scenario and provide a high-level feasibility estimates based on the results found during the Shared Use and Dedicated Use analyses. These estimates include:

- Operational estimates;
- Ridership and revenue;
- Capital Costs; and
- Operating and Maintenance Costs.

From these estimates, the study calculates the high-level operating ratio and Benefit-Cost ratio to compare against the previously identified Shared Use and Dedicated Use ratios to determine if the Hybrid High Performance scenario should be included in a future NEPA analysis.

The Hybrid High Performance scenario that provides a level of service between Shared Use and Dedicated Use, utilizing fully grade-separated track geometry with no shared-use freight operations. However, rather than electrified high-speed technology, the Hybrid High Performance scenario would implement Diesel-Electric Tilt Technology initially, and when ridership and revenue increase in later operating years, the service can be upgraded to a fully-electrified system, obtaining travel speeds of 220 mph or more.

One of the main benefits of the Hybrid High Performance scenario includes significantly lower capital costs compared to the 180-220 mph electrified technology assumed for the Dedicated Use route. However, the Hybrid High Performance scenario still has the potential to reach speeds of up to 130 mph. The study estimated that the Hybrid High Performance scenario would only take approximately 22 minutes longer than the electrified train on the Dedicated Use route. The 130 mph Hybrid High Performance scenario is approximately 1 hour, 16 minutes faster than auto travel by interstate from Atlanta to Birmingham (Table 8-1).

Table 8-1: Atlanta-Birmingham Operations Comparison

Segment	Shared Use	Dedicated Use	Hybrid High Performance
Rail Distance (miles)	176.0	150.7	150.7
Travel Time (hr : min)	2:46	1:18	1:40
Average Speed (mph)	64	117	90
Frequency (round trips/day)	6	10	10
Estimated Auto Time (hr : min)	2:56	2:56	2:56
Travel Time – Auto Time	+0:10	-1:38	-1:16

This chapter outlines the high-level revenue, cost, and feasibility results of the Hybrid High Performance scenario. However, it should be mentioned that these estimates do not incorporate the upgrade to electrification of the corridor, as those costs will only be incurred if ridership and revenue warrant the upgrade in later years.

8.1 Ridership and Revenue

To estimate ridership and revenue, the study calculated high-level estimates based on the decrease in vehicle speed as compared to the Dedicated Use. Travel time, speed profiles and train frequencies were adjusted as necessary.

Table 8-2: Atlanta-Birmingham Hybrid Operating Plan

	Hybrid High Performance Scenario
Travel Time	1 hour, 40 minutes
Train Frequency	10 round trips per day
Train Capacity	250 seats per train

The study estimated based on the decrease in average speed an increase in corridor travel time, the revenue for the Hybrid High Performance scenario would decrease by approximately 7.3 percent from the Dedicated Use forecasts (refer to Appendix G). Table 8-3 shows the estimated ridership and revenue for the Hybrid High Performance scenario for 2021, 2030, and 2040.

Table 8-3: Atlanta-Birmingham Hybrid High Performance Scenario Ridership and Revenue (in millions and 2010$)

Year	Conservative Scenario		Intermediate Scenario		Optimistic Scenario	
	Ridership	Revenue	Ridership	Revenue	Ridership	Revenue
2021	1,805,000	$67.5	3,158,000	$118.1	3,609,000	$135.0
2030	2,039,000	$78.0	3,568,000	$136.5	2,353,000	$156.0
2040	2,300,000	$89.6	4,025,000	$156.9	4,600,000	$179.3
Total	41,043,000	$1,571	71,825,000	$2,966	82,085,000	$3,143

8.2 Costs

As previously mentioned, the capital costs, operating costs, and maintenance costs will be significantly less than the Dedicated Use route due to the elimination of the track electrification. This also results in decreased in vehicle cost since diesel vehicles are also less expensive than fully electrified vehicles.

Table 8-4Table 8-4 outlines the Hybrid High Performance scenario capital cost estimates by major FRA SCC. Again, this alternative uses the Dedicated Use representative route and diesel, steel-wheel technology. Appendix F includes the detailed sub-category costs for the Hybrid High Performance scenario.

Table 8-4: Atlanta-Birmingham Total Hybrid Capital Cost by SCC Category (2010$)

Costing Category	Allocated Cost	Contingency (30%)	Total Cost
Track Structures & Track	$1,817,054,000	$ 545,116,000	$2,362,170,000
Stations, Terminals, Intermodal	$308,987,000	$92,696,000	$401,683,000
Support Facilities: Yards, Shops, Administration Buildings	$43,424,000	$13,027,000	$56,452,000
Sitework, R/W, Land	$832,505,000	$249,752,000	$1,082,257,000
Communications & Signaling	$257,181,000	$77,154,000	$334,336,000
Electric Traction	N/A	N/A	N/A
Vehicles	$217,250,000	$65175,000	$282,425,000
Professional Services	$1,016,855,000	N/A	$1,016,855,000
Unallocated Contingencies	N/A	N/A	N/A
Finance Charges	N/A	N/A	N/A
TOTAL COST	**$4,456,957,000**	**$1,030,714,000**	**$5,536,177,000**
TOTAL COST PER MILE (153.8 Miles)			**$36,003,000**

Operating and maintenance costs will also be reduced from the Dedicated Use estimates due to less required track inspection and maintenance. Table 8-5 illustrates the estimate Hybrid High Performance scenario operating and maintenance costs for 2021 (startup year) and 2040 (horizon year).

Table 8-5: Atlanta-Birmingham Hybrid O&M Costs (2010$ millions)

	2021	2030	2040	Total (2021-2040)
Variable O&M Costs	$34.4	$35.8	$37.2	$751.8
Fixed O&M Costs	$31.8	$31.8	$31.8	$667.8
Total O&M Costs	**$66.2**	**$67.6**	**$69.0**	**$1,420**

8.3 Feasibility Evaluation

Similar to the Shared Use and Dedicated Use, the study developed an operating ratio and benefit-cost ratio for the Hybrid High Performance scenario. Table 8-6 and Table 8-7 illustrate the results of these analyses for the three Conservative, Intermediate and Optimistic scenarios. Appendix G outlines more detailed operating ratio analysis.

Table 8-6: Atlanta-Birmingham Hybrid Operating Ratio

	Conservative	Intermediate	Optimistic
Hybrid High Performance			
2021	1.18	1.85	2.02
2030	1.34	2.00	2.14
2040	1.51	2.13	2.26
Dedicated Use			
2021	1.10	1.72	1.87
2030	1.25	1.86	2.00
2040	1.41	2.00	2.12

This positive operating performance is largely due to lower operating cost due to single tracking and the avoidance of electrification maintenance costs as well as lower operating costs associated with fewer frequencies (10 round trips per day).

Table 8-7: Atlanta-Birmingham Hybrid Benefit-Cost Analysis (2021-2050)

	Conservative	Intermediate	Optimistic
Hybrid High Performance	0.72	1.28	1.62
Dedicated Use	0.48	0.92	1.13

The Hybrid High Performance scenario produces benefit-cost ratios of 0.72 to 1.62 with an Intermediate case of 1.28. The Hybrid High Performance scenario shows the best potential for implementation, especially if combined with an integrated hub system (refer to Section V: Chapter 2).

8.4 PHASING SCENARIOS FOR CAPITAL COSTS

This discussion focuses on reducing capital costs for the initial implementation of high-speed rail within the Atlanta-Birmingham Corridor. The Hybrid High Performance scenario can be incrementally improved to 180-220 mph Dedicated Use service as corridor population trends results in higher ridership and demand for service improvements.

By phasing the corridor, the capital costs can also be phased in order to efficiently and effectively implement high-speed rail in order to meet current and future demands while maintain reasonable capital cost expenditure.

Phase I: Atlanta-Douglasville, GA

Phase I implementation of the passenger rail service proposes to connect the H-JAIA to Douglasville, GA, a distance of approximately 36 miles with station stops at H-JAIA, Atlanta MMPT and Douglasville. This phase would follow, primarily, I-20 right-of-way, with the exception of the route through downtown Atlanta in which it would utilize the Norfolk Southern right-of-way to access both the Atlanta MMPT and H-JAIA.

Phase I could potentially be paired with Intercity Passenger Rail, transporting commuters from the western Atlanta suburbs into the city, which would help boost initial ridership along the corridor.

Phase II: Douglasville, GA – Anniston, AL

Phase II implementation of the high-speed passenger rail service proposes to connect Douglasville to downtown Anniston, AL, a distance of approximately 76 miles and will include the station in Anniston. This route would continue to follow the I-20 right-of-way corridor and would face some topographic and curvature challenges entering and exiting the city of Anniston.

Phase III: Anniston – Birmingham, AL

Phase III of the implementation process would complete the high-speed rail route between Atlanta and Birmingham by providing the connection between Anniston and Birmingham. This final segment is approximately 64 miles, and would include the station in downtown Birmingham. Ridership along the corridor could be expected to increase significantly with the completion of this final segment allowing the full connection between the two major cities, Atlanta and Birmingham.

8.4.1 Additional Implementation Options – Commuter Rail

Commuter rail opportunities exist in both Atlanta and Birmingham and could serve as a first step in implementing the Atlanta-Birmingham Corridor. Currently, there are no specific plans for commuter service from Atlanta to the western portion of Georgia. However, possible commuter opportunities exist between Atlanta and Douglasville that would provide commuter benefits to western Atlanta suburbs as well as long-term intercity benefits, if constructed on the same route as the high-speed passenger rail service. Additionally, while there are no plans for commuter rail service in Alabama, the Birmingham to Anniston segment of the corridor could provide some commuter service in the future, potentially elevating ridership within the segment for the introduction of intercity high-speed passenger service.

8.5 CONCLUSION

Initial investigation into the Hybrid High Performance scenario indicates that an incremental approach to high-speed rail may provide significant advantages in the Atlanta-Birmingham Corridor both in terms of reducing initial capital cost requirement and increasing benefit-cost ratios.

The study used high-level estimates for revenue and costs associated with the Hybrid High Performance scenario. Therefore, a more detailed analysis of this alternative is needed to make definitive conclusions regarding the feasibility of the Hybrid High Performance scenario. The study recommends that the Hybrid High Performance scenario be included in the next phase of the passenger rail planning analysis as a viable technology alternative for passenger rail within the Atlanta-Birmingham Corridor.

SECTION V:
CONCLUSIONS AND NEXT STEPS

Section V: Conclusions and Next Steps

1 CORRIDOR COMPARISONS

1.1 SHARED USE

Table 1-1 compares the three study corridors and their respective Shared Use routes. Based on the table, the Atlanta-Macon-Jacksonville Corridor performs well when compared to the others with the lowest capital cost per mile and the highest benefit-cost ratio. Atlanta-Chattanooga-Nashville-Louisville Corridor reflects the highest capital cost per mile, but also shows the highest ridership and revenue and the best operating ratios. Atlanta-Birmingham Corridor also has relatively low capital costs and operating and maintenances costs, but shows the lowest average speed and has the lowest operating ratio driven by relatively low ridership and revenue results.

Table 1-1: Study Corridors 110 mph Diesel-Electric Shared Use Comparison

	Atlanta-Birmingham	Atlanta-Macon-Jacksonville	Atlanta-Chattanooga-Nashville-Louisville
Route Length (miles)	176.0	408.6	489.8
Travel Time (hour : minute)	2:46	5:19	6:55
Average Speed	64 mph	77 mph	72 mph
Total Ridership	37,177,000	47,430,000	101,962,000
Total Revenue	$1,077,851,000	$2,704,983,000	$4,277,336,000
Total Capital Cost	$2,937,324,000	$4,966,849,000	$11,589,054,000
Total Cost per Mile	$16,821,000	$11,492,000	$26,316,000
Total O&M Costs	$930,300,000	$2,067,000,000	$2,780,000,000
Operating Ratios			
Conservative[55]			
2021	1.15	1.25	1.49
2030	1.32	1.48	1.74
2040	1.49	1.73	2.01
Benefit-Cost			
Conservative Scenario	0.80	0.92	0.71
Intermediate Scenario	0.88	1.00	0.78
Optimistic Scenario	0.95	1.07	0.85

[55] Operating ratios were only prepared for the Conservative Scenario for the 110 mph Shared Use routes.

1.2 Dedicated Use

Table 1-2 compares the three study corridors and their Dedicated Use routes and technologies including Maglev in the Atlanta-Chattanooga-Nashville-Louisville Corridor. Again, all three study corridors and technologies have operating ratios greater than 1.0. The Atlanta-Macon-Jacksonville Corridor shows the best benefit-cost ratios largely due to its having the lowest capital cost per mile. The Atlanta-Chattanooga-Nashville-Louisville Corridor has the best operating ratios, but also the lowest benefit-cost ratios for all technologies. The Maglev technology in the Louisville Corridor has the highest operating ratio of any technology in any corridor. With the use of Maglev technology, the Atlanta-Chattanooga-Nashville-Louisville Corridor has the highest average speed. The Jacksonville Corridor has the highest average speed or electrified steel-wheel technology. Similar to Shared Use, the Atlanta-Birmingham 180-220 mph Dedicated Use service provides the lowest capital and operating and maintenance costs, but due to lower ridership and revenue, does not perform as well as the other corridors for either the operating ratio or benefit-cost ratio.

Table 1-2: Study Corridors Steel-Wheel/Maglev Dedicated Use Comparison

	Atlanta-Birmingham	Atlanta-Macon-Jacksonville	Atl-Chatt-Nash-Louis	Atl-Chatt-Nash-Louis (Maglev)
Corridor Length	150.7	368.1	428.2	428.2
Travel Time	1:18	2:48	3:33	3:02
Avg. Speed	117 mph	131 mph	122 mph	143 mph
Ridership	44,270,000	55,330,000	110,677,000	116,189,000
Revenue	$1694,837,000	$4,411,712,000	$6,494,937,000	$6,818,684,000
Capital Cost	$8,364,997,000	$16,144,036,000	$32,675,809,000	$47,030,000,000
Cost per Mile	$54,399,000	$41,323,000	$76,304,000	$100,490,000
O&M Costs	$1,700,000,000	$4,090,000,000	$5,814,000,000	$4,449,000,000
Operating Ratios				
Conservative				
2021	1.10	1.14	1.21	1.75
2030	1.25	1.35	1.39	1.91
2040	1.41	1.56	1.62	2.06
Intermediate				
2021	1.72	1.83	1.95	2.23
2030	1.86	2.00	2.23	2.38
2040	2.00	2.15	2.40	2.51
Optimistic				
2021	1.87	2.04	2.16	2.35
2030	2.00	2.17	2.45	2.49

	Atlanta-Birmingham	Atlanta-Macon-Jacksonville	Atl-Chatt-Nash-Louis	Atl-Chatt-Nash-Louis (Maglev)
2040	2.12	2.29	2.58	2.61
Benefit-Cost				
Conservative	0.48	0.49	0.40	0.34
Intermediate	0.92	0.93	0.78	0.65
Optimistic	1.13	1.12	0.96	0.80

1.3 Hybrid High Performance Scenario

Table 1-3 compares the three study corridors and the Hybrid High Performance scenario performs well in all three corridors. The Atlanta-Macon-Jacksonville and Atlanta-Chattanooga-Nashville-Louisville show a positive operation ratio for all three scenarios and a positive benefit-cost ratio at the Intermediate and Optimistic scenarios. However, this comparison shows that of the three corridors, the Atlanta-Birmingham Corridor Hybrid High Performance reflects the highest benefit-cost ratio. This is due to the small decrease in projected ridership as compared to the Dedicated Use (decrease of 7.3 percent); whereas, the Atlanta-Macon-Jacksonville and Atlanta-Chattanooga-Nashville-Louisville Corridors has significantly higher estimated reductions in ridership and revenue (decrease of 19.2 percent and 16.0 percent, respectively). Refer back to Section II-IV: Chapter 8 for more detailed description on the development of the Hybrid High Performance scenario.

Table 1-3: Study Corridors Hybrid Comparison

	Atlanta-Birmingham	Atlanta-Macon-Jacksonville	Atlanta-Chattanooga-Nashville-Louisville
Corridor Length (miles)	150.7	368.1	428.2
Travel Time (hour : minute)	1:40	3:55	5:02
Average Speed	90 mph	94 mph	85 mph
Total Ridership	41,043,000	48,414,000	92,925,000
Total Revenue	$1,571,284,000	$3,564,222,000	$5,453,149,000
Total Capital Cost	$5,487,672,000	$8,904,349,000	$16,428,173,000
Total Cost per Mile	$35,688,000	$22,792,000	$38,366,000
Total O&M Costs	$1,420,000,000	$3,541,000,000	$5,429,000,000
Operating Ratios			
Conservative			
2021	1.18	1.03	1.03
2030	1.34	1.21	1.21
2040	1.51	1.41	1.41

	Atlanta-Birmingham	Atlanta-Macon-Jacksonville	Atlanta-Chattanooga-Nashville-Louisville
Intermediate			
2021	1.85	1.66	1.66
2030	2.00	1.95	1.93
2040	2.13	2.18	2.22
Optimistic			
2021	2.02	1.86	1.86
2030	2.14	2.17	2.16
2040	2.26	2.39	2.46
Benefit-Cost			
Conservative Scenario	0.72	0.63	0.59
Intermediate Scenario	1.28	1.21	1.16
Optimistic Scenario	1.62	1.48	1.43

1.4 Key Conclusions

When comparing the three study corridors and the four operating technologies: 110 mph diesel-electric Shared Use, 180-220 mph electrified steel-wheel (Dedicated Use, Maglev, and the Hybrid High Performance, it should be recognized that all corridors and all technologies have operating ratios greater than 1.0.

- The Atlanta-Macon-Jacksonville Corridor has the best relative performance as measured by the benefit-cost ratio and has the second best operating ratios.
- The Atlanta-Chattanooga-Nashville-Louisville Corridor has the best performance as measured by the operating ratio, but the worst performance as measured by the benefit-cost ratio.
- The Atlanta-Birmingham Corridor has the second best benefit-cost ratio, but has the weakest performance as measured by the operating ratio.
- The Hybrid High Performance technology alternative shows the strongest performance in all corridors in terms of the benefit-cost ratio; however, further engineering and ridership analysis is required to confirm these results.
- With regard to the other technologies, the 180-220 mph steel-wheel technology outperforms 110 mph diesel-electric technology by the operating ratio in all three corridors, but trails when measured by the benefit-cost ratio.
- Maglev technology has the best operating ratios of any technology, but the worst benefit-cost performance.

2.1 SYSTEM INTEGRATION ANALYSIS

The initial feasibility analysis of the three study corridors examines each corridor as a separate free-standing service operating independently of other corridors. On the other hand, it is well known that there are significant system ridership benefits when a given corridor service operates as part of an interconnected network. With Atlanta providing an interconnected hub at the proposed MMPT, each of the individual corridors can feed ridership to the others with through-trips across the Atlanta hub or with seamless cross-platform transfers. In essence, coordinated system ridership will be substantially greater than the sum of independently operated corridors.

Atlanta functions as the current and historic rail hub of the South, similar to Chicago in the Midwest. Using ridership demand model results from the MWRRS[56], the study estimated the system ridership benefits of an Atlanta-hub system connecting the Birmingham, Macon-Jacksonville and Chattanooga-Nashville-Louisville Corridors. Using this ridership data, the study estimated resulting "system" operating ratios and benefit-cost ratios. Three technology scenarios were developed on a system-wide basis: 110 mph Shared Use diesel-electric technology, 180-220 mph Dedicated Use electrified, steel-wheel technology, and the 130 mph Hybrid technology. Maglev was not assessed from a system perspective, since Maglev evaluation was only evaluated for the Atlanta-Chattanooga-Nashville-Louisville Corridor.

- The Shared Use system utilizes the existing NS, CSXT, GCR and Seaboard rail lines and tilting diesel technology. The study estimated a 10 percent ridership increase for this scenario connecting the corridors through the Atlanta hub, based on a Conservative evaluation of the Midwest system model results.
- The Dedicated Use utilizes a double-tracked, dedicated corridor using electric rail technology. Based on the significant increase in frequencies over Shared Use (nearly 2x) and other factors, the study estimated the ridership for the Dedicated Use technology would receive a 30 percent increase.
- The Hybrid High Performance Rail uses the same dedicated corridor with single track with passing sidings every 25 miles. A 20 percent increase in ridership was estimated for this incremental approach.[57]

---

[56] "Midwest Regional Rail System – A Transportation Network for the 21st Century, Executive Report, September 2004". Prepared by Transportation Economics and Management Systems Inc. and the HNTB Corporation

[57] It should be noted that a fourth Georgia corridor, the Southeast High Speed Rail (SEHSR) route to Charlotte, NC (previously studied by Volpe Center in 2008) was not included in the system analysis. If it were included, the study estimates that the additional connectivity provided by what is in effect, an extension of the Northeast Corridor, could contribute additional system ridership in the range of 10 to 30 percent.
(footnote continued)

In addition to sharing the ridership benefits, the Atlanta-hub high-speed rail system would also share the burden of capital cost, operating costs and maintenance costs. For example, the system has the ability to share the cost of the fixed administrative structure, the Atlanta MMPT and H-JAIA infrastructure in addition to the track and infrastructure within the Atlanta area, primarily between Atlanta MMPT and H-JAIA stations.

Similar to the three corridors, the study calculated operating ratios and benefit-cost ratios for three sensitivity scenarios: Conservative, Intermediate and Optimistic reflecting variations in ridership and revenue as well as costs. The Shared Use calculations did not include ridership or revenue variations since there were no comparable benchmarks as with the Dedicated Use and Hybrid.

Table 3-1 outlines the comprehensive operating ratios for the high-speed rail system for Shared Use, Dedicated Use and Hybrid. All three alternatives show very strong operating ratios well above 1.0 indicating the ability to contribute at least in part to their own capital costs.

Table 2-1: High-Speed Rail System Operating Ratios (2021-2040)

		Conservative	Intermediate	Optimistic
Shared Use	2021	1.66	1.66	1.66
	2030	1.94	1.94	1.94
	2040	2.24	2.24	2.24
Dedicated Use	2021	2.39	2.24	1.56
	2030	2.50	2.36	1.78
	2040	2.62	2.51	2.04
Hybrid	2021	2.27	2.09	1.31
	2030	2.54	2.36	1.53
	2040	2.72	2.57	1.76

Table 3-2 illustrates the comprehensive benefit-cost ratios for the high-speed rail system for the three technologies. The Shared Use system benefit-cost ratio is close to 1.0 using Conservative ridership and capital cost assumptions. All technology alternatives have positive system benefit-cost ratios using the Intermediate ridership and capital cost assumptions.

Table 2-2: High-Speed Rail System Benefit-Cost Ratios (2021-2050)

	Conservative	Intermediate	Optimistic
Shared Use	0.91	1.01	1.11
Dedicated Use	0.58	1.09	1.24
Hybrid	0.78	1.46	1.78

It should be noted that while an Atlanta-hub high-speed rail system produces positive operating ratios and benefit-cost ratios and ultimately passes the feasibility tests, the capital investment required for a fully built out system will be significant. Capital cost estimates for such a system range from $15.0 billion for a 110 mph Shared Use system, to $23.4 billion for a Hybrid system and $43.5 billion for a 180-220 mph Dedicated Use system. Such a system would clearly have to be staged out over time and the magnitude of such a system would require a national funding commitment like that associated with national high speed rail systems in Europe and Asia.

3 Funding Opportunities

In order to better understand the financial feasibility issues associated with implementing high speed rail in the Southeastern U.S, the Study examined a variety of federal, state and local funding opportunities and strategies. In its research, the study examined sources of capital funding for infrastructure and equipment, as well as operating support to supplement fare revenue.

Capital Funding

Historically, funding for passenger rail service in the U.S. typically uses public sector grant and financing avenues to fund capital improvements including:

- Project development activities (i.e., planning, environmental compliance, preliminary engineering (PE) and final design (FD),
- Infrastructure construction (track, signals, stations), and
- Acquisition of operating equipment and construction of maintenance facilities.

These federal grant sources are usually matched with state funds. Local and private funding is typically limited to station development and instances where infrastructure improvements coincide with freight operations.

In addition to capital grant opportunities, there is also federal loan financing available to states to help fund capital costs for high-speed and intercity passenger rail programs. These financing options include low interest direct loans, loan guarantees, and federal interest tax expansions. In some areas, there are specialized financing tools such as tax incremental financing, local specialized transportation taxes, and public-private partnerships.

Operating Funding

With the limited federal and state funding across the country, a first step in managing operating support funding requirements, is to develop a service plan that maximizes ridership and revenues through high levels of service, aggressive pricing and traveler amenities.

Additionally, public-private partnership opportunities can be pursued to franchise the operation of the service and reduce public sector revenue risks. Public-private partnership opportunities can also be pursued through joint station development agreements and targeted advertising. Further, during the planning process, negotiations with Amtrak and/or private railroad owners can be used as a vehicle to help minimize operating costs. National and international experience in Europe and Asia has been that high levels of service, when cost effectively provided, can generate operating profits that can be used to reduce capital debt service and/or provide funds for future maintenance and infrastructure replacement.

This chapter provides an inventory of current funding and financing opportunities at the federal, state and local levels for the three Study Corridors.

3.1 Federal Capital Grants

3.1.1 Passenger Rail Investment and Improvement Act of 2008 (PRIIA)

In October of 2008, Congress passed the Passenger Rail Investment and Improvement Act (PRIIA). This legislation reauthorizes funding for Amtrak, and in addition, provides a new statutory framework for a federal/state partnership to fund and develop U.S. high-speed and intercity passenger service using 80/20 federal/state capital grants.

The PRIIA legislation authorizes $3.4 billion in capital grants over five years to states, groups of states, interstate compacts, public agencies, and in some cases Amtrak.

Congressional action is required each year to appropriate the amounts authorized. Section 301 of the Act provides grants for Intercity Passenger Rail Service Capital Assistance. Section 501 provides capital grants for High-Speed Rail Corridor Development for federally designated corridors with planned speeds of 110 mph or greater. Section 302 Congestion Grants are focused on relieving rail congestion bottlenecks.

3.1.2 American Recovery and Reinvestment Act of 2009 (ARRA) and Transportation Investment Generating Economic Recovery (TIGER)

In February 2009, Congress passed the American Recovery and Reinvestment Act (ARRA) which appropriated $8 billion in 100 percent federal funding providing "capital assistance for high-speed corridors and intercity passenger service." This program is based on the statutory framework provided by PRIIA and focused funding on state-sponsored projects.

ARRA also provided $1.5 billion in 100 percent flexible multi-modal funding under the Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant Program. Since then, another $600 million in 80 percent federal funding was appropriated in 2010 for the TIGER II Discretionary Grant Program.

US DOT is authorized to award $526.9 million in TIGER Discretionary Grants pursuant to Division B of the Department of Defense and Full-Year Continuing Appropriations

Act, 2011 (Pub. L. 112-010, Apr. 15, 2011). This appropriation is similar, but not identical to the appropriation for the "TIGER" program authorized and implemented pursuant to ARRA and the National Infrastructure Investments or "TIGER II" program under the FY 2010 Appropriations Act. As with the TIGER and TIGER II programs, funds for the FY2011 TIGER program are to be awarded on a competitive basis for projects that will have a significant impact on the nation, a metropolitan area or a region. October 31, 2011 was the deadline for submission of applications.

3.1.3 High-Speed and Intercity Passenger Rail (HSIPR)

In developing guidance for ARRA grants as well as grants offered under subsequent PRIIA appropriations, a structure for the FRA's High Speed and Intercity Passenger Rail (HSIPR) Program has evolved. The current structure is best reflected in the most recent notices of funding availability (NOFA) for FY 2010 appropriations for 80/20 federal/state grants under three program areas:

- *Service Development Program Grants* issued in the Federal Register on July 1, 2010;
- *Individual Project Grants* also issued on July 1, 2010; and,
- *Planning Grants* issued in the Federal Register on April 1, 2010.

FRA will develop final guidance and regulations for the HSIPR Program over the next few years; however, these interim guidance documents will provide the basic framework for the PRIIA grant program as well as for future funding programs.

Under the FY 2010 appropriation for these programs, $2.1 billion was provided for Service Development Program Grants, $245 million was provided for Individual Projects, and $50 million was provided for Planning Grants. The basic features of each program are outlined below. It should be noted that no new appropriations provided for HSIPR in FY 2011 or 2012.

3.1.3.1 Service Develop Program Grants

Investment in Service Development Programs (SDP) is "the long-term interest" of the new FRA HSIPR Program. SDP Grants focus on developing new high-speed or intercity passenger services or substantially upgrading existing services. A SDP Grant provides an 80/20 percent federal/state basis and in-kind contributions are allowable with FRA approval. An SDP Grant application will typically contain sets of inter-related projects, which constitute the entirety or a distinct phase (or geographic section) of a long-range SDP. These projects will collectively produce benefits greater than the sum of each individual project and will generally address, in a comprehensive manner, the construction and acquisition of infrastructure, equipment, stations, and facilities necessary to operate high-speed and intercity passenger service.

There are two SDP categories: 1) Major SDPs, which is the default category for SDP grant requirements, and 2) Standard SDPs which cost less than $100 million, primarily benefit intercity passenger rail service with top speeds of 79 mph, use proven technology, and are submitted by applicants with proven HSIPR project implementation experience.

Major SDP's are unique because the award instrument will be a "Letter of Intent" for the cost of the entire program which will contain milestones, grant conditions and other requirements agreed upon by FRA and the grantee which must be fulfilled prior to any disbursement of funds. Funding will be obligated through cooperative agreements and disbursed to grantees as the agreed upon milestones are achieved. The award instrument for the Standard SDP is a traditional "cooperative agreement" with funding made available to grantees on a reimbursable basis.

Major SDPs will typically require a "two-tiered" NEPA approach: utilizing a Tier 1 EIS to address broad service issues ("Service NEPA" document); followed by a Tier 2 EIS, Environmental Assessment (EA), or Categorical Exclusion (CE) to address site-specific project environmental review requirements ("project NEPA" document). To be eligible for a Major SDP grant, an applicant must have completed and submitted a NEPA document satisfying FRA's "Service NEPA" requirement with the application. A project's preliminary engineering, site-specific NEPA, final design, and construction activities are eligible for funding.

Standard SDP's can utilize a "non-tiered" NEPA approach where one EIS or EA would cover both service issues and individual project components. The applicant must have completed and submitted with the application an EIS or EA that addresses, at a minimum, Service NEPA issues. For applications intended to advance directly into final design (FD), FRA requires project NEPA documents and all preliminary engineering (PE) for project components to be completed and submitted with the application.

3.1.3.2 Individual Project Grants

Individual Project Grants are intended to assist applicants with the capital costs of improving existing high-speed or intercity passenger service. Individual Project Grants are provided on an 80/20 percent federal/state basis and in-kind contributions are allowable with FRA approval. Awards are for projects which involve FD/construction or projects already having completed site-specific NEPA documentation; or completion of project NEPA and PE documentation. Completion of the grant activities should result in all of the documentation necessary for the project to move into the FD/construction stage. The intent is to fund discrete individual projects that result in operation or other tangible improvements (e.g., station rehabilitation) benefiting one or more existing high-speed or intercity passenger services.

All individual projects must be addressed in a SDP, State Rail Plan, or similar planning document. Final design and construction projects must have project NEPA documentation completed as well as PE. Grants for PE/NEPA work must be developed sufficiently to support immediate commencement of FD. There is no requirement for a “tiered” NEPA approach. All individual project grants must have operational independence upon implementation; the project will provide measurable benefits with no additional investment.

3.1.3.3 Planning Grants

There are two types of eligible planning projects under HSIPR: 1) Passenger Rail Corridor Investment Plans and 2) State Rail Plans. Grants are provided on an 80/20 percent federal/state basis and in-kind contributions are allowable with FRA approval.

Passenger Rail Corridor Investment Plans must include both SDPs and Corridor-Wide Environmental Documentation meeting Tier 1 service NEPA requirements. If an application has completed one of these documents, FRA must have accepted that document to receive a grant to complete the remaining component(s).

SDPs must include: a corridor development program rational; service plan; capital investment need assessment; financial forecast; public benefits assessment; and program management approach. Corridor-Wide Environmental Documents must satisfy FRA service NEPA requirements. FRA has defined service NEPA as at least a programmatic/Tier 1 environmental review (using tiered reviews and documents), or alternatively, a project environmental review that also addresses broader questions and likely environmental effects for the entire corridor. Simple corridor programs can be addressed with a project NEPA approach while more complex programs will require a tiered approach.

State Rail Plans must meet PRIIA requirements and specific requirements included in the notice of funding availability. These include:

- State multimodal goals addressing the role of rail,
- Description of the existing rail system and its performance,
- Discussion of the existing state rail program and analysis of the economic and environmental effects of rail,
- Discussion of existing rail proposals,
- Vision for rail transportation,
- 5- and 20-year service and investment program for passenger and freight rail with an assessment of public and private benefits, and
- Description of public and stakeholder participation as well as coordination with other transportation programs.

3.1.4 Section 130 Highway-Rail Grade Crossing Improvement Program

The FHWA Section 130 Highway Railroad Grade Safety Crossing program provides grants for the improvement of highway railroad grade crossings which enhance safety. This includes: separation or protection of grades at crossings; the reconstruction of existing railroad grade crossing structures; and, the relocation of highways or rail lines to eliminate grade crossings.

Funds from the FHWA Section 130 Program can be used for freight and passenger projects provided that the projects improve safety at-grade crossings. This may include a variety of methods, such as installation of warning devices, elimination of at-grade crossings by grade separation or consolidation, and closing of crossings. Work may also include replacement of crossing surfaces, improvement of road approaches, installation of new gates/flashers, and installation of other safety signal equipment. Funding may also be used for elimination of crossing hazards should a state choose to use the funds for this purpose. For example, any repair, construction, or reconstruction of roads and bridges affected by a project would be eligible.

Federal funds for grade-crossing safety improvements are available at a 90 percent federal share, with the remaining 10 percent to be paid by state and/or local authorities and/or the railroad. The federal share may amount to 100 percent for the following projects: signing, pavement markings, active warning devices, the elimination of hazards, and crossing closures. The decision on whether to allow 100 percent Federal funding rests with the individual States.

3.1.5 Rail Line Relocation and Improvement Capital Grant Program

Section 9002 of Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorized $350 million per year for the Rail Line Relocation and Improvement Program to provide financial assistance for local rail line relocation projects. For FY 2010, Congress appropriated $34.5 million for the program. Any construction project which improves the route or structure of a rail line and 1) involves a lateral or vertical relocation of any portion of the rail line, or 2) is carried out for the purpose of mitigating the adverse effects of rail traffic on safety, motor vehicle traffic flow, community quality of life, or economic development is eligible. The federal share for these funds is 90 percent, not to exceed $20 million per project. This program can be useful for passenger rail projects which require re-routing freight operations to provide access for passenger service.

3.1.6 FHWA Congestion Mitigation and Air Quality

The Congestion Mitigation and Air Quality Program (CMAQ) (Title 23 USC Section 149) was created in 1991 in order to provide innovative funding for transportation projects which improve air quality and help achieve compliance with national air quality standards set forth by the Clean Air Act. Funding authorized through CMAQ is for projects in areas not meeting national air quality standards. The CMAQ program pays for transportation projects or programs which will contribute to attainment of national ambient air quality standards. The program encompasses projects and programs that reduce traffic congestion and help meet federal Clean Air Act requirements.

CMAQ funding may be used for freight and passenger projects that accomplish the program's air quality goals. Federal regulations indicate CMAQ funds may be used for intercity passenger projects located in a nonattainment or maintenance area if they reduce emissions and meet the program's other eligibility criteria. Capital costs, as well as operating expenses (for the first three years), are eligible as long as the project contributes to attainment or maintenance of the air quality standard through reduction in vehicle miles traveled, fuel consumption or through other factors. The regulations include eligibility for corridors where a portion of the corridor is in a non-attainment area. The federal cost share is typically 80 percent, although one hundred percent funding is also available under certain circumstances.

3.1.7 FHWA Surface Transportation Program

The FHWA Surface Transportation Program (STP) (Title 23 USC Section 133, 104(b) (3), 140) provides flexible funding for projects on any Federal-aid highway, bridges on public roads, transit capital investments, and intracity and/or intercity bus terminals and facilities. Eligible freight projects include preservation of abandoned rail corridors, bridge clearance increases to accommodate double-stack intermodal trains, and freight transfer yards.

3.1.8 FHWA Transportation Enhancement Program

Funds are available under the FHWA STP for the Transportation Enhancement Program. The purpose of this program is to fund projects which allow communities to strengthen the local economy, improve the quality of life, enhance the travel experience, and protect the environment. Transportation Enhancement Program funds can be used for rehabilitation and operation of historic transportation buildings, structures, or facilities and preservation of abandoned railway corridors (e.g. conversion of abandoned rail corridors to trails). The federal grant share is generally not less than 80 percent.

3.1.9 High-Speed Rail Crossing Improvement Program

The Federal Railroad Administration High-Speed Rail Crossing Improvement Program, authorized $50 million over the period of SAFETEA-LU, to fund projects which reduce or eliminate hazards at highway-rail grade crossings in designated high-speed corridors.

3.2 Federal Financing and Loan Programs

As aforementioned, there are a number of federal financing and loan programs that high-speed rail corridors may take advantage of in lieu of federal grants. These programs have lower interest than private bonds and do not necessarily require a state or local match.

3.2.1 Rail Rehabilitation and Improvement Financing Program (RRIF)

The Railroad Rehabilitation and Improvement Financing Program (RRIF) provides direct federal loans and loan guarantees to finance development of railroad infrastructure. The program was established by Transportation Equity Act for the 21st Century of 1998 (TEA- 21) and amended by SAFETEA-LU. Under this program, the FRA authorizes direct loans and loan guarantees up to $35 billion. Up to $7 billion is reserved for projects benefiting freight railroads other than Class I carriers.

The funding may be used to acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, track components, bridges, yards, buildings, and shops. In addition, the funding can be used to refinance outstanding debt incurred for the purposes listed above as well as for developing or establishing new intermodal or railroad facilities. While the program has been used largely for freight rail projects, Passenger rail projects are also eligible.

In the case of passenger projects, RRIF funding is only workable where investment grade revenue and operating cost forecasts demonstrate the project has the potential to provide a substantial revenue stream after a significant public investment is typically made in infrastructure and/or equipment. Typically, projects receiving RIFF credit assistance must obtain an investment grade rating from at least one nationally recognized credit rating agency. Direct loans can fund up to 100 percent of a railroad project, with repayment periods of up to 35 years and interest rates equal to the U.S. Treasury rate. Eligible borrowers include railroads, state and local governments, government-sponsored authorities and corporations, joint ventures which include at least one railroad, and limited option freight shippers intending to construct a new rail connection.

The RRIF program provides financing on favorable terms; however, the applicant must identify a viable revenue stream to make payments over the loan period. This program is administered by the FRA, and final award decisions are overseen by the USDOT Credit Council and the White House's Office of Management and Budget (OMB).

3.2.2 US DOT Transportation Infrastructure Finance and Innovation Act (TIFIA)

The USDOT's Transportation Infrastructure Finance and Innovation Act (TIFIA) administered by the FRA, authorizes $10.6 billion in credit assistance on flexible terms in the form of secured loans, loan guarantees, and standby lines of credit. The TIFIA program was created in 1998 by the TEA-21 and amended by SAFETEA-LU.

TIFIA financial assistance is provided directly to public-private sponsors of surface transportation projects of national significance. The TIFIA credit program's fundamental goal is to leverage federal funds by attracting substantial private and other non-federal investment in critical improvements to the nation's surface transportation system. TIFIA can be used for both freight and passenger projects. A wide variety of intermodal and rail infrastructure projects, including passenger rail, are eligible and can include equipment, facilities, track, bridges, yards, buildings and shops.

TIFIA credit assistance provides improved access to capital markets, flexible repayment terms, and potentially more favorable interest rates than in private capital markets for similar instruments. The interest rate for TIFIA loans is the U.S. Treasury rate and the debt must be repaid within 35 years. TIFIA can support up to 33 percent of a project's cost and is restricted to projects costing at least $50 million. TIFIA can help advance qualified, large-scale projects which otherwise might be delayed or deferred because of size, complexity, or uncertainty over the timing of revenues.

Similar to the RRIF program above, TIFIA is not a funding source, but a method of financing projects through assisted borrowing. In the case of passenger projects, RRIF financing is only workable where investment grade revenue and operating cost forecasts show the project has the potential to provide a substantial revenue stream after a significant public investment is typically made in infrastructure and/or equipment. Projects receiving TIFIA credit assistance must obtain an investment grade rating from at least one nationally recognized credit rating agency.

3.2.3 FHWA Grant Anticipation Revenue Vehicle Bond (GARVEE)

Grant Anticipation Revenue Vehicle Bond (GARVEE) bonds can be issued by states under the guidelines in Section 122 of Title 23 of the United States Code. These bonds can be used for transportation projects with no stated limitations on transportation mode. GARVEE bonds may only be used for projects receiving federal funding and the project details must be approved by the FHWA. States repay the funds using anticipated federal funds. While FHWA must approve the project for federal funding, they do not approve the financing method, a state or local government must notify FHWA they will be using GARVEE bonds.

GARVEE bonds are useful when it is desirable to bring a project to construction more quickly than otherwise would be possible. Inflation, increased congestion, and lost economic development benefits associated with delay provide offsets to the additional interest costs of debt financing. Grant Anticipation Bonds are typically intended to meet short-term funding needs, usually less than one year to maturity, but sometimes as long as two to three years.

The PRIIA "Letter of Intent" provisions of the FRA High Speed and Intercity Passenger Rail Program can provide a basis for documenting to investors the availability and commitment of future federal grant funding. These bonds are not guaranteed by the federal government and the States do not guarantee the federal government will provide the expected financing. The State's share of the bond is backed by the State and the State may elect to either carry high interest rates or use other sources of revenue as security on the federal portion of the bonds.

3.2.4 IRS Tax Exempt Private Activity Bonds (PAB)

Private Activity Bonds (PABs) are federally tax-exempt bonds which can be used to finance the activities of private firms. Congress introduced private activity bonding eligibility for transportation projects through the amendment of Section 142 of the Internal Revenue Code. SAFETEA-LU added PAB eligibility for highway and freight transfer facilities (including highway-rail transfer). Mass transit projects and high-speed rail facilities (over 150 mph) were already eligible for PABs, up to a $15 billion limit for transportation-related PABs. As of August 2010, more than $2 billion of PABs have been issued. The program is administered by the USDOT, and according to the Council of Development Finance Agencies, the 2011 budget allows for each state to receive $95 per capita or $277.8 million, whichever is greater.

State and local governmental authorities must issue the bonds and the authorities traditionally serving as conduits for bond issuance include Development Authorities, Downtown Development Authorities, among others. Qualified projects include "any surface transportation project which receives Federal assistance under Title 23, United States Code" (FHWA, 2010). This includes rail facilities and vehicles as long as these projects are also receiving TIFIA credit assistance. The premise of this requirement is that bringing TIFIA and PABs together on surface transportation projects will encourage more private equity investment to transportation.

An application for funding allocation is required on an annual basis, and is subject to the federal cap on PAB's established for each state. Requirements to be included in the application include proposed date of bond issuance, financing/development team information, borrower information, project description, project schedule, financial structure, and a description of Title 23/49 funding received by the project. If a project receives an allocation and the schedule agreed upon in the application is not met, the allocation may be withdrawn.

3.3 State and Local Capital Match Funding

3.3.1 State General Fund Appropriations

The use of a General Fund Appropriation for a high-speed passenger rail project offers the most flexibility in terms of the use of state tax revenues. The downside for a high-speed rail project, like other transportation infrastructure projects, is that the significant amount of funding typically required over multiple years is not easily obtained in a budgetary or political cycle given the many other recurring demands for state appropriations.

In many of the southeastern states, a large portion of the state DOT general funds is acquired through motor fuel taxes. In some cases, these funds may not be used for rail or transit projects and are only obligated towards road and bridge infrastructure. Therefore, only a small percentage of the general fund appropriations are available to be split among all other alternative transportation projects.

3.3.2 State General Obligation and General Revenue Bonds

Most of the states have the ability to issue state bonds for transportation purposes and state bonding has many advantages as a source of state capital funding to match federal grant funds. Bonding allows a state to spread funding for large capital projects with continuing benefits over long time periods (typically up to 20 years). The resulting impact on the state budget is thus relatively small in any one year.

General GO are backed with the legal pledge of all state revenues. On the other hand, state revenue bonds are backed by the pledge of revenues from a specific source such as a dedicated sales tax or in the case of a passenger ground transportation project, ticket revenues. Given the political and underwriting challenges in obtaining a dedicated and marketable revenue source, GO bonds have many advantages over revenue bonds.

3.3.3 Freight Railroad Contributions

Passenger rail projects in shared-use freight rail corridors may have the opportunity to obtain capital funding from the host railroad where the project provides freight benefits. An example might include adding a double track on a congested single-track main line. Here the capacity benefits to the freight railroad may exceed the capacity consumed by the additional passenger service. Another example might be the replacement of jointed rail with more reliable and higher performance continuous welded rail, which can reduce maintenance costs and increase freight rail speeds. The negotiations involved with the freight railroad in such an arrangement can be time consuming and will typically involve the use of sophisticated capacity models and other kinds of operations analysis.

3.3.4 Transportation Equity Funds

Some of these study states may have specialized state grant programs that allows the state to fund alternative transportation programs and opens larger state funding sources. However, most states have not developed such grant programs, with the exception of Tennessee.

In Tennessee, the DOT has developed a fund typically used for aviation, rail, and waterway transportation modes. The revenue is collected by a sales tax on the petroleum used in these modes of transportation. The budget for each mode is based on the amount of revenue collected for that mode.

3.3.5 Local General Fund Appropriations

Local municipalities have the option of using their general funds to help match federal funds or make improvements to transit stations and surrounding developments. This capital must be budgeted ahead of time and approval must be received from the county commissioners and/or councils. The use of local general fund appropriations for stations and similar improvements has the same considerations as state general fund appropriations discussed above.

3.3.6 Local Bonding

Local municipalities may issue bonds for transportation improvement projects such as high-speed and intercity passenger ground transportation. They may use these bonds as the local match for federal funds. The bonds, similar to the state bonds, will be repaid with future revenue or general tax money. The use of local general obligation bond funding for stations and similar improvements has the same considerations as state bonding discussed above.

3.3.7 Value Capture Taxes

Transportation infrastructure such as passenger rail stations can increase the value of adjacent properties. In some cases, this increase can be quite substantial and public entities leading the development of this infrastructure believe it is necessary to capture some of this added value. Multiple tools have been created as a mean to capture some of this added value and are classified as "value capture taxes". This method of obtaining capital to cover costs for transportation infrastructure is more prevalent in Asian and South American countries, but is become more popular in the U.S. It is important to note that value capture tools are limited to local tax jurisdictions and are most appropriate for local improvements such as stations. They are generally not feasible for intercity passenger ground transportation corridor improvements that cross multiple tax jurisdictions. There are five "tools" that are known as value capture taxes- these include Land Tax Increment Financing, Special Assessments, Development Impact Fees, and Air Rights. Each is allowed under the current Georgia and/or Tennessee statutes. A brief description of the methods follows:

3.3.7.1 Land Value Taxes

Land value taxes are a type of property tax where property is assessed based on just its land value rather than applying the same tax rate to land and buildings. Land around a ground transportation corridor and/or station will increase due to the accessibility to the network. Allowing for the taxation of the land rather than buildings creates incentives for development because "the supply of land fixed, taxing it at a higher rate resulting in little economic distortion" (Center for Transportation Studies, University of Minnesota, 2009).

3.3.7.2 Local Tax Incremental Financing (TIF) and Tax Allocation Districts (TAD)

Tax incremental financing is used by local governments in both Georgia and Tennessee to finance improvements and developments that have the potential to increase tax revenues over time. These "incremental" tax revenues are then set aside and used to amortize a local bond issue that can be used to fund the required improvements. The tax incremental financing mechanism is particularly appropriate for passenger ground transportation stations and other "transit friendly" developments which tend to increase surrounding property values.

When a TIF project is created, the district agrees to place increased property tax revenues into an earmarked funds for a period of 25 years. During this time period, the local government receives the same level of funding as it does in the year the district was created. The surplus of tax funds is then "banked" to pay back issued bonds. Once this 25-year period is complete, the banked money is used to pay back the tax-free bonds. The selling of bond provides immediate funding for costly projects without significantly impacting property owner finances. In addition, once the 25-year period has expired, the local government will see a significant increase in their funding levels due to the ever-increasing property tax revenue.

3.3.7.3 Special Assessments - Community Improvement Districts (CID)

Also referred to as business improvement districts, CIDs are defined areas where businesses agree to pay additional taxes or fees to fund improvements within the district. Usually, these funds provide services such as security, capital improvements, and marketing.

The creation of a CID relies upon local businesses to petition for a CID. It must be determined that a majority of businesses are in favor of creating a district. Further, the state legislature must grant each local government the authority to create these districts. If the district is approved and created, all property owners within the district are required to pay the additional taxes and/or fees. However, residents, non-profits, and government agencies are usually exempt from these contributions. The governance of the CID falls on a board created by property owners, businesses, and governments.

It is possible that a CID could be created along this high-speed ground transportation project to help fund passenger transportation stations and promote surrounding developments. Local development authorities around proposed stations may find this as an opportunity to fund a rail station, bring more business to the community, and spur real estate and economic growth.

3.3.7.4 Developer Impact Fees

Developer Impact Fees are charges on new developments by local jurisdictions. These charges are intended to cover additional public service costs that the development, when completed, will impose. The impact fees are typically calculated based on public service costs and may be used for off-site services such as roads, schools, and parks. The local jurisdiction in which the station is located may enact within their ordinances to impose developer impact fees for developments surrounding the stations' location.

3.3.7.5 Air Rights

Some state DOTs are authorized to lease air rights over existing or proposed limited-access highways for development such as commercial enterprises or activities. This could allow air rights to be leased to developers above transportation stations as long as the transportation line and station is within DOT right-of-way. Since stations can result in increases of property values, developers may want to develop land at higher densities around these stations.

3.3.7.6 Joint Development

The establishment of a passenger ground transportation station offers opportunities for additional on-site development beyond just the station facility. Other development opportunities can include restaurants and food service kiosks, vending machines, retail stores, and hotel and housing developments. Where such opportunities exist, developer financing can be a significant source of funding for station improvements in addition to public sources. The developer may also take on all property management responsibilities for the station, which can be a burden for either state or local government officials.

3.3.8 Special Purpose Local Option Sales Tax (SPLOST)

Special Purpose Local Option Sales Tax (SPLOST) is a tax increase that is applicable to the sales of fuels and food/beverages and may be used for a variety of purposes at the municipalities' discretion. On a Metropolitan Planning Organization or local level, a SPLOST can be implemented with voter approval. Typically, these SPLOSTs only last a few years and if funds are needed beyond the expiration date, the SPLOST will have to be put to voter referendum again.

The local authority will be able to decide which projects to fund with the sales tax money including ground transportation stations and other infrastructure projects. In some counties, a project list must be published prior to public referendum.

3.3.9 Specialized Local Funding Programs

3.3.9.1 Georgia Regional TSPLOST

The Georgia State Legislature has proposed a regional Transportation Special Purpose Local Option Sales Tax (TSPLOST) in which the state would be divided among 12 regions (Regional Commission Boundaries) and allows voters to decide on a sales tax increase of 1 percent for 10 years to fund transportation projects. Rather than raising the gas tax, this funding would allow for multimodal transportation projects such as high-speed ground transportation projects. These funds can also be used to match federal funds allowing for state and local funds to be spent on other projects.

The projects that will be selected for funding must be from existing plans and/or studies and must be consistent with the policies of the Statewide Strategic Transportation Plan and the Atlanta Region's PLAN 2040. Allocation for transit is between 10-40 percent for capital and 0-10 percent for operation and maintenance within the Atlanta Region. Outside of the Atlanta region, there is between 0-10 percent allocation for transit capital, operation, and maintenance.

Within the Atlanta region, projects will be given priority if they cross county boundaries and include stops within multiple counties. Outside of Atlanta, priority will be given to projects in the construction or acquisition phases and existing systems will be given priority over new capacity projects.

The issue lies in which regions will pass the TSPLOST during the election of 2012. This will depend heavily upon the project list for each region, which will be finalized in fall 2011.Therefore, this bill may allow for transportation funding in some regions of Georgia but not all. Further, many communities will have to make decisions whether to continue with local SPLOSTS for schools and other public infrastructure.

3.3.9.2 Tennessee: Gasoline Tax for Local Transportation Funding

The State of Tennessee implements the Motor and Diesel Fuel Tax for local transportation project funding. A portion of these funds is transferred to cities and counties throughout the state to be used for local transportation projects. The funds are allocated based on the percentage of population in the latest US Census. Cities and Counties may use their portion of the funds for public transportation service. The funds must be used to maintain the level of service and extend the areas presently served. It may not be used for personnel within the jurisdiction. Therefore, funds could be used to fund ground transportation station improvements or transit feeder systems to a station.

3.3.10 Public Private Partnerships (P3)

Public private partnerships (P3s) are a relatively new venture in transportation projects. Private investors and public entities join together to allow for more private sector participation from both a delivery and financing standpoint. There are many types of P3 structures, which vary in responsibility and risk. Some of the options include Design Build, Design Build Operate, Design Build Finance Operate, Long Term Lease, Lease Development Operate, and Private Contract Fee Services.

The P3s allow for more flexible funding by including the private sector into the project. Equity, bonds, PABs, flexible match, bank loans, Section 129 loans, and Transportation Infrastructure Finance and Innovation Act Credit are some examples of P3 financing techniques.

3.4 Funding Sources and Strategies for Operating Support

3.4.1 State Appropriations

Nationally, the predominate source for providing public sector operating support where revenues do not cover operating costs is the use of annual state appropriations. Most states currently contract with Amtrak to provide service, given that only Amtrak has a federal right of access to provide passenger rail service on existing freight lines. Amtrak then charges each state for any operating costs not covered by operating revenues. The challenge in using the annual state appropriations process to fund high-speed passenger service is that estimates must be made each year in advance of actual expenditure. If there is an unforeseen increase in factor costs such as fuel or labor, it may be difficult to adjust the appropriations level because of the long lead-time required by the state budget and appropriations process. The use of multi-year operating contracts is one mechanism to manage the uncertainty associated with the state budgetary process and potential changes in factor costs.

3.4.2 Congestion Mitigation and Air Quality Funds (CMAQ)

Operating expenses for intercity passenger rail service are eligible for FHWA Congestion Mitigation and Air Quality (CMAQ) funding for three years of operation. These provisions are clarified in the January 16, 2002 Federal Register Notice, “High Speed Rail Projects for the Congestion Mitigation and Air Quality Improvement Program (CMAQ)”. The project must be located in a non-attainment area and must be demonstrate a contribution to the attainment or maintenance of the air quality standard through reduction in vehicle miles traveled, fuel consumption or through other factors. The regulations include eligibility for corridors where a portion of the corridor is in a non-attainment area. The federal cost share is typically 80 percent although 100 percent funding is available under certain circumstances.

3.4.3 FHWA Traffic Mitigation Funding

FHWA Traffic Mitigation project funding is available to federally eligible highway projects to address congestion resulting from construction activities in a given highway corridor under the Work Zone Safety and Mobility Rule (23 CFR 630 Subpart J). Where cost-effective as documented in a project Transportation Management Plan (TMP), new or enhanced intercity passenger rail service can be considered as a traffic congestion mitigation measure.

Federal highway funding can be used to subsidize all or part of the passenger rail operating costs during the life of the construction project. This funding option is most applicable to major multi-year highway improvement projects on high-volume interstate highways where passenger rail service operates in parallel to the highway corridor. The federal cost share can be either 80 or 90 percent with the higher figure dependent on whether the project is associated with mitigating congestion on an interstate highway.

3.4.4 Revenue Maximizing Strategies

While not a direct funding source, a revenue maximization strategy should be a key element of any state approach to minimizing state operating subsidies for intercity passenger rail service. This strategy begins in the service development planning process and continues through start-up and on-going operation. Elements for consideration in a revenue maximization strategy include service levels, intermodal connectivity, feeder bus networks, aggressive ticket pricing, traveler amenities, and advertising and marketing campaigns.

Setting an appropriate level of service to maximize revenues involves increasing frequencies, speeds and other service features to the point that marginal ridership and resulting revenues equal marginal operating costs. Generally, this means adding infrastructure and equipment improvements to increase frequencies and decrease travel times until these components are substantially less than auto travel times in the same corridor. An integrated feeder bus network scheduled to meet arriving and departing trains is another low cost, low risk method to increase ridership. Other approaches to encourage intermodal connectivity for local transit, bike/pedestrian, intercity bus, and air are also important.

States generally have flexibility in their ticket pricing strategy and often underprice state-supported passenger rail services. Airline type “revenue yield maximization” strategies including time of day, day of week and seasonal pricing can also be considered. State sponsored passenger rail service is ultimately a business, and revenue maximization pricing is preferred over ridership maximization to insure its long-term financial viability.

Travelers are also attracted by the provision of on-board amenities, such as wide seats and ample foot room, food service, on-board video and audio programming. Wi-Fi access and 110-volt plug-in access for laptops, cell phones and other productivity enhancement devices used by travelers are other amenities to be considered. Passenger rail travel is a new experience for many potential travelers and an aggressive advertising and on-going marketing program is an important and cost-effective vehicle to maximize ridership.

3.4.5 Operating Cost Control Strategies

An operating cost control strategy should be a key element of a state's approach to minimizing state operating subsidies. An operating cost control strategy also begins in the service development planning process and continues through start-up and on-going operation. Elements for consideration in an operating cost control strategy include competitive bidding for the state operating franchise, careful negotiations with Amtrak or other operators, maintenance of operating equipment by the manufacturer or other outside vendor outsourcing of food service, cleaning services, station operations, and other activities.

Negotiations with Amtrak or other operators in developing an operating contract can also be used to control specific cost items. For example, some states have taken on the responsibility for reservations and information call centers to reduce contract costs. Other states have eliminated reserved service cut Amtrak contract costs.

Limited food service can be offered by vending machines at low cost and the use of carts for point of sale food service can be cheaper than operating a dining or bistro car. During periods of upward (or downward) uncertainty in fuel costs, Amtrak or other providers may agree to put these costs outside of an operating agreement. States may find this advantageous to accepting a high-end contract cost if they have the flexibility to budget for a range of fuel costs outside of a fixed cost contract.

Finally, states can consider contracting out for a variety of services which might be provided by the state more cheaply than through the operator. These services can include delivery of operating equipment maintenance services by the equipment manufacturer, as well as contracting out food service, cleaning services, and other activities.

Limited food service can be offered by vending machines at low cost and the use of carts for point of sale food service can be cheaper than operating a dining or bistro car. During periods of upward (or downward) uncertainty in fuel costs, Amtrak or other providers may agree to put these costs outside of an operating agreement.

States may find this advantageous to accepting a high-end contract cost if they have the flexibility to budget for a range of fuel costs outside of a fixed cost contract.

Finally, states can consider contracting out for a variety of services which might be provided by the state more cheaply than through the operator. These services can include delivery of operating equipment maintenance services by the equipment manufacturer, as well as contracting out food service, cleaning services, and other activities.

3.5 PRIVATE SECTOR ALTERNATIVES

3.5.1 JOINT DEVELOPMENT

The establishment of a passenger rail station offers opportunities for additional on-site development beyond just the station facility. Development opportunities can include restaurants and food service kiosks, vending machines, car rental, retail stores, and hotel and housing developments.

Where such opportunities exist, developer financing can be a significant source of funding for station improvements in addition to public sources. The developer may also take on all property management responsibilities for the station, which can be a burden for either state or local government officials.

3.5.2 PUBLIC PRIVATE PARTNERSHIPS

Long-term commercial contracts between governments and private companies to design, build, finance, and/or manage infrastructure projects, often labeled "public-private partnerships or P3" offer the potential to improve project quality and cost-effectiveness. However, the success of these contracts from the public's perspective depends upon government's capacity to capture these potential benefits. While some long-term infrastructure contracts have met their performance and cost-saving objectives, the failure of other high-visibility infrastructure contracts demonstrates that the long-term viability of these complex arrangements is far from guaranteed. [58]There are many types of P3 structures, which vary in responsibility and risk. Some of the options include: Design Build, Design Build Operate, Design Build Finance Operate, Long Term Lease, Lease Development Operate, and Private Contract Fee Services.

[58] See Pamela Bloomfield and F. Daniel Ahern, Jr., "Long-term Infrastructure Partnerships…" State and Local Government Review, Volume 43, No. 1, 2011, pages 49-59.

The P3s allow for more flexible funding by including the private sector into the project. Equity, bonds, private activity bonds (PABs), flexible match, bank loans, Section 129 loans, and TIFIA Credit are some examples of P3 financing techniques.

Offering a private sector operator a "franchise" to operate a service, is a public-private partnership opportunity which has advantages to a state governments interested in providing high speed rail service. Here the private operator takes on "revenue risk" that otherwise would be assumed by the public sector. State governments have extensive experience in funding and managing major transportation infrastructure projects and understand the risks involved. They do not generally have experience and expertise in railroad operations and business management.

Under a franchise agreement, the private operator takes on the future revenue risk associated with operating the service in return for the opportunity to capture future profits. The potential for a franchise agreement exists where forecast revenues exceed forecast operating costs i.e. where the operating ratio is greater than 1.0. The use of a competitive bidding process has the likelihood of further reducing costs to the state. Under this approach, the state award of a passenger rail service franchise would go to the proposal which has the greatest operating surplus or the least public funding contribution. For example, in circumstances where the operating ratio is substantially greater than 1.0, the franchisee may be willing use the revenue surplus to finance a portion of the capital investment required to implement the service. It should be recognized that based on national and international experience, the majority of the initial capital funding required for infrastructure and equipment will have to be provided by public sources.

The franchise approach will work best in situations where the state is pursuing high speed rail service on a dedicated use corridor that will be owned and fully controlled by the public sector. For shared-use operations on existing freight corridors, Amtrak has distinct advantages which make competition from other operators difficult. The National Rail Passenger Service Act of 1971, as amended by PRIIA, gives Amtrak the exclusive right of access to privately owned freight railroads. Under this federal statute, Amtrak can use existing available capacity on any privately owned freight corridor without cost. Beyond that, Amtrak is only obligated to pay incremental operating costs for use of host railroad track infrastructure.

3.6 FUNDING SUMMARY

There are two precepts to a general state funding strategy for high speed rail service: 1) maximize the use of non-state capital funding sources and 2) minimize revenue risk.

On the capital side, no single source of federal, local or private sector funding will likely be adequate for the major capital investment required for a state to initiate a new high speed rail service. A nimble solution that mixes and matches a broad array of grants and funding sources is essential. As with the development of the interstate highway system, significant federal funding will be essential for states to fully implement high speed rail service. The Passenger Rail Investment and Improvement Act is significant in that it offers an 80/20 federal/state funding partnership like that used to successfully implement the interstate highway program. However, capital funding from this program will likely have to be supplemented from one or more of the other sources listed above to minimize state contributions.

On the operating side, public sector revenue risk can be minimized by private sector franchising along with the use of other innovative federal and private sector sources of operating funds as discussed above.

Regardless, financial planning at the state level is complicated by a global economic recession that has challenged policy makers. A threshold decision must be made regarding the role of government investment in transportation infrastructure as a tool to stimulate economic activity. Debate over this question is seen most clearly at the federal level. In spite of well documented transportation improvement needs, the multi-year authorization of the Federal Surface Transportation Program continues to be stalled. Several re-authorization proposals include a significant consolidation of existing federal transportation programs into a limited number of modal programs, while offering additional flexibility to states to set funding priorities. Debate continues regarding ultimate funding levels for the federal transportation program.

HNTB

Georgia Department of Transportation