To: Priya Zachariah
Senior Transit Planner, METRO

From: Da Li
Traffic Engineers, Inc.

CC: Geoff Carleton, TEI
Sammy Chen, TEI
James Llamas, TEI
Patricia Wascowiak, PB
Jenny Wang, PB

Date: January 10, 2017

Re: Westheimer Enhanced Bus Service Study Traffic Simulation

The purpose of this memo is to document major findings of a traffic and transit modeling analysis for the enhancement of the local bus service on Westheimer Road. The goal of the VISSIM modeling was to quantify the trade-offs between travel time benefits to buses and impacts to other traffic along the Westheimer corridor and intersecting streets. The results were used to refine the travel time benefits assumed for the corridor strategies under study, and provide a basis for estimation of bus operation costs in the scenarios under study.

Key Findings

- Stop optimization by itself would offer slight travel time benefits to buses along Westheimer.
- Stop optimization combined with transit signal priority (TSP) at minor intersections could provide bus speed and travel time benefits of 10% to 15%. Overall intersection performance would improve while small increases in delay would be experienced at minor intersection side streets.
- Higher levels of TSP and signal preemption would have additional benefits to bus service but additional impacts to side street delay.

- Conversion of a lane for transit priority (bus/right turn only) would benefit bus speeds and travel time by 25 to 45% but would cause considerable delay to general traffic in the peak direction.
- A median busway could double bus speeds and cut travel time in half. The lane reduction required to minimize right-of-way acquisition in the busway scenario would cause even more significant delay to general traffic in the peak direction.

Scope of Study

As shown in Figure 1, the VISSIM model in this study covers the selected segment of Westheimer Road from Hillcroft Street/S. Voss Road to Fountain View Drive, a distance of about 1.3 miles. The signalized intersections that were modeled include the intersections with Hillcroft Street/S Voss Road, Winrock Boulevard, Briarhurst Drive, Greenridge Drive, and Fountain View Drive.

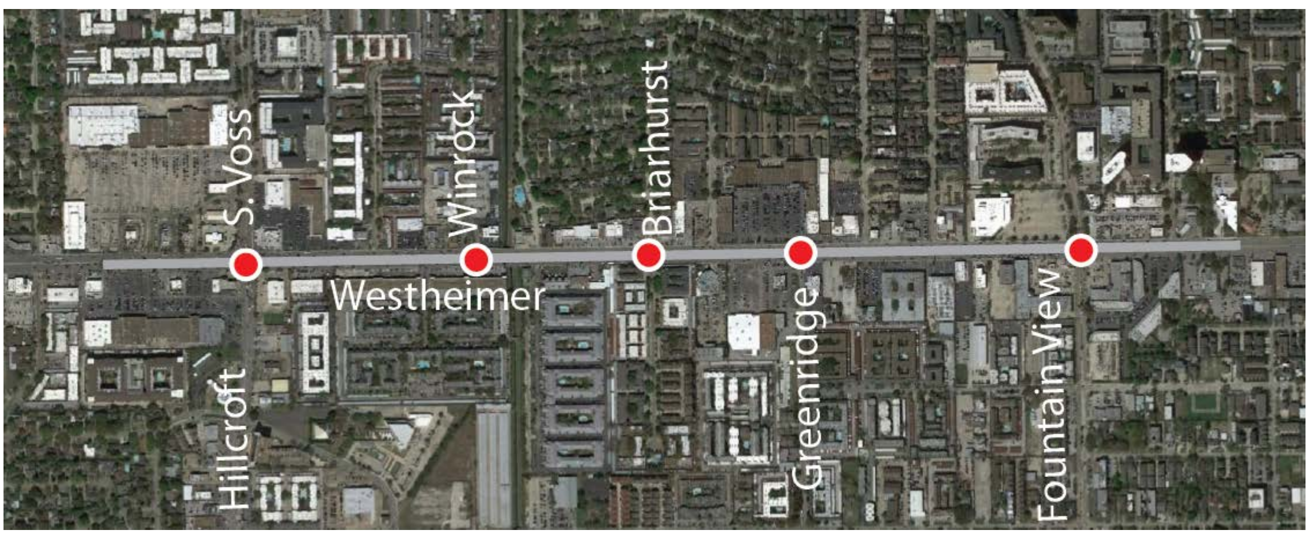


Figure 1 VISSIM Analysis Area and Signalized Intersections

This segment of Westheimer Road was selected for analysis as it is located near the peak load point for the 82 Westheimer route and handles some of the highest traffic volumes in the corridor. The existing cross-section of the analyzed segment of Westheimer Road is shown in Figure 2.

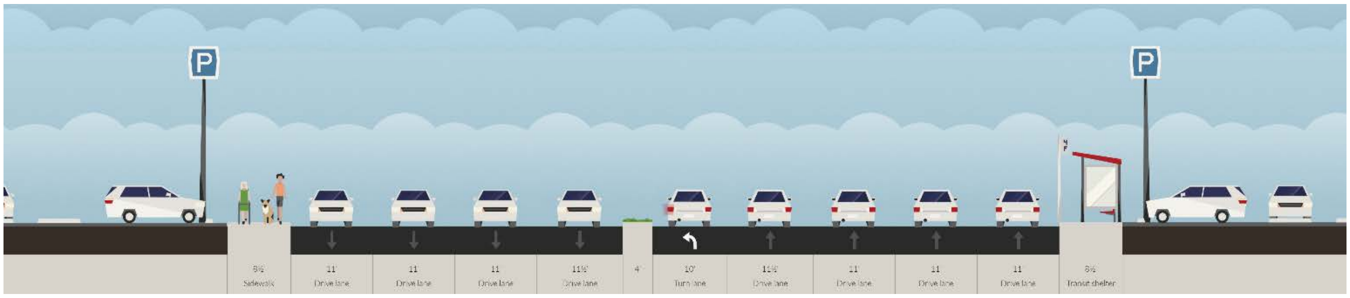


Figure 2 Existing Westheimer Cross-Section (Approx. 120′ ROW)

Data Collection

The following data were collected for use in conducting the modeling and analyses:

- Turning movement counts were collected during 7:00 – 9:00 AM and 4:00 – 6:00 PM on Tuesday, May 10, 2016 at the studied intersections
- Existing traffic signal timing at the intersections (from the City of Houston)
- Bus headway during peak hours (from METRO, also shown in Table 5)
- Existing bus ridership numbers including boarding & alighting passengers (from METRO, also shown in Figure 3)
- Ridership projections of local and rapid bus for future scenarios (from METRO, see Table 3)
- Bus occupancy (from METRO) estimated based on the average of the METRO recorded occupancy (in percentage) for the ten buses during the PM peak hour of a selected Thursday in 2016, multiplied by the bus capacity (38 seats), which is 24 passengers/bus for the eastbound trip and 32 passengers/bus for the westbound trip on average.
- Passenger car occupancy (1.2 persons/car, per Texas average from United States Census 2000)
- Bus specifications (dimensions, acceleration/deceleration rates, etc.)
- GPS-based travel times, as benchmarks for model calibration, were collected on June 29, 2016 with three runs performed for each direction of travel during the PM peak.

Model Calibration and Validation

The data associated with traffic conditions, signal timing, roadway geometrics, bus specifications, and desired bus headway were input to the VISSIM traffic simulation software. Ridership information including boarding and alighting passengers at each stop and the bus occupancy of each bus was also input to VISSIM to estimate dwell times at stops. The baseline model was developed to replicate the existing geometrics, PM peak traffic, signal operation conditions, as well as bus operation along the selected segment on Westheimer Road. The baseline model was fine-tuned by adjusting VISSIM parameters such that the difference between the model-estimated and field-measured travel times were within an acceptable range (i.e., ±5%). Table 1 shows the goodness of fit of the baseline model for the existing conditions.

Table 1: Goodness of Fit of Existing Condition Model

	Distance (ft.)	Measured Travel Time (sec.)	Simulated Travel Time (sec.)	Relative Error
Westheimer Eastbound	5,780	208	199	-4.3%
Westheimer Westbound	6,180	270	276	2.2%

Design Alternatives for Analysis

As part of the Westheimer Enhanced Bus Service Study, several potential service enhancement scenarios have been identified for the Westheimer corridor. Each scenario is designed to enhance transit service by implementing corridor treatments to improve travel time, reliability, and overall customer experience. These scenarios may be implemented incrementally or in combination over time.

<u>Scenario 1: Enhanced Local Service</u>

Scenario 1 focuses on enhancing the existing 82 Westheimer route. Scenario 1 improvements that were analyzed include:

- <u>Stop Optimization</u>

  Local buses travel the segment with optimized stop locations and existing signal timing. The existing and optimized stop locations are illustrated in Figure 1. Stop optimization includes the following improvements:

  - Stop relocation: relocate existing near-side stops to far-side stops,
  - Stop consolidation: remove closely-spaced stops with relatively low ridership. The proposed density of stops is typically less than METRO's Service Standard goal of 0.25 miles spacing with no stops more than 0.33 miles apart.

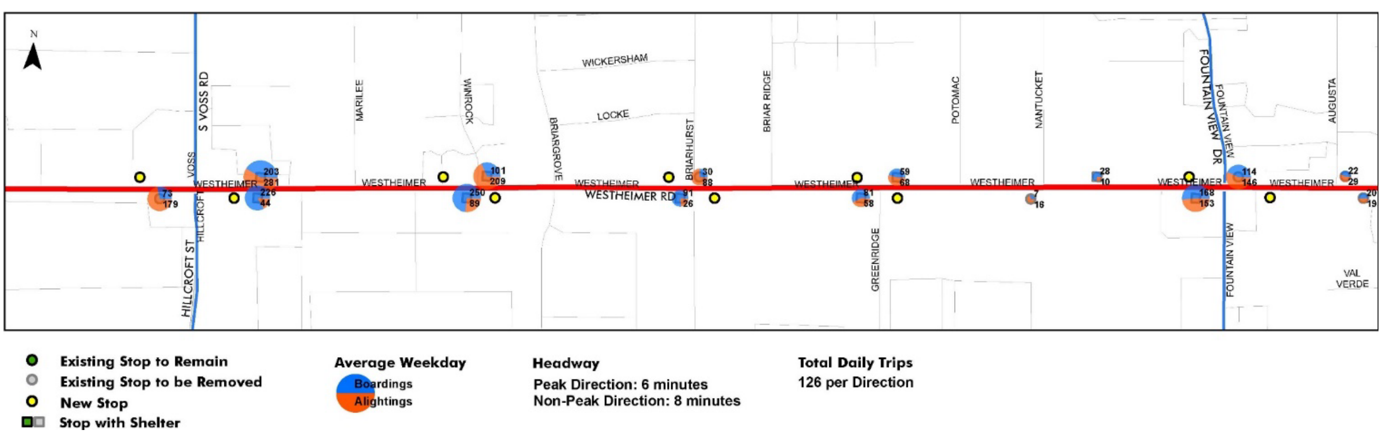


Figure 3: Existing and Optimized Bus Stop Locations

- Stop Optimization & Signal Priority at Minor Intersections

  Local buses travel the segment with optimized stop locations and some degree of priority at the following intersections:

  - Winrock Boulevard
  - Briarhurst Drive
  - Greenridge Drive

Other options for Scenario 1 were also modeled for better understanding the potential benefits and to evaluate the merits of TSP. These options include:

- Stop Optimization & Signal Preemption at Minor Intersections

  Local buses travel the segment with optimized stop locations and full preemption at the minor intersections mentioned previously.

- Stop Optimization & Signal Priority at Major and Minor Intersections

  Local buses travel the segment with optimized stop locations and some degree of priority at all five study intersections.

In addition to enhanced local service, other scenarios include higher-level investments such as bus priority lanes, dedicated bus lanes, and rapid service with limited stops.

Scenarios 2 and 3: Westheimer Rapid Bus with Mixed Traffic

Scenario 2 and 3 improvements include the implementation of rapid service in mixed traffic on Westheimer corridor, overlaid upon enhanced local service (Scenario 1 – stop optimization and signal priority at minor intersections). In order to travel faster, rapid service would make fewer stops. In this segment the only rapid stops would be at Hillcroft/Voss and Fountain View. The rapid service was assumed to be introduced to Westheimer corridor incrementally as:

- Scenario 2: Outer Westheimer Rapid: Implementation of rapid service between Dairy Ashford and Uptown

- Scenario 3: Full Westheimer Rapid: Extension of rapid service from Uptown to Greenway Plaza and Downtown

The same model assumptions were used for Scenarios 2 and 3 as bus and traffic operations on the study segment are expected to be similar for the two scenarios.

Scenario 4: Full Westheimer Rapid with Bus/Right-turn Lane

In the proposed improvement for Scenario 4, curb-side lanes on Westheimer Road are converted to bus only/right-turn lane (also known as a business access/transit (BAT) lane). Travel lanes on Westheimer Road are reduced from four lanes to three lanes for each direction. Pocket left-turn lanes remained unchanged at the intersections.

Subsequent to this traffic simulation, an additional scenario called Scenario X was developed in the overall Westheimer Enhanced Bus Service Study. The proposed improvements in Scenario X are similar to those in Scenario 4 on the study segment; therefore, results from 4 can be applied to X.

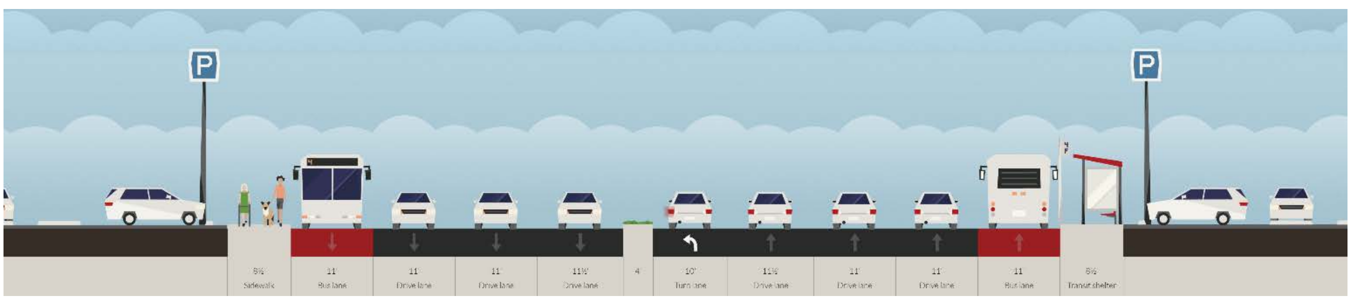


Figure 4: Cross-Section for Scenario 4

Scenario 5 A/B: Bus Rapid Transit in Dedicated Busway

In Scenario 5, dedicated busways are built in the median of Westheimer Road. Local buses run in mixed traffic. BRT has higher level of signal priority than a local bus does when they arrive at the same time at an intersection. Scenarios 5A and 5B operate similarly in the study segment; therefore, the assumptions and findings of the simulation apply to both.

Two types of cross-sections were modeled for Scenario 5:

- Scenario 5 – 1: BRT Station at Intersection in Minimum ROW (Approx. 130′)

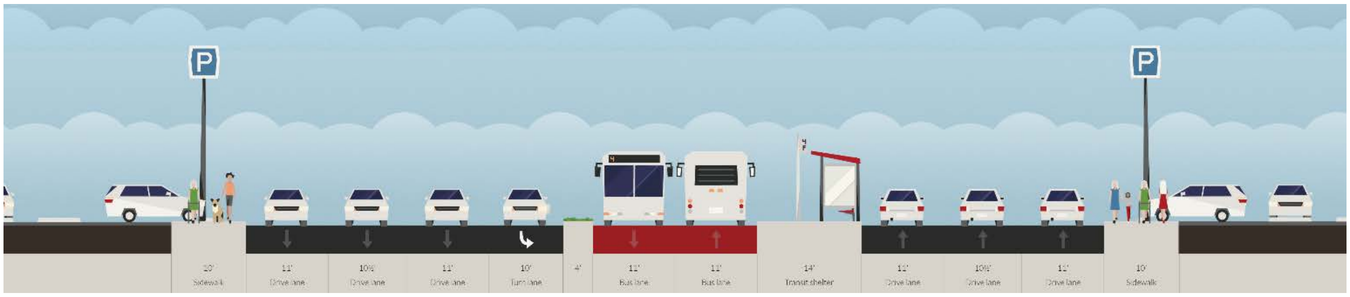


Figure 5: Cross-Section for Scenario 5-1

- Scenario 5 – 2: BRT Station with No Lane Reduction (Approx. 150′)

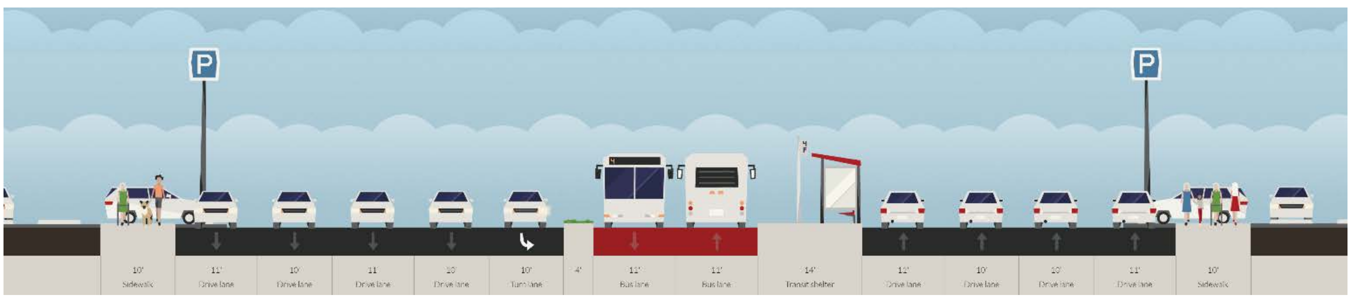


Figure 6: Cross-Section for Scenario 5-2

For Scenario 4 and Scenario 5, different bus-friendly signal operations were modeled for a better understanding of the potential benefits from signal priority. Specifications of the design alternatives are summarized in Table 2.

Table 2: Description of Design Alternatives

Design Alternatives	Bus Operation	Signal Operation	Number of Through Lanes on Westheimer
Scenario 1 (Stop Opt.)	Bus stop relocation and reduction	No transit-friendly signal timing	8
Scenario 1 (Minor TSP)		Transit signal priority at minor intersections	8
Scenario 1 (Minor PRE)		Transit preemption at minor intersections	8
Scenario 1 (All TSP)		Transit signal priority at minor and major intersections	8
Scenario 2/3	Local and rapid bus run in mixed traffic on Westheimer	Transit signal priority at minor intersections	8
Scenario 4 (Minor TSP)	Local and rapid bus run in bus/right-turn lane	Transit signal priority at minor intersections	6
Scenario 4 (All TSP)		Transit signal priority at minor and major intersections	6
Scenario 4 (All PRE)		Transit preemption at minor and major intersections	6
Scenario 5 – 1 (Minor TSP)	BRT runs in dedicated bus lane, local bus runs in mixed traffic on Westheimer.	Transit signal priority at minor intersections	6
Scenario 5 – 1 (All TSP)		Transit signal priority at minor and major intersections	6
Scenario 5 – 1 (All PRE)		Transit preemption at minor and major intersections	6
Scenario 5 – 2 (Minor TSP)		Transit signal priority at minor intersections	8
Scenario 5 – 2 (All TSP)		Transit signal priority at minor and major intersections	8
Scenario 5 – 2 (All PRE)		Transit preemption at minor and major intersections	8

Note: In 5-1 space for BRT is created by allocated one travel lanes in each direction and requires some ROW expansion particularly near stations. In 5-2 Westheimer was assumed to be widened to allow BRT and maintain existing number through lanes and requires more ROW to operate. Scenario 5-1 requires minimum of additional 10-feet ROW; Scenario 5-2 require approximately 30-feet additional ROW.

Assumptions

Ridership Assumptions

METRO's travel demand modeling staff provided local and rapid bus ridership projections for the study segment (Table 3).

Table 3: Number of Westheimer Bus Boardings between IH 610 and BW 8

Travel Demand Model Results	Scenario 1	Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Boardings between IH 610 and BW 8	Local	Local	Rapid	Local	Rapid	Local	Rapid	Local	Rapid
	5,200	5,050	750	4,650	1,400	5,400	1,600	3,600	8,950

Ridership was allocated to specific stops relative to their existing numbers of boardings/alightings along the corridor based on the segment-level projection.

Dwell Time Assumptions

Assumptions for local and rapid bus dwell time at stops are summarized in Table 4.

Table 4: Dwell Time Assumptions

Scenarios	Scenario 1	Scenarios 2, 3, & 4	Scenario 5A & 5B	
Bus Route	Local	Local/Rapid	Local	Rapid
Bus Type	Two-Door Articulated Bus	Two-Door Articulated Bus	Two-Door Articulated Bus	Three-Door Artic (5 Door Channels)
Situation	Front Door Boarding, All Door Alighting	All Door Boarding	All Door Boarding	All-Door Boarding
Payment Type	90% Q Card, 10% Cash	100% Q Card	100% Q Card	Off-Board Fare Collection
Service Time (s/passenger)	2.9B + 0.6A	1.9B + 0.6A	1.9B + 0.6A	0.5(B+A)

Note: All scenarios assumed front door boarding time controls; "B" = Boarding, "A" = Alighting

Source: TCRP Report 165 Exhibits 6-4 & 6-58

Headway Assumptions

Headway assumptions for local and rapid buses during PM peak for the service scenarios are shown in Table 5. As westbound is the peak travel direction in the PM peak on Westheimer, it has shorter existing headways. While headways are slightly longer for the individual services in subsequent scenarios, the effective headways for most customers would be shortened as they would have two different routes coming every 8 minutes.

Table 5: Peak Hour Bus Headways

Bus Route	Local		Rapid	
	Eastbound	Westbound	Eastbound	Westbound
Existing	8 min	6 min	-	-
Scenario 1	8 min	6 min	-	-
Scenarios 2 & 3	8 min	8 min	8 min	8 min
Scenario 4	8 min	8 min	8 min	8 min
Scenario 5	8 min	8 min	8 min	8 min

Transit Signal Priority and Preemption

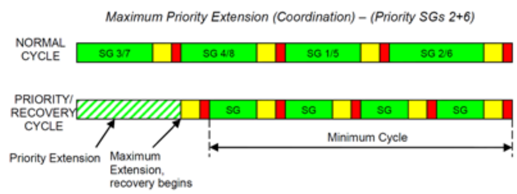
When transit signal priority is enabled and a traffic signal controller at an intersection receives a transit priority call, the controller will arrange to either call early or extend the green time for the transit signal phase and allow the signal to abbreviate or omit the conflicting signal phases. A transit preemption represents the highest level of priority that a bus may have and will cut off any phases conflicting with the bus movement and change to yellow and all-red when a traffic signal controller receives and authorizes a transit preemption call. Note that Westheimer Road is operating under signal coordination mode and the signal cycle length is assumed to remain unchanged from cycle to cycle even during a cycle when a priority or preemption is being executed. After priority or preemption is done, the traffic controller will recover to a normal cycle in an appropriate manner as predefined. The technical details of the transit priority and transit preemption signal timings used in this study are summarized in Table 6.

Table 6: Transit Signal Priority vs. Transit Preemption

<table>
<tr><th></th><th>Transit Signal Priority (TSP, Coordination Mode)</th><th>Transit Preemption (Coordination Mode)</th></tr>
<tr><td>Mode</td><td>

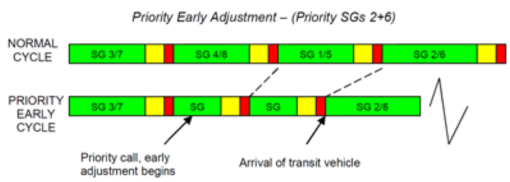
Early/Extend

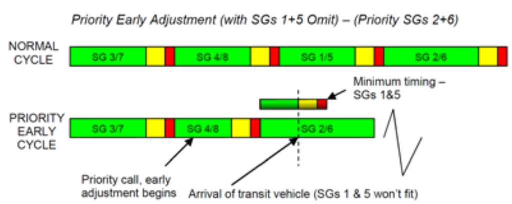
- Maximum Extension (Extend Limit = 40 s)



- Early Adjustment

  Left-turns from Westheimer Road can be shortened or omitted





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Immediately zeros greens for conflicting phases

- Left-turn greens from Westheimer Road can be zeroed immediately.
- Side street greens can be zeroed immediately.

</td></tr>
<tr><td>Dwell Phase</td><td>

Parent Phase: through movements on the same approach

Dwell Phase: through movements from the opposite approach/left-turn movements from the same approach

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Dwell Phase:

- through movements on the same approach
- left-turn movements from the same approach or through movements from the opposite approach

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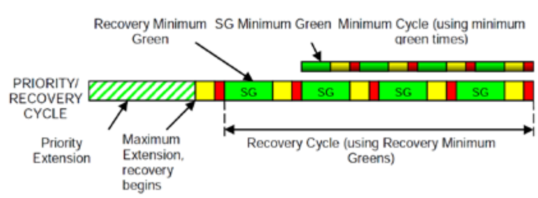
<tr><td>Recovery Mode</td><td>

During a recovery phase, greens are proportional to minimum split of upcoming phases



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Exit into the regular pattern

- The signal groups that would normally be timing at the current point in the cycle will be selected provided those signal groups have a call and there is enough time remaining in the cycle to serve a min. green;
- If those signal groups cannot be selected, the first signal group(s) with a call to follow the signal groups that would normally be timing will be selected.

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Analysis Results

Figure 7 shows the travel time results for local and rapid buses for different service scenarios in terms of the number of seconds to travel the analysis corridor. Shorter bars indicate faster travel times. Figure 8 converts those travel times into average speeds for the buses on the corridor. As shown in the figure, travel time for rapid buses (orange bars) could be reduced incrementally by implementation of each scenario. Local bus travel times are shown as blue bars. Travel time for eastbound local buses (non-peak direction during PM peak) could also be reduced by each successive scenario. As the westbound intersection approaches along the corridor are currently operating at or near capacity (v/c = 0.82) during the PM peak, reducing one through lane (Scenario 4 and Scenario 5-1) on Westheimer can result in increased traffic delays for vehicles in the westbound traffic lanes. For Scenario 5-1, travel time for westbound local buses is increased significantly as it is impacted by westbound traffic congestion resulting from the through lane reduction. The model assumes current traffic volumes with some conversion of trips from driving to transit but levels of congestion may deter some driving trips to other routes or to not be made during the peak period.

The implementation of Scenario 1 (Stop Optimization and Signal Priority at Minor Intersections) could save 40 seconds of travel time for westbound buses and 60 seconds for eastbound buses on the analyzed 1.2-mile segment of Westheimer Road. This represents an approximately 8% reduction in travel time and a 1 mph increase in westbound bus speeds. The time savings for eastbound buses would be even greater.

The implementation of Scenario 4 (Full Westheimer Rapid with Bus/Right-Turn Lane) could further reduce the travel time for both rapid and local buses, but increase the traffic delays for westbound main lanes and the side-streets (see Table 7 and Table 8 for details of intersection Level of Service for each intersection).

The implementation of Scenario 5-2 (BRT in Dedicated Busways with No Lane Reduction) would gain most benefits for both buses and passenger cars on Westheimer. However, it would require extensive ROW acquisition along the corridor.

Incremental bus travel time improvements are also possible when looking at strategies including signal priority or pre-emption at minor intersections or at all corridor intersections including the major intersections at Hillcroft and Fountain View. While these were not specifically recommended as part of the treatments included in the service scenarios, the results of these analyses are also summarized in Figure 7, Table 7, and Table 8 to provide a more complete view of various corridor treatments that should be considered as investments are made along the corridor. As shown in Table 7 and Table 8, these bus travel time improvements would have some negative impacts on traffic operations of the streets intersecting with Westheimer. Delays experienced by side street traffic would be increased by different levels of transit-friendly signal operation, especially on major arterials like Hillcroft and Fountain View where LOS are already operated at LOS E in existing conditions. The approach LOS of side streets would vary from D to F if signal priority/preemption were provided to transit on Westheimer.

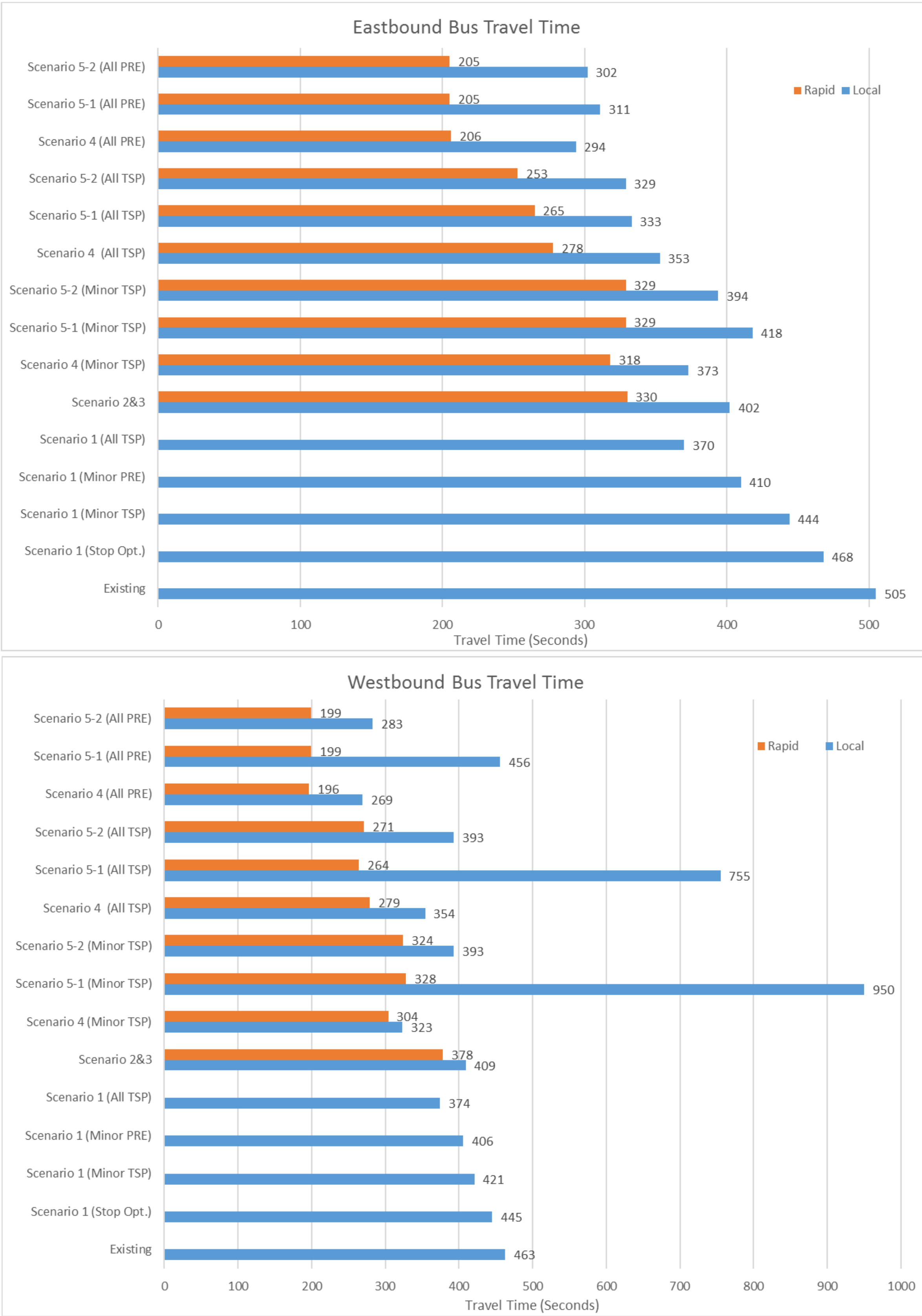

Figure 7: Bus Travel Time Results

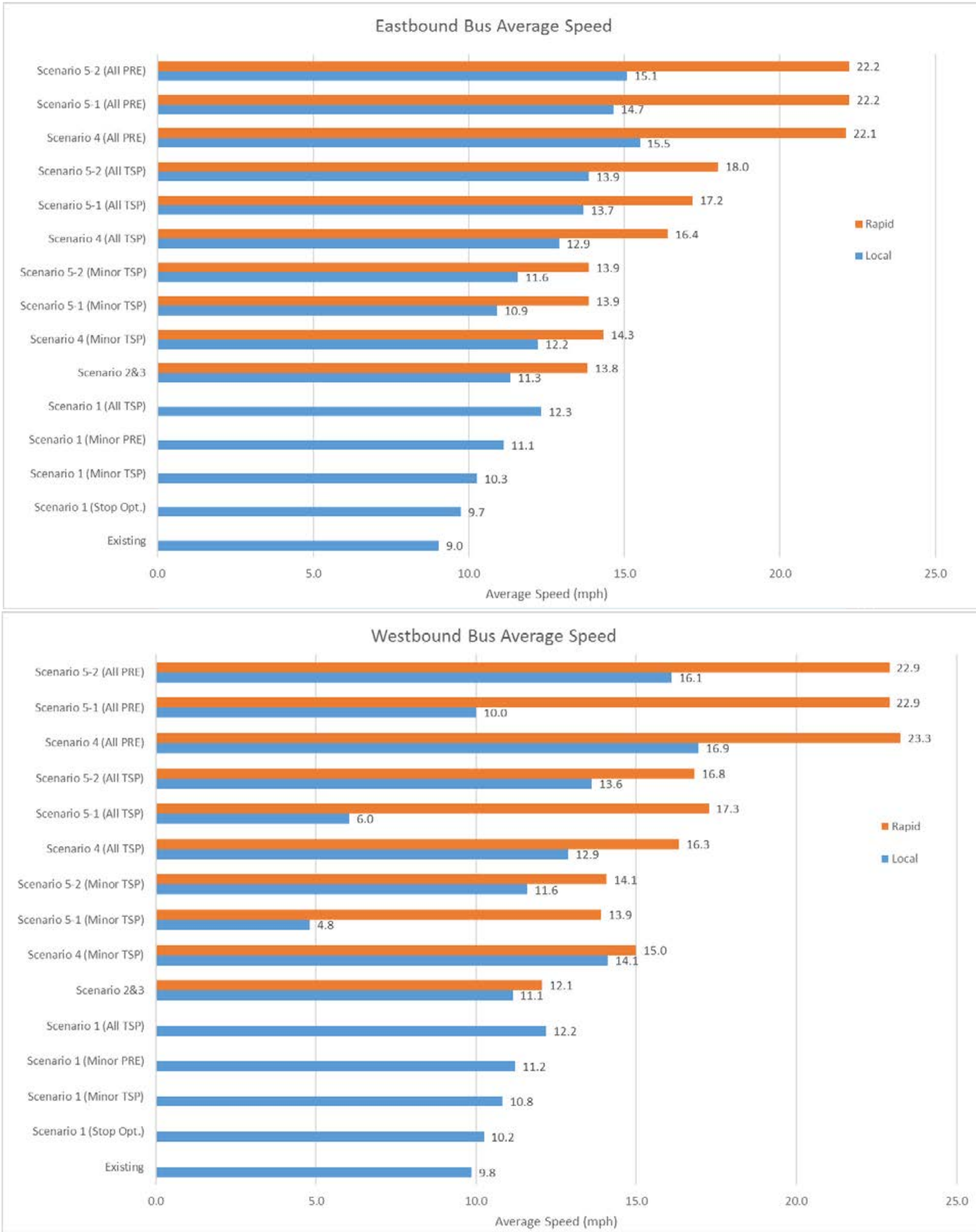

Figure 8 Bus Average Travel Speeds

Table 7: Impacts on Intersections and Side Streets (1)

Existing	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	42	D	49	E	59	C	34	D	40
Westheimer at Greenridge	B	13	D	49	D	46	B	11	A	8
Westheimer at Briarhurst	A	4	D	37	D	46	A	5	A	2
Westheimer at Winrock	B	10	D	48	D	41	A	6	A	10
Westheimer at Hillcroft	E	62	E	56	D	44	D	44	F	88
Scenario 1 - Stop Optimization	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	41	D	49	E	59	C	33	D	40
Westheimer at Greenridge	B	13	D	50	D	45	B	11	A	8
Westheimer at Briarhurst	A	4	D	38	D	46	A	5	A	2
Westheimer at Winrock	B	10	D	49	D	41	A	6	B	10
Westheimer at Hillcroft	E	63	E	55	D	44	D	44	F	91
Scenario 1 - Stop Optimization (Minor TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	42	D	49	E	59	D	35	D	40
Westheimer at Greenridge	B	14	E	67	D	46	B	11	A	8
Westheimer at Briarhurst	A	4	D	37	D	47	A	5	A	2
Westheimer at Winrock	B	10	D	49	D	41	A	6	A	10
Westheimer at Hillcroft	E	62	E	56	D	45	D	44	F	88
Scenario 1 - Stop Optimization (Minor PRE)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	42	D	49	E	59	C	35	D	40
Westheimer at Greenridge	B	16	F	90	D	50	A	10	A	8
Westheimer at Briarhurst	A	6	E	63	F	90	A	4	A	3
Westheimer at Winrock	B	11	E	65	E	65	A	6	A	8
Westheimer at Hillcroft	E	62	E	56	D	45	D	44	F	89
Scenario 1 - Stop Optimization (All TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	47	E	77	F	84	C	28	D	40
Westheimer at Greenridge	B	14	E	63	D	45	B	12	A	8
Westheimer at Briarhurst	A	5	D	38	D	47	A	6	A	2
Westheimer at Winrock	A	9	D	47	D	42	A	6	A	8
Westheimer at Hillcroft	E	59	F	81	E	57	D	43	E	62
Scenario 2/3 - Rapid Bus with Mix Traffic	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	42	D	49	E	59	D	36	D	40
Westheimer at Greenridge	B	15	E	75	D	50	A	9	A	8
Westheimer at Briarhurst	A	4	D	38	D	47	A	4	A	3
Westheimer at Winrock	B	11	D	50	D	43	A	6	B	11
Westheimer at Hillcroft	E	64	E	56	D	45	D	44	F	92
Scenario 4 - Full Westheimer Rapid with Bus/Right-Turn Lane (Minor TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	E	67	E	72	E	62	D	35	F	95
Westheimer at Greenridge	C	33	F	120	D	47	A	10	F	92
Westheimer at Briarhurst	C	22	D	39	D	53	A	4	C	33
Westheimer at Winrock	C	30	D	48	D	46	A	7	D	45
Westheimer at Hillcroft	F	85	E	57	D	47	D	39	F	157

Table 8: Impacts on Intersections and Side Streets (2)

Scenario 4 - Full Westheimer Rapid with Bus/Right-Turn Lane (All TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	43	E	59	E	71	B	19	D	47
Westheimer at Greenridge	C	31	F	100	D	47	B	11	F	97
Westheimer at Briarhurst	A	9	D	38	D	48	A	5	A	9
Westheimer at Winrock	B	18	D	50	D	47	A	8	C	22
Westheimer at Hillcroft	E	76	F	109	D	51	D	42	F	98
Scenario 4 - Full Westheimer Rapid with Bus/Right-Turn Lane (All PRE)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	E	64	F	99	F	115	C	27	E	66
Westheimer at Greenridge	C	32	F	107	D	44	B	12	E	72
Westheimer at Briarhurst	B	18	D	42	E	62	A	6	C	25
Westheimer at Winrock	C	25	D	50	E	57	A	7	C	34
Westheimer at Hillcroft	F	84	F	83	E	65	D	38	F	128
Scenario 5-1 BRT in Dedicated Busway with Min ROW (Minor TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	F	80	E	62	E	63	E	65	F	110
Westheimer at Greenridge	D	41	F	139	D	50	A	10	D	50
Westheimer at Briarhurst	C	24	D	41	E	57	A	6	D	36
Westheimer at Winrock	C	29	D	52	D	52	A	8	D	42
Westheimer at Hillcroft	F	91	D	53	D	46	D	47	F	177
Scenario 5-1 BRT in Dedicated Busway with Min ROW (All TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	E	74	F	116	F	105	D	41	E	77
Westheimer at Greenridge	D	37	F	116	D	50	B	12	D	42
Westheimer at Briarhurst	C	23	D	43	E	57	A	8	C	32
Westheimer at Winrock	C	26	D	47	D	50	A	7	D	37
Westheimer at Hillcroft	F	94	F	84	E	58	D	42	F	160
Scenario 5-1 BRT in Dedicated Busway with Min ROW (All PRE)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	E	60	E	76	F	130	D	45	D	44
Westheimer at Greenridge	C	24	E	77	D	42	B	14	C	23
Westheimer at Briarhurst	B	14	D	38	D	50	A	8	B	17
Westheimer at Winrock	B	19	E	59	E	57	A	8	C	22
Westheimer at Hillcroft	F	96	F	170	F	106	D	55	F	97
Scenario 5-2 BRT in Dedicated Busway with No Lane Reduction (Minor TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	43	D	49	E	57	D	38	D	39
Westheimer at Greenridge	B	17	F	88	D	50	A	9	B	10
Westheimer at Briarhurst	A	4	D	38	D	46	A	5	A	2
Westheimer at Winrock	A	9	D	50	D	40	A	7	A	8
Westheimer at Hillcroft	E	56	D	53	D	44	D	44	E	73
Scenario 5-2 BRT in Dedicated Busway with No Lane Reduction (All TSP)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	54	F	88	F	87	C	28	D	50
Westheimer at Greenridge	B	16	E	70	D	50	B	11	B	10
Westheimer at Briarhurst	A	5	D	38	D	45	A	6	A	2
Westheimer at Winrock	A	9	D	50	D	40	A	6	A	8
Westheimer at Hillcroft	E	60	F	86	E	63	D	39	E	61
Scenario 5-2 BRT in Dedicated Busway with No Lane Reduction (All PRE)	Intersection Average		NB		SB		EB		WB	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Westheimer at Fountainview	D	49	E	76	F	97	D	37	C	31
Westheimer at Greenridge	B	14	E	72	D	50	A	9	A	8
Westheimer at Briarhurst	A	5	D	46	E	62	A	5	A	3
Westheimer at Winrock	A	10	E	61	D	53	A	7	A	7
Westheimer at Hillcroft	E	60	E	74	F	83	D	46	D	50