

# **I-45 Ramp Improvement**

(HGAC Project ID #1307)

## **Benefit-Cost Analysis**



Montgomery County

August 2024

## Table of Contents

- 1.0 Executive Summary
- 2.0 Purpose
  - 2.1 Methodology
  - 2.2 HGAC RTP Goals
- 3.0 Benefits
- 4.0 BCA Results

## Figures

- Figure 1: Project Map
- Figure 2: Benefits Share

## Tables

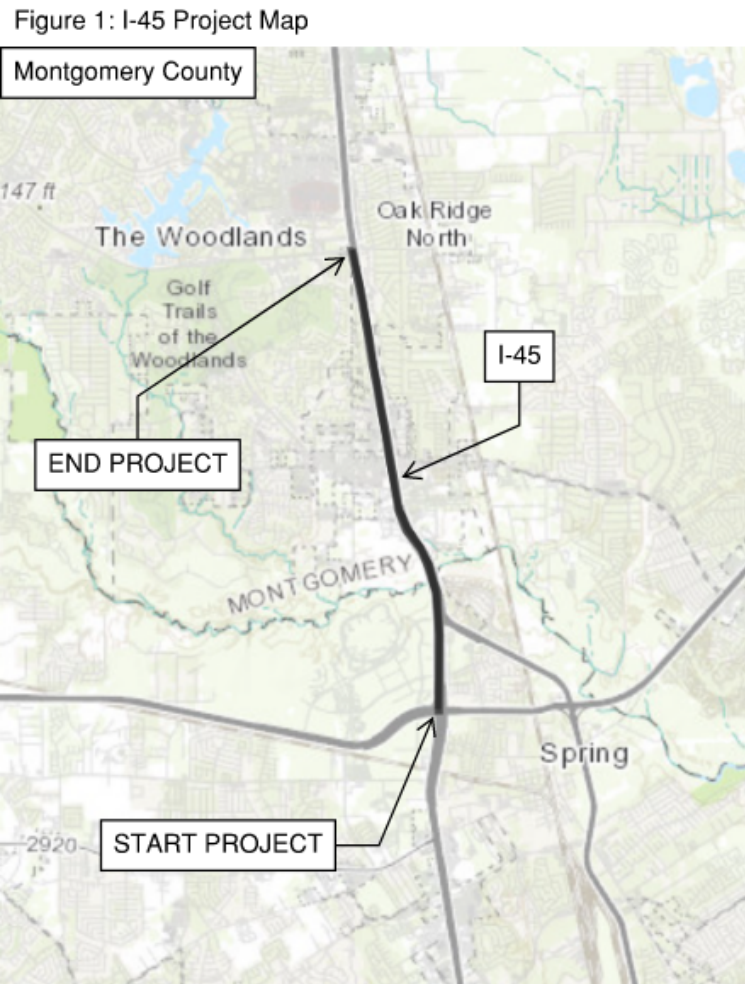
- Table 1: Project Information
- Table 2: Proposed Improvements (Crash Benefits)
- Table 3: Daily Travel Demand (Crash Benefits)
- Table 4: Crash Benefit Results
- Table 5: Proposed Improvements (Roadway Emissions Benefits)
- Table 6: Daily Travel Demand (Roadway Emissions Benefits)
- Table 7: Benefit Results (Roadway Emissions Benefits)
- Table 8: Total Emissions Benefit Results (Roadway Emissions Benefits)
- Table 9: Total Emissions Reductions (Roadway Emissions Benefits)
- Table 10: Proposed Improvements (Transit Delay Benefits)
- Table 11: Interim Calculations for the Delay Reductions
- Table 12: VHT Improvements
- Table 13: Daily Travel Demand (Transit Delay Benefits)
- Table 14: Benefit Results (Transit Delay Benefits)
- Table 15: Proposed Improvements (Transportation Emissions Benefits)
- Table 16: Daily VMT Reductions
- Table 17: Benefit Results (Transportation Emissions Benefits)
- Table 18: Total Emissions Benefit Results (Transportation Emissions Benefits)
- Table 19: Total Emissions Reductions (Transportation Emissions Benefits)
- Table 20: Total Discounted Benefits
- Table 21: BCR Analysis

## 1.0 Executive Summary

IH 45, between Woodlands Parkway and SH 99, is an 8-10-lane roadway, classified as an interstate highway. A confluence of 3 major facilities (I45/Hardy Toll/SH 99), this facility serves as a major north/south connection between Houston and the Woodlands/Conroe. The proposed improvements will help eliminate merging conflict points. There has been a substantial increase in traffic and congestion due to the residential and commercial developments situated along I45, SH 99, Rayford Road and Woodlands Parkway. Due to the development and growth adjacent to project limits and those north and south, and increasing speeds and traffic demand, the existing layout has caused the existing layout to become outdated, congested and in need of a facelift.

Just within our project boundaries ¼ mile buffer, there is an estimated additional 670 homes planned as part of future development. An estimated 18,000 more jobs will be created along the corridor.

Per the 5 years crash data (2018-22), we found that the crash rates along the project corridor are significantly higher than the statewide average. The project's planned improvements will ease bottlenecks, create safer merger/diverge options, increase lighting and signage, all while extending corridor service life.



Project Title:	IH 45 Ramp Improvements
County:	Montgomery
Facility Type:	Freeway
Federal Functional Class:	Principal Arterial or Higher Functional Class
Street Name:	IH 45
Limits (From):	SH 99
Limits (To):	Woodlands Parkway
Length (in Miles):	3.52
Application ID Number:	1307

*Table 1: Project Information*

The I-45 corridor expects substantial population and household growth along the corridor, which in turn will create new jobs, activity centers, and more traffic congestion.

The greatest benefit of the project would be the widening of the bridge and re-imagining the confluence of 3 major highways. This will improve the current congestion and delays on I-45, allowing traffic to flow more freely, decrease daily interruptions, increase safety, and increase the overall speed of traffic.

## **2.0 Purpose**

This benefit-cost analysis (BCA) quantifies the net benefits and cost of building and maintaining I-45 in Montgomery County. The BCA illustrates that the benefits of widening the bridge and improving the horizontal alignment of the ramps justify 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 I-45 meet the five goals of the 2045 RTP:

1. **Improve Safety:** The I-45 improvements will adjust traffic on the main lanes, toll lanes and frontage roads, reducing the number of conflict points, improving connections (ramps and direct connectors) and creating clearer driver directions and expectations, while providing additional capacity within this confluence zone. Improvements are anticipated to reduce crashes by 30% over the service life of 20 years. Our proposed improvements go beyond just widening the bridge and improving the Horizontal alignment, and include the following:

- Widen Bridge (55% Crash Reduction Factor)
- Improve Horizontal Alignment (55% Crash Reduction Factor)
- Improve Vertical Alignments (50% Crash Reduction Factor)
- Install Traffic Signal (35% Crash Reduction Factor)
- Install Warning/Guide Signs (20% Crash Reduction Factor)
- Install Raised Median (25% Crash Reduction Factor)
- Safety Treat Fixed Objects (50% Crash Reduction Factor)
- Safety Lighting (49% Crash Reduction Factor)
- Widen Paved Shoulders (25% Crash Reduction Factor)
- Construct Interchange (65% Crash Reduction Factor)

2. **Achieve and Maintain a State of Good Repair:** The proposed project should bring main lanes and frontage roads a decade of year life, resetting minimal maintenance for at least 10-15 years after completion.

3. **Move People and Goods Efficiently:** As a proposed multimodal facility, IH 45 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. The section of IH 45 is part of the Texas Highway Freight Network, Strategic Highway Network, National Highway System. IH 45 is also a designated Hurricane Evacuation Route.

4. **Strengthen Regional Economic Competitiveness:** The ramp improvements to IH 45 will provide congestion relief for automobile users. The proposed improvements to IH 45 are needed to support future residential and commercial development, adjacent to project limits, and areas north and south of the project segment. Activity centers include Northgate Elementary School, Woodlands Specialty Hospital, Spring Creek Greenway and multiple parks and recreation areas. H-GAC land use estimates an increase in nearly 96 % for housing units within a ¼ mile of the project corridor. 2045 population estimates a 13.4% growth from 2018, along with 67% growth in employment within the TAZ.

Households:

2018: 14,354

2045: 17,376

Population:

2018: 34,484

2045: 38,276

Jobs:

2018: 52,692

2045: 73,987

5. Conserve and Protect Natural and Cultural Resources: Montgomery County will be conducting an Environmental Assessment (EA) for the proposed improvements along I-45. After assessing environmental resources and constraints, the alignment and footprint of the roadway will be designed to avoid, minimize and mitigation sensitive environmental resources (natural and cultural). By adding one additional travel lane in each direction, congestion along the facility would be reduced, therefore improving overall air quality.

### 3.0 Benefits

We have selected the following safety improvements as they are the most critical and beneficial to I-45.

## Roadway - Crash Benefits

After inputting our traffic volumes from 2022 and projected values for 2029, 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.

<b>Year Open to Traffic?</b>	2029
<b>Safety Improvement Type 1</b>	Widen Bridge
Work Type Code	218
Preventable Crash Type	Non-Intersection related (Roadway Related)
Appropriate Crash Reduction Factor (%):	55%
Service Life (years):	20
<b>Safety Improvement Type 2</b>	Improve Horizontal Alignment
Work Type Code	506
Preventable Crash Type	Non-Intersection related (Roadway Related)
Appropriate Crash Reduction Factor (%):	55%
Service Life (years):	10
<b>Safety Improvement Type 3</b>	Safety Lighting
Work Type Code	304
Preventable Crash Type	Non-Intersection related (Roadway Related)

Table 2: Proposed Improvements (Crash Benefits)

Appropriate Crash Reduction Factor (%):	49%
Service Life (years):	15
<b>Bike/Ped Improvement Type</b>	Install Pedestrian Crosswalk
Work Type Code	403
Preventable Crash Type	Pedestrian, Cyclist
Appropriate Crash Reduction Factor (%):	10%
Service Life (years):	2

Table 2: Proposed Improvements (Crash Benefits) (Continued)

2022 Traffic Volume	243,893
Estimated traffic volume in year Open to Traffic	297,392
2022 Potential Daily Walk/Bike Commuters	698
Potential Daily Walk/Bike Commuters in Year Open to Traffic	830

Table 3: Daily Travel Demand (Crash Benefits)

Discounted Safety Benefits @ 7% (\$)	<b>\$756,340,000</b>
--------------------------------------	----------------------

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.

<b>Year Open to Traffic?</b>	2029
<b>Type of Improvement</b>	Roadway improvements (Added Capacity, Grade Separations) including HOV
Type of Facility	Freeway
Total Length of Corridors Affected by Project (miles)	3.5
Average Roadway Speed Before Improvement (mph)	52
Average Roadway Speed After Improvement (mph)	62
Service Life of Project (from MoSERS)	20

Table 5: Proposed Improvements (Roadway Emissions Benefits)

2022 Average Daily Traffic Volume of Corridors Affected by project	243,893
--	---------

Table 6: Daily Travel Demand (Roadway Emissions Benefits)

Discounted NOx Benefits @ 7% (\$)	\$16,166
Discounted VOC Benefits @ 7% (\$)	\$14,185,424

Table 7: Benefit Results (Roadway Emissions Benefits)

Discounted Emissions Benefits @ 7% (\$)	<b>\$14,201,590</b>
---	---------------------

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

NOx Emission Reductions (tons)	<b>1.18</b>
VOC Emission Reductions (tons)	<b>21.35</b>

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.

<b>Year Open to Traffic?</b>	2029
<b>Type of Improvement 1</b>	Adding New Lanes or Roads
Estimated Delay Reductions (in %)	30%
Service Life (years):	20
<b>Type of Improvement 2</b>	Access Management
Estimated Delay Reductions (in %)	20%
Service Life (years):	20
<b>Type of Improvement 3</b>	Active Traffic Management
Estimated Delay Reductions (in %)	15%
Service Life (years):	15

Table 10: Proposed Improvements (Transit Delay Benefits)

Interim Calculations	Per Veh In hours	Per Veh In minutes
Estimated Free Flow Travel Time	0.068	4.06
Estimated Average Peak Period Travel Time without project	0.120	7.22
Estimate Average Delay without project	0.053	3.16
Estimated Delay with project 1	0.037	2.21
Estimated Average Peak Travel Time with project 1	0.105	6.27
Estimated Delay with project 1 & 2	0.029	1.77
Estimated Average Peak Travel Time with project 2	0.097	5.83
Estimated Delay with projects 1, 2 & 3	0.025	1.50
Estimated Average Peak Travel Time with projects 1, 2 & 3	0.093	5.57

Table 11: Interim Calculations for the Delay Reductions



VHT Improvements	Without Project	With Project
Peak period VHT In year open to traffic in hours	16,101	12,410

Table 12: VHT Improvements

2022 Traffic Volume (AADT)	243,893
2022 Peak Period Traffic Volume	104,168
Peak Period Traffic Volume in Year Open to Traffic	133,793
Estimated Free Flow Speed before improvement (mph)	52
Average Peak Period Corridor Speed before improvement (mph)	29

Table 13: Daily Travel Demand (Transit Delay Benefits)

Discounted Delay Benefits @ 7% (\$)	<b>\$1,241,046,000</b>
-------------------------------------	------------------------

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?	2029
Type of Improvement Project	Paved Shoulder/Shared Use Path
Length	3.52
Applicable Project Service Life (years)	20

Table 15: Proposed Improvements (Transportation Emissions Benefits)

Total Daily VMT Reductions (H-GAC ACE)	968.87
Estimated Total Walking/Bicycling Commuter Daily VMT Reduction with potential mode shift in Year Open to Traffic	1,076

Table 16: Daily VMT Reductions

Discounted NOx Benefits @ 7% (\$)	<b>\$3,814</b>
Discounted VOC Benefits @ 7% (\$)	<b>\$185,279</b>

Table 17: Benefit Results (Transportation Emissions Benefits)

Discounted Emissions Benefits @ 7% (\$)	<b>\$189,093</b>
---	------------------

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

NOx Emission Reductions (tons)	<b>0.28</b>
VOC Emission Reductions (tons)	<b>0.28</b>

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 \$2,011,776,683.

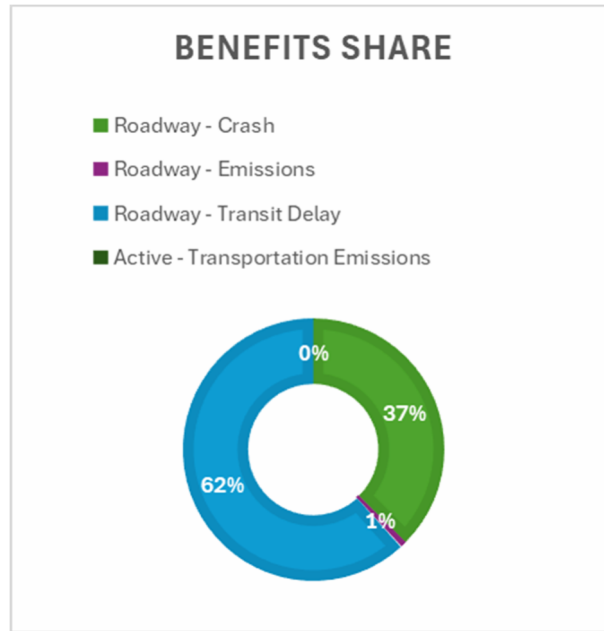


Figure 2: Benefits Share

Roadway - Crash	Roadway - Emissions	Roadway - Transit Delay	Active - Transportation Emissions	SUM
\$756,340,000	\$14,201,590	\$1,241,046,000	\$189,093	<b>\$2,011,776,683</b>

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 13.41 in 2022 real dollars.

Scenario	\$2022 Real Dollars
Benefits	\$2,011,776,683
Construction Costs (Scoping estimate provided by Montgomery County)	\$150,000,000
BCA Ratio	13.41
Net Present Value	\$1,861,776,683

Table 21: BCR Analysis