

# Technical Memorandum No. 4: Origin & Destination Study

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## Table of Contents

1 Why conduct an Origin & Destination Study as Part of the US 2 Route Development Plan?	1
2 What did the O&D study accomplish?	1
3 What methodology was used to collect data?	1
4 What was the output of the study?	2
5 What does this data tell us?	9
6 Will the transfer of trips help US 2?	9
7 Should we build the bypass based on this data?	11

### List of Exhibits

Exhibit 1 Weekday Through Trips 6:30 - 8:30 AM (Tuesday, August 15, 2006)	2
Exhibit 2 Weekday Through Trips, 4:00 - 6:00 PM (Tuesday, August 15, 2006)	3
Exhibit 3 Weekend Through Trips, 3:00 - 6:00 PM (Sunday, August 13, 2006)	4
Exhibit 4 Percentage of Potential Through Trips Taking Monroe Bypass	5
Exhibit 5 Forecasted Weekday Through Trips, PM Peak Hour (2030)	5
Exhibit 6 Forecasted Weekend Through Trips, PM Peak Hour (2030)	6
Exhibit 7 Potential Monroe Bypass Thru Traffic (Weekday ADT – 2006)	7
Exhibit 8 Potential Monroe Bypass Thru Traffic (Weekend ADT – 2006)	7
Exhibit 9 Potential Monroe Bypass Thru Traffic (Weekday ADT – 2030)	8
Exhibit 10 Potential Monroe Bypass Thru Traffic (Weekend ADT – 2030)	8
Exhibit 11 Potential Through Trips Taking Monroe Bypass (2006 & 2030)	9
Exhibit 12 2030 Weekday PM Traffic Turning Movements	10
Exhibit 13 2030 Weekend PM Traffic Turning Movements	10
Exhibit 14 2030 Intersection Delay & LOS	10

# US 2 - Origin & Destination Study

## **1 Why conduct an Origin & Destination Study as Part of the US 2 Route Development Plan?**

There are two primary reasons why an origin & destination (O&D) study was conducted as part of the US 2 Route Development Plan (RDP):

- To provide better data from which to evaluate the effectiveness of the long planned bypass of the City of Monroe; and
- The City of Monroe requested the data, if it could be made available through the RDP process.

## **2 What did the O&D study accomplish?**

The O&D Study provided the data from which we were able to document three primary areas of concern, as follows:

- Total incoming and outgoing traffic volumes at 5 strategic locations in the study area;
- Through traffic flow on US 2 within the City of Monroe for three different periods (an extended weekday AM and PM peak and an extended weekend peak); and
- Possible traffic flow redistribution and Level of Service along US 2 in Monroe if a staged Monroe bypass is constructed.

## **3 What methodology was used to collect data?**

An automatic license plate recognition (ALPR) technology was used to collect the “raw” license plate data. The ALPR-specific camera and data processing unit collects, deciphers and stores license plate image data, and all corresponding event information. A license plate image is captured and processed by an Optical Character Recognition (OCR) software program.

During the O&D study, a non-intrusive simultaneous survey was conducted of license plates at 5 strategic points along the US 2, SR 522 and SR 203 corridors to collect information regarding travel patterns. The video recording equipment was used to photograph license plates in each travel lane in both directions and a computer program was used to match license plates in other locations during select peak periods. The number of matching plates between each of the detection points provides information regarding length of trips and the entering and exiting locations of trips within the US 2 study area.

The area for this O&D study extends from west of Monroe to east of Sultan. Recording video cameras were placed in five locations within the study area, as follows:

- Between Sultan and Gold Bar on US 2;
- Between Sultan and Monroe on US2;
- South of Monroe on SR 203
- West of Monroe on US2; and
- South of Monroe on SR 522.

**4 What was the output of the study?**

The output of the O&D study can best be shown using a series of tables. Each table identifies an origin (the location of an ALPR camera identifying vehicles entering the study area) and a destination (the location of an ALPR camera identifying vehicles exiting the study area). The table also identifies the total number of vehicles passing a camera during the recording period, as well as how many vehicles originated at an incoming point and exited at a destination point during the recording period. For example, within **Exhibit 1**, 131 vehicles are indicated as having come from the US 2 inbound camera station, west of SR 522 and exited at the SR 203 out bound station, south of Monroe.

**Exhibit 1**

**Weekday Through Trips 6:30 - 8:30 AM (Tuesday, August 15, 2006)**

Destination	US 2 W/O Monroe WB (1151)	SR 522 S/O Monroe SB (558)	SR 203 S/O Monroe SB (1594)	US 2 E/O Monroe WB (1295)	US 2 E/O Monroe EB (487)	US 2 E/O Sultan EB (331)	Total Percent
Origin							
US 2 W/O Monroe EB (989)	0	12	131	0	114	51*	<b>257</b> 25.99%
SR 522 S/O Monroe NB (314)	12	0	11	0	50	22*	<b>73</b> 23.25%
SR 203 S/O Monroe NB (337)	64	8	0	0	29	10*	<b>101</b> 29.97%
US 2 E/O Monroe WB (1295)	224	138	233	0	0	0	<b>595</b> 45.95%
US 2 E/O Monroe EB (487)	0	0	0	0	0	141	<b>141</b> 28.95%
US 2 E/O Sultan WB (757)				387	0	0	<b>387</b> 51.12%

Source: HW Lochner, 2006. \*Data not included in total to avoid double count.

**Exhibit 2**  
**Weekday Through Trips, 4:00 - 6:00 PM (Tuesday, August 15, 2006)**

Destination	US 2 W/O Monroe WB (1585)	SR 522 S/O Monroe SB (749)	SR 203 S/O Monroe SB (732)	US 2 E/O Monroe WB (797)	US 2 E/O Monroe EB (908)	US 2 E/O Sultan EB (990)	Total Percent
Origin							
US 2 W/O Monroe EB (957)	0	15	74	0	119	83*	<b>208</b> 21.73%
SR 522 S/O Monroe NB (765)	20	0	8	0	104	56*	<b>132</b> 17.25%
SR 203 S/O Monroe NB (1661)	180	20	0	0	114	78*	<b>314</b> 18.90%
US 2 E/O Monroe WB (797)	204	147	57	0	0	0	<b>408</b> 51.19%
US 2 E/O Monroe EB (908)	0	0	0	0	0	308	<b>308</b> 33.92%
US 2 E/O Sultan WB (590)				278	0	0	<b>278</b> 47.12%

Source: HW Lochner, 2006. \*Data not included in total to avoid double count.

**Exhibit 3  
Weekend Through Trips, 3:00 - 6:00 PM (Sunday, August 13, 2006)**

Destination	US 2 W/O Monroe WB (2357)	SR 522 S/O Monroe SB (1535)	SR 203 S/O Monroe SB (1150)	US 2 E/O Monroe WB (1684)	US 2 E/O Monroe EB (1402)	US 2 E/O Sultan EB (563)	Total Percent
Origin							
US 2 W/O Monroe EB (1600)	0	35	183	0	300	103*	<b>518</b> 32.38%
SR 522 S/O Monroe NB (947)	47	0	29	0	219	94*	<b>295</b> 31.15%
SR 203 S/O Monroe NB (1201)	223	34	0	0	85	19*	<b>342</b> 28.48%
US 2 E/O Monroe WB (1684)	390	376	100	0	0	0	<b>866</b> 51.43%
US 2 E/O Monroe EB (1402)	0	0	0	0	0	295	<b>295</b> 21.04%
US 2 E/O Sultan WB (1591)				619	0	0	<b>619</b> 38.91%

Source: HW Lochner, 2006. \*Data not included in total to avoid double counting.

Another way to look at this data is to combine the trip tables and express the data in terms of the percentage of incoming trips that would potentially take a Monroe Bypass if constructed. These percentages are shown within **Exhibit 4**. For the purposes of this evaluation, north bound vehicles passing the SR 203 station south of Monroe are not included. There is no logical travel route that would put these vehicles on the proposed Monroe Bypass.

Consequently, the **through** trips that would potentially take the proposed Monroe Bypass would include:

- West bound trips originating east of Monroe on US 2 and exiting either west of Monroe on US 2 or south of Monroe on SR 522 (the US 2 trips originating east of Sultan, going west bound are included in the east Monroe station);
- East bound trips west of Monroe on US 2, exiting east of Monroe and remaining on US 2; and
- North bound trips originating south of Monroe on SR 522, exiting east of Monroe on US 2.

We can also apply the percentages and ratios from Exhibits 2 and 3 to create 2030 PM peak hour tables as well as calculate the total number of trip that could potentially take the proposed Monroe Bypass.

**Exhibit 4**

**Percentage of Potential Through Trips Taking Monroe Bypass**

Peak Period Direction	Weekday		Weekend
	AM Peak	PM Peak	PM Peak
Westbound	362 ÷ 1295 <b>28%</b>	351 ÷ 797 <b>44%</b>	766 ÷ 1684 <b>45%</b>
Eastbound	164 ÷ 1303 <b>12%</b>	223 ÷ 1722 <b>13%</b>	519 ÷ 2547 <b>20%</b>

Source: HW Lochner, 2006

Based on the forecasts provided in Technical Report No. 1 (derived from both the Monroe Transportation Model and the PSRC Transportation Model), **Exhibit 5** and **Exhibit 6** include through trip forecast data for each of the originating stations described above.

**Exhibit 5**

**Forecasted Weekday Through Trips, PM Peak Hour (2030)**

Destination	US 2 W/O Monroe WB (2243)	SR 522 S/O Monroe SB (710)	SR 203 S/O Monroe SB (844)	US 2 E/O Monroe WB (1810)	US 2 E/O Monroe EB (993)	US 2 E/O Sultan EB (1553)	Total Percent
Origin							
US 2 W/O Monroe EB (1508)	0	25	117	0	188	131*	<b>330</b> 21.73%
SR 522 S/O Monroe NB (1580)	41	0	17	0	215	116*	<b>273</b> 17.25%
SR 203 S/O Monroe NB (972)	105	12	0	0	67	46*	<b>184</b> 18.90%
US 2 E/O Monroe WB (1810)	463	334	129	0	0	0	<b>926</b> 51.19%
US 2 E/O Monroe EB (993)	0	0	0	0	0	337	<b>337</b> 33.92%
US 2 E/O Sultan WB (1130)				532	0	0	<b>532</b> 47.08%

Source: HW Lochner, 2006. \*Data not included in total to avoid double count

**Exhibit 6  
Forecasted Weekend Through Trips, PM Peak Hour (2030)**

Destination	US 2 W/O Monroe WB (2000)	SR 522 S/O Monroe SB (1000)	SR 203 S/O Monroe SB (600)	US 2 E/O Monroe WB (1034)	US 2 E/O Monroe EB (1857)	US 2 E/O Sultan EB (1289)	Total Percent
Origin							
US 2 W/O Monroe EB (1155)	0	25	132	0	217	74*	<b>374</b> <b>32.28%</b>
SR 522 S/O Monroe NB (624)	31	0	19	0	144	62*	<b>194</b> <b>31.15%</b>
SR 203 S/O Monroe NB (628)	117	18	0	0	44	10*	<b>179</b> <b>28.48%</b>
US 2 E/O Monroe WB (1857)	430	415	110	0	0	0	<b>955</b> <b>51.43%</b>
US 2 E/O Monroe EB (1034)	0	0	0	0	0	217	<b>217</b> <b>21.92%</b>
US 2 E/O Sultan WB (2972)				1156	0	0	<b>1156</b> <b>38.90</b>

Source: HW Lochner, 2006. \*Data not included in total to avoid double count

**Exhibits 7, 8, 9 and 10** graphically portray through movements along the proposed Monroe Bypass at four time periods (2006, weekday & weekend; 2030, weekday and weekend). The data is also shown in tabular form in **Exhibit 11**. AM forecasts are not provided because the forecast models are based on the PM Peak.<sup>1</sup> In addition, the west bound total was increased by transferring ½ of trips going from East of Monroe on US 2 to South of Monroe on SR 203 to South of Monroe on SR 522. During the O&D study period, SR 522 was under construction. Local agency representatives report that current commuters avoid SR 522 due to construction delays by taking SR 203. With the bypass in place and construction on SR 522 completed it is anticipated that those trips will return to SR 522.

<sup>1</sup> Exhibits 5 & 6 are based on a peak hour. Exhibits 1, 2, 3 & 4 are peak period.

Exhibit 7

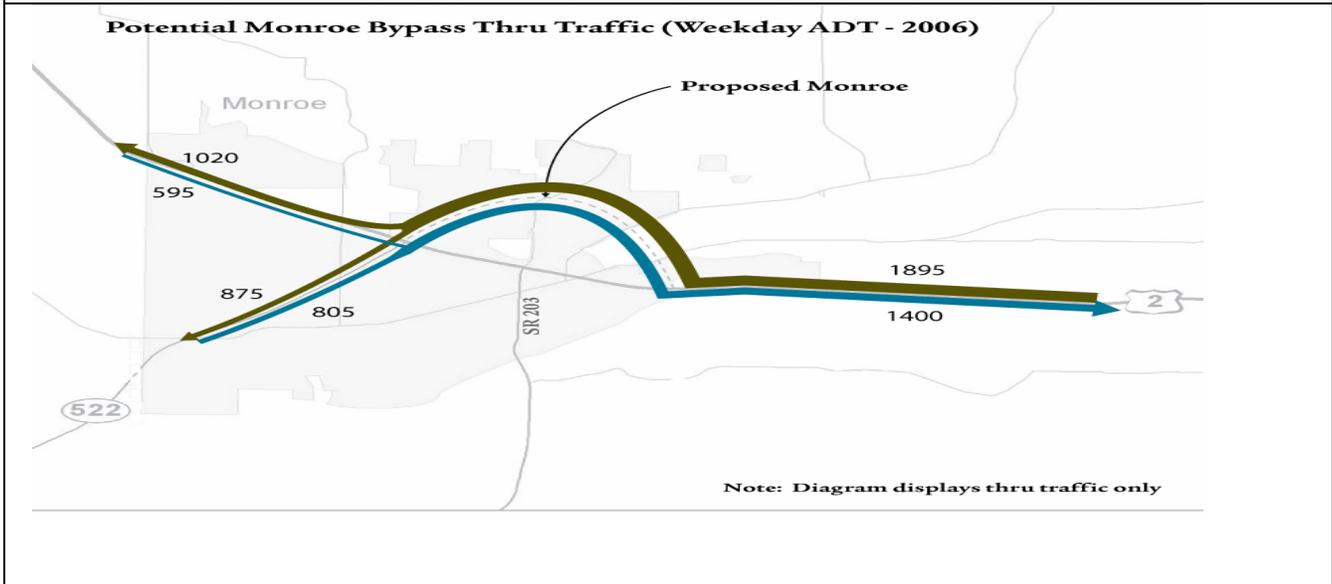


Exhibit 8

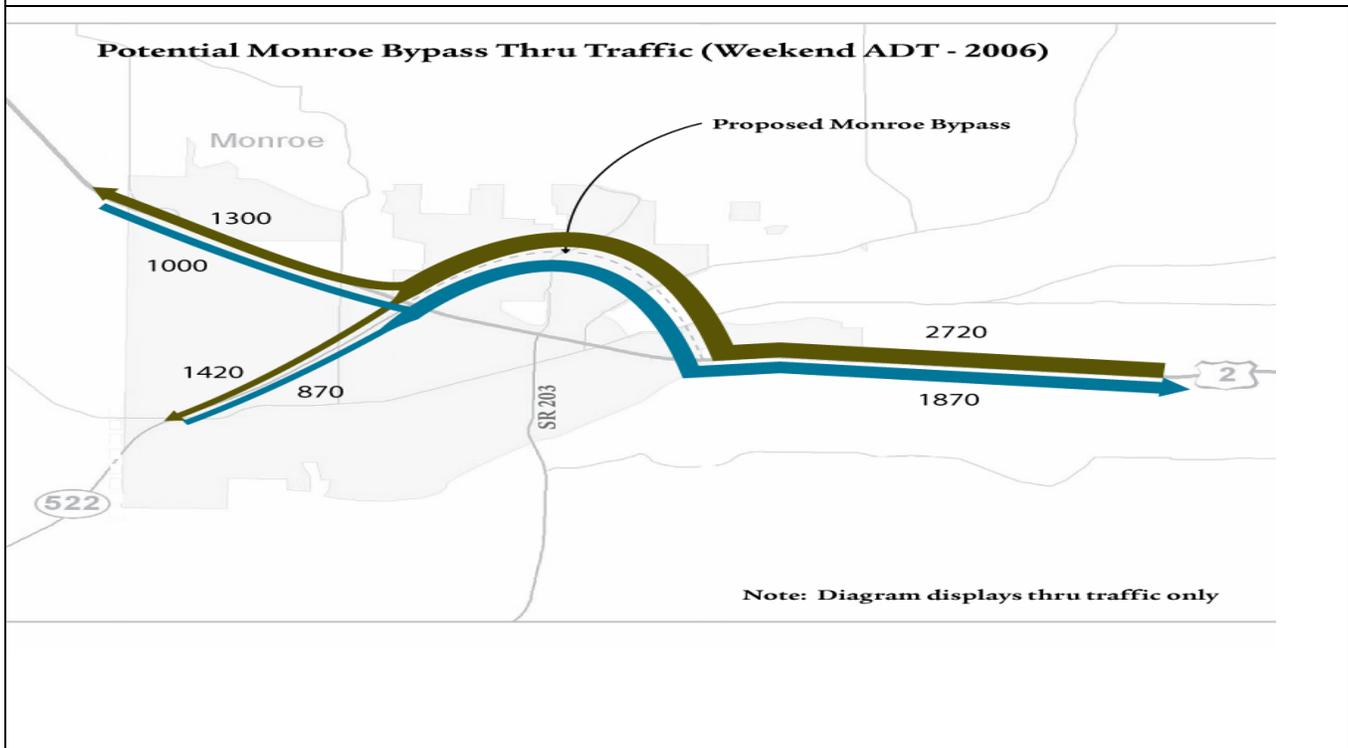


Exhibit 9

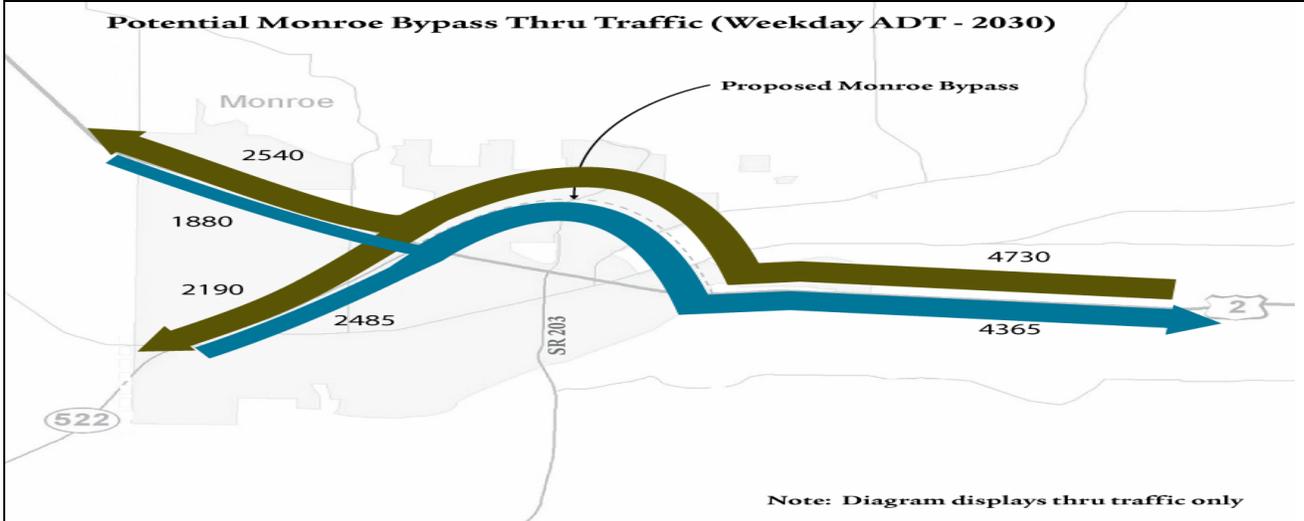
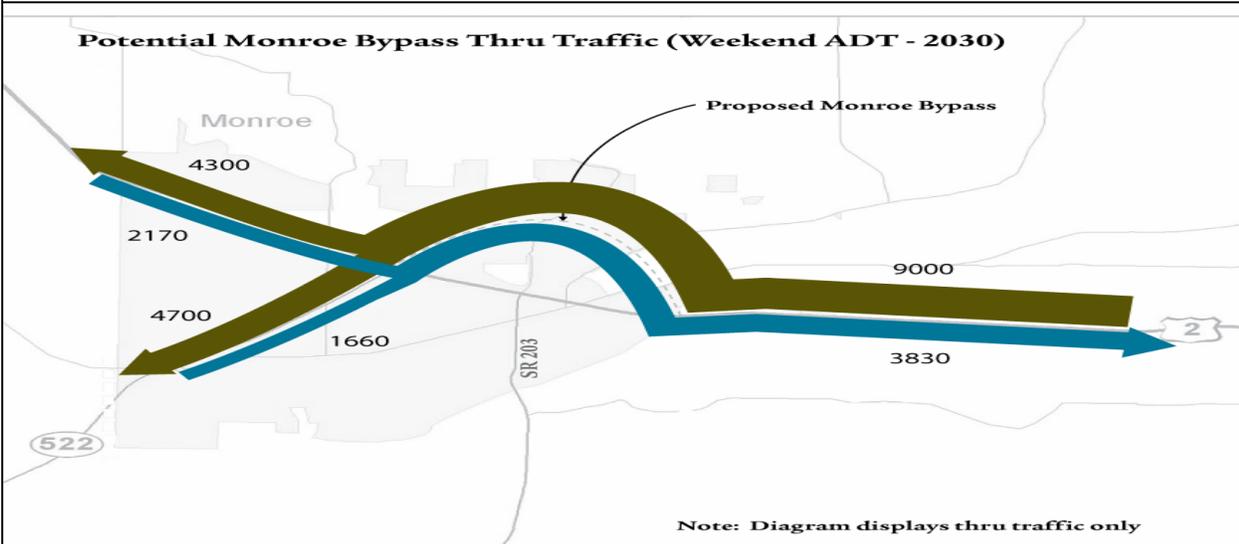


Exhibit 10



**Exhibit 11****Potential Through Trips Taking Monroe Bypass (2006 & 2030)**

Period Direction	Weekday			Weekend		
	EB	WB	Total	EB	WB	Total
2006	1,400	1,895	3,295	1,870	2,720	4,590
2030	4,365	4,730	9,095	3,830	9,000	12,830

Source: HW Lochner, 2006

**5 What does this data tell us?**

The data suggests that if a bypass was constructed to carry through traffic only, it would carry less than 4,000 vehicles on a typical weekday and less than 5,000 vehicles on a typical weekend. By the year 2030, assuming travel patterns remain relatively consistent, weekday through trips would be less than 10,000; weekend less than 13,000.

**6 Will the transfer of trips help US 2?**

**Exhibits 12, 13** and **14** tell more of the story. **Exhibits 12** and **13** include turning movement data at five major intersections with US 2 in Monroe. **Exhibit 14** includes intersection delays in 2030 with and without the proposed bypass at these same intersections. While a simplistic way to look at the results, if you total the average weekday and weekend delay at each of these critical intersections, the bypass would improve travel time through these intersections by 44% (weekday) and 77% (weekend) respectively. The level of service, as measured using the A, B, C, D, E, F scale remains the same for the weekday, but improves substantially on the weekend.

<b>Exhibit 12 2030 Weekday PM Traffic Turning Movements</b>												
Location	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
SR 522 Interchange	80	1610	0	0	1057	630	0	0	0	1111	0	220
Kelsey Street	630	1373	210	190	737	70	250	230	110	210	240	510
SR 203	512	1059	226	263	505	53	478	330	164	434	355	114
Ann Street	878	721	102	0	647	116	0	0	37	0	0	405
Main Street	290	698	15	109	368	43	367	178	476	199	159	275

<b>Exhibit 13 2030 Weekend PM Traffic Turning Movements</b>												
Location	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
SR 522 Interchange	87	1265	0	0	663	913	0	0	0	396	0	62
Kelsey Street	546	752	181	183	711	88	137	210	86	329	377	763
SR 203	375	798	162	189	403	45	367	172	90	232	249	64
Ann Street	616	458	72	0	712	59	0	0	15	0	0	398
Main Street	213	384	22	163	764	30	171	110	176	92	152	239

**Exhibit 14  
2030 Intersection Delay & LOS**

Location	Without Monroe Bypass in Place				With Monroe Bypass in Place			
	Weekday		Weekend		Weekday		Weekend	
	Average Delay (s)	LOS	Average Delay (s)	LOS	Average Delay (s)	LOS	Average Delay (s)	LOS
SR 522 Interchange	201	F	181	F	64	E	12	B
Kelsey Street	148	F	199	F	63	E	62	E
SR 203	208	F	81	F	121	F	52	D
Ann Street	102	E	140	E	31	D	10	C
Main Street	85	F	98	F	47	D	28	C

## **7 Should we build the bypass based on this data?**

It is too early in the process to definitively answer this question without at least two more evaluations. First, WSDOT should evaluate the benefit of an access point somewhere along the bypass to see if further safety and congestion relief can be gained. Second, a cost effectiveness evaluation should be completed.

As with all projects completed by any agency, an evaluation must be completed in context of all competing projects. This additional evaluation will better enable decision makers to compare projects, one against all others, and the benefits to the traveling public as a whole.