Appendix A

Benefit-Cost (BCA) Methodology and Assumptions

The benefit-cost analysis outlined in this report compared the total project cost for planned multimodal transportation improvements to the aggregate value of the following quantified project benefits:

- Passenger vehicle mobile-source emissions savings
- Heavy truck mobile-source emissions savings
- Passenger vehicle social cost of carbon savings
- Heavy truck social cost of carbon savings
- Time savings for operators of motor vehicles

Benefits were projected over the 20-year long-range transportation planning period from 2018-2038. All future benefits except the social cost of carbon were discounted at the annual rate of seven percent (7%) as prescribed by the U.S. Department of Transportation (DOT) guidance. For benefits related to the social cost of carbon, the three percent per annum discount rate prescribed by the Environmental Protection Agency was used.

Benefits were derived by comparing the costs associated with the build and no-build alternatives and calculating the difference for each year from 2018 to 2038 inclusive. Costs for each alternative were based on data provided by representative from Lawrence County. The designated study area encompassed all streets and highways within Lawrence, Marion, and Walthall Counties. Output data analyzed included vehicle miles of travel (VMT), vehicle hours of travel (VHT), and vehicle hours of delay (VHD). Data were derived for both heavy trucks and passenger vehicles in order to apply distinct emission rates appropriate to each category.

Project Cost

The total estimated cost for construction of the proposed project is $24.76 million. The estimated annual cost for maintenance of the roadway is approximately $50,928.58 (see Table 3). The undiscounted aggregate cost for roadway construction and maintenance over the 20-year life of the project, from 2018 through 2038, totals an estimated $1,018,571.

Results of the Analysis for the Existing Network (No-Build Alternative)

Roadway Operating Data for the Existing Network (No-Build Alternative)

Traffic data from Jefferson Davis, Lawrence, Marion, and Walthall Counties were used to generate daily traffic assignments for the existing street and highway network in the years 2018, 2028, and 2038. Data for the intervening years were interpolated by deriving and applying annual growth factors. Aggregate operating data for streets and highways within the four abovementioned counties were extracted (see Table 1). Three routes were analyzed for potential corridors from Monticello -Columbia, Columbia-Jayess, and Prentiss-Tylertown. It was assumed that 33.3% of daily traffic volumes would travel the Monticello-Columbia route, 33.3% of daily traffic volumes travel the Columbia-Jayess route, and 33.4% of daily traffic volumes travel the Pretiss-Tylertown route.

Daily vehicle miles of travel (VMT) on the existing network were projected to increase from more than 122,000 in 2018 to 144,500 in 2028 and to 168,600 in 2038. The corresponding annual totals are approximated at 44.53 million miles in 2018, to 57.74 in 2028, and 61.54 million miles in 2038. Daily vehicle hours of travel (VHT) were

projected to increase from 2,722 in 2018 to 3,267 in 2028 and to 3,812 in 2038. The corresponding annual totals for vehicle hours ranged from 993,530 in 2018 to 1.19 million in 2028 and to 1.39 million in 2038.

Vehicle hours of delay (VHD) represents the difference in time required for travel under actual (i.e., congested) conditions compared to ideal (i.e., free-flow) conditions. Projected daily VHD on the existing network increased from 437 hours in 2018 to 525 hours in 2028 and to 612 in 2038. Annual totals increased from 159,505 hours in 2018 to 191,625 hours in 2028 and to 223,380 hours in 2038.

Data from 2016 County representatives as well as the 2028 and 2038 interpolations were used to derive passenger-vehicle and heavy-truck VMT for the existing street and highway network in the four counties over the 20-year life of the project (see Tables 5 & 6). This made it possible to apply rates appropriate to each vehicle type for the estimation of vehicle emissions.

Passenger-Vehicle Emissions for the Existing Network (No-Build Alternative)

Annual passenger-vehicle emissions for four criteria pollutants regulated by the Environmental Protection Agency (EPA), in conformance with the National Ambient Air Quality Standards (NAAQS), were estimated using the South Coast Air Quality Management District EMFAC2007 factors for heavy-duty trucks and for passenger vehicles and delivery trucks.

Aggregated annual emissions for the period from 2019 through 2038 were estimated (see Table 13) for oxides of nitrogen (NOX – 0.3750 metric tons), particulate matter (PM10 – 0.1278 metric tons and PM2.5 – 0.0846 metric tons) and sulfur dioxide (SOX – 0.0142 metric tons). Aggregated annual costs associated with emissions over the 20-year period analyzed were $3,004.89 for NOX, $46,842.49 for PM10, $31,14.59 for PM2.5, and $672.02 for SOX.

Truck Emissions for the Existing Network (No-Build Alternative)

Aggregated annual emissions were also estimated for truck traffic on the existing street and highway network from 2019 through 2038 (see Table 14). Totals were derived for oxides of nitrogen (NOX – 10.6025 metric tons), particulate matter (PM10 – 0.5486 metric tons and PM2.5 – 0.4089 metric tons) and sulfur dioxide (SOX – 0.0452 metric tons). Aggregated annual costs associated with emissions over the 20-year period analyzed were $84,968.11 for NOX, $201,157.74 for PM10, $149,930.09 for PM2.5, and $2,139.31 for SOX.

Carbon Output by Passenger Vehicles and Trucks on the Existing Network

Carbon dioxide (CO_2) emissions were projected for both passenger vehicles and trucks operating on the existing network during the period from 2019 through 2038. Annual total output for passenger vehicles amounted to 1,465.69 metric tons with a calculated social cost of $34.615 million based on pre-discounted EPA yearly values (see Table 9). The corresponding totals for $C0_2$ generated by trucks were 5,370.81 metric tons and $128.094 million (see Table 9).

Results of the Analysis for the Improved Network (Build Alternative)

The methodological approach described above with regard to the existing (no-build) network alternative was applied in parallel fashion to the improved (build) network alternative, assuming implementation of roadway improvements associated with the proposed project (see tables 5-15). The resulting emissions and social cost of

carbon data were compared to those for the existing network in order to assess the long-term benefits of the project.

Roadway Operating Data for the Improved Network (Build Alternative)

Traffic data from Jefferson Davis, Lawrence, Marion, and Walthall Counties were used to generate daily traffic assignments for the existing street and highway network in the years 2019, 2028, and 2038. Data for the intervening years were interpolated by deriving and applying annual growth factors. Aggregate operating data for streets and highways within the four abovementioned counties were extracted (see Table 1).

Daily vehicle miles of travel (VMT) on the improved network were projected to increase from more than 29,000 in 2019 to 34,500 in 2028 and to 40,000 in 2038. The corresponding annual totals are approximated at 10.6 million miles in 2019, to 12.6 in 2028, and 14.6 in 2038. Daily vehicle hours of travel (VHT) were projected to increase from 549 in 2019 to 647 in 2028 and to 754 in 2038. The corresponding annual totals for vehicle hours ranged from 200,385 in 2019 to 236,155 in 2028 and to 275,210 in 2038.

Time-Savings (Reduced Vehicle Hours of Delay)

In addition to the benefits associated with reduced emissions and carbon output, the project would result in a significant reduction in VHD, producing substantial time-savings (see Tables 7 & 8). The analysis indicated that travel time along the Forward Mississippi corridor would be lessened by 3.3 million hours over 20 years, assuming the proposed project is constructed. The estimated (undiscounted) value of time saved amounted to $355.4 million.

Passenger-Vehicle Emissions for the Improved Network (Build Alternative)

Annual passenger-vehicle emissions for four criteria pollutants regulated by the Environmental Protection Agency (EPA), in conformance with the National Ambient Air Quality Standards (NAAQS), were estimated using the South Coast Air Quality Management District EMFAC2007 factors for heavy-duty trucks and for passenger vehicles and delivery trucks.

Aggregated annual emissions for the period from 2019 through 2038 were estimated (see Table 13) for oxides of nitrogen (NOX – 0.0896 metric tons), particulate matter (PM10 – 0.0305 metric tons and PM2.5 – 0.0202 metric tons) and sulfur dioxide (SOX – 0.0034 metric tons). Aggregated annual costs associated with emissions over the 20-year period analyzed were $718.26 for NOX, $11,196.83 for PM10, $7,413.36 for PM2.5, and $160.63 for SOX.

Truck Emissions for the Improved Network (Build Alternative)

Aggregated annual emissions were also estimated for truck traffic on the existing street and highway network from 2019 through 2038 (see Table 14). Totals were derived for oxides of nitrogen (NOX – 2.5343 metric tons), particulate matter (PM10 – 0.1311 metric tons and PM2.5 – 0.0977 metric tons) and sulfur dioxide (SOX – 0.0108 metric tons). Aggregated annual costs associated with emissions over the 20-year period analyzed were approximately $20,31.06 for NOX, $48,083.04 for PM10, $35,838.02 for PM2.5, and $511.36 for SOX.

Carbon Output by Passenger Vehicles and Trucks on the Improved Network

Carbon dioxide (CO_2) emissions were projected for both passenger vehicles and trucks operating on the existing network during the period from 2019 through 2038. Annual total output for passenger vehicles amounted to

350.35 metric tons with a calculated social cost of $22,670 based on pre-discounted EPA yearly values (see Table 9). The corresponding totals for $C0_2$ generated by trucks were 1,143.44 metric tons and $73,975 (see Table 9).

Analysis Results

The results of the analysis are presented in Table 16. Costs and benefits were discounted at a rate of seven percent per annum except for the social cost of carbon. The EPA pre-discounted (at three percent per annum) yearly values were used for carbon dioxide. The following is a brief summary of the savings projected for each cost category:

Passenger Vehicle Emissions – Improved operating conditions resulting from the proposed Forward Mississippi Project would reduce the undiscounted estimated value of mobile-source pollutants emitted by passenger vehicles by more than $22 million over the 20-year period examined.

Heavy-Truck Emissions – Emissions savings related to heavy-truck traffic would total approximately $121.7 million.

Passenger-Vehicle Carbon Savings – The value of carbon output savings related to passenger-vehicle travel would amount to roughly $34.6 million between 2019 and 2038, assuming implementation of the project.

Heavy-Truck Carbon Savings – The carbon savings associated with heavy-truck operations would exceed $128 million over the period considered.

Time-Savings - The value of time saved over the life of the project would be substantial, totaling $355.4 million.

Benefit-Cost Ratio - The resulting ratio of total benefit ($474.32 million) to project cost ($24.76 million) is 18.97.