# 2.0 Traffic and Crash Data

#### **Traffic Analysis** 2.1

#### 2.1.1 Source of Data

This section presents the results of traffic volume projections and capacity analyses for mainline I-40 from MP 183, west of the Bellemont TI, extending east to MP 214, east of the Winona TI.

The sources of the data include a 2004 Climbing Lane Prioritization Study, a 2010 Preliminary Traffic Report, and a 2010 traffic memo. The Climbing Lane Prioritization Study was conducted for ADOT in May 2004. The study identified and prioritized climbing lane projects in the northern part of the state. The Preliminary Traffic Report was prepared in March 2010 and presented the results of the traffic data collection effort, analysis of existing traffic conditions, analysis of existing crash data, and analysis of 2040 traffic projections for the No Build Alternative and 2040 Build Alternative. The Traffic Memo was prepared in April 2010 for I-40 from east of the new US 89 TI (MP 203.59) to the eastern end of the project (MP 214.00) and analyzed the 2050 level of service (LOS).

#### 2.1.2 Existing (2008) Traffic Counts

Existing 24-hour average daily traffic (ADT) data for the study section of I-40 was collected by ADOT Multimodal Planning Division (MPD) in October 2008 at all of the on- and off-ramps and at the I-40/I-17 system TI. To determine mainline segment volumes, data for the corresponding time period was obtained from an ADOT Automated Traffic Recorder (ATR) located between the I-40/I-17 system TI and the Butler TI. The ATR data was used as a basis from which the ramp ADT volume data was added/subtracted to obtain directional ADT volumes for each segment along the entire corridor.

An October 2008 seasonal adjustment factor, provided by ADOT MPD, was applied to the ADT to estimate the 2008 Annual Average Daily Traffic (AADT) volumes. The October seasonal adjustment factor was also applied to the on-ramp, off-ramp and cross road traffic volumes to estimate the 2008 AADT volumes for each interchange. Figure 4 and Figure 5 depict the 2008 AADT, as well as the AM and PM peak hour volumes collected by ADOT in October 2008.

K, D, and T factors for the study section of I-40 were obtained from ADOT. K is the percentage of the ADT expected to occur in the design hour. D is the percentage of the design hourly volume (DHV) in the direction of heavier flow. T is the percentage of trucks expected in the design hour. The K, D, and T factors for the study section of I-40 are shown in Table 10. The Directional Design Hourly Volume (DDHV) is computed as: DDHV = AADT \* K \* D \* T and is expressed in terms of passenger car equivalent traffic.

#### Table 10 – Corridor K, D, and T Factors

| FROM                  | то                    | BEGIN<br>MP | END<br>MP | K<br>(%) | D<br>(%) | Т<br>(%) |
|-----------------------|-----------------------|-------------|-----------|----------|----------|----------|
| West of Bellemont TI  | Bellemont TI          | 183.00      | 185.15    | 8        | 53       | 35       |
| Bellemont TI          | A-1 Mountain TI       | 185.15      | 190.54    | 8        | 53       | 35       |
| A-1 Mountain TI       | West Flagstaff TI     | 190.54      | 191.69    | 8        | 53       | 35       |
| West Flagstaff TI     | Flagstaff Ranch TI    | 191.69      | 192.56    | 8        | 53       | 35       |
| Flagstaff Ranch TI    | I-40 / I-17 System TI | 192.56      | 195.42    | 8        | 53       | 35       |
| I-40 / I-17 System TI | Butler TI             | 195.42      | 198.28    | 9        | 53       | 23       |
| Butler TI             | Country Club TI       | 198.28      | 201.10    | 9        | 53       | 23       |
| Country Club TI       | Walnut Canyon TI      | 201.10      | 204.87    | 9        | 53       | 23       |
| Walnut Canyon TI      | Cosnino TI            | 204.87      | 207.24    | 9        | 53       | 23       |
| Cosnino TI            | Winona TI             | 207.24      | 211.16    | 9        | 65       | 47       |
| Winona TI             | East of Winona TI     | 211.16      | 214.00    | 9        | 65       | 47       |

Figure 6 and Figure 7 depict the DDHV used for analyzing the existing (2008) traffic conditions.

#### 2.1.3 Existing (2008) Capacity Analysis

The existing posted speed limit along the I-40 mainline varies within the study section. The posted speed limit is typically 75 mph, decreasing to 65 mph within the Flagstaff city limits. The limits of the reduced 65 mph posted speed are MP 193.0 to MP 201.7 eastbound and westbound.

The concepts of quality and level of service are defined in the Highway Capacity Manual (HCM) 2000 published by the Transportation Research Board. Quality of service is a quantitative measure to characterize operational conditions within a traffic stream. LOS is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Letters designate each level from A to F, with A representing the best operating conditions and F the worst. The quality measure used to provide an estimate of freeway LOS is density expressed in terms of the number of equivalent passenger cars per lane per mile (pc/ln/mi), while delay is the quality measure used to provide an estimate of intersection performance.

HCS+ was used to evaluate freeway mainline and ramp LOS and Synchro 6 was used to evaluate ramp / cross road intersection LOS. Design LOS and capacity goals for Arizona state roadways are described in the Roadway Design Guidelines (RDG) from the ADOT Roadway Engineering Group. The design LOS for various highway types as published in Table 103.2A of the RDG are shown in Table 11.

#### Table 11 – ADOT RE

| CONTROLLED ACCESS HIGHWAY TYPE | DESIGN LOS |
|--------------------------------|------------|
| Level Terrain                  | В          |
| Rural / Rolling Terrain        | В          |
| Mountainous Terrain            | B-C        |
| Urban / Fringe Urban Areas     | C-D        |



Figure 4 – 2008 AADT & Peak Hour Turning Movement Volumes (1 of 2)

## Figure 5 – 2008 AADT & Peak Hour Turning Movement Volumes (2 of 2)





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## Figure 7 – 2008 Directional Design Hourly Volumes (2 of 2)



The Flagstaff Urban Area Functionally Classified Road map (2005) was used to classify the mainline segments according to highway type and design LOS. Table 12 lists the different segments within the study area and the corresponding classification and design LOS used for the 2008 analysis.

|                       |                       | DEGION      |           |                            |     |
|-----------------------|-----------------------|-------------|-----------|----------------------------|-----|
| FROM                  | то                    | BEGIN<br>MP | END<br>MP | TYPE                       | LOS |
| West of Bellemont TI  | Bellemont TI          | 183.00      | 185.15    | Rural/Rolling<br>Terrain   | В   |
| Bellemont TI          | A-1 Mountain TI       | 185.15      | 190.54    | Rural/Rolling<br>Terrain   | В   |
| A-1 Mountain TI       | West Flagstaff TI     | 190.54      | 191.69    | Rural/Rolling<br>Terrain   | В   |
| West Flagstaff TI     | Flagstaff Ranch TI    | 191.69      | 192.56    | Rural/Rolling<br>Terrain   | В   |
| Flagstaff Ranch TI    | I-40 / I-17 System TI | 192.56      | 195.42    | Urban/Fringe<br>Urban Area | С   |
| I-40 / I-17 System TI | Butler TI             | 195.42      | 198.28    | Urban/Fringe<br>Urban Area | С   |
| Butler TI             | Country Club TI       | 198.28      | 201.10    | Urban/Fringe<br>Urban Area | С   |
| Country Club TI       | Walnut Canyon TI      | 201.10      | 204.87    | Urban/Fringe<br>Urban Area | С   |
| Walnut Canyon TI      | Cosnino TI            | 204.87      | 207.24    | Rural/Rolling<br>Terrain   | В   |
| Cosnino TI            | Winona TI             | 207.24      | 211.16    | Rural/Rolling<br>Terrain   | В   |
| Winona TI             | East of Winona TI     | 211.16      | 214.00    | Rural/Rolling<br>Terrain   | В   |

Table 12 – Existing (2008) Highway Type and Design LOS

Design LOS goals for signalized intersections are for overall intersection operation. It is rare for all individual approaches and/or turning movements at heavily-travelled intersections in developed urban areas to operate at a LOS D or better. This is especially true for left turn movements at service interchanges in urban areas, where longer cycle lengths and clearance intervals typically increase vehicle delay.

The ADOT RDG allows for LOS D for segments designated as "Urban/Fringe Urban Area." A target LOS C was established for use in this study for "Urban/Fringe Urban Area" segments for existing conditions.

## I-40 Mainline Level of Service

All ramp and freeway LOS analysis was completed assuming "rolling terrain". A freeway mainline segment analysis was performed for the I-40 study corridor. Table 13 summarizes the results of this analysis. All segments of I-40 within the study area were found to operate at LOS B or better for existing traffic conditions, with the exception of the segment between the I-40/I-17 system TI and the Butler TI, which was found to operate at LOS C.

#### Table 13 – Existing (2008) I-40 Mainline LOS

|                       | DEGION                | 2009        | 2-Lanes   |     |              |     |                       |
|-----------------------|-----------------------|-------------|-----------|-----|--------------|-----|-----------------------|
| FROM                  | то                    | BEGIN<br>MP | END<br>MP | LOS | 2008<br>DDHV | LOS | Density<br>(pc/mi/ln) |
| West of Bellemont TI  | Bellemont TI          | 183.00      | 185.15    | В   | 1,140        | А   | 8.4                   |
| Bellemont TI          | A-1 Mountain TI       | 185.15      | 190.54    | В   | 1,319        | А   | 9.8                   |
| A-1 Mountain TI       | West Flagstaff TI     | 190.54      | 191.69    | В   | 1,337        | А   | 9.9                   |
| West Flagstaff TI     | Flagstaff Ranch TI    | 191.69      | 192.56    | В   | 1,139        | А   | 8.4                   |
| Flagstaff Ranch TI    | I-40 / I-17 System TI | 192.56      | 195.42    | С   | 1,284        | А   | 9.5                   |
| I-40 / I-17 System TI | Butler TI             | 195.42      | 198.28    | С   | 2,633        | С   | 19.7                  |
| Butler TI             | Country Club Tl       | 198.28      | 201.10    | С   | 2,244        | В   | 16.6                  |
| Country Club TI       | Walnut Canyon TI      | 201.10      | 204.87    | С   | 1,265        | А   | 9.4                   |
| Walnut Canyon TI      | Cosnino TI            | 204.87      | 207.24    | В   | 1,300        | А   | 9.6                   |
| Cosnino TI            | Winona TI             | 207.24      | 211.16    | В   | 1,821        | В   | 13.5                  |
| Winona TI             | East of Winona TI     | 211.16      | 214.00    | В   | 1,706        | В   | 12.6                  |

## I-40 Service TI Ramp Merge / Diverge Level of Service

A ramp merge and diverge analysis was performed for the service interchanges along the I-40 study corridor. Table 14 summarizes the results of this analysis. All of the on- and off-ramps within the study area were found to operate at LOS C or better for existing traffic conditions, with the exception of the westbound on-ramps at the Butler and Country Club TIs. These on-ramps were found to operate at LOS D for existing traffic conditions.

## Table 14 – Existing (2008) Ramp Merge/Diverge LOS

|                    | DESIGN | EB       |          | W        | В        |
|--------------------|--------|----------|----------|----------|----------|
| TI                 | LOS    | OFF-RAMP | ON-RAMP  | OFF-RAMP | ON-RAMP  |
| Bellemont TI       | В      | B – 12.9 | B – 14.8 | B – 14.6 | B – 11.7 |
| A-1 Mountain TI    | В      | B – 15.1 | B – 16.0 | B – 14.8 | B – 11.3 |
| West Flagstaff TI  | В      | B – 14.8 | B – 13.2 | B – 12.9 | B – 13.7 |
| Flagstaff Ranch TI | С      | B – 12.9 | B – 14.1 | B – 14.3 | B – 11.0 |
| Butler TI          | С      | C – 25.8 | C – 26.0 | C – 23.0 | D – 31.1 |
| Country Club TI    | С      | C – 23.4 | B – 13.2 | B – 14.5 | D – 29.0 |
| Walnut Canyon TI   | С      | B – 12.3 | B – 11.9 | B – 12.6 | B – 11.0 |
| Cosnino TI         | В      | B – 14.4 | B – 18.5 | B – 14.2 | B – 13.5 |
| Winona TI          | В      | B – 17.1 | B – 16.8 | B – 18.3 | B – 18.7 |

## I-40 / I-17 System TI Ramp Merge / Diverge Level of Service

A ramp merge and diverge analysis was performed for the existing I-40/I-17 system TI. Table 15 summarizes the analysis. For existing traffic conditions all of the system TI ramps were found to operate at LOS C or better with the exception of two ramps. The ramp diverge point for the northbound I-17 to westbound I-40 ramp was found to operate at LOS D; the merge point for the westbound I-40 to northbound I-17 ramp was found to operate at LOS E.

| RAMPS                           | JUNCTION<br>TYPE | DESIGN<br>LOS | RAMP<br>DHV | MAINLINE<br>DDHV | LOS | Density<br>(pc/mi/ln) |
|---------------------------------|------------------|---------------|-------------|------------------|-----|-----------------------|
| I-17 NB to I-40 EB              | DIVERGE          | С             | 606         | 3,458            | С   | 23.1                  |
| I-17 NB to I-40 WB              | DIVERGE          | С             | 114         | 3,024            | D   | 30.9                  |
| I-17 SB to I-40 EB              | DIVERGE          | С             | 843         | 2,012            | В   | 14.5                  |
| I-17 SB to I-40 WB              | DIVERGE          | С             | 194         | 2,206            | С   | 20.4                  |
| I-40 EB to I-17 NB & SB         | DIVERGE          | С             | 310         | 1,284            | В   | 14.7                  |
| I-40 WB to I-17 NB & SB         | DIVERGE          | С             | 1,733       | 2,633            | А   | 2.4                   |
| I-17 NB to I-40 EB <sup>1</sup> | MERGE            | С             | 606         | 1,817            | С   | 19.7                  |
| I-17 NB to I-40 WB <sup>1</sup> | MERGE            | С             | 114         | 900              | А   | 9.5                   |
| I-17 SB to I-40 EB              | MERGE            | С             | 843         | 974              | В   | 13.9                  |
| I-17 SB to I-40 WB              | MERGE            | С             | 194         | 1,014            | А   | 9.0                   |
| I-40 EB to I-17 NB              | MERGE            | С             | 172         | 2,852            | С   | 27.5                  |
| I-40 EB & WB to I-17 SB         | MERGE            | С             | 943         | 1,169            | А   | 3.2                   |
| I-40 WB to I-17 NB              | MERGE            | С             | 928         | 2,910            | Е   | 36.7                  |

Table 15 – Existing (2008) I-40/I-17 System TI Ramps LOS

Ramp exists as added lane, mainline LOS and density reported

#### I-40 Ramp / Cross Road Intersection Level of Service

Analysis of the ramp/cross road intersections was performed based on the existing AM and PM peak hour turning movement volumes. The overall intersection LOS and delay (seconds/vehicle) are reported for signalized intersections, and the worst movement LOS and delay are reported for unsignalized intersections. Table 16 summarizes the results of this analysis. All of the ramp/cross road intersections were found to operate at LOS C or better for existing traffic conditions.

| INTERSECTION                | AM       | PM       |
|-----------------------------|----------|----------|
| SIGNALIZED INTERSECTION     |          |          |
| Butler @ EB Ramps           | 25.1 – C | 20.0 – C |
| Butler @ WB Ramps           | 16.5 – B | 23.0 – C |
| Country Club @ EB Ramps     | 7.0 – A  | 7.7 – A  |
| Country Club @ WB Ramps     | 25.5 – C | 22.0 – C |
| UNSIGNALIZED INTERSECTION   |          |          |
| Bellemont @ EB Ramps        | 14.0 – B | 11.6 – B |
| Bellemont @ WB Ramps        | 10.6 – B | 10.5 – B |
| A-1 Mountain @ EB Ramps     | 8.6 – A  | 8.6 – A  |
| A-1 Mountain @ WB Ramps     | 8.4 – A  | 8.4 – A  |
| West Flag @ Route 66        | 9.0 – A  | 8.7 – A  |
| Flagstaff Ranch @ EB Ramps  | 11.6 – B | 10.5 – B |
| Flagstaff Ranch @ WB Ramps  | 10.9 – B | 9.8 – A  |
| Walnut Canyon @ EB Ramps    | 9.3 – A  | 9.6 – A  |
| Walnut Canyon @ WB Off Ramp | 9.4 – A  | 9.1 – A  |
| Walnut Canyon @ WB On Ramp  | 6.1 – A  | 6.1 – A  |
| Cosnino @ EB Ramps          | 9.0 – A  | 9.6 – A  |

| INTERSECTION                           | AM              | РМ      |
|--|-----------------|---------|
| Cosnino @ WB On Ramp                   | 1.3 – A         | 0.4 – A |
| Cosnino @ WB Off Ramp                  | 8.5 – A         | 8.8 – A |
| Winona @ EB Ramps                      | 9.0 – A         | 9.2 – A |
| Winona @ WB Ramps                      | 8.9 – A         | 8.7 – A |
| Note: Results shown as delay (seconds, | /vehicle) - LOS | 3       |

### **Existing (2008) Condition Capacity Deficiencies**

The following freeway segments and ramps within the I-40 study area were identified as having a LOS D or worse for the existing (2008) condition. The deficient locations and associated LOS and density (pc/mi/ln) are shown below:

Existing (2008) Conditions

Ramps:

- Butler TI
  - Westbound On-Ramp Merge: LOS D 31.1 pc/mi/ln
- Country Club TI
  - Westbound On-Ramp Merge: LOS D 29.0 pc/mi/ln
- I-40/I-17 system TI
  - I-17 Northbound to I-40 Westbound Diverge: LOS D 30.9 pc/mi/ln
  - I-40 Westbound to I-17 Northbound Merge: LOS E 36.7 pc/mi/ln

#### 2.1.4 Forecast (2040) Traffic Volumes

The Flagstaff Metropolitan Planning Organization is responsible for the modeling and long-range planning for the City of Flagstaff incorporated limits and planning area. FMPO maintains TransCAD models for the Flagstaff regional area which are used for predicting future year traffic volumes. The models include all of the greater City of Flagstaff planning area and include I-40 from the Bellemont TI to the Winona TI. FMPO created these models while developing the "Flagstaff Pathways 2030 Regional Transportation Plan."

These models were provided to the study team for use in determining design year traffic volumes for the I-40 corridor. The Existing (2007) model is the calibrated baseline condition used by FMPO for developing the 2030 and 2050 models.

The 2030 No Build Alternative and 2050 No Build Alternative traffic models for the study section of I-40 were provided by FMPO. The models account for existing roadway network conditions, as well as near-term improvements (i.e., committed projects that will be constructed in the near future) within the study area; however, they do not include any improvements to ADOT facilities along the study section of I-40. FMPO has termed these models as "existing plus committed," but for consistency they are referred to as "No Build Alternative" models within this report. The 2040 No Build Alternative traffic volumes were interpolated from the volumes produced in the 2030 No Build Alternative and 2050 No Build Alternative models.

The 2030 Build Alternative and 2050 Build Alternative traffic models for the study section of I-40 were also provided by FMPO. The models account for existing roadway network conditions, as well as near-term improvements that were included in the No Build Alternative and the same land use assumptions. The 2030 Build Alternative and 2050 Build Alternative models included improvements to ADOT facilities along the study section of I-40. These improvements included widening I-40 to three lanes in each direction through the study area and four new service interchanges. FMPO has termed these models as "full network", but for consistency they are referred to as "Build Alternative" models within this report. The 2040 Build Alternative traffic volumes were interpolated from the volumes produced in the 2030 Build Alternative and 2050 Build Alternative models.

During the development of the transportation demand modeling process, adjustments to the FMPO model runs were discussed with FMPO staff, and several of these were incorporated into revised model runs. Three adjustments to the model traffic projections could not be incorporated into the model and were addressed through post-model calculations and adjustments to the traffic volume projections. These adjustments are discussed in the following sections.

#### **Minimum Growth Adjustments**

Comparing the existing ADOT 2008 traffic volumes with the 2040 No Build Alternative and 2040 Build Alternative traffic volumes prepared by FMPO, daily traffic at the Bellemont TI, the A-1 Mountain TI, and the Cosnino TI are expected to remain constant or decrease. The FMPO 2030 and 2050 models used to interpolate the 2040 traffic volumes were calibrated to 2007 traffic volumes, which are generally lower than the 2008 traffic volumes collected for this study. The 2040 No Build Alternative and 2040 Build Alternative traffic projections generally reflect small increases in daily traffic from the 2007 base condition, but in some instances do not reflect increases in daily traffic when compared to the 2008 traffic counts. The FMPO models reflect only minor future development impacting these service TIs. FMPO does expect minor incremental increases in development impacting these service interchanges, resulting in minor traffic increases. A one percent annual increase in traffic was suggested by FMPO for these rural locations to reflect this minor increase in development.

Daily traffic volumes on several of the service interchange ramps and cross roads were increased so that the growth in traffic from 2008 to 2040 reflected a minimum increase of one percent per year from 2008 to 2040 (an increase of 32 percent). Adjustments were made separately for the 2040 No Build Alternative and 2040 Build Alternative.

#### **Twin Arrows Casino Adjustments**

The Navajo Nation is proposing a casino and resort to be located on a 300-acre site near the I-40 and Twin Arrows TI (MP 219), approximately 8 miles east of the Winona TI. The Traffic Impact Study for the proposed project estimates that the project will add 7678 weekday trips to I-40 west of MP 219. No additional information as to the destination or origin of this traffic was provided in the *Twin Arrows Casino Traffic Impact Study*.

The inclusion of the casino in the traffic models would require additional land use and origin-destination studies to correctly reflect the traffic impact of the casino. Due to this development's location outside the model boundaries, it was decided to add the casino traffic in a post-model adjustment so that the addition of the casino traffic would result in general traffic increases throughout the study area. The casino traffic adjustments were made separately for the 2040 No Build Alternative and 2040 Build Alternative.

#### **Camp Navajo Adjustments**

The Camp Navajo facility, located south of I-40 at the Bellemont TI, has been classified as a "Collective Training Center" and is currently undergoing an expansion plan. One project will increase the camp's building area by 50,000 square feet, with the expansion to house an engineer company of 104 personnel, two fire departments totaling 14 employees, and a military police company of 180. Future development will include plans to build a new fire station. Currently there are plans to develop military ranges and training facilities to make Camp Navajo a premier training center for troops. No specific information regarding the number of trips or timetable for these development plans was available to the study team.

Other potential developments in the Bellemont area include an industrial/business park and government facilities. Model results, interpolation and reasonable adjustments resulted in a year 2040 increase on I-40 of 17,030 vehicles per day east of the Bellemont TI and 9,570 vehicles per day west of the Bellemont TI. An early proposal for the business park located on 600-800 acres in the northeast base was for 14,000,000 square feet of development. Given that the FMPO region today only contains 17,000,000 square feet of non-residential development, this projection was deemed unrealistic. To estimate future traffic volumes, an increase in the base activity of 5,000,000 square feet of industrial use, approximately 10,000 employees by 2030, was assumed, with an additional 3,000,000 square feet by 2050.

Due to the size of this development and the limited nature of specific planning information, initial efforts to include the development in the model were limited to the industrial park expansion only. No commensurate population increase was added. However, as a large trip attractor, including the Camp Navajo traffic increase in the model runs resulted in trips being attracted to Camp Navajo and notable drops in traffic volumes at other service interchanges in the study area. The Camp Navajo expansion traffic was therefore re-distributed in a post-model adjustment so that the addition of the Camp Navajo traffic would result in general traffic increases throughout the study area.

#### 2.1.5 2040 No Build Alternative Traffic Volumes

The I-40 mainline, I-40 service interchanges, and I-40/I-17 system TI ADT volumes for the 2040 No Build Alternative are shown in Figure 8 and Figure 9. The K, D, and T factors shown in Table 10 were used to develop the 2040 No Build Alternative DDHV. To compute DDHV for the 2040 No Build Alternative analysis, the D and T factors for the I-40 segments from the Cosnino TI to east of the Winona TI were adjusted to be consistent with the adjacent corridor segments to the west of the Cosnino TI. The adjustments were made based on the assumption that as the volume of vehicles on these rural interstate sections increases with future development, the percent of trucks will decrease and the traffic will become more directionally proportionate and similar to the traffic patterns on I-40 west of the Cosnino TI. Figure 8 and Figure 9 depict the 2040 No Build Alternative DDHV.



Figure 8 – 2040 No Build Alternative Traffic Volumes (1 of 2)

![](_page_9_Figure_0.jpeg)

## Figure 9 – 2040 No Build Alternative Traffic Volumes (2 of 2)

## 2.1.6 2040 No Build Alternative Capacity Analysis

Table 17 lists the different segments of I-40 in the study area and the classification used for the 2040 No Build Alternative LOS calculations. The table also lists the target design LOS for each segment of mainline I-40.

|                       |                       |          | TARGET |                            |               |
|-----------------------|-----------------------|----------|--------|----------------------------|---------------|
| FROM                  | то                    | BEGIN MP | END MP | TYPE                       | DESIGN<br>LOS |
| West of Bellemont TI  | Bellemont TI          | 183.00   | 185.15 | Rural/Rolling<br>Terrain   | В             |
| Bellemont TI          | A-1 Mountain TI       | 185.15   | 190.54 | Urban/Fringe<br>Urban Area | С             |
| A-1 Mountain TI       | West Flagstaff TI     | 190.54   | 191.69 | Urban/Fringe<br>Urban Area | С             |
| West Flagstaff TI     | Flagstaff Ranch TI    | 191.69   | 192.56 | Urban/Fringe<br>Urban Area | С             |
| Flagstaff Ranch TI    | I-40 / I-17 System TI | 192.56   | 195.42 | Urban/Fringe<br>Urban Area | C/D           |
| I-40 / I-17 System TI | Butler TI             | 195.42   | 198.28 | Urban/Fringe<br>Urban Area | C/D           |
| Butler TI             | Country Club TI       | 198.28   | 201.10 | Urban/Fringe<br>Urban Area | C/D           |
| Country Club TI       | Walnut Canyon TI      | 201.10   | 204.87 | Urban/Fringe<br>Urban Area | C/D           |
| Walnut Canyon TI      | Cosnino TI            | 204.87   | 207.24 | Urban/Fringe<br>Urban Area | С             |
| Cosnino TI            | Winona TI             | 207.24   | 211.16 | Urban/Fringe<br>Urban Area | С             |
| Winona TI             | East of Winona TI     | 211.16   | 214.00 | Rural/Rolling<br>Terrain   | В             |

Table 17 – 2040 No Build Alternative Highway Type and Design LOS

Considering the traffic volumes using I-40 and the proposed level of development at Bellemont and other locations in 2040, for the year 2040 LOS analysis it may be appropriate to classify I-40 from the Bellemont TI to the Flagstaff Ranch TI and from the Walnut Canyon TI to the Winona TI as "Urban/Fringe Urban Area" rather than the existing classification of "Rural/Rolling Terrain." These recommended changes in Highway Type and Target Design LOS are reflected in Table 17. A target LOS C was established for use in this study for "Urban/ Fringe Urban Area" segments for 2040 traffic conditions; however, a target LOS D was established for the more urbanized "Urban/Fringe Urban Area" segments between the Flagstaff Ranch TI and the Walnut Canvon TI with the conditional requirement that LOS D is not anticipated to be reached until year 2035 or later.

### I-40 Mainline Level of Service

A freeway mainline segment analysis was performed for the I-40 study corridor using the 2040 No Build Alternative traffic volume projections. Table 18 summarizes the results of this capacity and LOS analysis.

#### Table 18 – 2040 No Build Alternative I-40 Mainline LOS

| LOCATION              |                       | Design      | 2040      | 2-Lanes |       | 3-Lanes |                       |     |                       |
|-----------------------|-----------------------|-------------|-----------|---------|-------|---------|-----------------------|-----|-----------------------|
| FROM                  | то                    | BEGIN<br>MP | END<br>MP | LOŠ     | DDHV  | LOS     | Density<br>(pc/mi/ln) | LOS | Density<br>(pc/mi/ln) |
| West of Bellemont TI  | Bellemont TI          | 183.00      | 185.15    | В       | 3,301 | D       | 26.0                  | В   | 16.3                  |
| Bellemont TI          | A-1 Mountain TI       | 185.15      | 190.54    | С       | 3,934 | Е       | 35.4                  | С   | 19.6                  |
| A-1 Mountain TI       | West Flagstaff TI     | 190.54      | 191.69    | С       | 3,954 | Е       | 35.8                  | С   | 19.7                  |
| West Flagstaff TI     | Flagstaff Ranch TI    | 191.69      | 192.56    | С       | 3,528 | D       | 28.8                  | В   | 17.4                  |
| Flagstaff Ranch TI    | I-40 / I-17 System TI | 192.56      | 195.42    | C/D     | 3,859 | D       | 34.7                  | С   | 19.4                  |
| I-40 / I-17 System TI | Butler TI             | 195.42      | 198.28    | C/D     | 5,459 | F       | -                     | D   | 30.4                  |
| Butler TI             | Country Club Tl       | 198.28      | 201.10    | C/D     | 4,408 | F       | -                     | С   | 16.2                  |
| Country Club Tl       | Walnut Canyon TI      | 201.10      | 204.87    | C/D     | 3,279 | С       | 25.8                  | В   | 16.2                  |
| Walnut Canyon TI      | Cosnino TI            | 204.87      | 207.24    | С       | 3,266 | С       | 25.6                  | В   | 16.1                  |
| Cosnino TI            | Winona TI             | 207.24      | 211.16    | С       | 2,937 | С       | 22.3                  | В   | 14.5                  |
| Winona TI             | East of Winona TI     | 211.16      | 214.00    | В       | 2,876 | С       | 21.7                  | В   | 14.2                  |

The shaded cells in Table 18 reflect the minimum roadway cross section that meets the design LOS. The capacity analyses for the 2040 No Build Alternative DDHV indicate that the I-40 mainline segments from the Bellemont TI to the Country Club TI will operate at a worse LOS than the target LOS with no capacity improvements. The segment between the Country Club TI and the Winona TI will operate at the target LOS C.

In order to achieve the respective target LOS, the I-40 mainline segments from the Bellemont TI to the Country Club TI would need to be widened to three or more lanes in each direction. The analysis of additional travel lanes on I-40 for the No Build Alternative was conducted to identify the number of travel lanes to use in the initial modeling for build alternatives.

## I-40 Service TI Ramp Level of Service

A ramp merge and diverge analysis was performed for the service interchanges using the 2040 No Build Alternative traffic volumes. Table 19 summarizes the results of this analysis. The target LOS for ramps was assumed to be the same as the corresponding section of I-40.

|                    | DESIGN | El       | 3        | WB       |          |  |
|--------------------|--------|----------|----------|----------|----------|--|
| ТІ                 | LOS    | OFF-RAMP | ON-RAMP  | OFF-RAMP | ON-RAMP  |  |
| Bellemont TI       | С      | D – 33.5 | D – 34.7 | E – 39.6 | D – 28.9 |  |
| A-1 Mountain TI    | С      | E – 40.0 | E – 38.6 | E – 39.8 | D – 34.0 |  |
| West Flagstaff TI  | С      | E – 39.8 | D – 34.0 | E – 35.7 | D – 34.6 |  |
| Flagstaff Ranch TI | C/D    | E – 35.7 | D – 34.7 | E – 39.2 | D – 31.4 |  |
| Butler TI          | C/D    | F – 52.8 | F – 40.4 | F – 43.7 | F – 47.4 |  |
| Country Club TI    | C/D    | F – 44.1 | D – 28.5 | D – 33.5 | F – 36.5 |  |
| Walnut Canyon TI   | C/D    | D – 33.6 | D – 28.3 | D – 31.4 | D – 28.4 |  |
| Cosnino TI         | С      | D – 33.2 | D – 28.2 | C – 24.9 | D – 29.4 |  |
| Winona TI          | С      | C – 27.8 | C – 26.9 | D – 29.5 | C – 27.6 |  |

Table 19 – 2040 No Build Alternative Service TI LOS

Note: Results shown as LOS – Density (pc/mi/ln)

As shown in Table 19, for the 2040 No Build Alternative with the I-40 mainline providing two travel lanes in each direction, most of the service interchange ramps are expected to operate at a worse LOS than their respective target LOS or are expected to reach LOS D prior to 2040 (shown in bold in Table 19).

## I-40/I-17 System TI Ramp Merge / Diverge Level of Service

A ramp merge and diverge analysis was performed for the I-40/I-17 system TI using the 2040 No Build Alternative traffic volume projections. Table 20 summarizes the results of this analysis.

| Table 20 – 2040 No Build Alternative I-40/I-17 | 7 System TI Ramp LOS |
|--|----------------------|
|--|----------------------|

|                                 |                  |               |             |                  | -   |                       |
|---------------------------------|------------------|---------------|-------------|------------------|-----|-----------------------|
| RAMPS                           | JUNCTION<br>TYPE | DESIGN<br>LOS | RAMP<br>DHV | MAINLINE<br>DDHV | LOS | Density<br>(pc/mi/ln) |
| I-17 NB to I-40 EB              | DIVERGE          | C/D           | 1,466       | 4,355            | D   | 30.7                  |
| I-17 NB to I-40 WB              | DIVERGE          | C/D           | 555         | 3,915            | Е   | 39.4                  |
| I-17 SB to I-40 EB              | DIVERGE          | C/D           | 1,625       | 2,499            | В   | 19.1                  |
| I-17 SB to I-40 WB              | DIVERGE          | C/D           | 901         | 3,400            | D   | 31.8                  |
| I-40 EB to I-17 NB & SB         | DIVERGE          | C/D           | 1,629       | 3,895            | Е   | 39.7                  |
| I-40 WB to I-17 NB & SB         | DIVERGE          | C/D           | 3,010       | 5,459            | F   | 29.4                  |
| I-17 NB to I-40 EB <sup>1</sup> | MERGE            | C/D           | 1,466       | 3,891            | F   | -                     |
| I-17 NB to I-40 WB <sup>1</sup> | MERGE            | C/D           | 555         | 2,449            | D   | 34.7                  |
| I-17 SB to I-40 EB              | MERGE            | C/D           | 1,625       | 2,266            | D   | 31.5                  |
| I-17 SB to I-40 WB              | MERGE            | C/D           | 901         | 3,004            | D   | 32.0                  |
| I-40 EB to I-17 NB              | MERGE            | C/D           | 1,026       | 2,889            | D   | 34.8                  |
| I-40 EB & WB to I-17 SB         | MERGE            | C/D           | 2,115       | 874              | В   | 10.2                  |
| I-40 WB to I-17 NB              | MERGE            | C/D           | 1,498       | 3,360            | F   | 45.2                  |

<sup>1</sup> Ramp exists as added lane, mainline LOS and density reported

The majority of the I-40/I-17 system TI ramps are expected to operate at a LOS D or worse, or reach LOS D prior to 2040 for the 2040 No Build Alternative. The only exceptions are the I-17 SB to I-40 EB diverge and the I-40 EB and WB to I-17 SB merge, which are expected to operate at LOS B.

## **2040 No Build Alternative Capacity Deficiencies**

With the I-40 mainline providing two travel lanes in each direction, the following freeway segments and ramps within the I-40 study area were identified as having a LOS D or worse, or to reach LOS D prior to 2040. The deficient locations are summarized below and are potential candidate locations for improvements in the development of build alternatives:

## I-40 Mainline:

All segments between the Bellemont TI and the Country Club TI will operate at a worse LOS than the target design LOS.

## Service Interchange Ramps:

A majority of the service interchange ramps are expected to operate at a worse LOS than their respective target LOS. Only four of the off- and on-ramps within the study area are expected to operate at LOS C in 2040.

## I-40/I-17 System TI:

The system TI ramps are expected to operate at a LOS D or worse. The only exceptions are the I-17 SB to I-40 EB diverge and the I-40 EB and WB to I-17 SB merge, which are expected to operate at LOS B.

## 2.1.7 2040 Build Alternative Traffic Volumes

The 2040 Build Alternative traffic estimates for the I-40 mainline, the I-40 service interchanges, and the I-40/I-17 system TI were analyzed to determine the LOS for the 2040 Build Alternative roadway network.

The 2040 Build Alternative was developed to address the roadway deficiencies identified in the 2040 No Build Traffic Analysis and includes four new service interchanges to meet the transportation needs of the Flagstaff area. The I-40 improvements included in the FMPO Build Alternative include:

## I-40 Mainline:

The I-40 mainline was assumed to have three travel lanes in each direction throughout the study area.

### Existing Service Interchange Ramps:

No improvements were assumed at the existing service interchange off- and on-ramps.

## I-40/I-17 System TI:

No improvements were assumed at the existing system TI ramp merge and diverge points.

## New Service Interchanges:

FMPO presented the need for four additional service interchanges within the study area in the "Flagstaff Pathways 2030 Regional Transportation Plan," which was prepared by FMPO to meet the area's long-term transportation needs. Several of these new service interchanges have been studied at some level by ADOT. These new service interchanges are expected to be funded by a combination of public and private funding sources. Specific funding sources and construction schedules have not been identified for the new service interchanges. The locations of the new service interchanges are approximate and subject to further study. The four new service interchanges are:

- New Camp Navajo TI, west of the existing Bellemont TI, at MP 183.66.
- New Woody Mountain TI, between the existing Flagstaff Ranch TI and the I-40/I-17 system TI, at MP 193.47. Woody Mountain Road is an existing underpass.
- is an existing overpass, although the new interchange is proposed east of the existing overpass.

New Lone Tree TI, between the I-40/I-17 system TI and the existing Butler TI, at MP 196.70. Lone Tree

• New US 89 TI, between the existing Country Club TI and the existing Walnut Canyon TI, at MP 202.31.

The I-40 mainline, I-40 service interchanges, and I-40/I-17 system TI AADT volumes for the 2040 Build Alternative are shown in Figure 10 and Figure 11. The K, D, and T factors shown in Table 10 were used to develop the 2040 Build Alternative DDHV. The D and T factors for the segments of the corridor from the Cosnino TI to east of the Winona TI were adjusted to be consistent with the adjacent corridor sections to the west of the Cosnino TI. The adjustments were made based on the assumption that as the volume of vehicles on these rural interstate sections increases with future development, the percent of trucks will decrease and the traffic will become more directionally proportionate and similar to the traffic patterns on I-40 west of the Cosnino TI. Figure 10 and Figure 11 also depict the 2010 Build Alternative DDHV.

## 2.1.8 2040 Build Alternative Capacity Analysis

Table 21 lists the different segments of I-40 in the study area and the classification used for the 2040 LOS calculations. The table also lists the target design LOS for each segment of mainline I-40 and includes the addition of the proposed four new service interchanges.

|                            |                       |             | TARGET    |                            |               |
|----------------------------|-----------------------|-------------|-----------|----------------------------|---------------|
| FROM                       | то                    | BEGIN<br>MP | END<br>MP | TYPE                       | DESIGN<br>LOS |
| West of New Camp Navajo TI | New Camp Navajo TI    | 183.00      | 183.60    | Rural/Rolling<br>Terrain   | В             |
| New Camp Navajo Tl         | Bellemont TI          | 183.60      | 185.15    | Urban/Fringe<br>Urban Area | С             |
| Bellemont TI               | A-1 Mountain TI       | 185.15      | 190.54    | Urban/Fringe<br>Urban Area | С             |
| A-1 Mountain TI            | West Flagstaff TI     | 190.54      | 191.69    | Urban/Fringe<br>Urban Area | С             |
| West Flagstaff TI          | Flagstaff Ranch TI    | 191.69      | 192.56    | Urban/Fringe<br>Urban Area | С             |
| Flagstaff Ranch TI         | New Woody Mountain TI | 192.56      | 193.47    | Urban/Fringe<br>Urban Area | C/D           |
| New Woody Mountain TI      | I-40 / I-17 System TI | 193.47      | 195.42    | Urban/Fringe<br>Urban Area | C/D           |
| I-40 / I-17 System TI      | New Lone Tree TI      | 195.42      | 196.70    | Urban/Fringe<br>Urban Area | C/D           |
| New Lone Tree TI           | Butler TI             | 196.70      | 198.28    | Urban/Fringe<br>Urban Area | C/D           |
| Butler TI                  | Country Club TI       | 198.28      | 201.10    | Urban/Fringe<br>Urban Area | C/D           |
| Country Club TI            | New US 89 TI          | 201.10      | 202.31    | Urban/Fringe<br>Urban Area | C/D           |
| New US 89 TI               | Walnut Canyon TI      | 202.31      | 204.87    | Urban/Fringe<br>Urban Area | C/D           |
| Walnut Canyon TI           | Cosnino TI            | 204.87      | 207.24    | Urban/Fringe<br>Urban Area | С             |
| Cosnino TI                 | Winona TI             | 207.24      | 211.16    | Urban/Fringe<br>Urban Area | С             |
| Winona TI                  | East of Winona TI     | 211.16      | 214.00    | Rural/Rolling<br>Terrain   | В             |

Table 21 – 2040 Build Alternative Highway Type and Design LOS

Similar to the 2040 No Build Alternative analysis, for the year 2040 Build Alternative LOS analysis it may be appropriate to classify I-40 from the Bellemont TI to the Flagstaff Ranch TI and from the Walnut Canyon TI to the Winona TI as "Urban/Fringe Urban Area" rather than the existing classification of "Rural/ Rolling Terrain." These recommended changes in Highway Type and Target Design LOS are reflected in Table 21. A target LOS C was established for use in this study for "Urban/Fringe Urban Area" segments for 2040 traffic conditions; a target LOS D was established for the more urbanized "Urban/Fringe Urban Area" segments between the Flagstaff Ranch TI and the Walnut Canyon TI with the conditional requirement that LOS D is not anticipated to be reached until year 2040 or later.

## I-40 Mainline Level of Service

A freeway mainline segment analysis was performed for the I-40 study corridor using the 2040 Build Alternative traffic volume projections. Table 22 summarizes the results of this capacity and level of service analysis.

| Table | 22 – | 2040 | Build | Alter |
|-------|------|------|-------|-------|
|-------|------|------|-------|-------|

| LOCATION                   |                       |             |           | DESIGN 2 | 2040  | 3-Lanes |                       | 2-Lanes |                       |
|----------------------------|-----------------------|-------------|-----------|----------|-------|---------|-----------------------|---------|-----------------------|
| FROM                       | то                    | BEGIN<br>MP | END<br>MP | LOS      | DDHV  | LOS     | Density<br>(pc/mi/ln) | LOS     | Density<br>(pc/mi/ln) |
| Vest of New Camp Navajo TI | New Camp Navajo TI    | 183.00      | 183.60    | В        | 3,301 | В       | 16.3                  | D       | 26.0                  |
| New Camp Navajo TI         | Bellemont TI          | 183.60      | 185.15    | С        | 3,463 | В       | 17.1                  |         |                       |
| Bellemont TI               | A-1 Mountain TI       | 185.15      | 190.54    | С        | 3,936 | С       | 19.6                  |         |                       |
| A-1 Mountain TI            | West Flagstaff TI     | 190.54      | 191.69    | С        | 3,959 | С       | 19.7                  |         |                       |
| Vest Flagstaff TI          | Flagstaff Ranch TI    | 191.69      | 192.56    | С        | 3,338 | В       | 16.5                  |         |                       |
| Flagstaff Ranch TI         | New Woody Mountain TI | 192.56      | 193.47    | C/D      | 3,392 | В       | 16.8                  |         |                       |
| New Woody Mountain TI      | I-40 / I-17 System TI | 193.47      | 195.42    | C/D      | 3,919 | С       | 19.5                  |         |                       |
| -40 / I-17 System TI       | New Lone Tree TI      | 195.42      | 196.70    | C/D      | 5,806 | D       | 34.2                  |         |                       |
| New Lone Tree TI           | Butler TI             | 196.70      | 198.28    | C/D      | 5,610 | D       | 32.0                  |         |                       |
| Butler TI                  | Country Club TI       | 198.28      | 201.10    | C/D      | 4,960 | D       | 26.1                  |         |                       |
| Country Club TI            | New US 89 TI          | 201.10      | 202.31    | C/D      | 4,173 | С       | 20.9                  |         |                       |
| New US 89 TI               | Walnut Canyon TI      | 202.31      | 204.87    | C/D      | 3,286 | В       | 16.2                  |         |                       |
| Valnut Canyon TI           | Cosnino TI            | 204.87      | 207.24    | С        | 3,250 | В       | 16.1                  | С       | 25.5                  |
| Cosnino TI                 | Winona TI             | 207.24      | 211.16    | С        | 2,997 | В       | 14.8                  | С       | 22.9                  |
| Vinona TI                  | East of Winona TI     | 211.16      | 214.00    | В        | 2,877 | В       | 14.2                  | С       | 21.7                  |

The capacity analyses for the 2040 Build Alternative DDHV indicate that the I-40 mainline segments within the study area will meet or exceed their target LOS with three travel lanes in each direction.

rnative I-40 Mainline LOS

![](_page_13_Figure_0.jpeg)

Figure 10 – 2040 Build Alternative Traffic Volumes (1 of 2)

![](_page_14_Figure_0.jpeg)

## Figure 11 – 2040 Build Alternative Traffic Volumes (2 of 2)

#### **Auxiliary Lane Level of Service**

For the three I-40 mainline segments between the I-40/I-17 system TI and the Country Club TI that are expected to operate at LOS D, it was important to estimate when the transition from LOS C to LOS D would occur.

The I-40 segments between the I-40/I-17 system TI and the Lone Tree TI, and between the Lone Tree TI and the Butler TI are expected to reach LOS D in year 2032/2033. I-40 between the Butler TI and the Country Club TI is expected to reach LOS D in 2039 with three travel lanes in each direction, which is the recommended number of travel lanes for this segment.

Therefore, in order to meet the study objective of reaching LOS D no earlier than year 2035 the I-40 segments between the I-40/I-17 system TI and the Butler TI will require either a fourth travel lane or an auxiliary lane. An auxiliary lane LOS analysis was performed and is presented below in Table 23.

| LOCATION              |                  |             |           | DESIGN |       |     | Donaity    |  |
|-----------------------|------------------|-------------|-----------|--------|-------|-----|------------|--|
| FROM                  | то               | BEGIN<br>MP | END<br>MP | LOS    | LANES | LOS | (pc/mi/ln) |  |
| I-40 / I-17 System TI | New Lone Tree TI | 195.42      | 196.70    | C/D    | 3+1   | С   | 22.0       |  |
| New Lone Tree TI      | Butler TI        | 196.70      | 198.28    | C/D    | 3+1   | С   | 21.1       |  |

Table 23 – 2040 Build Alternative I-40 Mainline with Auxiliary Lanes LOS

Based on the analysis described above, I-40 between the I-40/I-17 system TI and the Butler TI will operate at LOS C in 2040 with an auxiliary lane. Therefore, an auxiliary lane is recommended between the on- and offramps at adjacent traffic interchanges for these two segments of I-40 instead of a fourth travel lane. The revised mainline levels of service are shown in Figure 12 and Figure 13.

#### I-40 Mainline LOS Sensitivity Analysis

The I-40 mainline segments between the Walnut Canyon TI and the Winona TI were well above their design LOS with three travel lanes in each direction; therefore, these segments were reanalyzed with two travel lanes in each direction. As shown in Table 24, these segments are expected to operate at the target LOS C with two lanes in each direction.

However, following the completion of the 2010 Preliminary Traffic Report, additional analysis was performed to determine when the I-40 mainline segments between the Walnut Canyon TI and the Winona TI would reach LOS D. Using Build Alternative DDHV for Year 2050, the levels of service for MP 203.59 to MP 214.00 were calculated. Table 24 shows the results of this analysis.

## Table 24 – I-40 2050 LOS, MP 203.59 to MP 214.00

| Milepost | Distance Between<br>Service TIs | Eastbound<br>Number of Lanes<br>Main + Auxiliary | LOS | Interchange         | Westbound<br>Number of Lanes<br>Main + Auxiliary | LOS |
|----------|---------------------------------|--|-----|---------------------|--|-----|
| 203.59   |                                 | 2+0  | D   | Drop/Add Third Lane | 2+0  | D   |
|          | 1.28                            | 2+0  | D   |                     | 2+0  | D   |
| 204.87   |                                 | 2+0  | D   | Walnut Canyon TI    | 2+0  | D   |
|          | 2.37                            | 2+0  | D   |                     | 2+0  | D   |
| 207.24   |                                 | 2+0  | D   | Cosnino TI          | 2+0  | D   |
|          | 3.92                            | 2+0  | D   |                     | 2+0  | D   |
| 211.16   |                                 | 2+0  | С   | Winona TI           | 2+0  | С   |
|          | 2.84                            | 2+0  | С   |                     | 2+0  | С   |
| 214.00   |                                 | 2+0  | С   | End Study Limit     | 2+0  | С   |

The Year 2050 capacity analysis shows that between MP 203.59 (just east of the new US 89 TI) and MP 211.16 (Winona TI), I-40 will operate at a LOS D in the Year 2050. Using a linear interpolation, the approximate year when each segment would no longer operate at LOS C and would begin operating at a LOS D was calculated. Table 25 lists the approximate years when this is projected to occur.

> Table 25 – LOS Sensitivity Analysis I-40, MP 203.59 to MP 211.16 Year LOS D Is Reached

|                          | Year LOS D is<br>Reached |
|--------------------------|--------------------------|
| US 89 to Walnut Canyon   | 2040.3                   |
| Walnut Canyon TI         | 2043.0                   |
| Walnut Canyon to Cosnino | 2041.0                   |
| Cosnino TI               | 2047.6                   |
| Cosnino to Winona        | 2047.0                   |

Since the segments between MP 203.59 and the Cosnino TI (MP 207.24) drop to a LOS D shortly after the 2040 design year, it is recommended that the proposed third lane in each direction be extended to the Cosnino TI. Two lanes are recommended on I-40 east of the Cosnino TI; therefore, the third lane would be dropped/added just east of the Cosnino TI.

#### I-40 Mainline Recommended Geometry

The shaded cells in Table 22 reflect the I-40 mainline recommended cross section.

Along with what is described above, two lanes are recommended on I-40 west of the new Camp Navajo TI to match the existing roadway cross section west of the study limits. It is recommended that the third lane in each direction be dropped and be added at the New Camp Navajo TI.

#### I-40 Service TI Ramp Merge / Diverge Level of Service

A ramp merge and diverge analysis was performed for the service interchanges along the I-40 study corridor using the 2040 Build Alternative traffic volumes. The target LOS for ramps was assumed to be the same as the corresponding section of I-40. Table 26 summarizes the results of this analysis.

|                       | DESIGN | EB           |             | DESIGN EB WB |          |  | /B |
|-----------------------|--------|--------------|-------------|--------------|----------|--|----|
| ТІ                    | LOS    | OFF-<br>RAMP | ON-<br>RAMP | OFF-<br>RAMP | ON-RAMP  |  |    |
| New Camp Navajo TI    | С      | D – 34.2     | C – 22.7    | C – 25.5     | D – 32.6 |  |    |
| Bellemont TI          | С      | C – 25.6     | D – 28.4    | D – 29.0     | C – 24.8 |  |    |
| A-1 Mountain TI       | С      | C – 27.2     | C – 22.2    | C – 27.3     | C – 22.0 |  |    |
| West Flagstaff TI     | С      | D – 28.3     | B – 19.0    | C – 24.0     | C – 23.6 |  |    |
| Flagstaff Ranch TI    | С      | C – 24.2     | B – 19.5    | C – 24.6     | B – 19.2 |  |    |
| New Woody Mountain TI | C/D    | C – 24.5     | C – 23.1    | D – 28.3     | B – 19.5 |  |    |
| New Lone Tree TI      | C/D    | D – 31.8     | C – 23.0    | D – 29.9     | C – 24.4 |  |    |
| Butler TI             | C/D    | D – 33.8     | D – 29.2    | D – 33.7     | D – 28.1 |  |    |
| Country Club TI       | C/D    | D – 34.9     | C – 25.0    | D – 29.6     | D – 31.1 |  |    |
| New US 89 TI          | C/D    | D – 30.2     | B – 19.0    | C – 23.9     | C – 25.8 |  |    |
| Walnut Canyon TI      | C/D    | C – 23.9     | B – 18.8    | C – 23.7     | B – 19.4 |  |    |
| Cosnino TI            | С      | C – 23.9     | B – 17.1    | C – 22.1     | B – 19.3 |  |    |
| Winona TI             | С      | D – 31.3     | C – 26.5    | D – 30.2     | C – 27.7 |  |    |

Table 26 – 2040 Build Alternative Ramp Merge / Diverge LOS

Note: Results shown as LOS – Density (pc/mi/ln)

Many of the on- and off-ramps within the study area are expected to operate at LOS worse than their target LOS. A secondary analysis was conducted assuming the existing taper type ramps were reconstructed with a longer taper length or as parallel type ramps. The results of this analysis are summarized in Table 27.

With this analysis, all ramps are expected to meet or exceed its target LOS. The decision to use a longer taper length or a parallel ramp will need to be further analyzed during the continued development of the DCR and final design.

| Table 27 – 2040 Build | Alternative | Modified | Ramp | LOS |
|-----------------------|-------------|----------|------|-----|
|-----------------------|-------------|----------|------|-----|

|                       | DESIGN | EI       | EB       |          | В        |  |
|-----------------------|--------|----------|----------|----------|----------|--|
| TI                    | LOS    | OFF-RAMP | ON-RAMP  | OFF-RAMP | ON-RAMP  |  |
| New Camp Navajo TI    | С      | C – 22.3 |          |          | C – 27.0 |  |
| Bellemont TI          | С      |          | C – 23.6 | C – 25.2 |          |  |
| A-1 Mountain TI       | С      |          |          |          |          |  |
| West Flagstaff TI     | С      | B – 16.4 |          |          |          |  |
| Flagstaff Ranch TI    | С      |          |          |          |          |  |
| New Woody Mountain TI | C/D    |          |          |          |          |  |
| New Lone Tree TI      | C/D    |          |          |          |          |  |
| Butler TI             | C/D    |          |          |          |          |  |

|                  | DESIGN | DESIGN EB |         |          | WB      |  |  |
|------------------|--------|-----------|---------|----------|---------|--|--|
| ТІ               | LOS    | OFF-RAMP  | ON-RAMP | OFF-RAMP | ON-RAMP |  |  |
| Country Club TI  | C/D    |           |         |          |         |  |  |
| New US 89 TI     | C/D    |           |         |          |         |  |  |
| Walnut Canyon TI | C/D    |           |         |          |         |  |  |
| Cosnino TI       | С      |           |         |          |         |  |  |
| Winona TI        | С      | B – 19.4  |         | B – 18.2 |         |  |  |

Note: Results shown as LOS - Density (pc/mi/ln)

## I-40/I-17 System TI Ramp Merge / Diverge Level of Service

A ramp merge and diverge analysis was performed for the I-40/I-17 system TI using the 2040 Build Alternative traffic volume projections. Table 28 summarizes the results of this analysis.

| Table | 28 – | 2040 | Build | Alternative |
|-------|------|------|-------|-------------|
|-------|------|------|-------|-------------|

| RAMPS                           | JUNCTION<br>TYPE | Design<br>LOS | RAMP<br>DHV |
|---------------------------------|------------------|---------------|-------------|
| I-17 NB to I-40 EB              | DIVERGE          | C/D           | 1,704       |
| I-17 NB to I-40 WB              | DIVERGE          | C/D           | 542         |
| I-17 SB to I-40 EB              | DIVERGE          | C/D           | 1,571       |
| I-17 SB to I-40 WB              | DIVERGE          | C/D           | 590         |
| I-40 EB to I-17 NB & SB         | DIVERGE          | C/D           | 1,160       |
| I-40 WB to I-17 NB & SB         | DIVERGE          | C/D           | 2,686       |
| I-17 NB to I-40 EB <sup>1</sup> | MERGE            | C/D           | 1,704       |
| I-17 NB to I-40 WB <sup>1</sup> | MERGE            | C/D           | 592         |
| I-17 SB to I-40 EB              | MERGE            | C/D           | 1,571       |
| I-17 SB to I-40 WB              | MERGE            | C/D           | 590         |
| I-40 EB to I-17 NB              | MERGE            | C/D           | 537         |
| I-40 EB & WB to I-17 SB         | MERGE            | C/D           | 2,005       |
| I-40 WB to I-17 NB              | MERGE            | C/D           | 1,304       |

<sup>1</sup> Ramp exists as added lane, mainline LOS and density reported

Two I-40/I-17 system TI ramps are expected to operate at a LOS D or worse prior to 2035. These ramps do not meet the target LOS. These ramps can be improved to LOS C by adding an additional lane on the mainline in advance of these exit ramps. These ramps are:

- I-17 NB to I-40 EB, Diverge
- I-40 EB to I-17 NB & SB, Diverge

Figure 12 and Figure 13 - 2008, 2040 No Build and 2040 Build Alternative LOS Comparison, depicts the comparison between the existing 2008 LOS analysis results, the 2040 No Build Alternative LOS analysis results, and the 2040 Build Alternative (with the recommended travel lanes) LOS analysis results.

MAINLINE Additional Lane Density LOS DDHV (pc/mi/ln) LOS Density D 31.5 С 4.256 27.9 С 23.7 3,089 В 3,141 19.2 С 3,731 23.7 3,919 D 29.1 С 25.5 5,806 В 16.3 С 22.0 4.330 С 3.120 19.5 2,759 С 25.9 3,712 С 23.0 2,552 В 19.0 1,570 А 9.5 2,497 С 27.2

I-40 / I-17 System TI Ramp LOS

![](_page_17_Figure_0.jpeg)

Figure 12 – 2008, 2040 No Build and 2040 Build Alternative LOS Comparison (1 of 2)

![](_page_18_Figure_0.jpeg)

## Figure 13 – 2008, 2040 No Build and 2040 Build Alternative LOS Comparison (2 of 2)

#### **2040 Build Alternative Capacity Improvements**

To provide acceptable levels of service for 2040 traffic volumes, the 2040 Build Alternative recommends several improvements to I-40 within the study area. These improvements are:

#### I-40 Mainline:

Widen the I-40 mainline to provide three travel lanes in each direction between the new Camp Navajo TI and the Cosnino TI.

#### Auxiliary Lanes

In addition to the I-40 mainline travel lanes, auxiliary lanes are recommended between the adjacent traffic interchanges for the following segments:

- I-40/I-17 System TI to New Lone Tree TI
- New Lone Tree TI to Butler TI

#### New Service Interchanges:

Four new service interchanges are proposed:

- New Camp Navajo TI, west of the existing Bellemont TI, at approximate MP 183.60.
- New Woody Mountain TI, between the existing Flagstaff Ranch TI and the I-40/I-17 system TI, at approximate MP 193.47. Woody Mountain is an existing underpass.
- New Lone Tree TI, between the I-40/I-17 system TI and the existing Butler TI, at approximate MP 196.70. Lone Tree is an existing overpass, although the new interchange is proposed to be constructed east of the existing overpass.
- New US 89 TI, between the existing Country Club TI and the existing Walnut Canyon TI, at approximate MP 202.31.

### Existing and Proposed Service Interchange Ramps:

Some of the on- and off-ramps at the existing and proposed service interchanges would need to be reconstructed with a longer taper length or as a parallel type ramp to accommodate increased traffic. At a minimum, the following ramps are recommended to be reconstructed based on the LOS analysis results:

- New Camp Navajo TI
  - Eastbound Off-Ramp
  - Westbound On-Ramp
- Bellemont TI
  - Eastbound On-Ramp
  - Westbound Off-Ramp
- West Flagstaff TI
  - Eastbound Off-Ramp
- Cosnino TI
  - Eastbound Off-Ramp
  - Westbound Off-Ramp
  - Westbound On-Ramp
- Winona TI
  - Eastbound Off-Ramp
  - Westbound Off-Ramp

### I-40/I-17 System TI:

Improvements were identified at the existing I-40/I-17 system TI merge and diverge points including additional through lanes or auxiliary lanes at the following locations:

- I-17 NB to I-40 EB, Diverge
- I-40 EB to I-17 NB & SB, Diverge

### 2.1.9 Climbing Lane Analysis

#### **Previous ADOT Climbing Lane Study**

A Climbing Lane Prioritization Study was conducted for ADOT in May 2004. The study identified and prioritized climbing lane projects in the northern part of the state. The candidate locations were ranked and grouped into three tiers, Tier 1 through Tier 3, with Tier 1 being the highest priority.

Two locations identified in the *Climbing Lane Prioritization Study* are within the project limits. The capacity analyses were performed on these sections of I-40 using the HCM 2000 methodology. Milepost information, LOS and the priority rankings of each candidate location within the project limits are summarized in Table 29.

#### Table 29 – Previous ADOT Climbing Lane Study, I-40 between MP 184-214

| DIRECTION | <b>BEGINNING MP</b> | ENDING MP | LOS | TIER |
|-----------|---------------------|-----------|-----|------|
| EB        | 188                 | 189       | D   | 2    |
| WB        | 194                 | 193       | D   | 3    |

### Climbing Lane Analysis – 2040 Build Alternative

An initial review of I-40 eastbound and westbound vertical alignments within the study area revealed three segments of the I-40 mainline where the uphill grade might have an impact on heavy vehicle speeds and degrade the mainline LOS. To further investigate the need for a climbing lane for the 2040 Build Alternative, additional capacity analysis was performed for the three identified I-40 mainline segments. This analysis was performed using the HCS+ software with the specific grade methodology. The results of the analysis using the specific grade method are summarized in Table 30.

### Table 30 – 2040 Build Alternative I-

| LOC       | ATION       |           | LENGTH GRADE |     | E 2040 |     | 3-Lane                |     | With Climbing<br>Lane |  |
|-----------|-------------|-----------|--------------|-----|--------|-----|-----------------------|-----|-----------------------|--|
| DIRECTION | BEGIN<br>MP | END<br>MP | (mi)         | (%) | DDHV   | LOS | Density<br>(pc/mi/ln) | LOS | Density<br>(pc/mi/ln) |  |
| EB        | 188.28      | 188.52    | 0.24         | 4.0 | 3,936  | С   | 19.6                  | В   | 14.6                  |  |
| WB        | 191.75      | 192.28    | 0.53         | 4.0 | 3,338  | В   | 16.5                  | -   | -                     |  |
| WB        | 194.25      | 194.95    | 0.70         | 4.6 | 3,392  | В   | 16.8                  | -   | -                     |  |

Eastbound I-40 (MP 188.28 to 188.52) lies within a segment of I-40 (Bellemont TI to A-1 Mountain TI) with an existing highway type designation of "Rural/Rolling Terrain" with a target design LOS B and a future highway

type designation of "Urban/Fringe Urban Area" with a target design LOS C. This segment would operate at LOS C with three travel lanes in each direction without the climbing lane and would meet the target LOS C in 2040. With three travel lanes in each direction, this segment would not require a climbing lane.

Westbound I-40 (MP 191.75 to MP 192.28) lies within a segment of I-40 (West Flagstaff TI to the Flagstaff Ranch TI) with an existing highway type designation of "Rural/Rolling Terrain" with a target design LOS B and a future highway type designation of "Urban/Fringe Urban Area" with a target design LOS C. This segment would operate at LOS B with three travel lanes in each direction without the climbing lane. This segment would not require a climbing lane.

Westbound I-40 (MP 194.25 to MP 194.95) lies within a segment of I-40 (Flagstaff Ranch TI to I-40/I-17 system TI) with a highway type designation of "Urban/Fringe Urban Area" with a target design LOS C. This segment would operate at LOS C with three travel lanes in each direction without the climbing lane. This segment would not require a climbing lane.

## 2.2 Crash History

#### 2.2.1 Source of Data

Crash data was obtained from ADOT for the I-40 mainline from MP 183.0 to MP 214.0. The available data covers a five-year period from January 2004 through December 2008. Total eastbound and westbound crashes for the area are 656 and 492, respectively.

### 2.2.2 Crash Data

Table 31 shows crashes by manner of collision. The data indicates that the eastbound direction tends to have more crashes with a yearly average of 131 crashes, while the westbound direction has a yearly average of 98 crashes. The majority of the crashes in the study section are single vehicle crashes. There are also notable proportions of rear end and sideswipe crashes.

| MANNER OF<br>COLLISION | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |  |  |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|--|--|
|                        | EASTBOUND              |                        |                        |                        |                        |               |                          |  |  |
| Single Vehicle         | 96                     | 62                     | 62                     | 85                     | 110                    | 83.0          | 63.26%                   |  |  |
| Rear End               | 19                     | 11                     | 12                     | 13                     | 43                     | 19.6          | 14.94%                   |  |  |
| Sideswipe (Same Dir)   | 18                     | 24                     | 7                      | 13                     | 21                     | 16.6          | 12.65%                   |  |  |
| Head-On                | 1                      | 0                      | 0                      | 1                      | 0                      | 0.4           | 0.30%                    |  |  |
| Angle                  | 0                      | 1                      | 1                      | 0                      | 12                     | 2.8           | 2.13%                    |  |  |
| Other                  | 10                     | 7                      | 5                      | 11                     | 11                     | 8.8           | 6.71%                    |  |  |
| EB TOTAL               | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |  |  |
| WESTBOUND              |                        |                        |                        |                        |                        |               |                          |  |  |
| Single Vehicle         | 79                     | 65                     | 47                     | 49                     | 75                     | 63.0          | 64.02%                   |  |  |
| Rear End               | 8                      | 7                      | 8                      | 7                      | 28                     | 11.6          | 11.79%                   |  |  |
| Sideswipe (Same Dir)   | 11                     | 14                     | 11                     | 19                     | 22                     | 15.4          | 15.65%                   |  |  |
| Head-On                | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |  |  |

| MANNER OF<br>COLLISION | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|
| Angle                  | 0                      | 0                      | 0                      | 1                      | 0                      | 0.2           | 0.20%                    |
| Other                  | 2                      | 7                      | 6                      | 10                     | 16                     | 8.2           | 8.33%                    |
| WB TOTAL               | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |

Table 32 shows the number of crashes by severity. The data indicates that both eastbound and westbound tend to be similar with respect to crash severity. Approximately 71 percent of the crashes in the eastbound and westbound directions are No Injury type crashes. The data indicate an average of approximately two fatal crashes per year in the eastbound direction and one fatal crash per year in the westbound direction within the study area.

| Table | 32 – | Crash |
|-------|------|-------|
|-------|------|-------|

| SEVERITY                  | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |
|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|
|                           |                        | E/                     | ASTBOUN                | D                      |                        |               |                          |
| Fatal                     | 3                      | 3                      | 0                      | 3                      | 2                      | 2.2           | 1.68%                    |
| Incapacitating Injury     | 1                      | 6                      | 10                     | 9                      | 4                      | 6.0           | 4.57%                    |
| Non-Incapacitating Injury | 40                     | 13                     | 14                     | 19                     | 30                     | 23.2          | 17.68%                   |
| Possible Injury           | 9                      | 2                      | 3                      | 5                      | 16                     | 7.0           | 5.34%                    |
| No Injury                 | 91                     | 81                     | 60                     | 87                     | 145                    | 92.8          | 70.73%                   |
| Unknown                   | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| EB TOTAL                  | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |
|                           |                        | W                      | ESTBOUN                | D                      |                        |               |                          |
| Fatal                     | 0                      | 1                      | 0                      | 1                      | 3                      | 1.0           | 1.02%                    |
| Incapacitating Injury     | 2                      | 1                      | 1                      | 0                      | 3                      | 1.4           | 1.42%                    |
| Non-Incapacitating Injury | 18                     | 19                     | 9                      | 20                     | 26                     | 18.4          | 18.70%                   |
| Possible Injury           | 9                      | 6                      | 9                      | 6                      | 8                      | 7.6           | 7.72%                    |
| No Injury                 | 71                     | 66                     | 53                     | 59                     | 101                    | 70.0          | 71.14%                   |
| Unknown                   | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| WB TOTAL                  | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |

Table 33 shows the number of crashes by First Harmful Event for the study section. Approximately 33 percent of the crashes in the both the eastbound and westbound directions are Collisions with Other Motor Vehicles. Approximately 15 percent of the yearly crashes in the eastbound direction are due to Overturning. Wild Animal Game/Non-Game crashes in the eastbound and westbound directions were approximately 9 percent.

### hes by Severity

| Table 33 – Crashes I | y First Harmful Event |
|----------------------|-----------------------|
|----------------------|-----------------------|

| FIRST HARMFUL EVENT                               | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |  |  |  |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|--|--|--|
| EASTBOUND   |                        |                        |                        |                        |                        |               |                          |  |  |  |
| Collision w/ other Motor Vehicle                  | 41                     | 37                     | 22                     | 31                     | 82                     | 42.6          | 32.47%                   |  |  |  |
| Overturning                                       | 24                     | 15                     | 13                     | 23                     | 25                     | 20.0          | 15.24%                   |  |  |  |
| Collision w/ Guardrail/Barrier/Curb               | 22                     | 11                     | 8                      | 16                     | 22                     | 15.8          | 12.04%                   |  |  |  |
| Collision w/ other Fixed Objects <sup>1</sup>     | 16                     | 17                     | 17                     | 12                     | 25                     | 17.4          | 13.26%                   |  |  |  |
| Collision w/ Wild Animal Game/Non-<br>Game        | 15                     | 5                      | 8                      | 17                     | 13                     | 11.6          | 8.84%                    |  |  |  |
| Non-Collision Incidents <sup>2</sup>              | 8                      | 7                      | 11                     | 5                      | 9                      | 8.0           | 6.10%                    |  |  |  |
| Collision w/ other Non-Fixed Objects <sup>3</sup> | 8                      | 6                      | 2                      | 11                     | 8                      | 7.0           | 5.34%                    |  |  |  |
| Collision w/ Tree                                 | 6                      | 3                      | 3                      | 3                      | 7                      | 4.4           | 3.35%                    |  |  |  |
| Collision w/ Motor Vehicle Parked                 | 2                      | 1                      | 1                      | 1                      | 2                      | 1.4           | 1.07%                    |  |  |  |
| Collision w/ Unknown                              | 2                      | 1                      | 2                      | 2                      | 1                      | 1.6           | 1.22%                    |  |  |  |
| Collision w/ Ped or Ped Conveyance                | 0                      | 1                      | 0                      | 1                      | 3                      | 1.0           | 0.76%                    |  |  |  |
| Collision w/ Pets                                 | 0                      | 1                      | 0                      | 1                      | 0                      | 0.4           | 0.30%                    |  |  |  |
| EB TOTAL  | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |  |  |  |
|   | -                      | WESTBO                 | DUND                   | -                      | -                      |               |                          |  |  |  |
| Collision w/ other Motor Vehicle                  | 21                     | 25                     | 22                     | 32                     | 59                     | 31.8          | 32.32%                   |  |  |  |
| Overturning                                       | 22                     | 16                     | 8                      | 12                     | 20                     | 15.6          | 15.85%                   |  |  |  |
| Collision w/ Guardrail/Barrier/Curb               | 13                     | 18                     | 8                      | 12                     | 22                     | 14.6          | 14.84%                   |  |  |  |
| Collision w/ other Fixed Objects <sup>1</sup>     | 19                     | 10                     | 10                     | 6                      | 14                     | 11.8          | 11.99%                   |  |  |  |
| Collision w/ Wild Animal Game/Non-<br>Game        | 7                      | 6                      | 10                     | 11                     | 8                      | 8.4           | 8.54%                    |  |  |  |
| Non-Collision Incidents <sup>2</sup>              | 7                      | 7                      | 3                      | 2                      | 8                      | 5.4           | 5.49%                    |  |  |  |
| Collision w/ other Non-Fixed Objects <sup>3</sup> | 6                      | 5                      | 5                      | 8                      | 5                      | 5.8           | 5.89%                    |  |  |  |
| Collision w/ Tree                                 | 3                      | 3                      | 3                      | 3                      | 1                      | 2.6           | 2.64%                    |  |  |  |
| Collision w/ Motor Vehicle Parked                 | 2                      | 3                      | 0                      | 0                      | 1                      | 1.2           | 1.22%                    |  |  |  |
| Collision w/ Unknown                              | 0                      | 0                      | 3                      | 0                      | 1                      | 0.8           | 0.81%                    |  |  |  |
| Collision w/ Ped or Ped Conveyance                | 0                      | 0                      | 0                      | 0                      | 2                      | 0.4           | 0.41%                    |  |  |  |
| Collision w/ Pets                                 | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |  |  |  |
| WB TOTAL  | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |  |  |  |

| ~ ~                      | -                     |   |
|--------------------------|-----------------------|---|
| <sup>3</sup> This catego | ry includes objects t | nrown/falling, objects fell/jumped from vehicle, livestock. |

Table 34 shows the number of crashes by Road Surface Conditions for the study section. Approximately 59 percent and 48 percent of the crashes occurred when the road surface condition was dry in the eastbound and westbound directions, respectively. Approximately 30 percent and 44 percent of the crashes occur during snow, slush or icy conditions in the eastbound and westbound directions, respectively.

| ROAD SURFACE<br>CONDITION | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |  |  |  |  |
|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|--|--|--|--|
| EASTBOUND                 |                        |                        |                        |                        |                        |               |                          |  |  |  |  |
| Dry                       | 73                     | 54                     | 59                     | 81                     | 115                    | 76.4          | 58.23%                   |  |  |  |  |
| Snow                      | 19                     | 19                     | 5                      | 20                     | 27                     | 18.0          | 13.72%                   |  |  |  |  |
| Ice/Frost                 | 19                     | 12                     | 12                     | 10                     | 35                     | 17.6          | 13.41%                   |  |  |  |  |
| Wet                       | 17                     | 9                      | 7                      | 3                      | 14                     | 10.0          | 7.62%                    |  |  |  |  |
| Slush                     | 9                      | 6                      | 2                      | 1                      | 1                      | 3.8           | 2.90%                    |  |  |  |  |
| Water Standing/Moving     | 0                      | 4                      | 1                      | 4                      | 4                      | 2.6           | 1.98%                    |  |  |  |  |
| Unknown                   | 5                      | 1                      | 1                      | 3                      | 1                      | 2.2           | 1.68%                    |  |  |  |  |
| Other                     | 2                      | 0                      | 0                      | 1                      | 0                      | 0.6           | 0.46%                    |  |  |  |  |
| EB TOTAL                  | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |  |  |  |  |
|                           |                        | WE                     | STBOUND                |                        | -                      |               | -                        |  |  |  |  |
| Dry                       | 45                     | 50                     | 45                     | 54                     | 41                     | 47.0          | 47.76%                   |  |  |  |  |
| Snow                      | 22                     | 16                     | 11                     | 15                     | 69                     | 26.6          | 27.03%                   |  |  |  |  |
| Ice/Frost                 | 18                     | 13                     | 10                     | 7                      | 24                     | 14.4          | 14.63%                   |  |  |  |  |
| Wet                       | 8                      | 7                      | 5                      | 7                      | 2                      | 5.8           | 5.89%                    |  |  |  |  |
| Slush                     | 3                      | 4                      | 0                      | 0                      | 3                      | 2.0           | 2.03%                    |  |  |  |  |
| Water Standing/Moving     | 0                      | 1                      | 1                      | 3                      | 0                      | 1.0           | 1.02%                    |  |  |  |  |
| Unknown                   | 3                      | 2                      | 0                      | 0                      | 1                      | 1.2           | 1.22%                    |  |  |  |  |
| Other                     | 1                      | 0                      | 0                      | 0                      | 1                      | 0.4           | 0.41%                    |  |  |  |  |
| WB TOTAL                  | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |  |  |  |  |

Table 35 shows the number of crashes by Weather Conditions for the study section. Approximately 56 percent and 48 percent of the crashes occur during Clear Weather conditions in the eastbound and westbound directions, respectively. Approximately 30 percent and 43 percent of the crashes occur during Snow, Sleet/Hail or Rain in the eastbound and westbound directions, respectively.

## Table 35 – Crashes by Weather Condition

| WEATHER CONDITION                | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |
|----------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|
|                                  |                        | EAS                    | TBOUND                 |                        |                        |               |                          |
| Clear                            | 72                     | 50                     | 56                     | 71                     | 119                    | 73.6          | 56.10%                   |
| Snow                             | 38                     | 30                     | 10                     | 25                     | 42                     | 29.0          | 22.10%                   |
| Cloudy                           | 17                     | 16                     | 14                     | 17                     | 15                     | 15.8          | 12.04%                   |
| Rain                             | 13                     | 9                      | 4                      | 7                      | 15                     | 9.6           | 7.32%                    |
| Sleet/Hail/Freezing Rain/Drizzle | 4                      | 0                      | 2                      | 2                      | 0                      | 1.6           | 1.22%                    |
| Blowing Sand/Soil/Dirt           | 0                      | 0                      | 0                      | 0                      | 5                      | 1.0           | 0.76%                    |
| Unknown                          | 0                      | 0                      | 0                      | 0                      | 1                      | 0.2           | 0.15%                    |
| Severe Crosswinds                | 0                      | 0                      | 1                      | 1                      | 0                      | 0.4           | 0.30%                    |

## Table 34 – Crashes by Road Surface Condition

| WEATHER CONDITION                | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |
|----------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|
| Fog/Smog/Smoke                   | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| EB TOTAL                         | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |
|                                  |                        | WES                    | TBOUND                 |                        |                        |               |                          |
| Clear                            | 43                     | 52                     | 42                     | 46                     | 50                     | 46.6          | 47.36%                   |
| Snow                             | 39                     | 27                     | 18                     | 18                     | 80                     | 36.4          | 36.99%                   |
| Cloudy                           | 8                      | 5                      | 7                      | 13                     | 8                      | 8.2           | 8.33%                    |
| Rain                             | 6                      | 5                      | 5                      | 9                      | 1                      | 5.2           | 5.28%                    |
| Sleet/Hail/Freezing Rain/Drizzle | 2                      | 3                      | 0                      | 0                      | 0                      | 1.0           | 1.02%                    |
| Blowing Sand/Soil/Dirt           | 0                      | 0                      | 0                      | 0                      | 1                      | 0.2           | 0.20%                    |
| Unknown                          | 2                      | 0                      | 0                      | 0                      | 1                      | 0.6           | 0.61%                    |
| Severe Crosswinds                | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| Fog/Smog/Smoke                   | 0                      | 1                      | 0                      | 0                      | 0                      | 0.2           | 0.20%                    |
| WB TOTAL                         | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |

Figure 14 – EB Crashes by Milepost

![](_page_22_Figure_2.jpeg)

Table 36 shows the number of crashes by Daylight Conditions for the study section. Approximately 60 percent and 59 percent of the crashes occur during Daylight conditions in the eastbound and westbound directions, respectively. The remaining 40 percent and 41 percent of crashes occurred during Dark/Unknown or Dawn conditions in the eastbound and westbound directions, respectively.

Table 36 – Crashes by Daylight Condition

![](_page_22_Figure_4.jpeg)

| DAYLIGHT CONDITION                   | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |  |  |  |
|--------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|--|--|--|
| EASTBOUND                            |                        |                        |                        |                        |                        |               |                          |  |  |  |
| Daylight 89 68 48 65 122 78.4 59.76% |                        |                        |                        |                        |                        |               |                          |  |  |  |
| Dark/Unknown                         | 48                     | 33                     | 36                     | 49                     | 64                     | 46            | 35.06%                   |  |  |  |
| Dawn                                 | 6                      | 4                      | 3                      | 9                      | 11                     | 6.6           | 5.03%                    |  |  |  |
| Not Reported                         | 1                      | 0                      | 0                      | 0                      | 0                      | 0.2           | 0.15%                    |  |  |  |
| EB TOTAL                             | 144                    | 105                    | 87                     | 123                    | 197                    | 131.2         | 100.00%                  |  |  |  |
|                                      | -                      | WES                    | TBOUND                 | -                      |                        |               | -                        |  |  |  |
| Daylight                             | 43                     | 49                     | 49                     | 50                     | 95                     | 57.2          | 58.13%                   |  |  |  |
| Dark/Unknown                         | 48                     | 32                     | 20                     | 26                     | 39                     | 33.0          | 33.54%                   |  |  |  |
| Dawn                                 | 9                      | 12                     | 3                      | 10                     | 6                      | 8.0           | 8.13%                    |  |  |  |
| Not Reported                         | 0                      | 0                      | 0                      | 0                      | 1                      | 0.2           | 0.20%                    |  |  |  |
| WB TOTAL                             | 100                    | 93                     | 72                     | 86                     | 141                    | 98.4          | 100.00%                  |  |  |  |

The crash data was also sorted and grouped by milepost location to identify potential high crash locations within the study area. The results of this analysis are presented in the bar charts shown in Figure 14 and Figure 15. Each bar represents the average number of crashes within a one mile segment. There is a noticeable spike in crashes at westbound MP 188 (Figure 15). The data also indicates slightly more crashes in both directions near the middle of the study area, from approximately MP 194 to MP 208.

![](_page_22_Figure_7.jpeg)

## Figure 15 – WB Crashes by Milepost

### **Wildlife Crashes**

Crashes involving wildlife have been identified by ADOT as an area of concern within the study section. Therefore, crashes with Wild Animal Game/Non-Game were sorted and grouped for more detailed analysis. The ADOT Statewide Crash Database does not contain information regarding type of animal; the database includes crashes involving coyotes, javelina, and turkey, in addition to deer or elk. Additionally, not all animal/vehicle crashes are reported and therefore are not reflected in the Statewide Crash Database. The ADOT Northern Region Traffic Engineering office maintains a separate database which tracks dead animals found along the side of the road. This database contains information regarding type of animal. No attempt was made to compare or reconcile the two databases as part of the analysis presented herein. A separate wildlife crash reduction report will be prepared as a part of this study and will provide a more detailed analysis to support recommendations to reduce crashes involving deer and elk.

Table 37 shows the severity of crashes with wildlife. Approximately 81 percent and 90 percent of crashes with wildlife did not result in injury to the motorist in the eastbound and westbound directions, respectively. There were no human fatalities associated with crashes with wildlife within the study section during the five-year period from January 2004 through December 2008.

Figure 16 shows the number of crashes with Wild Animal Game/Non-Game aggregated per mile for the study section. Wildlife crashes were also sorted by Time of Year. The results of the total crashes over 5 years are shown graphically in Figure 17 and Figure 18.

The data indicates that crashes with Wild Animals/Game generally peak in late spring/early summer. Figure 19 shows wildlife crashes as a percentage of the total eastbound crashes by milepost and Figure 20

Figure 20 shows wildlife crashes as a percentage of the total westbound crashes by milepost.

| WILD ANIMAL<br>GAME/NON GAME<br>CRASHES BY<br>SEVERITY | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|
|  |                        | EA                     | STBOUND                |                        |                        |               |                          |
| No Injury  | 10                     | 5                      | 7                      | 14                     | 11                     | 9.4           | 81.03%                   |
| Non-Incapacitating Injury                              | 4                      | 0                      | 1                      | 2                      | 2                      | 1.8           | 15.52%                   |
| Possible Injury  | 1                      | 0                      | 0                      | 0                      | 0                      | 0.2           | 1.72%                    |
| Incapacitating Injury                                  | 0                      | 0                      | 0                      | 1                      | 0                      | 0.2           | 1.72%                    |
| Fatal  | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| EB TOTAL   | 15                     | 5                      | 8                      | 17                     | 13                     | 11.6          | 100.00%                  |
|  | -                      | WE                     | STBOUND                | )                      | -                      | -             | -                        |
| No Injury  | 6                      | 6                      | 9                      | 9                      | 8                      | 7.6           | 90.48%                   |
| Non-Incapacitating Injury                              | 1                      | 0                      | 1                      | 1                      | 0                      | 0.6           | 7.14%                    |
| Possible Injury  | 0                      | 0                      | 0                      | 1                      | 0                      | 0.2           | 2.38%                    |
| Incapacitating Injury                                  | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| Fatal  | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |
| WB TOTAL   | 7                      | 6                      | 10                     | 11                     | 8                      | 8.4           | 100.00%                  |

![](_page_24_Figure_0.jpeg)

## LEGEND: XXX MILEPOST • CRASH

![](_page_25_Figure_0.jpeg)

## Figure 18 – WB Wild Animal Crashes by Month

![](_page_25_Figure_2.jpeg)

![](_page_25_Figure_3.jpeg)

![](_page_25_Figure_5.jpeg)

## Figure 19 – EB Percent Wild Animal of Total EB Crashes by Milepost

## Figure 20 – WB Percent Wild Animal of Total WB Crashes by Milepost

### **Truck Crashes**

Crashes involving trucks were sorted and grouped for more detailed analysis. The data shown below includes body style of vehicles as truck tractor, semi-trailer and all other truck combinations. There were a total of 120 crashes involving trucks in each the eastbound and westbound directions.

Table 38 shows the number of truck crashes by First Harmful Event for the study section. Crashes involving Collision with Other Motor Vehicles average 44 percent and 50 percent in the eastbound and westbound directions, respectively. The next highest crash rate are Collisions with Wild Animal Game/Non-Game, which account for 15 percent and 12 percent in the eastbound and westbound directions, respectively.

|   |                        |                        | -                      |                        |                        |               |                          |  |  |  |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|--------------------------|--|--|--|
| FIRST HARMFUL EVENT                               | JAN-04<br>TO<br>DEC-04 | JAN-05<br>TO<br>DEC-05 | JAN-06<br>TO<br>DEC-06 | JAN-07<br>TO<br>DEC-07 | JAN-08<br>TO<br>DEC-08 | YEARLY<br>AVG | YEARLY<br>AVG<br>PERCENT |  |  |  |
| EASTBOUND   |                        |                        |                        |                        |                        |               |                          |  |  |  |
| Collision w/ other Motor Vehicle                  | 10                     | 16                     | 7                      | 8                      | 12                     | 10.6          | 44.17%                   |  |  |  |
| Collision with Wild Animal<br>Game/Non-Game       | 1                      | 3                      | 2                      | 7                      | 5                      | 3.6           | 15.00%                   |  |  |  |
| Collision w/ other Non-Fixed Objects <sup>3</sup> | 2                      | 4                      | 0                      | 2                      | 2                      | 2.0           | 8.33%                    |  |  |  |
| Collision w/ Guardrail/Barrier/Curb               | 2                      | 2                      | 2                      | 2                      | 0                      | 1.6           | 6.67%                    |  |  |  |
| Collision w/ other Fixed Objects <sup>1</sup>     | 2                      | 0                      | 3                      | 1                      | 4                      | 2.0           | 8.33%                    |  |  |  |
| Overturning                                       | 1                      | 4                      | 0                      | 2                      | 1                      | 1.6           | 6.67%                    |  |  |  |
| Non-Collision Incidents <sup>2</sup>              | 0                      | 0                      | 3                      | 0                      | 3                      | 1.2           | 5.00%                    |  |  |  |
| Collision w/ Tree                                 | 0                      | 0                      | 1                      | 1                      | 2                      | 0.8           | 3.33%                    |  |  |  |
| Collision w/ Unknown                              | 1                      | 0                      | 1                      | 0                      | 0                      | 0.4           | 1.67%                    |  |  |  |
| Collision w/ Motor Vehicle Parked                 | 0                      | 0                      | 0                      | 1                      | 0                      | 0.2           | 0.83%                    |  |  |  |
| Collision w/ Ped or Ped Conveyance                | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |  |  |  |
| EB Total  | 19                     | 29                     | 19                     | 24                     | 29                     | 24.0          | 100.00%                  |  |  |  |
|   |                        | WESTB                  | OUND                   |                        |                        |               |                          |  |  |  |
| Collision w/ other Motor Vehicle                  | 13                     | 7                      | 5                      | 15                     | 20                     | 12.0          | 50.00%                   |  |  |  |
| Collision with Wild Animal<br>Game/Non-Game       | 3                      | 3                      | 3                      | 3                      | 2                      | 2.8           | 11.67%                   |  |  |  |
| Collision w/ other Non-Fixed Objects <sup>3</sup> | 2                      | 3                      | 2                      | 2                      | 2                      | 2.2           | 9.17%                    |  |  |  |
| Collision w/ Guardrail/Barrier/Curb               | 0                      | 4                      | 2                      | 0                      | 3                      | 1.8           | 7.50%                    |  |  |  |
| Collision w/ other Fixed Objects <sup>1</sup>     | 1                      | 1                      | 1                      | 1                      | 2                      | 1.2           | 5.00%                    |  |  |  |
| Overturning                                       | 1                      | 2                      | 0                      | 1                      | 1                      | 1.0           | 4.17%                    |  |  |  |
| Non-Collision Incidents <sup>2</sup>              | 2                      | 0                      | 3                      | 1                      | 1                      | 1.4           | 5.83%                    |  |  |  |
| Collision w/ Tree                                 | 1                      | 1                      | 1                      | 1                      | 0                      | 0.8           | 3.33%                    |  |  |  |
| Collision w/ Unknown                              | 0                      | 0                      | 2                      | 0                      | 1                      | 0.6           | 2.50%                    |  |  |  |
| Collision w/ Motor Vehicle Parked                 | 0                      | 0                      | 0                      | 0                      | 0                      | 0.0           | 0.00%                    |  |  |  |
| Collision w/ Ped or Ped Conveyance                | 0                      | 0                      | 0                      | 0                      | 1                      | 0.2           | 0.83%                    |  |  |  |
| WB TOTAL  | 23                     | 21                     | 19                     | 24                     | 33                     | 24.0          | 100.00%                  |  |  |  |

Table 38 – Truck Crashes by First Harmful Event

The truck crash data was also sorted and grouped by milepost location to identify potential high truck crash locations within the study section. The results of this analysis are presented in Figure 21 and Figure 22. Each bar represents the average number of crashes per year within a one mile segment.

![](_page_26_Figure_6.jpeg)

![](_page_26_Figure_7.jpeg)

![](_page_26_Figure_8.jpeg)

This category includes collisions with fences, culverts, bridge overhead structures, traffic sign supports, and utility poles.

<sup>2</sup>This category includes fire and explosion incidents.

<sup>3</sup> This category includes objects thrown/falling, objects fell/jumped from vehicle.

![](_page_26_Figure_14.jpeg)

#### Conclusions 2.3

In conclusion, the existing I-40 mainline, ramps, and ramp/cross road intersections are currently operating at LOS C or better, with the exception of a few locations:

- I-40/I-17 system TI: I-17 Northbound to I-40 Westbound Ramp Diverge (LOS D 30.9 pc/mi/ln). This LOS indicates that the loop ramp is experiencing a large amount of northbound through traffic at the diverge point, which is affecting the relatively low volume using the ramp.
- I-40/I-17 system TI: I-40 Westbound to I-17 Northbound Ramp Merge (LOS E 36.7 pc/mi/ln). This LOS indicates that there are currently operational issues, likely due to the high northbound through traffic volumes heading into Flagstaff, the high ramp merging traffic volume entering mainline I-17, and I-17 north of I-40 transitioning to an arterial street.
- Butler TI: Westbound On-Ramp is operating at LOS D 31.1 pc/mi/ln. This LOS indicates that both the high on-ramp volume combined with the heavy mainline DDHV through this area is resulting in operational deficiencies at this location.
- Country Club TI: Westbound On-Ramp is operating at LOS D 29.0 pc/mi/ln. This LOS indicates that both the high on-ramp volume combined with the heavy mainline DDHV through this area is resulting in operational deficiencies at this location.

The I-40 mainline crash data was analyzed using several different criteria to identify potential areas of concern. The analysis revealed the following:

- Crash data did not indicate any unusual patterns within the corridor for Crashes by Manner of Collision or Crashes by First Harmful Event. Approximately 64 percent of all crashes were single vehicle crashes.
- The Crashes by Severity analysis shows that the rate of fatalities in the eastbound direction is double the rate of fatalities in the westbound direction.
- The Crashes by Road Surface Condition analysis show that there is nearly double the rate of crashes • under snowy conditions in the westbound direction compared to the eastbound direction.
- Both total crashes by milepost and total truck crashes by milepost for the eastbound direction show a ٠ spike from MP 195 to MP 197, in the area of the I-40/I-17 system TI.
- Both total crashes by milepost and total truck crashes by milepost for the westbound direction spike at MP 188, west of the A-1 Mountain TI.
- Wildlife crashes throughout the corridor appear fairly uniform. Over the five year analysis period, most of • the crashes involving wildlife occurred between late spring and early fall, although December was the peak month for crashes involving westbound vehicles and wildlife.

The 2040 No Build Alternative analysis revealed the following:

- All I-40 mainline segments between the Bellemont TI and the Country Club TI will operate at a worse LOS than the target LOS with no capacity improvements.
- A majority of the service interchange ramps are expected to operate at a worse LOS than their target LOS.

are the I-17 SB to I-40 EB diverge and the I-40 EB & WB to I-17 SB merge.

To provide acceptable LOS for 2040 traffic volumes, the 2040 Build Alternative includes recommended improvements to I-40 within the study area. Table 39 presents the LOS and a summary of the recommended new service interchanges. I-40 mainline travel lanes, and auxiliary lanes. The 2040 Build Alternative recommended improvements are:

- Cosnino TI to the project study limits.
- Auxiliary lanes are recommended between the adjacent traffic interchanges for the following segments:
  - I-40/I-17 system TI to New Lone Tree TI
  - New Lone Tree TI to Butler TI
- addition of auxiliary lanes than what is shown in Table 39.
- Four proposed new service interchanges:
  - New Camp Navajo TI, west of the existing Bellemont TI, at approximate MP 183.60.
  - approximate MP 193.47.
  - 196.70.
  - approximate MP 202.31.
- constructed with longer taper lengths or as parallel type ramps to accommodate increased traffic:
  - New Camp Navajo TI EB Off-Ramp
  - New Camp Navajo TI WB On-Ramp
  - Bellemont TI EB On-Ramp
  - Bellemont TI WB Off-Ramp
  - West Flagstaff TI EB Off-Ramp 0
  - Winona TI EB Off-Ramp
  - Winona TI WB Off-Ramp
  - Winona TI WB On-Ramp
- Ramp type recommendations can be found in Section 4.12.16.
- adding additional through lanes or auxiliary lanes at the following locations:
  - I-17 NB to I-40 EB, Diverge
  - o I-40 EB to I-17 NB & SB, Diverge

• All of the I-40/I-17 system TI ramps are expected to operate at a LOS D or worse. The only exceptions

• I-40 mainline provides three travel lanes in each direction between the New Camp Navajo TI and the Cosnino TI, and two travel lanes in each direction west of the New Camp Navajo TI and east of the

• Note that due to the close proximity of the Flagstaff Ranch TI and the Woody Mountain TI, auxiliary lanes are recommended between these adjacent traffic interchanges; see Section 4.12.6 Flagstaff Ranch TI. The auxiliary lanes are not required for LOS purposes, but rather as a result of the geometrics. Therefore, I-40 from the Flagstaff Ranch TI to the Woody Mountain TI will have a better LOS due to the

• New Woody Mountain TI, between the existing Flagstaff Ranch TI and the I-40/I-17 system TI, at

New Lone Tree TI, between the I-40/I-17 system TI and the existing Butler TI, at approximate MP

• New US 89 TI, between the existing Country Club TI and the existing Walnut Canyon TI, at

The following on- and off-ramps at the existing and proposed service interchanges would need to be

Improvements were identified at the existing I-40/I-17 system TI merge and diverge points including

| Milepost | Distance Between<br>Service TIs | Eastbound<br>Number of Lanes<br>Main + Auxiliary | LOS | Interchange                   | Westbound<br>Number of<br>Lanes<br>Main + Auxiliary | LOS |
|----------|---------------------------------|--|-----|-------------------------------|---|-----|
| 183.00   |                                 | 2+0  | D   | Begin Study Limit             | 2+0   | D   |
|          | 0.66                            | 2+0  | D   |                               | 2+0   | D   |
| 183.66   |                                 | 2+0  | D   | New Camp Navajo TI            | 2+0   | D   |
|          | 1.49                            | 3+0  | В   | Drop/Add 3 <sup>rd</sup> Lane | 3+0   | В   |
| 185.15   |                                 | 3 + 0  | С   | Bellemont TI                  | 3+0   | С   |
|          | 5.39                            | 3 + 0  | С   |                               | 3+0   | С   |
| 190.54   |                                 | 3 + 0  | С   | A-1 Mountain TI               | 3 + 0   | С   |
|          | 1.15                            | 3+0  | С   |                               | 3+0   | С   |
| 191.69   |                                 | 3+0  | В   | West Flagstaff TI             | 3+0   | В   |
|          | 0.87                            | 3+0  | В   |                               | 3+0   | В   |
| 192.56   |                                 | 3 + 0  | В   | Flagstaff Ranch TI            | 3 + 0   | В   |
|          | 0.91                            | 3 + 0  | В   |                               | 3 + 0   | В   |
| 193.47   |                                 | 3 + 0  | В   | New Woody Mountain TI         | 3 + 0   | В   |
|          | 1.95                            | 3 + 0  | С   |                               | 3 + 0   | С   |
| 195.42   |                                 | 3 + 0  | С   | I-40 / I-17 System TI         | 3 + 0   | С   |
|          | 1.28                            | 3 + 1  | С   |                               | 3 + 1   | С   |
| 196.70   |                                 | 3 + 0  | D   | New Lone Tree TI              | 3 + 0   | D   |
|          | 1.58                            | 3 + 1  | С   |                               | 3 + 1   | С   |
| 198.28   |                                 | 3 + 0  | С   | Butler TI                     | 3 + 0   | С   |
|          | 2.82                            | 3 + 0  | D   |                               | 3 + 0   | D   |
| 201.10   |                                 | 3 + 0  | В   | Country Club TI               | 3 + 0   | В   |
|          | 1.21                            | 3 + 0  | С   |                               | 3 + 0   | С   |
| 202.31   |                                 | 3 + 0  | В   | New US 89 TI                  | 3 + 0   | В   |
|          | 2.56                            | 3 + 0  | В   |                               | 3 + 0   | В   |
| 204.87   |                                 | 3 + 0  | В   | Walnut Canyon TI              | 3 + 0   | В   |
|          | 2.37                            | 3 + 0  | В   |                               | 3+0   | В   |
| 207.24   |                                 | 3 + 0  | В   | Cosnino TI                    | 3 + 0   | В   |
|          | 1.17                            | 3 + 0  | В   |                               | 3+0   | В   |
| 208.41   |                                 | 2+0  | С   | Drop/Add 3 <sup>rd</sup> Lane | 2+0   | С   |
|          | 2.75                            | 2+0  | С   |                               | 2+0   | С   |
| 211.16   |                                 | 2+0  | С   | Winona TI                     | 2+0   | С   |
|          | 2.84                            | 2+0  | С   |                               | 2+0   | С   |
| 214.00   |                                 | 2 + 0  | С   | End Study Limit               | 2+0   | С   |

## Table 39 – 2040 Build Alternative I-40 Recommended Improvements and LOS