

State Highway 36A New Road Expansion Benefit Cost Analysis

REMI Users Conference, Boise, ID

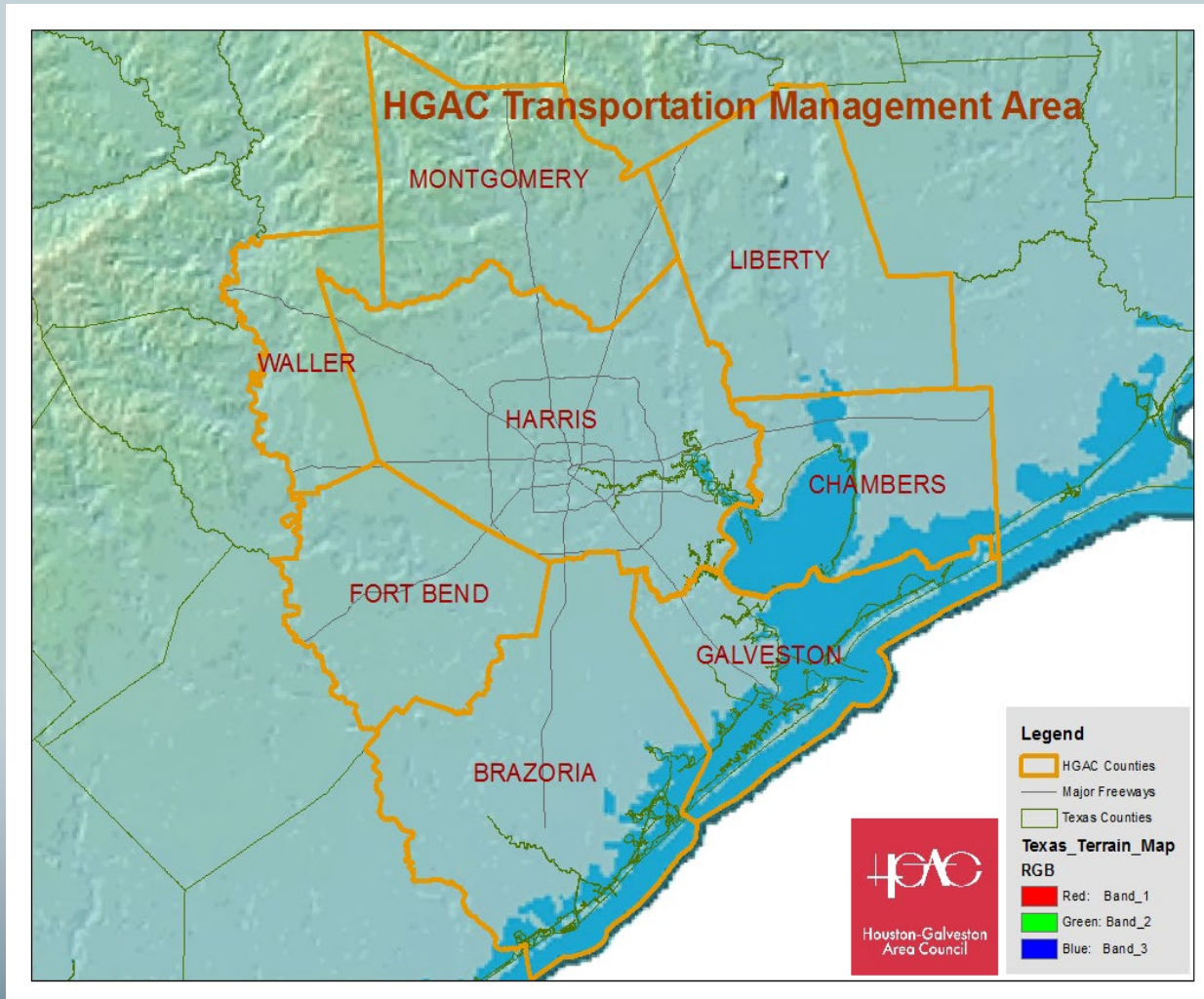
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Data Analytics and Research

Houston-Galveston Area Council

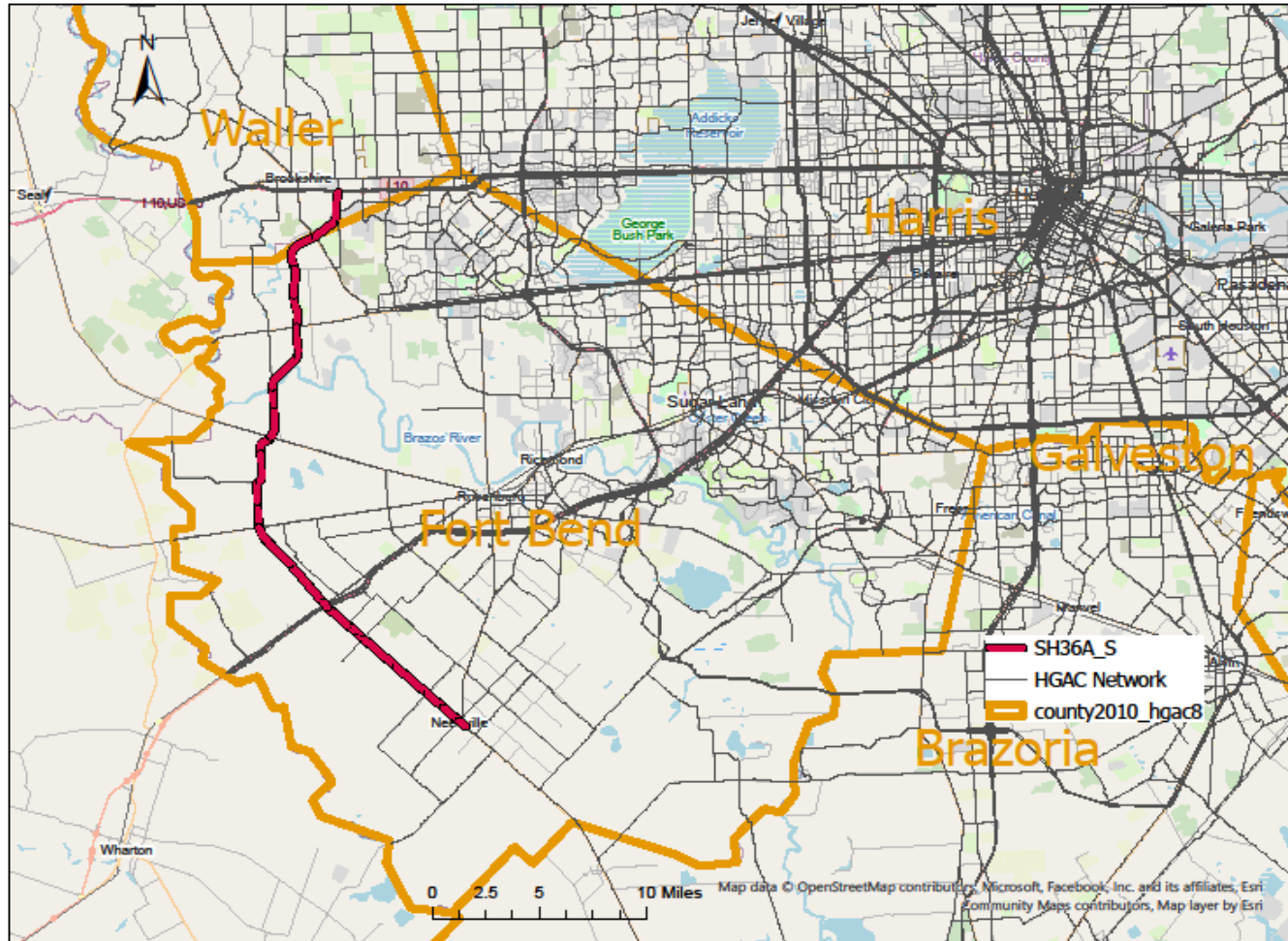
H-GAC Service Region



About H-GAC

- The 13-county H-GAC region is growing, becoming more diverse.
- Its service area is 12,500 square miles and contains 7 million plus people.
- We are also the Metropolitan Planning Organization (MPO) for the region.
- H-GAC's mission is to serve as the instrument of local government cooperation, promoting the region's orderly development and the safety and welfare of its citizens.

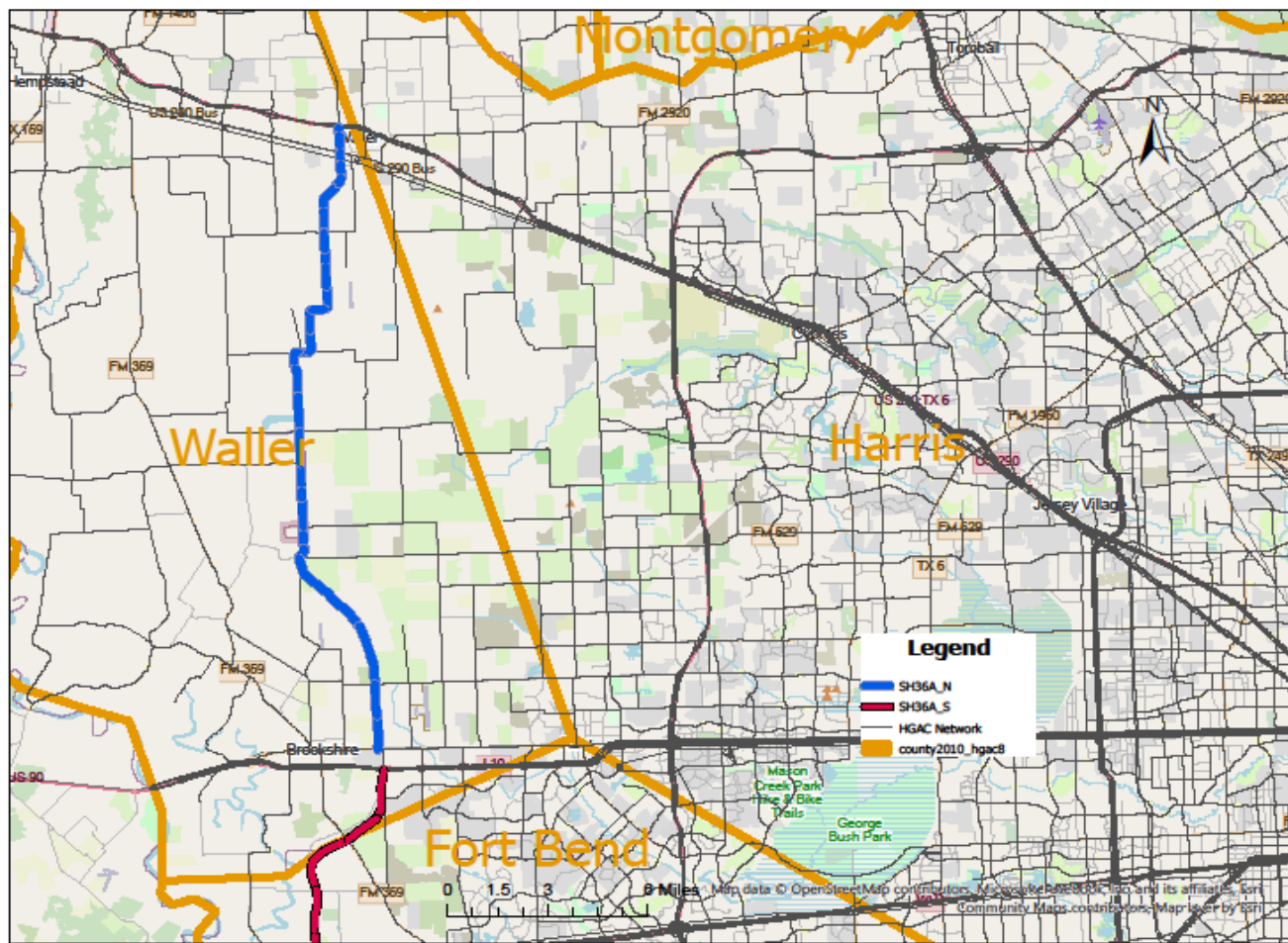
RTP Project SH36 A South Map



RTP SH36A South Project Costs and Completion Info

- SH36A South is a 4-lane new roadway construction project.
- It connects from SH36 to I-10W.
- The total construction cost is 1 billion.
- The let year is 2027. And the completion year is 2040.
- The roadway is 36 miles in length. It is located at west Fort Bend County.

RTP Project SH36A North Map



RTP SH36A North Project Costs and Completion Info

- SH36A North is a 4-lane new roadway expansion project.
- It connects from I-10W to SH290.
- The total construction cost is 1.4 billion.
- The let year is 2040, and the completion year is 2045.
- The new roadway is 30 miles in length. It is located in west Waller County.

TDM No-Built Annual Input for SH36 A South

2045 VMT_SH36A_S (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	37,453.0	1,988.9	4,689.4	1,753.6	691.3	4,402.6	787.1	509.6
Brazoria	1,897.7	2,241.5	498.3	352.4	6.5	71.3	12.6	17.6
Fort Bend	4,620.8	506.3	3,870.1	141.2	122.3	167.4	13.2	17.1
Galveston	504.4	17.9	17.4	63.1	0.9	56.2	58.3	156.8
Waller	1,678.9	337.1	136.3	1,579.0	4.5	99.4	27.6	61.6
Montgomery	666.4	6.2	122.1	4.3	171.8	81.7	1.4	0.8
Liberty	4,314.8	67.3	162.6	97.2	81.7	3,925.8	186.7	54.7
Chambers	746.5	11.3	11.6	27.5	1.3	188.7	315.7	58.1

2045 VHT SH36A_S (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	1,240.0	50.4	137.6	42.3	16.6	121.0	18.0	11.1
Brazoria	47.8	63.0	13.0	9.0	0.1	1.6	0.3	0.4
Fort Bend	135.3	13.2	124.4	3.4	3.1	4.0	0.3	0.4
Galveston	11.0	0.4	0.4	1.3	0.0	1.2	1.2	3.8
Waller	40.0	8.7	3.3	45.9	0.1	2.1	0.6	1.3
Montgomery	15.9	0.1	3.1	0.1	4.3	1.9	0.0	0.0
Liberty	117.6	1.5	3.9	2.1	1.9	118.4	4.3	1.1
Chambers	17.1	0.2	0.3	0.6	0.0	4.4	8.4	1.2

2045 Vehicle Trips SH36A_S (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	5,035.7	86.3	243.8	77.3	31.5	174.5	21.4	19.7
Brazoria	83.4	379.6	27.1	19.8	0.1	1.1	0.2	0.3
Fort Bend	241.0	27.9	600.9	3.0	8.9	3.0	0.2	0.3
Galveston	19.6	0.3	0.3	1.6	0.0	0.8	2.3	28.1
Waller	74.3	19.1	2.8	270.4	0.1	1.5	0.5	1.6
Montgomery	30.7	0.1	9.1	0.1	30.2	3.8	0.0	0.0
Liberty	173.8	1.1	2.9	1.4	3.8	598.0	7.8	0.9
Chambers	20.7	0.2	0.2	0.5	0.0	7.7	52.6	2.3



TDM No-Built Annual Input for SH36 A North

2045 VMT_SH36A_N (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	37,453.4	1,993.2	4,697.0	1,753.5	689.8	4,403.8	786.6	509.6
Brazoria	1,902.4	2,240.7	499.5	352.1	7.0	71.5	12.6	17.7
Fort Bend	4,629.2	507.5	3,881.4	141.0	124.5	167.1	13.2	17.1
Galveston	504.5	17.9	17.3	63.1	0.9	56.2	58.3	156.8
Waller	1,677.4	337.0	136.1	1,579.1	4.5	99.3	27.5	61.5
Montgomery	664.7	6.8	124.5	4.3	169.8	81.5	1.4	0.8
Liberty	4,316.8	67.5	162.3	97.2	81.6	3,925.8	186.7	54.7
Chambers	746.1	11.3	11.6	27.5	1.3	188.8	315.7	58.1

2045 VHT_SH36A_N (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	1,240.5	50.4	137.2	42.3	16.6	121.1	18.0	11.1
Brazoria	47.9	62.9	13.0	9.0	0.1	1.6	0.3	0.4
Fort Bend	134.9	13.2	124.1	3.4	3.1	4.0	0.3	0.4
Galveston	11.0	0.4	0.4	1.3	0.0	1.2	1.2	3.8
Waller	40.0	8.7	3.3	45.9	0.1	2.1	0.6	1.3
Montgomery	15.9	0.1	3.1	0.1	4.3	1.9	0.0	0.0
Liberty	117.6	1.5	3.9	2.1	1.9	118.4	4.3	1.1
Chambers	17.1	0.2	0.3	0.6	0.0	4.4	8.4	1.2

2045 Vehicle Trips (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	5,035.4	86.4	244.0	77.3	31.5	174.6	21.4	19.7
Brazoria	83.5	379.5	27.1	19.8	0.1	1.1	0.2	0.3
Fort Bend	241.2	27.9	600.7	3.0	9.0	3.0	0.2	0.3
Galveston	19.6	0.3	0.3	1.6	0.0	0.8	2.3	28.1
Waller	74.3	19.1	2.8	270.4	0.1	1.5	0.5	1.6
Montgomery	30.6	0.1	9.2	0.1	30.1	3.8	0.0	0.0
Liberty	173.8	1.1	2.9	1.4	3.8	597.9	7.8	0.9
Chambers	20.7	0.2	0.2	0.5	0.0	7.7	52.6	2.3



TDM Built Annual Input for SH36A South & North

2045 VMT Built (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	37,458.0	1,993.0	4,692.8	1,753.6	689.9	4,405.8	786.9	509.6
Brazoria	1,902.3	2,240.6	499.4	352.0	7.1	71.5	12.6	17.6
Fort Bend	4,630.3	507.6	3,879.5	141.0	127.6	168.2	13.2	17.1
Galveston	504.3	17.9	17.3	63.1	0.9	56.3	58.3	156.8
Waller	1,677.6	336.8	136.0	1,578.9	4.5	99.2	27.6	61.6
Montgomery	664.9	6.8	127.6	4.3	171.5	81.4	1.3	0.8
Liberty	4,318.0	67.5	163.2	97.3	81.5	3,925.0	186.6	54.8
Chambers	746.5	11.3	11.6	27.5	1.2	188.7	315.7	58.1

2045 VHT Built (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	1,240.2	50.4	137.2	42.3	16.6	121.1	18.0	11.1
Brazoria	47.8	62.9	12.9	9.0	0.1	1.6	0.3	0.4
Fort Bend	135.0	13.1	124.0	3.4	3.1	4.0	0.3	0.4
Galveston	11.0	0.4	0.4	1.3	0.0	1.2	1.2	3.8
Waller	40.0	8.6	3.3	45.9	0.1	2.1	0.6	1.3
Montgomery	15.9	0.1	3.1	0.1	4.3	1.9	0.0	0.0
Liberty	117.7	1.5	3.9	2.1	1.9	118.4	4.3	1.1
Chambers	17.1	0.2	0.3	0.6	0.0	4.4	8.4	1.2

2045 Vehicle Trips (Million)	Harris	Brazoria	Fort Bend	Waller	Montgomery	Liberty	Chambers	Galveston
Harris	5,035.4	86.4	244.0	77.3	31.4	174.6	21.4	19.7
Brazoria	83.4	379.5	27.1	19.8	0.1	1.1	0.2	0.3
Fort Bend	241.2	27.9	600.6	3.0	9.1	3.0	0.2	0.3
Galveston	19.6	0.3	0.3	1.6	0.0	0.8	2.3	28.1
Waller	74.3	19.0	2.8	270.4	0.1	1.5	0.5	1.6
Montgomery	30.6	0.1	9.3	0.1	30.1	3.8	0.0	0.0
Liberty	173.8	1.1	2.9	1.4	3.8	597.9	7.8	0.9
Chambers	20.7	0.2	0.2	0.5	0.0	7.7	52.6	2.3

REMI Input for SH36 A South & North

Expenditure	REMI VARIABLE	UNITS	SCENARIO	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Highway Construciton	Exogenous Final Demand - Construction	2022 \$ (M)	SH36A_S	51	51	51	51	51	51	51	51	51	51	51	51	51	51	0	0	0	0	0
Highway Construciton	Exogenous Final Demand - Construction	2022 \$ (M)	SH36A_N	0	0	0	0	0	0	0	0	0	0	0	0	0	69	69	69	69	69	69

SH36A South User Benefits (2023 - 2045)

Benefit-Cost Category	Region	Harris	Brazoria	Fort Bend	Galveston	Waller	Montgomery	Liberty	Chambers
Discount Rate	7%	7%	7%	7%	7%	7%	7%	7%	7%
Analysis Period	23	23	23	23	23	23	23	23	23
Evaluation Year	2023	2023	2023	2023	2023	2023	2023	2023	2023
Evaluation from 2023 to 2045	2045	2045	2045	2045	2045	2045	2045	2045	2045
Total Benefits, Mil PV\$	95.3	9.8	4.9	84.9	-0.2	5.1	-2.1	-8.1	1.0
Emissions Benefits, Mil PV\$	-9.4	-2.6	-1.0	-4.8	0.0	0.4	-0.9	-0.6	0.0
Travel Time Savings, Mil PV\$	104.7	12.4	5.9	89.7	-0.2	4.7	-1.3	-7.5	1.0
Total Costs, Mil PV\$	385.3	0.0	0.0	385.3	0.0	0.0	0.0	0.0	0.0
Design & Construction Costs, Mil PV\$	385.3	0.0	0.0	385.3	0.0	0.0	0.0	0.0	0.0
Benefit-Cost Ratio	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0

SH3 6 A South Economic Impact (2023-2045)

County	Employment	Population	GDP (M \$2023)	Personal Income (M \$2023)
Brazoria	205	698	38	42
Chambers	11	64	2	3
Fort Bend	7,928	21,819	926	1,237
Galveston	62	82	8	8
Harris	444	(697)	107	(315)
Liberty	(122)	(1,028)	(11)	(31)
Montgomery	36	(65)	(3)	(7)
Waller	71	397	9	15
Region	8,633	21,269	149	953

SH3 6 A South Combined User and Economic Benefit (2023-2045)

County	Emissions Benefits (M \$2023)	Travel Time Savings (M \$2023)	GDP (M \$2023)	Personal Income (M \$2023)	Total Benefits (M \$2023)	Total Costs (M \$2023)	Benefit-Cost Ratio	Employment	Population
Brazoria	(1.0)	5.9	38.4	41.8	85.0	-	-	205	698
Chambers	-	1.0	1.6	3.2	5.8	-	-	11	64
Fort Bend	(4.8)	89.7	925.8	1,236.9	2,247.6	385.3	5.8	7,928	21,819
Galveston	0.0	(0.2)	8.1	8.4	16.4	-	-	62	82
Harris	(2.6)	12.4	107.4	(314.5)	(197.3)	-	-	444	(697)
Liberty	(0.6)	(7.5)	(11.1)	(30.6)	(49.8)	-	-	(122)	(1,028)
Montgomery	(0.9)	(1.3)	(3.2)	(6.7)	(12.1)	-	-	36	(65)
Waller	0.4	4.7	9.3	14.7	29.0	-	-	71	397
Region	(9.4)	104.7	1,076.3	953.2	2,124.7	385.3	5.5	8,633	21,269

SH36A North User Benefits (2023 - 2045)

Benefit-Cost Category	Region	Harris	Brazoria	Fort Bend	Galveston	Waller	Montgomery	Liberty	Chambers
Discount Rate	7%	7%	7%	7%	7%	7%	7%	7%	7%
Analysis Period	23	23	23	23	23	23	23	23	23
Evaluation Year	2023	2023	2023	2023	2023	2023	2023	2023	2023
Evaluation from 2023 to 2045	2045	2045	2045	2045	2045	2045	2045	2045	2045
Total Benefits, Mil PV\$	45.8	59.0	1.8	-16.5	0.5	1.2	2.9	-2.6	-0.4
Emissions Benefits, Mil PV\$	-2.3	-0.5	0.1	-0.6	0.0	0.0	-1.1	-0.2	-0.1
Travel Time Savings, Mil PV\$	48.1	59.5	1.7	-15.9	0.4	1.2	4.0	-2.4	-0.3
Total Costs, Mil PV\$	113.8	0.0	0.0	0.0	0.0	113.8	0.0	0.0	0.0
Design & Construction Costs, Mil PV\$	113.8	0.0	0.0	0.0	0.0	113.8	0.0	0.0	0.0
Benefit-Cost Ratio	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SH3 6 A North Economic Impact (2023–2045)

County	Employment	Population	GDP (M \$2023)	Personal Income (M \$2023)
Brazoria	52	189	8	12
Chambers	2	(13)	1	1
Fort Bend	(67)	(1,361)	(7)	(32)
Galveston	34	91	10	12
Harris	1,220	2,538	215	203
Liberty	(40)	(333)	(3)	(9)
Montgomery	221	602	51	70
Waller	2,629	1,429	293	131
Region	4,051	3,142	568	388

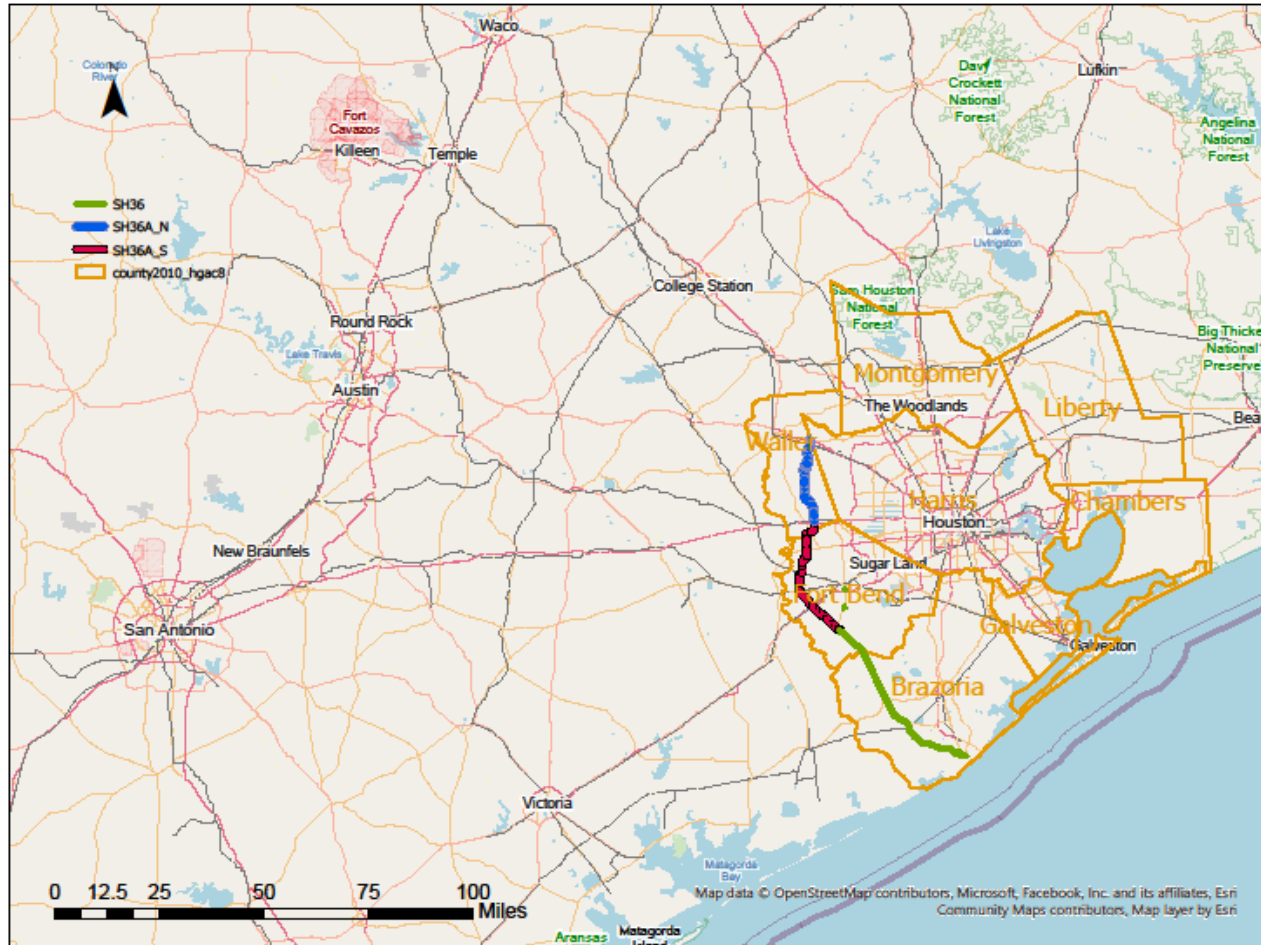
SH36A North Combined User and Economic Benefit (2023–2045)

County	Emissions Benefits (M \$2023)	Travel Time Savings (M \$2023)	GDP (M \$2023)	Personal Income (M \$2023)	Total Benefits (M \$2023)	Total Costs (M \$2023)	Benefit-Cost Ratio	Employment	Population
Brazoria	0.1	1.7	8.1	12.0	21.8	-	-	52.1	188.7
Chambers	(0.1)	(0.3)	0.9	0.5	1.0	-	-	1.6	(13.3)
Fort Bend	(0.6)	(15.9)	(7.2)	(31.7)	(55.4)	-	-	(67.4)	(1,360.6)
Galveston	0.0	0.4	10.4	11.9	22.8	-	-	34.4	90.8
Harris	(0.5)	59.5	215.1	203.3	477.3	-	-	1,220.1	2,538.1
Liberty	(0.2)	(2.4)	(2.8)	(8.9)	(14.3)	-	-	(40.4)	(333.2)
Montgomery	(1.1)	4.0	51.2	70.5	124.7	-	-	221.2	601.8
Waller	-	1.2	292.7	130.9	424.8	113.8	3.7	2,629.1	1,429.5
Region	(2.3)	48.1	568.5	388.4	1,002.7	113.8	8.8	4,050.7	3,141.7

SH36A Study Findings

- Both SH36A South and SH36A North project's economic benefits beat user benefits.
- The purpose of SH36A roadway expansion is for resiliency planning and emergency evacuation.
- Fort Bend County is benefiting the most from SH36A South project as expected.
- Waller and Harris County are benefiting the most from SH36A North project due to accessibility to the road.

An Extended View of SH36 A



REMI Modeling Tips and Discussion

- REMI TranSight is very sensitive to TDM output. If REMI simulation result doesn't make sense, consider to verify your TDM output.
- When user benefit cost ratio is low, try to limit the number of benefits calculation options to focus on the big picture.
- For county REMI simulation result, we might need to refer to TDM network for proper explanation.

Acknowledgement

- A big thanks to Jeff Dykes of REMI for his dedicated support for TDM import setup and his valuable input on simulation results evaluation.
- Thank TDM Program Manager Heng Wang for his support in conducting this study.
- I thank my colleague, Weijie Zhuo, for his tireless support in helping run TDM for the SH36A project and getting results out of TDM.

Questions and Comments?

- Please contact sharon.ju@h-gac.com

Thank you!