SH-99 Eastbound Frontage Road Improvements

(HGAC Project ID #1309)

Benefit-Cost Analysis

Montgomery County

August 2024

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1.0 Executive Summary

The proposed eastbound off ramps along SH99 at Rayford Road and Birnham Woods Drive controls traffic flow and access management in the project area. Adding the additional frontage road lane and adjusting the off-ramps will alleviate current bottleneck merge conditions, by reducing conflict points and easing regional goods movement.

SH 99 EBFR improvements will extend beyond the frontage road, adding pedestrian intersection safety elements (crosswalks, ramps, island relief stations, and pedestrian signals) as well as traffic lane improvements.

Figure 1: SH-99 EBFR Project Map

Project Title:	SH99 EBFR Improvements
County:	Montgomery
Facility Type:	Non-Freeway & Freeway
Federal Functional Class:	Major Collector
Street Name:	SH99 Frontage Rd
Limits (From):	Rayford Rd
Limits (To):	N. of Benders Landing Blvd
Length (in Miles):	0.91
Application ID Number:	1309

Table 1: Project Information

The SH99 EBFR corridor expects substantial population and household growth along the corridor, which will create new jobs, new activity centers, and more traffic.

The greatest benefit of the project would be eliminating bottlenecks and conflict points. Adding an additional FR lane and improving the exit ramps will positively impact the existing and future driving conditions, while reducing the risk of accidents on SH99 EBFR and SH99 ML, allowing traffic to flow more freely, decreasing daily interruptions, increasing safety, and increasing the overall speed of traffic.

2.0 Purpose

This benefit-cost analysis (BCA) quantifies the net benefits and cost of building and maintaining SH99 EBFR in Montgomery County. The BCA illustrates that the benefits of improving the alignment and resurfacing justifies the costs.

This BCA analysis details the benefits and costs identified, benefit methodologies, project costs, and the overall benefit-cost ratio for the proposed project. Furthermore, this BCA outlines additional quantitative benefits of the project that have not been assigned a monetary value.

2.1 Methodology

Montgomery County has elected to use HGAC's BCA methodology and spreadsheets to calculate the safety and mobility benefits of the proposed improvements. The HGAC methodology utilized the crash, emissions, and delay benefits template spreadsheets to calculate the project benefits. The spreadsheets contain all standardized assumptions to determine present value benefits.

- Roadway - Crash Benefits
- Roadway - Emissions Benefits
- Roadway - Transit Delay Benefits
- Active Transportation - Emissions Benefits

**All the template calculators used to find the benefit results are in the link below.*
Transportation Project Selection Process | Houston-Galveston Area Council (H-GAC)

2.2 2045 RTP Goals

The proposed improvements to SH99 EBFR meet the goals of the 2045 RTP:

1. Improve Safety: Widening FR from two to three lanes and re-aligning ramps is anticipated to reduce crashes by 28% over the service life of 20 years. Additional safety benefits include adding dedicated right turn lanes for safer vehicle turn movements and reduction of collisions/conflicts. Our proposed improvements go beyond just improving the horizontal alignment, and include the following:

- Improve Horizontal Alignment (55% Crash Reduction Factor)
- Improve Vertical Alignments (50% Crash Reduction Factor)
- Improve Traffic Signal(s) (24% Crash Reduction Factor)

- Install Warning/Guide Signs (20% Crash Reduction Factor)
- Install Chevrons (25% Crash Reduction Factor)
- Safety Treat Fixed Objects (50% Crash Reduction Factor)
- Install Sidewalks/SUP (65% Crash Reduction Factor)
- Add Right Turn Lane (25% Crash Reduction Factor)
- Add Through Lane (28% Crash Reduction Factor)
- Construct Interchange (65% Crash Reduction Factor)

2. Achieve and Maintain a State of Good Repair: The proposed project would add new FR travel lanes, rehabilitate existing frontage road lanes and reconstruct the EB SH99 ramps, requiring minimal maintenance for at least 20 years after completion.

3. Move People and Goods Efficiently: As a proposed multimodal facility, SH99 EB ML and EB FR would be able to efficiently move vehicles, goods, and pedestrians/cyclists in a safe manner. The additional capacity will also improve mobility by reducing travel time delays and improving incident response time.

4. Strengthen Regional Economic Competitiveness: The widening of SH99 EBFR will provide congestion relief for automobile users. The proposed widening of SH99 EBFR is needed to support future residential development. Within this TAZ, population is expected to increase by nearly 34%, from 2018 to 2045, and jobs are expected to increase by 126%. Within a quarter mile of the SH99 EBFR project limits, there are currently 11,983 housing units; 2045 projections estimate 16,529 housing units which is a 38% increase from existing. Non-residential building square footage is expected to increase by 7.2% in 2045 and lane use dedicated to residential is expected to increase by 160%.

Households:

2018: 11,983

2045: 16,529

Population:

2018: 37,170

2045: 49,773

Jobs:

2018: 2,738

2045: 6,198

3.0 Benefits

We have selected the following safety improvements as they are the most critical and beneficial to SH99 EBFR.

Roadway - Crash Benefits

After inputting our traffic volumes from 2022 and projected values for 2027, we were able to see how the Safety Benefits were being calculated. Using the HGAC Methodology, the following results have been outputted from the Roadway - Crash Template.

Year Open to Traffic?	2027
Safety Improvement Type 1	Improve Horizontal Alignment
Work Type Code	506
Preventable Crash Type	Non-Intersection related (Roadway Related)
Appropriate Crash Reduction Factor (%):	55%
Service Life (years):	10
Safety Improvement Type 2	Resurfacing
Work Type Code	303
Preventable Crash Type	Non-Intersection related (Roadway Related)
Appropriate Crash Reduction Factor (%):	30%
Service Life (years):	10
Safety Improvement Type 3	Improve Traffic Signals
Work Type Code	108
Preventable Crash Type	Intersection Related
Appropriate Crash Reduction Factor (%):	24%
Service Life (years):	10
Bike/Ped Improvement Type	Install Pedestrian Signal
Work Type Code	110
Preventable Crash Type	Pedestrian, Cyclist
Appropriate Crash Reduction Factor (%):	34%
Service Life (years):	10

Table 2: Proposed Improvements (Crash Benefits)

2022 Traffic Volume	8,536
Estimated traffic volume in year Open to Traffic	9,905
2022 Potential Daily Walk/Bike Commuters	80
Potential Daily Walk/Bike Commuters in Year Open to Traffic	91

Table 3: Daily Travel Demand (Crash Benefits)

Discounted Safety Benefits @ 7% ($)	**$19,165,000**

Table 4: Crash Benefit Results

Roadway - Emissions Benefits

Inputting our type of improvements and average speeds of before and after, we can see the output NOx and VOC Benefits. Using the HGAC Methodology, the following results were calculated from the Roadway - Emissions Template.

Year Open to Traffic?	2027
Type of Improvement	Roadway improvements (Added Capacity, Grade Separations) including HOV
Type of Facility	Non-Freeway
Total Length of Corridors Affected by Project (miles)	0.9
Average Roadway Speed Before Improvement (mph)	38
Average Roadway Speed After Improvement (mph)	43
Service Life of Project (from MoSERS)	20

Table 5: Proposed Improvements (Roadway Emissions Benefits)

2022 Average Daily Traffic Volume of Corridors Affected by project	8,536

Table 6: Daily Travel Demand (Roadway Emissions Benefits)

Discounted NOx Benefits @ 7% ($)	**$289**
Discounted VOC Benefits @ 7% ($)	**$140,680**

Table 7: Benefit Results (Roadway Emissions Benefits)

Discounted Emissions Benefits @ 7% ($)	**$140,969**

Table 8: Total Emissions Benefit Results (Roadway Emissions Benefits)

NOx Emission Reductions (tons)	**0.02**
VOC Emission Reductions (tons)	**0.20**

Table 9: Total Emissions Reductions (Roadway Emissions Benefits)

Roadway - Transit Delay Benefits

After incorporating the Interim calculations, inputting our improvements, speeds, and traffic volumes we were given our calculated benefits. Using the HGAC Methodology, the following results have been given to us from the Roadway - Transit Delay Template.

Year Open to Traffic?	2027
Type of Improvement 1	Adding New Lanes or Roads
Estimated Delay Reductions (in %)	30%
Service Life (years):	20

Table 10: Proposed Improvements (Transit Delay Benefits)

Type of Improvement 2	Bottleneck Removal
Estimated Delay Reductions (in %)	25%
Service Life (years):	20
Type of Improvement 3	Access Management
Estimated Delay Reductions (in %)	20%
Service Life (years):	20

Table 10: Proposed Improvements (Transit Delay Benefits) (Continued)

Interim Calculations	Per Veh In hours	Per Veh In minutes
Estimated Free Flow Travel Time	0.024	1.43
Estimated Average Peak Period Travel Time without project	0.034	2.04
Estimate Average Delay without project	0.010	0.61
Estimated Delay with project 1	0.007	0.43
Estimated Average Peak Travel Time with project 1	0.031	1.86
Estimated Delay with project 1 & 2	0.005	0.32
Estimated Average Peak Travel Time with project 2	0.029	1.75
Estimated Delay with projects 1, 2 & 3	0.004	0.26
Estimated Average Peak Travel Time with projects 1, 2 & 3	0.028	1.68

Table 11: Interim Calculations for the Delay Reductions

VHT Improvements	*Without Project*	*With Project*
Peak period VHT In year open to traffic in hours	191	158

Table 12: VHT Improvements

2022 Traffic Volume (AADT)	8,536
2022 Peak Period Traffic Volume	5,090
Peak Period Traffic Volume in Year Open to Traffic	5,621
Estimated Free Flow Speed before improvement (mph)	38
Average Peak Period Corridor Speed before improvement (mph)	27

Table 13: Daily Travel Demand (Transit Delay Benefits)

Discounted Delay Benefits @ 7% ($)	**$10,530,000**

Table 14: Benefit Results (Transit Delay Benefits)

Active Transportation - Emissions Benefits

After finding our daily VMT reductions from the HGAC Activity-Connectivity Explorer (ACE), we saw our NOx and VOC benefits and reductions. Using the HGAC Methodology, the following results have been calculated from the Active Transportation - Emissions Benefits Template.

Year Open to Traffic?	2027
Type of Improvement Project	ADA Ramps
Length	0.91
Applicable Project Service Life (years)	10

Table 15: Proposed Improvements (Transportation Emissions Benefits)

Total Daily VMT Reductions (H-GAC ACE)	108.72
Estimated Total Walking/Bicycling Commuter Daily VMT Reduction with potential mode shift in Year Open to Traffic	119

Table 16: Daily VMT Reductions

Discounted NOx Benefits @ 7% ($)	**$244**
Discounted VOC Benefits @ 7% ($)	**$11,817**

Table 17: Benefit Results (Transportation Emissions Benefits)

Discounted Emissions Benefits @ 7% ($)	**$12,061**

Table 18: Total Emissions Benefit Results (Transportation Emissions Benefits)

NOx Emission Reductions (tons)	**0.01**
VOC Emission Reductions (tons)	**0.01**

Table 19: Total Emissions Reductions (Transportation Emissions Benefits)

4.0 BCA Results

After using the Roadway – Crash, Roadway – Emissions, Roadway – Transit Delay, and Active Transportation – Emissions template sheets, we were able to sum up all sheets to get a final benefits summary. Our final value including each of the 4 sheets totaled out to be $29,848,030.

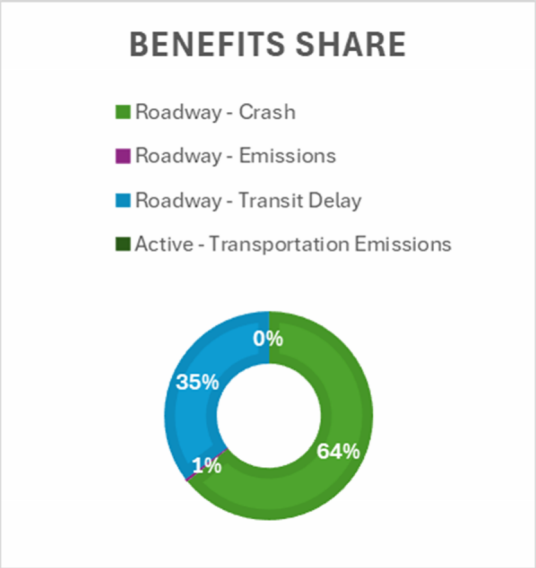

Figure 2: Benefits Share

Roadway - Crash	Roadway - Emissions	Roadway - Transit Delay	Active - Transportation Emissions	SUM
$19,165,000	$140,969	$10,530,000	$12,061	**$29,848,030**

Table 20: Total Discounted Benefits

Benefit-Cost Ratio Analysis

Using the benefits we have calculated from HGAC's Benefit templates, we calculated a Benefit-Cost Ratio where our cost considers all construction, design, and labor encompassed over the duration of the project. Anything over a 1.0 ratio means the 20-year life-cycle benefits of a project exceed the estimated project-related costs over the same period.

This cost was provided to us by Montgomery County. Benefits and Costs in real dollars are shown in the table below. The benefit-cost ratio is 9.95 in 2022 real dollars.

Scenario	$2022 Real Dollars
Benefits	$29,848,030
Construction Costs (Scoping estimate provided by Montgomery County)	$3,000,000
BCA Ratio	9.95
Net Present Value	$26,848,030

Table 21: BCR Analysis