**TO:** **Jason Ullman P.E., City of Montrose**

**FROM:** **Mohan Garakhalli P.E.,PTOE**

**DATE:** **March 7, 2009**

**SUBJECT:** **Downtown Traffic Study**

## 1.0 INTRODUCTION

The Town of Montrose has requested that PBS&J investigate the benefits of access optimization and intersection control relocation for a few streets in downtown Montrose. The downtown study area is generally bounded by North 2nd Street on the north; South 6th Street on the south; Townsend Avenue (US 550) on the west; and Mesa Avenue on the east. This study area was defined to account for change in progression along Townsend Avenue and account for adequate spatial re-distribution of volume due to re-configuration of access points and roadways.

## 2.0 EXISTING CONDITIONS

### 2.1 EXISTING TRAFFIC VOLUMES

PBS&J initiated the study by collecting AM and PM peak hour turning movement counts (TMCs) at the intersections within the downtown study area and supplementing this with data received by the City of Montrose. PBS&J also collected daily directional traffic counts on the streets within the downtown study area. The data collection was performed by PBS&J at all major intersections in the study area. Daily directional counts were also conducted along major arterials in the study area. A map showing the existing traffic data that was collected is shown in Figure 2-1.

**Figure 2-1**
**Existing Data Collection Locations**

## 2.2 EXISTING LEVEL OF SERVICE ANALYSIS (ALTERNATIVE 1)

PBS&J calculated the level of service (LOS) of the intersections in the downtown study area using the methodologies described in the *2000 Highway Capacity Manual* (HCM). At intersections, LOS was calculated separately for AM peak hour and PM peak hour conditions. The results of this analysis are depicted in Table 2-1. The analysis indicates that most intersections are currently operating at an acceptable LOS.

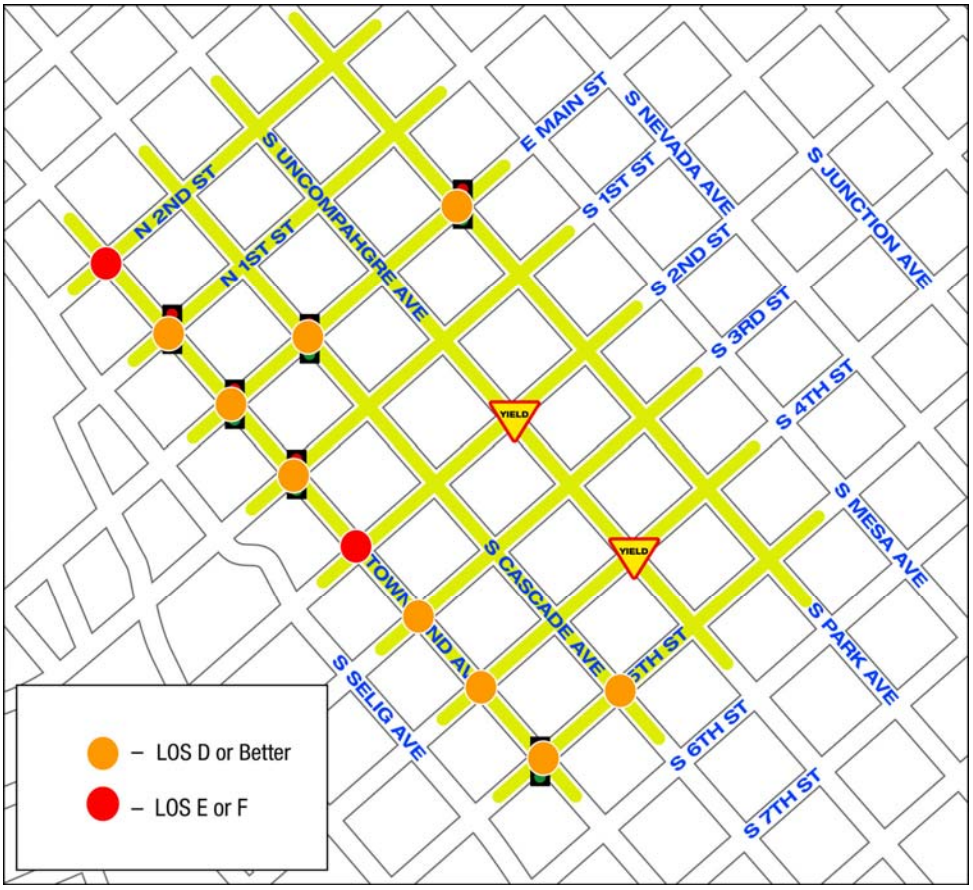
**Table 2-1**
**Existing Conditions Level of Service**

| Intersection | AM | | PM | |
|---|---|---|---|---|
| | Delay (sec) | LOS | Delay (sec) | LOS |
| **US 50 and N. 2nd** | 69.2 | F | 70.7 | F |
| **US 50 and N. 1st** | 4.5 | A | 2.8 | A |
| **US 550 and Main** | 16.8 | B | 24.3 | C |
| **US 550 and S. 1st** | 5.6 | A | 5.6 | A |
| **US 550 and S. 2nd** | 19.7 | C | 105.5 | F |
| **US 550 and S. 3rd** | 0.7 | A | 1.2 | A |
| **US 550 and S. 4th** | 0.3 | A | 0.6 | A |
| **US 550 and S. 5th** | 4.5 | A | 5.2 | A |
| **Cascade and N. 2nd** | 4.8 | A | 4.8 | A |
| **Cascade and N. 1st** | 4.6 | A | 6.9 | A |
| **Cascade and Main** | 4.8 | A | 8.7 | A |
| **Cascade and S. 1st** | 4.6 | A | 5.8 | A |
| **Cascade and S. 2nd** | 4.8 | A | 6.5 | A |
| **Cascade and S. 3rd** | 6.3 | A | 6.5 | A |
| **Cascade and S. 4th** | 6.6 | A | 4.0 | A |
| **Cascade and S. 5th** | 2.2 | A | 4.7 | A |
| **Uncompahgre and N. 2nd** | 4.8 | A | 4.8 | A |
| **Uncompahgre and N. 1st** | 3.7 | A | 4.1 | A |
| **Uncompahgre and Main** | 0.4 | A | 0.6 | A |
| **Uncompahgre and S. 1st** | 1.5 | A | 1.1 | A |
| **Uncompahgre and S. 2nd** | 2.9 | A | 3.1 | A |
| **Uncompahgre and S. 3rd** | 3.2 | A | 3.2 | A |
| **Uncompahgre and S. 4th** | 4.8 | A | 4.3 | A |
| **Uncompahgre and S. 5th** | 1.1 | A | 1 | A |
| **Park and N. 2nd** | 7.8 | A | 8.4 | A |
| **Park and N. 1st** | 2.4 | A | 2.6 | A |
| **Park and Main** | 11.9 | B | 7.8 | A |
| **Park and S. 1st** | 1.8 | A | 2.9 | A |
| **Park and S. 2nd** | 1.6 | A | 1.2 | A |
| **Park and S. 3rd** | 1.6 | A | 3.8 | A |
| **Park and S. 4th** | 0.8 | A | 1.7 | A |
| **Park and S. 5th** | 8.2 | A | 13.7 | B |

Results of the analysis indicate that most of the intersections in the study area operate acceptably except the N. 2nd Street/US 50 and S 2nd Street/US 550 intersections. Figure 2-2 shows existing

intersection operations in the study area. Side street approach delays at a few intersections are in the LOS D range.

**Figure 2-2**
**Existing Intersection Operations**




Several operational issues were observed along N.2nd Street and S.2nd Street during the field visit. Most of the issues observed were due to parking maneuvers and pedestrian traffic along S.1st Street and S.2nd Street. Significant vehicular friction between vehicles performing parking maneuvers and vehicles travelling along the roadway were observed. Lack of physical separation between traffic and parked vehicles amplifies this problem and creates conditions that are not conducive to pedestrian traffic along these streets.

## 2.3 STUDY ALTERNATIVES (EXISTING VOLUME CONDITIONS)

Reconfiguration of the street network was considered to help alleviate capacity issues. These measures would also address the operational issues observed in the study area. The following options were developed and evaluated to determine the best alternative:

### 2.3.1 Alternative 2: The following changes are proposed to the roadway network for this alternative:

- Analyze the existing roadway network for existing volume conditions

Existing conditions analysis was performed to quantify traffic operations for current conditions. Results of the existing conditions analysis was also used as a baseline scenario against which all other alternatives could be compared. Results of the analysis are summarized in Section 2.4 of the document and the resultant volumes are summarized in the Appendix.

### 2.3.2 Alternative 2: The following changes are proposed to the roadway network for this alternative:

- Converting N. 1$^{st}$/N.2$^{nd}$ Streets to a clockwise one-way pair
- Converting S.1$^{st}$/S.2$^{nd}$ Streets to a clockwise one way pair
- Relocating the signal from N.1$^{st}$ Street to N.2$^{nd}$ Street
- Relocating the signal from S.1$^{st}$ Street to S.2$^{nd}$ Street

Conversion of these streets to clockwise-one-way pairs would offer the following advantages:

- Conversion of the street pairs to one-way street allows for dedication of additional right of way to parking maneuvers reducing the risk of vehicles collisions due to these maneuvers.
- Conversion to one-way reduces friction due to parking maneuvers.
- Availability of additional right of way also introduces a healthy buffer between vehicular traffic and pedestrians.
- One-way streets offer a narrower travelled way, which translates to shorter crossing distances for pedestrians and encourages the use of cross-walks.
- Conversion to one-way streets also enables re-timing of signals to balance service times between main street and side-street traffic.

To analyze the identified improvements for this alternative, traffic volumes were re-distributed throughout the network to account for the one-way street conversion and intersection controls were changed to match the proposed signal relocation. Results of the analysis are summarized in Section 2.4 of the document and the resultant volumes are summarized in the Appendix.

### 2.3.3 Alternative 3: The following changes are proposed to the roadway network for this alternative:

- Re-location of the existing signal from N.1$^{st}$ to N.2$^{nd}$ Street
- Re-location of the existing signal from S.1$^{st}$ to S.2$^{nd}$ Street.

Relocation of existing signals would offer the following advantages:

- Relocation of signals would provide better signal spacing on US 50/550 which would help traffic flow on US 50/550
- Improvement of operations along US 50/550 would translate to better access and shorter wait times for vehicles accessing facilities in the downtown area
- Better spacing of signals allow for significant improvements of adjacent intersections including lengthening of turn bays for adjacent intersections.
- Signal relocation will create better gaps in traffic along US 550, in turn improving access to and off of other adjacent side streets

Intersection controls were changed to match the proposed signal relocation prior to performing the traffic analysis for the study area. Results of the analysis are summarized in Section 2.4 of the document and the resultant volumes are summarized in the Appendix.

### 2.3.4 Alternative 4: The following changes are proposed to the roadway network for this alternative:

- Convert the east leg of US 550 and S.1$^{st}$ Street to a right-in/right-out
- Convert the east leg of US 50 and N.1$^{st}$ Street to a right-in/right-out
- Relocate the signal from S.1$^{st}$ Street to S.2$^{nd}$ Street.
- Relocate the signal at N.1$^{st}$ Street to N.2$^{nd}$ Street

This option would offer the following benefits

- S.2$^{nd}$ Street experiences significant ingress and egress traffic due to surrounding land uses. Relocation of a signal to S.2nd Street would improve service to side-street traffic on S.2nd Street.
- Relocation of signals would provide better signal spacing on US 50/550 which would help traffic flow on US 50/550
- Signal relocation will create better gaps in traffic along US 50/550 in turn improving access to and off of S.1$^{st}$ Street.

Traffic volumes were re-distributed to account for the change in access to N.1$^{st}$ and S.1$^{st}$ Streets and intersection controls were changed to match the proposed signal relocation prior to performing the traffic analysis for the study area. Results of the analysis are summarized in Section 2.4 of the document and the resultant volumes are summarized in the Appendix.

### 2.3.5 Alternative 5: The following changes are proposed to the roadway network for this alternative:

- Close the east leg of US 550 and S.1st Street and relocate the signal to S.2nd Street.
- Convert the east leg of US 550 and N.1st Street to a right-in/right-out
- Relocate the signal from S.1st Street to S.2nd Street.
- Relocate the signal at N.1st Street to N.2nd Street

This option would offer the following benefits

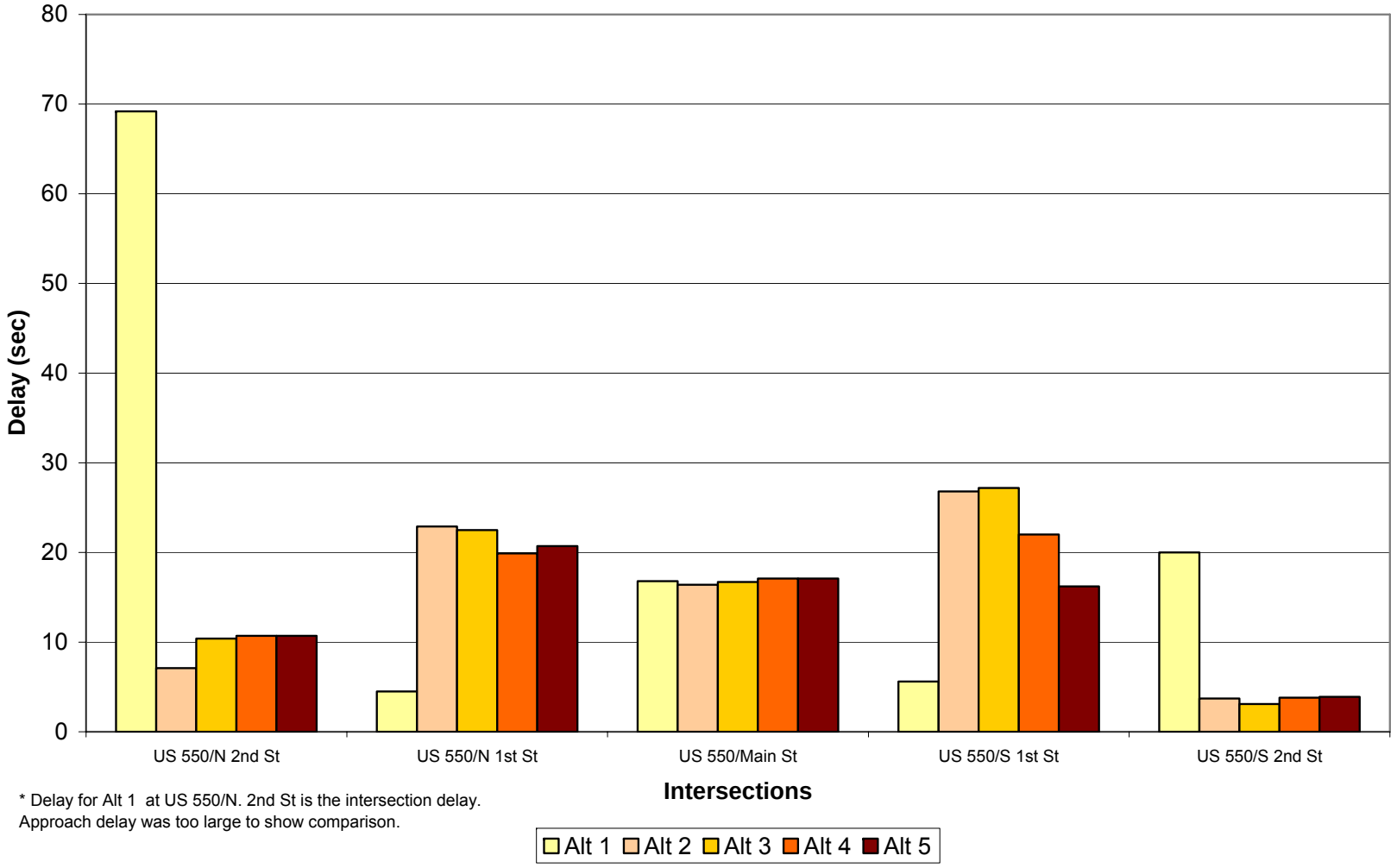
- S.2nd Street experiences significant ingress and egress traffic due to surrounding land uses. Relocation of a signal to S.2nd Street would improve service to side-street traffic on S.2nd Street.
- Relocation of signals would provide better signal spacing on US 50/550 which would help traffic flow on US 550
- Signal relocation will create better gaps in traffic along US 50/550.
- Additional parking opportunities could be created along S.1st Street to meet local demands.

It was assumed that trip redistribution will occur to accommodate the closed east leg at S.1st Street and will access Main Street or S.2nd Street to complete their trip. Traffic was re-distributed throughout the network to reflect this change in trip pattern. Intersection controls were changed to match the proposed signal relocation prior to performing the traffic analysis for the study area. Results of the analysis are summarized in Section 2.4 of the document and the resultant volumes are summarized in the Appendix.

## 2.4 RESULTS (EXISTING CONDITIONS)

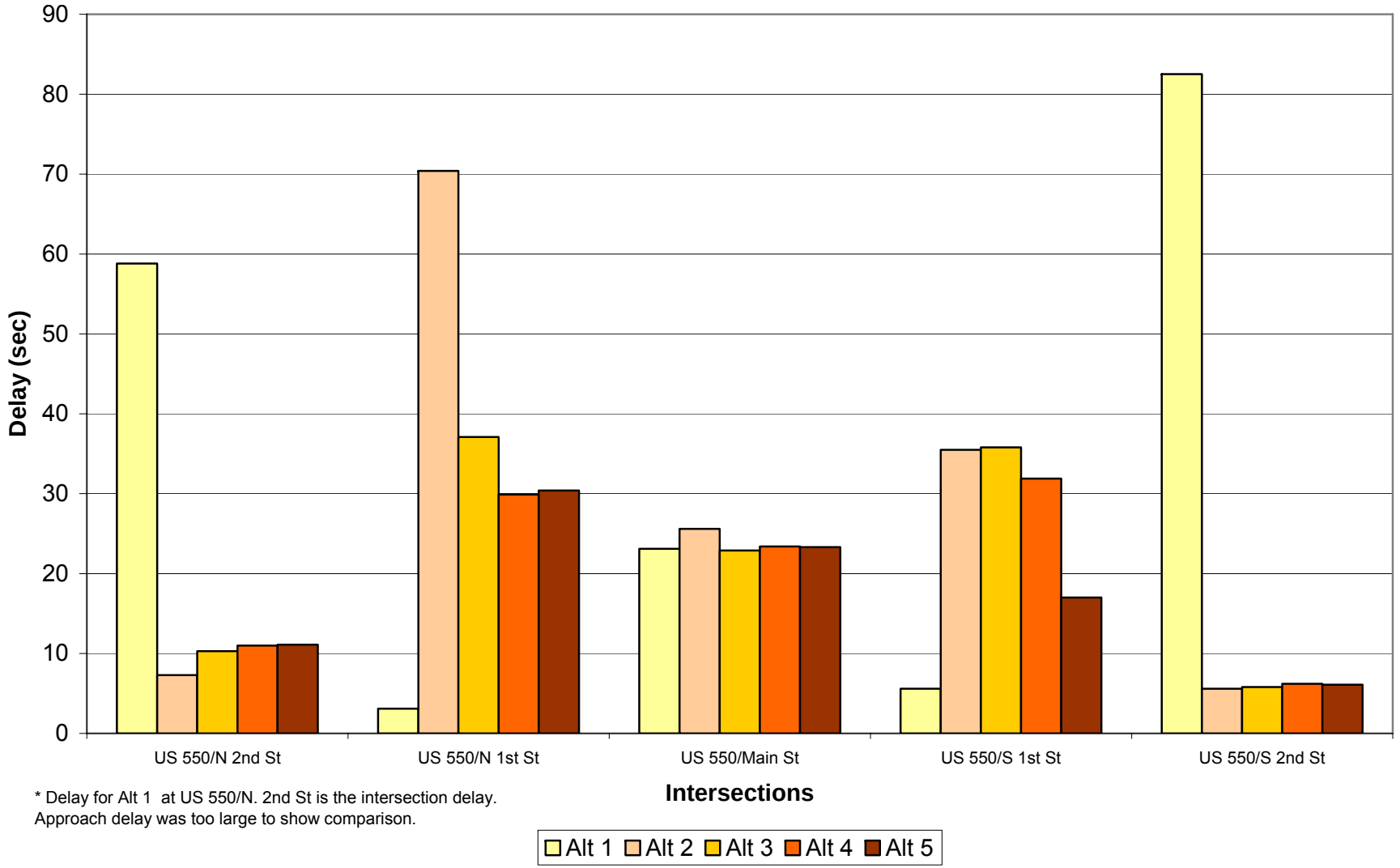
Inspection of the results for existing volume conditions indicate that most alternatives function acceptably and with low delays (delay less that 55 seconds per vehicle – LOS D). The results also indicate that intersections with signals function with lower delay than those that have side-street stop control. **Figure 2-3** and **Figure 2-4** summarizes the results of the analyses for existing conditions.

**Figure 2-3**
**Summary of operations for Existing AM Peak**




* Delay for Alt 1 at US 550/N. 2nd St is the intersection delay. Approach delay was too large to show comparison.

**Figure 2-4**
**Summary of operations for Existing PM Peak**




* Delay for Alt 1 at US 550/N. 2nd St is the intersection delay. Approach delay was too large to show comparison.

The intersection of N.2nd Street and US 50 experiences the highest delay during existing conditions due to the side-street stop control which functions with higher delays for the side street. This intersection functions with lower delays for all other alternatives (alternatives 2 through 5) due to the relocation of the N.1st Street and US 550 signal to this intersection. Redistribution of volumes has minimal impact on the operations of the intersection for alternatives 2 through 5 for the AM and PM peak hours.

The intersection of N.1st Street and US 50 experiences the least delay during existing conditions as a signalized intersection. This intersection functions with higher delays for all other alternatives (alts 2 through 5). Conversion of the east leg to a right-in right-out access results in comparatively lower delays (alternatives 3 through 5) during the AM and PM peak hours. This difference in delay is more pronounced during the PM peak hour which experiences higher volumes than the AM peak hour. The intersection operates with acceptable delays for all alternatives.

The intersection of Main Street and US 550 experiences very little change in delays between alternatives. Volume re-distribution due to alternatives 2, 4 and 5 increased traffic on Main Street slightly. This increase in traffic does not translate to a change in delay for this intersection. The intersection is projected to operate with acceptable delays for the AM and PM peak hours.

S.1st Street experiences the most significant change in travel patterns as compared to other streets in the study area. Alternatives 2, 3 and 5 are projected to decrease travel along S.1st Street between US 550 and Cascade Avenue. A portion of the existing traffic is expected to use other routes to reach their destination due to reconfiguration of the intersection of S.1st Street and US 550 for some of the alternatives. This intersection experiences the least delay during existing conditions as a signalized intersection. This intersection functions with higher delays for all other alternatives (alts 2 through 5). Conversion of the east leg to a right-in right-out access or closure of the east leg results in comparatively lower delays (alternatives 4 and 5) during the AM and PM peak hours. This difference in delay is more pronounced during the PM peak hour which experiences higher volumes than the AM peak hour. The intersection operates with acceptable delays for all alternatives.

Change in delay along S.1st is summarized in **Figure 2-5** and **Figure 2-6**. Review of the analysis indicates that delay at intersection adjacent to US 550 along S.1st experience very minor changes and that restriction of access along S.1st has negligible impact on other intersections along the streets due to volume re-distribution.

**Figure 2-5**
**Summary of operations for S.1st Street (Existing AM Peak Hour)**

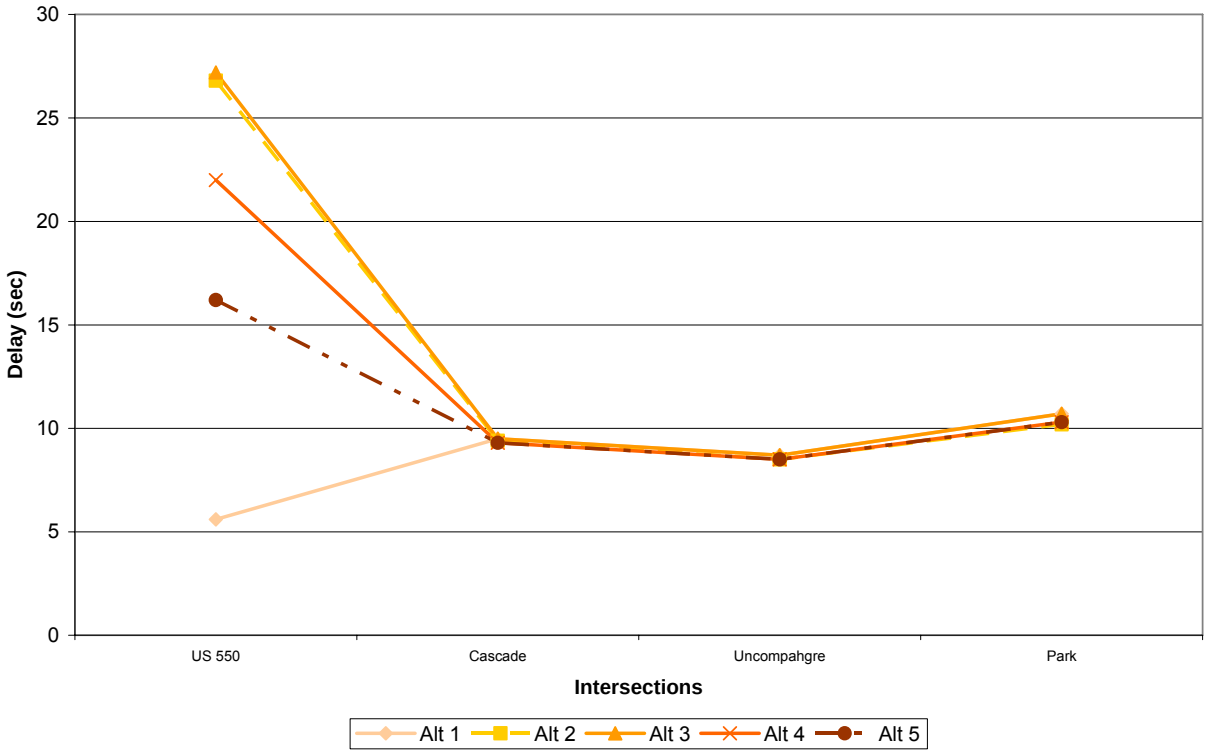
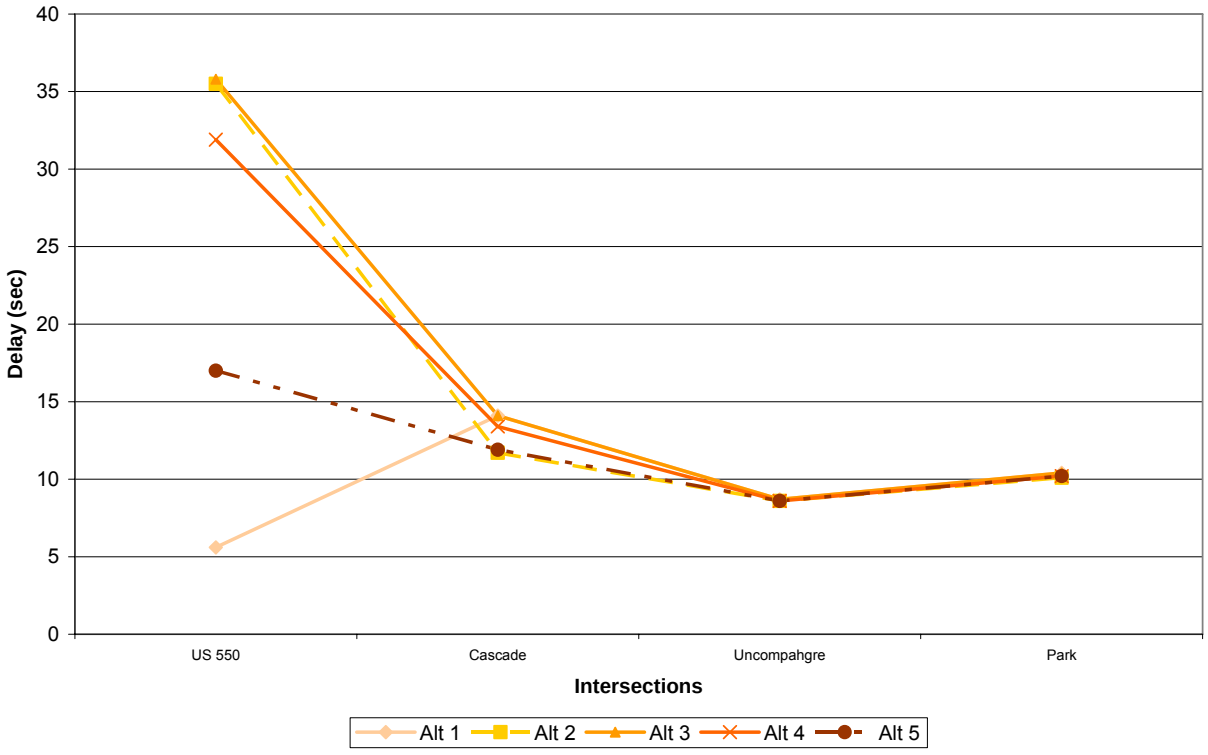



**Figure 2-6**
**Summary of operations for S.1st Street (Existing PM Peak Hour)**



The intersection of S 2nd Street will require a signal to maintain low delays and shows little change between the one-way and 2-way alternative. The intersection of S.2nd Street and Townsend experiences the highest delay during existing conditions due to the side-street stop control which functions with higher delays for the side street. This intersection functions with lower delays for all other alternatives (alts 2 through 5) due to the relocation of the S.1st Street and US 550 signal to this intersection. Redistribution of volumes has minimal impact on the operations of the intersection for alternatives 2 through 5 for the AM and PM peak hours.

## 3.0 FUTURE CONDITIONS (YEAR 2030)

Traffic growth projection was conducted to arrive at year 2030 traffic conditions. Growth projection was conducted to account for local change in traffic over time. Colorado Department of Transportation (CDOT) lists the local growth for the Montrose area at approximately 1.6% annually. Projected traffic volumes on Main Street for future conditions were verified to ensure that the projected traffic was lower than the maximum capacity of a four lane roadway with turn lanes since Main Street may be converted to a two lane roadway in the future. Projected volumes for future conditions are listed in the Appendix.

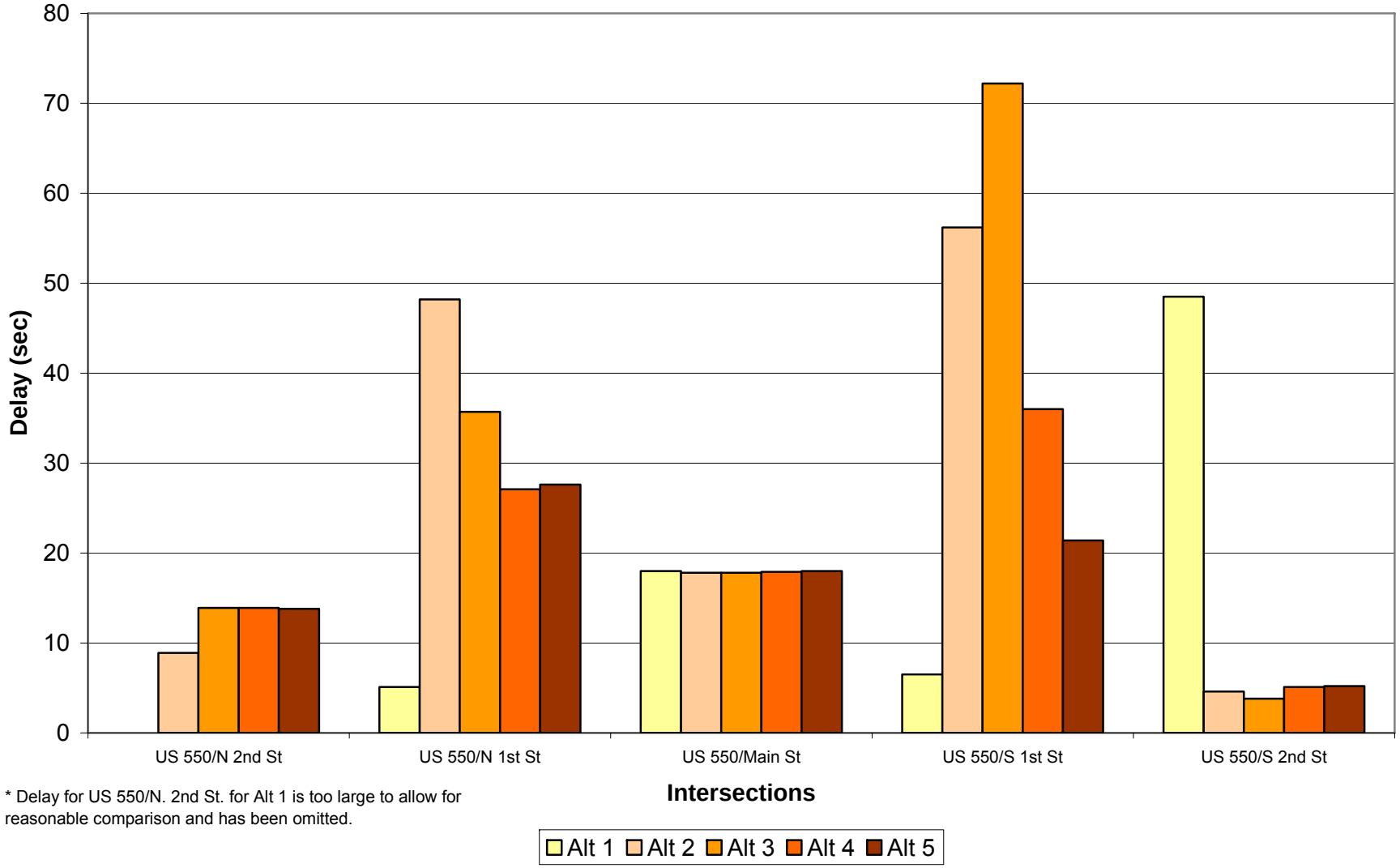
### 3.1 STUDY ALTERNATIVES (FUTURE VOLUME CONDITIONS)

In addition to investigating intersection re-timing, reconfiguration of the street network as listed in section 2.3 was considered for future year analysis. These measures would also address the operational issues observed in the study area. Future year growth rate was applied to all traffic in the study area and traffic analysis conducted for the previously listed five alternatives and the corresponding roadway configurations. Results of the analysis are summarized in Section 3.2.

### 3.2 RESULTS (FUTURE CONDITIONS)

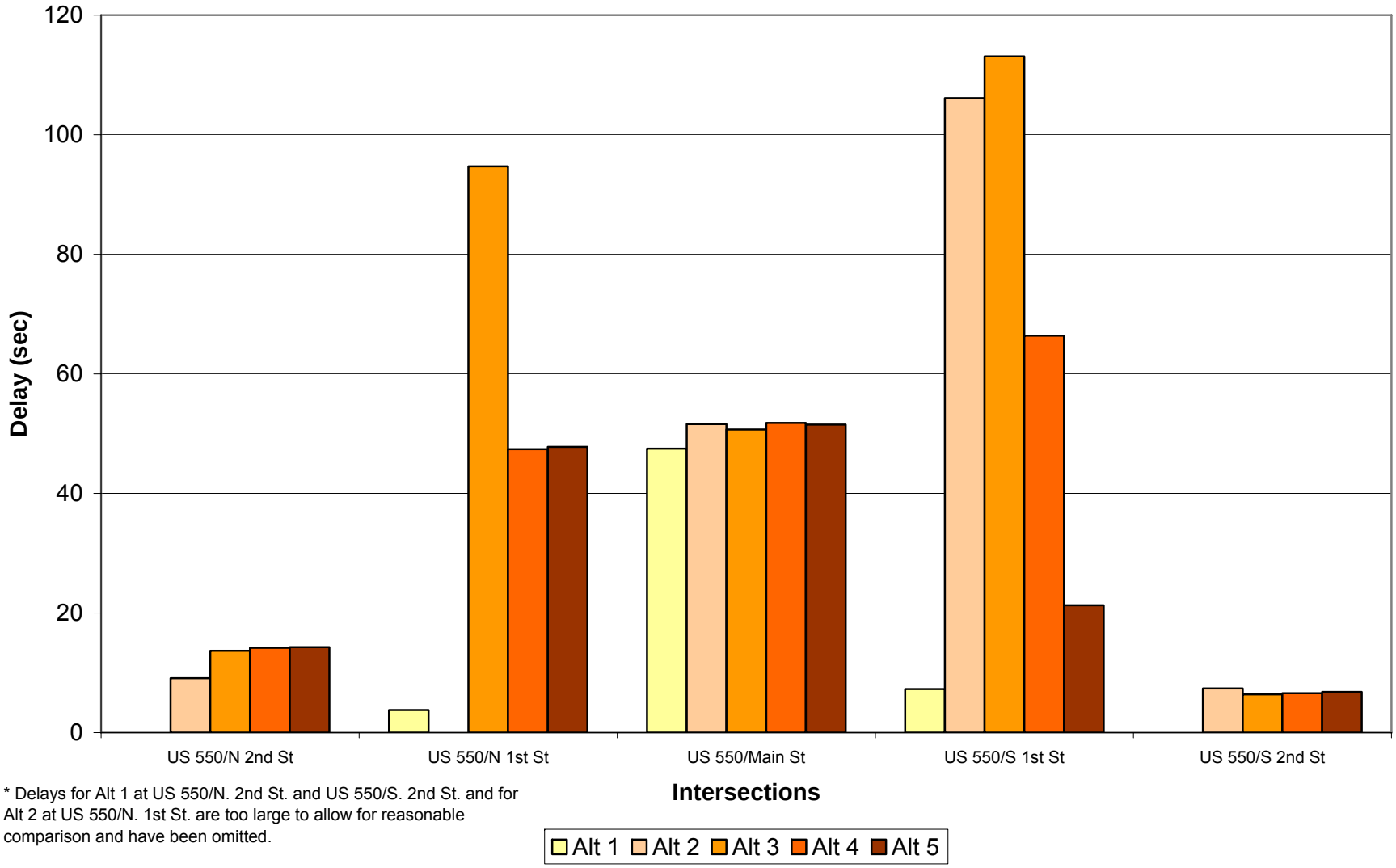
Delay trends that are similar to existing conditions are displayed by intersections for future volume conditions. These results are shown in **Figure 3-1** and **Figure 3-2**. Growth in traffic demand for future years will translate to an increase in projected delay for study intersections. Traffic analysis results indicate that the benefit of restricting access and re-locating signals will be even more pronounced with growth in traffic in the future.

**Figure 3-1**
**Summary of operations for Future AM Peak**




* Delay for US 550/N. 2nd St. for Alt 1 is too large to allow for reasonable comparison and has been omitted.

**Figure 3-2**
**Summary of operations for Future PM Peak**




* Delays for Alt 1 at US 550/N. 2nd St. and US 550/S. 2nd St. and for Alt 2 at US 550/N. 1st St. are too large to allow for reasonable comparison and have been omitted.

## 4.0 CONCLUSION

Results of the analyses indicate that there is noticeable difference between a one-way pair option and the option of restricting access at S.1st and N.1st Street with two way streets for existing conditions. Inspection of future conditions indicates that the benefits of re-locating the signal and restricting access are more pronounced.

Alternative 4 offers improved operations for existing and future year conditions with limited impact to local travel patterns. Alternative 5, however, provides the best operations overall by reducing delays at S.1st Street even further than Alternative 4. Closure of the east leg of S.1st Street at US 550 will eliminate the pedestrian and vehicular conflict along N.1st Street. Alternative 5 should be considered as the preferred alternatives due to the benefits offered by this option. Alternative 3 could be pursued in the future if parking demand exceeds available parking in the area along with growth in traffic volume since Alternative 3 can be implemented to maintain roadway capacity and maximize available right-of-way for parking, pedestrians and vehicular traffic.