USA Parkway
SR 439

Traffic Operations Analysis Memorandum

August 2012

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JACOBS™

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Technical Memorandum

TO:	Hoang Hong, NDOT	**DATE:**	August 28, 2012
FROM:	John Karachepone, Jacobs		
SUBJECT:	USA Parkway – Traffic Operations Analysis		
COPIES:	Pedro Rodriguez, NDOT; Bryan Gant, Jacobs; Randy Travis, NDOT		

1. INTRODUCTION AND BACKGROUND

USA Parkway (SR 439) is a minor rural arterial that begins at I-80 about 10 miles east of Reno, Nevada, at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median and limited shoulders. Extension of USA Parkway southeast from Storey County into Lyon County to tie into US 50 in Silver Springs is proposed.

USA Parkway has been envisioned as an important link between US 50 and I-80. Currently, US 395 through Carson City, SR 341 through Virginia City and US 95A through Fernley are used to connect the Reno metro area with points south and east. A complete USA Parkway between US 50 and I-80 will improve that connectivity. In addition, the development of the Tahoe-Reno Industrial Center (TRIC) along USA Parkway continues to change the employment and transportation character of the region. The TRIC is planned to become a large industrial park. Figure 1-1 illustrates the proposed project in relation to surrounding roadways and land use.

Figure 1-2 shows the general traffic study area within the regional context. This is the project traffic influence area; specifically the area bounded by I-80 to the north, US 50 to the south, US 95A to the east and USA Parkway to the west.

Jacobs is retained by the Nevada Department of Transportation (NDOT) to provide environmental and preliminary engineering services for the proposed USA Parkway project. At the present time, it appears that an Environmental Assessment (EA) will be the appropriate class of action for National Environmental Policy Act (NEPA) conformance. The lead agency is the Federal Highway Administration (FHWA) with joint NDOT and Bureau of Land Management (BLM) participation. The anticipated opening year for the proposed project is 2017. The design year is 2037, consistent with NDOT and FHWA's 20-year beyond opening year policy.

As part of the EA, traffic operations analyses were performed to determine required improvements to existing geometry and traffic control, and to evaluate proposed roadway geometry and traffic control for new facilities. The operations analysis will assist in determining the appropriate mobility and safety improvements needed.

Traffic forecasts documented in this memorandum (and used for traffic operations analyses) were developed and presented in the *"USA Parkway Traffic Forecast Memorandum"* dated July 11, 2012. The traffic forecast memorandum was approved by NDOT on August 1, 2012 (see Appendix A). The study area exhibit (Figure 1-1) shows a "Highlands Specific Plan Area" (Highlands) south of the county line along USA Parkway. At the time of the preparation of the

Figure 1-1: Proposed Project

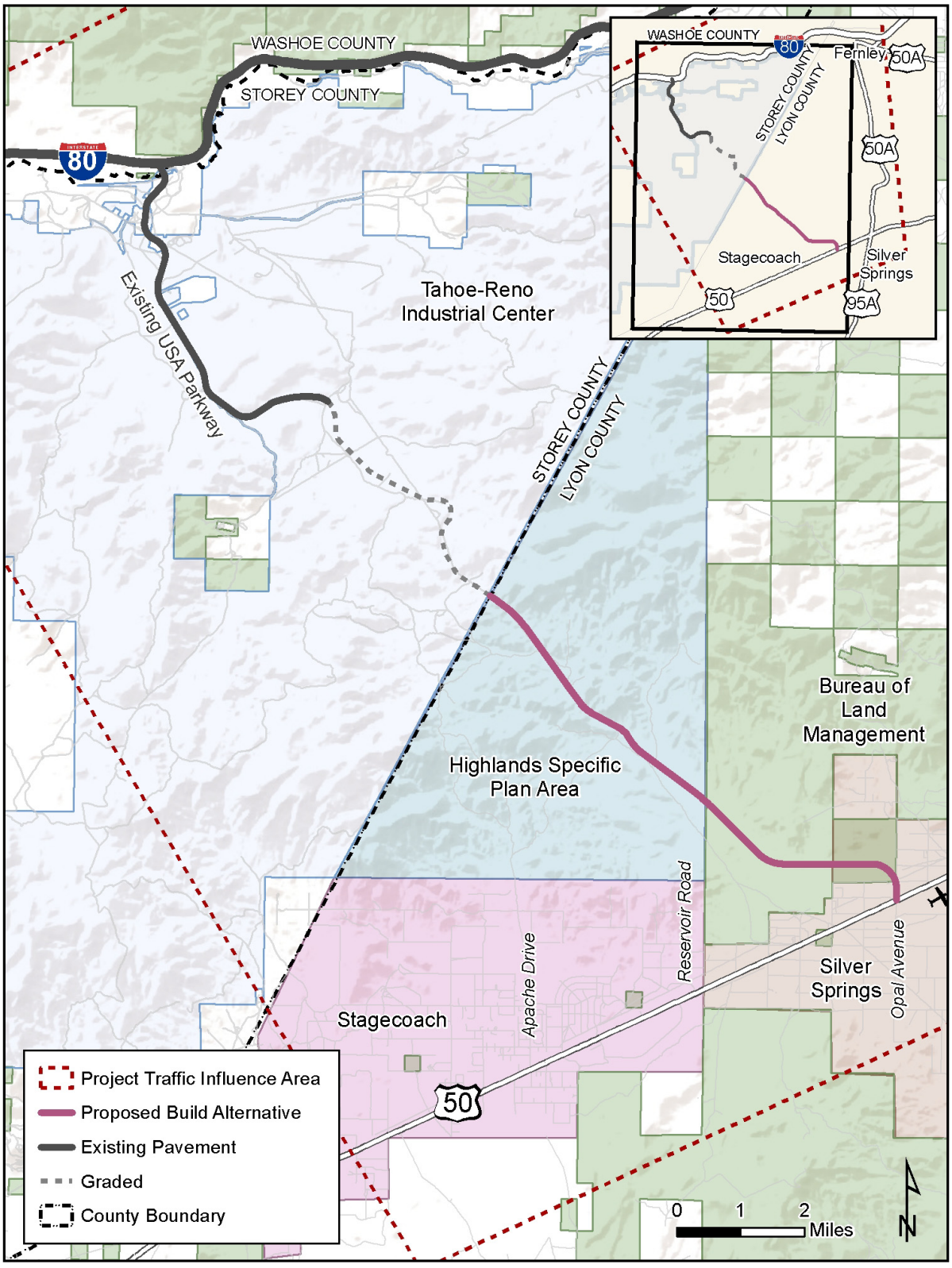
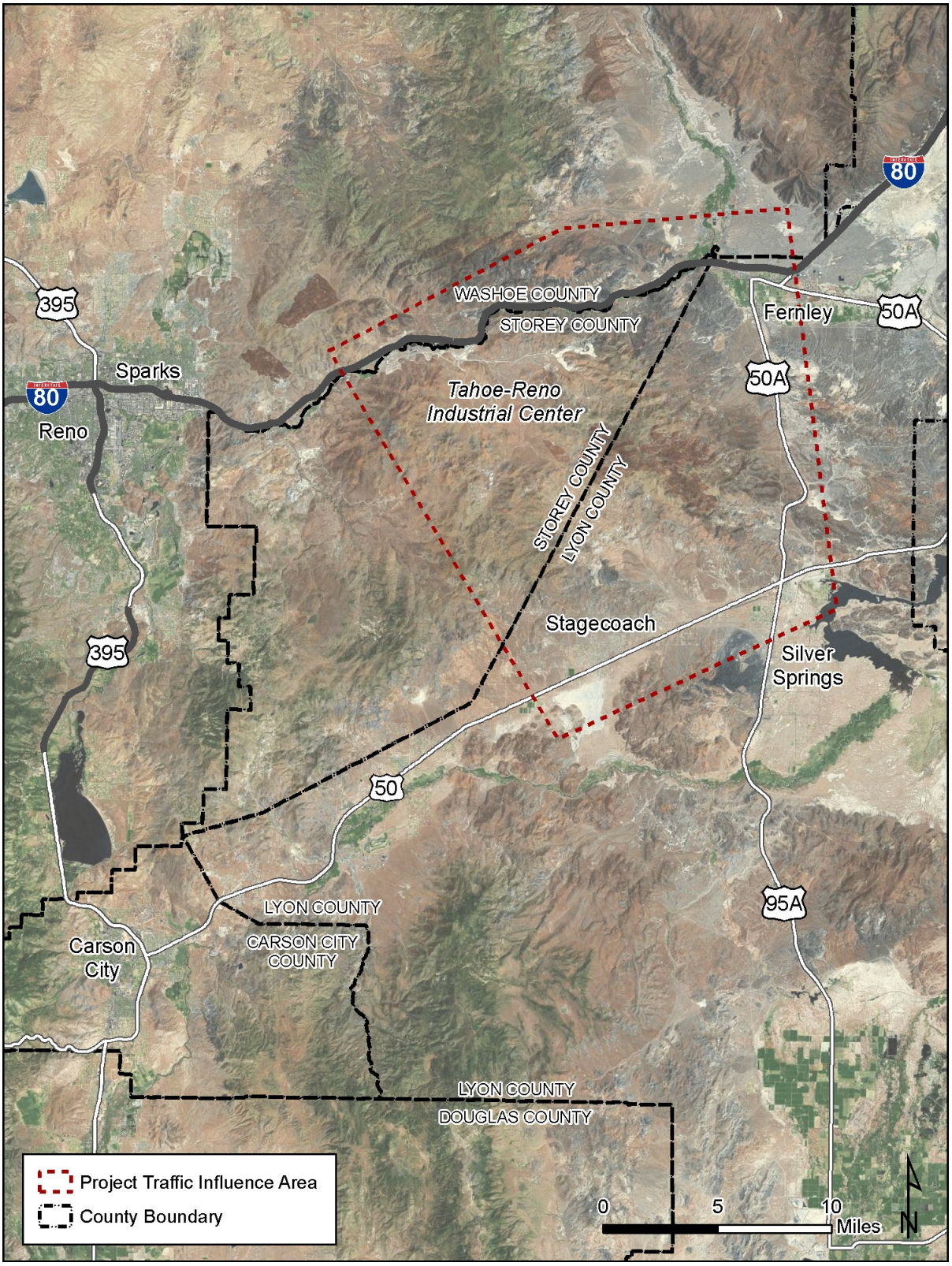


Figure 1-2: General Traffic Study Area



traffic forecasts for USA Parkway EA, it was uncertain if Highlands would be developed. Hence, the project team developed traffic forecasts for two scenarios: “With Highlands” (i.e. Highlands is built) and “No-Highlands” (Highlands does not develop). Subsequently, the No-Highlands scenario was determined to be the most likely scenario of development in the study area by the stakeholders. Furthermore, the Highlands development is not included in future land use plan of Lyon County. Hence, the traffic operations analyses conducted and reported in this traffic operations memorandum corresponds to the forecast volumes for the “No-Highlands” scenario in the *USA Parkway Traffic Forecast Memorandum*.

Methodologies used in this memorandum are consistent with the previously approved “*USA Parkway Traffic Analysis Methodology*” (Methodology Memorandum), dated December 28, 2011 and approved in January 5, 2012 (see Appendix B).

This technical memorandum reports traffic operations analyses for the following:

- Year 2011 Existing Conditions
- Design Year 2037 No-Action Alternative
- Design Year 2037 Build Alternative
- Opening Year 2017 No-Action Alternative
- Opening Year 2017 Build Alternative

The main focus of the traffic operations analysis is the proposed extension of USA Parkway to US 50, as the subject extension is what constitutes the project. However, an analysis of the USA Parkway Interchange with I-80 is also completed to identify potential impacts of the proposed project on this existing interchange. Furthermore, an evaluation of the impacts of USA Parkway on major roadways within the traffic influence area (US 50, US 95A, I-80) is presented.

2. TECHNICAL GUIDANCE AND TRAFFIC ANALYSIS TOOLS

The analyses documented in this memorandum were completed according to the following technical documents and guidelines:

- Highway Capacity Manual (HCM), Transportation Research Board, 2010
- A Policy on Geometric Design of Highways and Streets, AASHTO, 2011
- Manual on Uniform Traffic Control Devices, FHWA, 2009

In addition, the analyses were conducted in accordance to the approved “USA Parkway Traffic Analysis Methodology”, and the “USA Parkway Traffic Forecast Memorandum”.

Highway Capacity Software (HCS) 2010 Version 6.3 was used for the analyses documented in this memorandum.

3. ANALYSIS METHODOLOGY & ASSUMPTIONS

The traffic operations analyses documented in this memorandum were conducted with the following general methodology/assumptions:

- Analysis periods are the AM and PM design hours.
- Peak Hour Factor of 0.90 was used as per the approved *USA Parkway Traffic Analysis Methodology Memorandum*.
- Peak hour truck percentage of 12% was used for I-80 and USA Parkway, peak hour truck percentage of 6% was used for US 50, as per the approved *USA Parkway Traffic Forecast Memorandum*.
- Existing geometry, traffic control and speed limit information was obtained from Google Maps and field visits.
- Free flow speed of "posted speed + 5 mph" was used in the analyses.
- For signalized intersections, yellow time of 4s and all red time of 1s was chosen as clearance times.
- The proposed signalized intersections for the opening year 2017 and design year 2037 were analyzed as actuated intersections. Optimized traffic signal cycle lengths and splits were used. Phasing was based on most reasonable phasing scenario.
- Analysis of intersections was completed using HCS 2010 Version 6.3, following HCM 2010 methodology.
- Analysis of freeway merge and diverge segments was completed using HCS 2010 Version 6.3, following HCM 2010 methodology.

Additional details on the methodology and assumptions are provided in the subsequent chapters of this memorandum.

4. EXISTING CONDITIONS TRAFFIC OPERATIONS ANALYSIS

Existing USA Parkway begins at I-80 about 10 miles east of Reno at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median and limited shoulders.

An existing operations analysis could not be performed for the proposed USA Parkway extension, as it currently does not exist. Existing conditions on the USA Parkway Interchange at I-80 were analyzed. Additionally, existing conditions on the major roadways within the project traffic influence area; specifically I-80 to the north, US 50 to the south, and US 95A to the east; were evaluated. Existing conditions analysis year is year 2011.

Figure 4-1 illustrates the existing conditions on the general project influence area roadway network. Existing number of lanes, NDOT functional classification and existing (year 2011) AADT, level of service (LOS) and volume to capacity ratios (V/C) are shown. LOS for the general project influence area roadway network were estimated (see Appendix C 1) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C. The following is a description of the existing conditions on these study area roadways:

- Existing USA Parkway is a four-lane rural minor arterial. LOS is B.
- I-80 within the project influence area is a four-lane rural interstate. I-80 is planned to be widened in the future to six lanes west of USA Parkway. Widening is not planned for I-80 east of the USA Parkway Interchange. LOS is B, both west and east of USA Parkway.
- US 50 within the project influence area is a two-lane rural principal arterial with wide shoulders. In Silver Springs, US 50 intersects with US 95A at a four-way stop controlled intersection. US 50 is planned to be widened in the future to four lanes west of US 95A. Widening is not planned for US 50 east of US 95A. LOS along US 50 is C west of US 95A and B east of US 95A.
- US 95A is a two-lane rural minor arterial between US 50 and I-80; and currently is one of the roads that connect the Reno/Sparks metropolitan area with points south and east. Widening is not planned for US 95A within the study area. LOS is D on US 95A, south of Fernley and C north of Silver Springs.
- Ramsey-Weeks Cut-off is a two-lane rural minor collector that provides diversion for trips between US 50 to the west and US 95A to the south. Widening is not planned for Ramsey-Weeks cut-off. LOS is B.

Analysis of I-80/USA Parkway Interchange: A traffic operations analysis of the existing USA Parkway Interchange with I-80 was completed as detailed in Section 4.1 and Section 4.2. Figure 4-2 shows the year 2011 peak hour traffic volumes used for the existing conditions analysis at I-80/USA Parkway Interchange. Figure 4-3 shows the existing intersection geometry and traffic control. The ramp terminal intersections at this interchange are both currently unsignalized (stop-controlled).

Figure 4-1: Existing Conditions on the General Project Influence Area Roadway Network

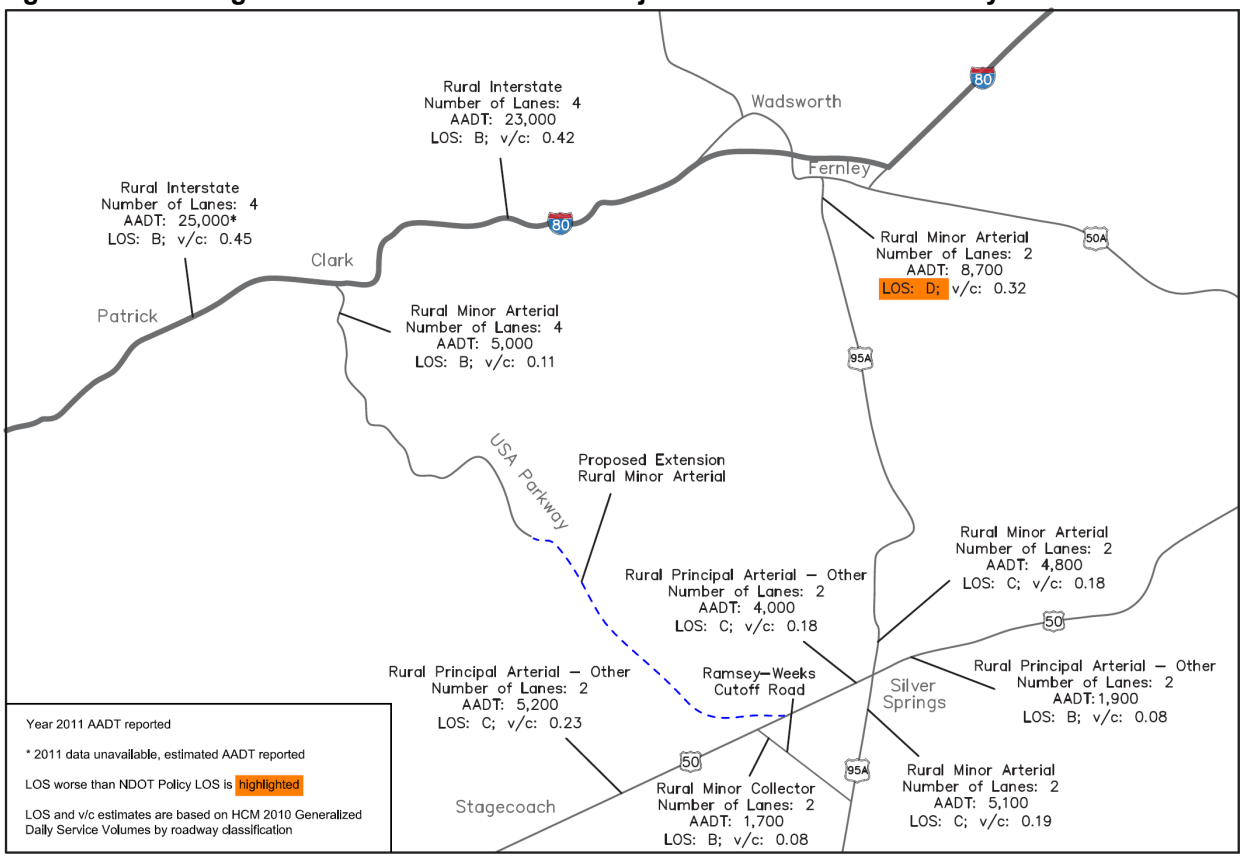


Figure 4-2: Existing Conditions - Year 2011 Peak Hour Volumes

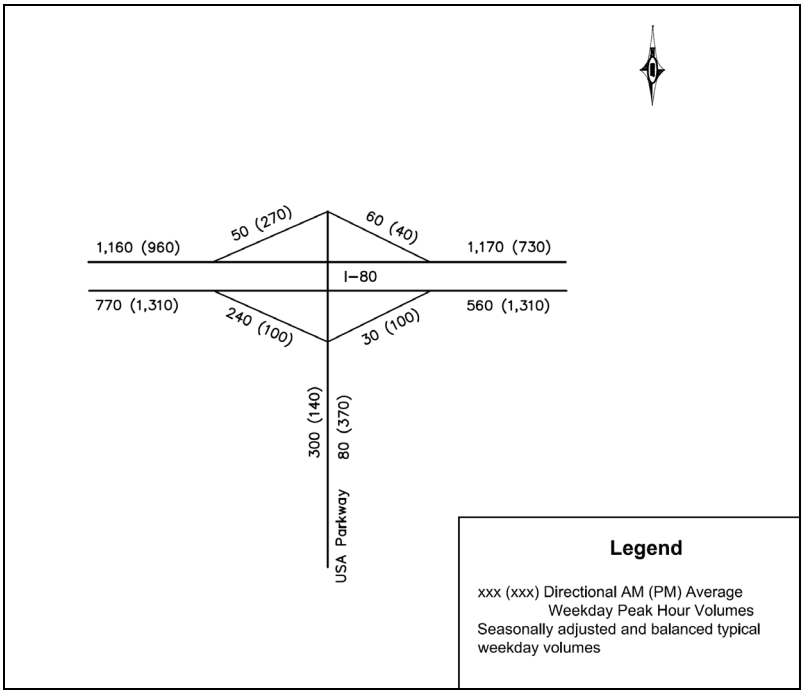
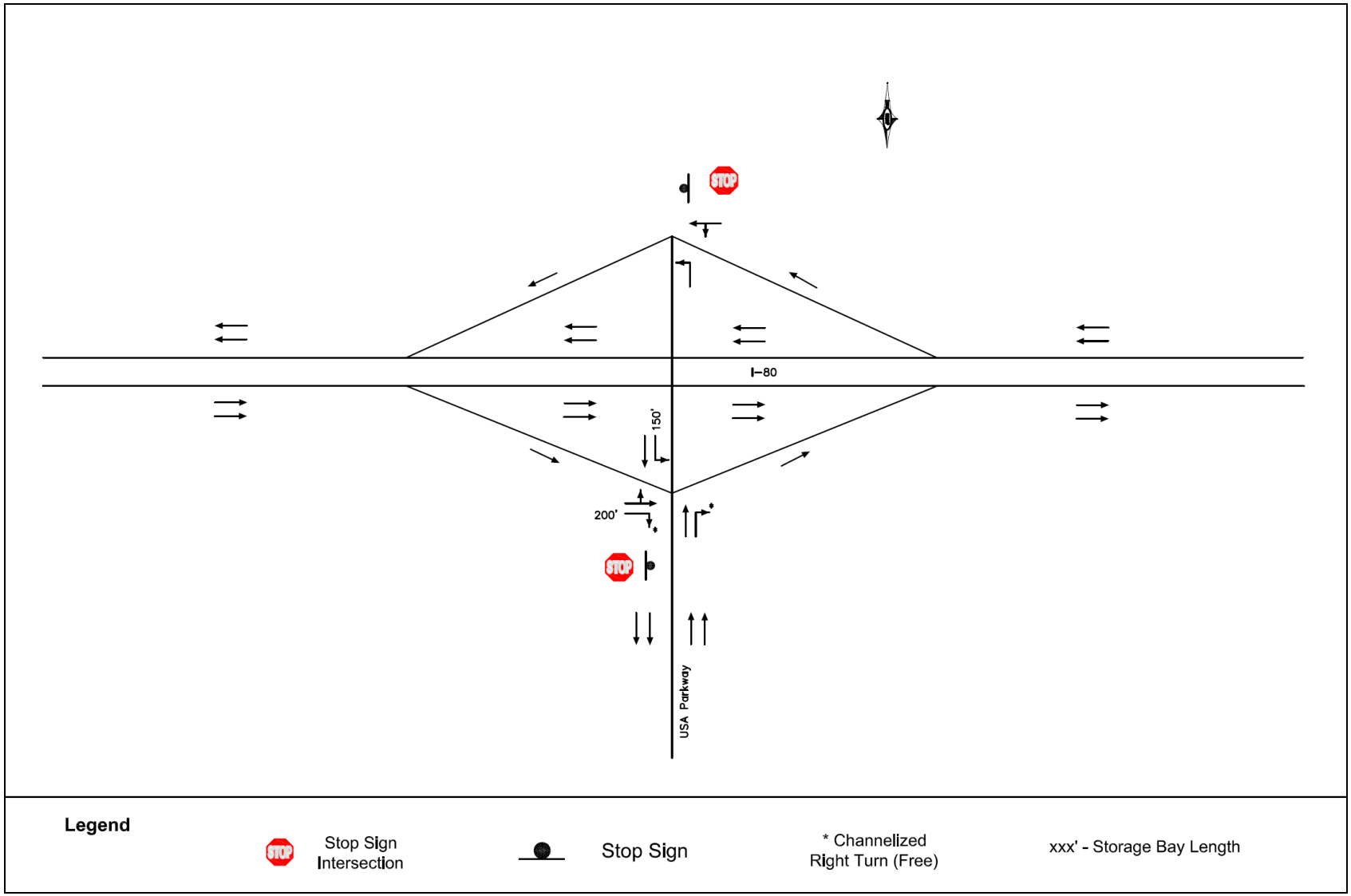


Figure 4-3: Existing Conditions Geometry and Control at the I-80/USA Parkway Interchange



4.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 software Version 6.3 following HCM 2010 methodology.

HCM LOS criteria for intersections are shown in Table 4-1.

Table 4-1: HCM LOS Criteria for Intersections

LOS	Control Delay per Vehicle (in seconds)	
	Signalized Intersections	Unsignalized Intersections
A	0-10	0-10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

Source: Highway Capacity Manual 2010, Transportation Research Board

The results of the existing conditions intersection traffic operations analysis are shown in Table 4-2. HCS analysis worksheets are provided in Appendix D 1.

Table 4-2: Existing Conditions Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	9.7	A	0.08	16.5	C	0.13
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	9.6	A	0.01	11.1	B	0.01

The worst movement delay and the corresponding LOS and V/C are reported.

Source: Jacobs, 2012

4.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines.

HCM LOS criteria for freeway merge and diverge segments are shown in Table 4-3.

Table 4-3: HCM LOS Criteria for Freeway Merge and Diverge Segments

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	Demand exceeds capacity
Source: Highway Capacity Manual 2010, Transportation Research Board	

The results of the existing conditions freeway merge and diverge analysis are shown in Table 4-4. HCS analysis worksheets are provided in Appendix E 1.

Table 4-4: Existing Conditions Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	10.2	B	16.3	B
I-80 EB On-Ramp at USA Parkway	8.4	A	16.7	B
I-80 WB Off-Ramp at USA Parkway	14.7	B	9.8	A
I-80 WB On-Ramp at USA Parkway	13.7	B	13.8	B
Source: Jacobs, 2012				

Analysis results indicate that USA Parkway Interchange at I-80 currently operates satisfactorily as per NDOT's policy LOS.

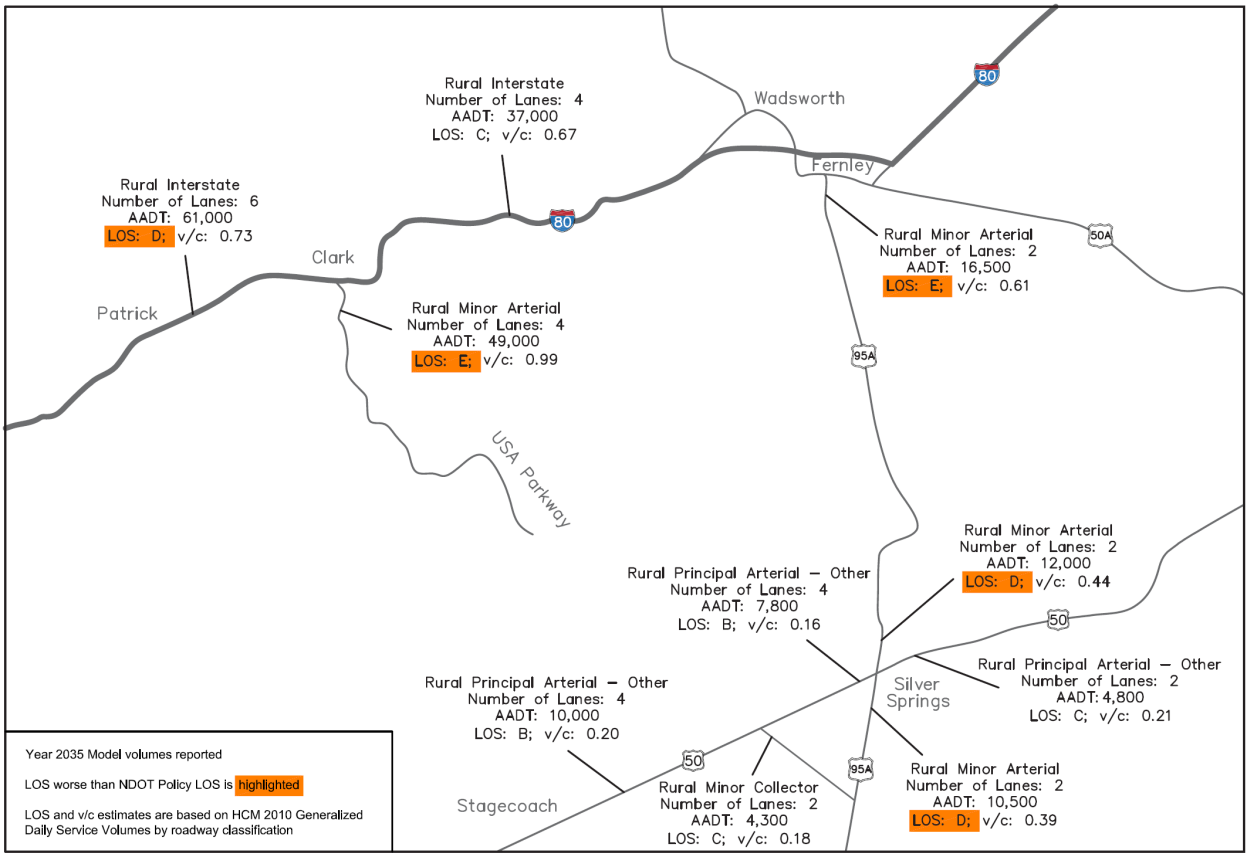
5. DESIGN YEAR 2037 NO-ACTION ALTERNATIVE ANALYSIS

No-Action alternative represents the future conditions without the proposed project (i.e. no extension of USA Parkway). Typically, a No-Action network is defined to be the existing roadway system, together with committed improvement projects as planned in state, regional and local plans. For the USA Parkway EA, the design year 2037 No-Action network is same as existing roadway network, as there are no planned/programmed new roads. However, the following two improvements are planned:

- I-80 is planned to be widened to a six-lane section west of USA Parkway.
- US 50 is planned to be widened to a four-lane section west of US 95A.

Figure 5-1 illustrates the conditions on the general project influence area roadway network for the No-Action alternative. Future number of lanes, NDOT functional classification, future year AADT, LOS and V/C are shown. LOS for the general project influence area roadway network were estimated (see Appendix C 2) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C; hence, LOS worse than C are highlighted.

Figure 5-1: No-Action Alternative - Conditions on the General Project Influence Area Roadway Network



Without the proposed project, LOS substantially degrades compared to the existing conditions. The TRIC development is expected to attract a significant number of vehicles to the overall road

network in the study area and the impact due to these additional vehicles are clearly seen in Figure 5-1. In the No-Action alternative, the absence of the proposed project leads to a deterioration in the performance of the area roadways. The following is a description of the conditions on the project influence area roadways for the No-Action alternative:

- A significant deterioration in the LOS along USA Parkway near the I-80 interchange is anticipated; this is attributable to the large increase in traffic along this segment due to the expected growth of TRIC. LOS is anticipated to be E, very close to F.
- Along I-80 west of USA Parkway, road improvements are planned and I-80 is planned to be widened to six lanes, whereas no improvements are planned for I-80 east of USA Parkway. Despite the planned improvement on I-80, LOS is anticipated to be D, west of USA Parkway due to the increase in traffic. On I-80 east of USA Parkway, LOS is anticipated to be C, approaching D.
- Along US 50 west of US 95A, LOS is anticipated to be B. On US 50 east of US 95A, LOS is anticipated to be C.
- No improvements are planned along US 95A; the LOS is anticipated to degrade to LOS E on US 95A south of Fernley and LOS D north and south of Silver Springs.
- Ramsey-Weeks Cut-off is anticipated to operate at LOS C.

In the No-Action alternative, USA Parkway is not extended, and hence I-80 and US 50 are not connected. There are no major north-south routes for approximately 30 miles between US 395, which connects the City of Reno to Carson City, and US 95A, which connects the communities of Fernley, Silver Springs, and Yerington. The lack of north-south routes connecting I-80 and US 50 results in out-of-direction travel for trips between the US 50 corridor communities (Stage Coach and Silver Springs) and major job centers in the cities of Reno and Sparks and TRIC. Vehicles travelling to TRIC from the southern region of the study area are forced to travel east along US 50, north along US 95A and west along I-80 to reach the TRIC. This is reflected by the deterioration in LOS along these road segments. Table 5-1 illustrates the additional travel distance and travel time incurred by travelers between select origin-destination pairs if USA Parkway does not get extended to US 50. From Table 5-1 it can be seen that the presence of USA Parkway would greatly reduce the travel distance for travelers in the region.

Table 5-1: Comparison of Travel Distances and Travel Times between Select Origin-Destination Pairs - No-Action Alternative vs. Build Alternative

Origin-Destination	Travel Distance No-Action Alternative (miles)	Travel Distance Build Alternative (miles)	Percent Reduction in Travel Distance	Travel Time No-Action Alternative (minutes)	Travel Time Build Alternative (minutes)	Percent Reduction in Travel Time
Silver Springs to Reno	49	42	14%	45	42	7%
Silver Springs to TRIC	32	19	41%	32	20	38%
Stagecoach to TRIC	42	23	45%	40	25	38%

The travel time estimates are approximate values based on the travel distance and the posted speed limit, calculated without consideration of the impact of congestion.

Analysis of I-80/USA Parkway Interchange: A traffic operations analysis of the I-80/USA Parkway Interchange was completed for the No-Action alternative as detailed in Section 5.1 and Section 5.2. Figure 5-2 shows the design year 2037 peak hour volumes; and Figure 5-3 shows the design year 2037 turning movement volumes at the I-80/USA Parkway interchange. Figure 5-4 shows the year 2037 No-Action alternative intersection geometry and traffic control at the I-80/USA Parkway interchange.

Figure 5-2: No-Action Alternative – Year 2037 Peak Hour Volumes

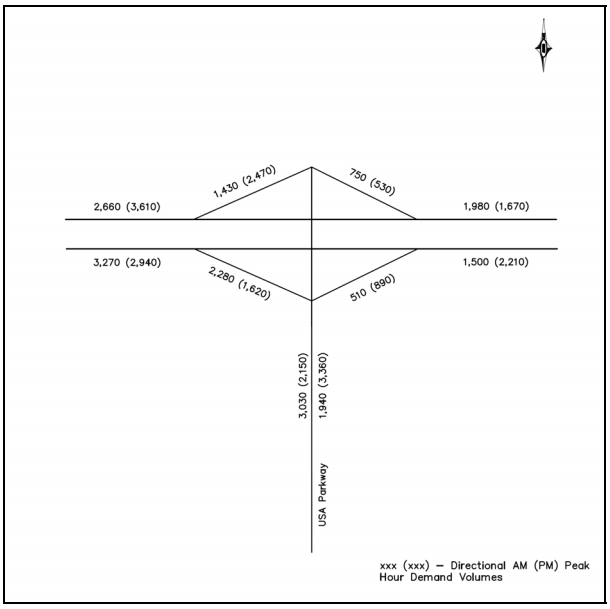


Figure 5-3: No-Action Alternative – Year 2037 Turning Movement Volumes

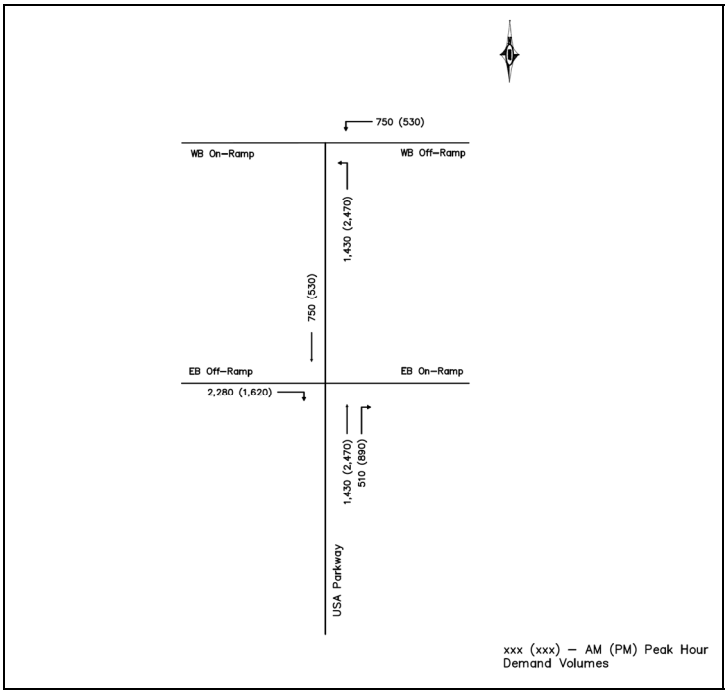
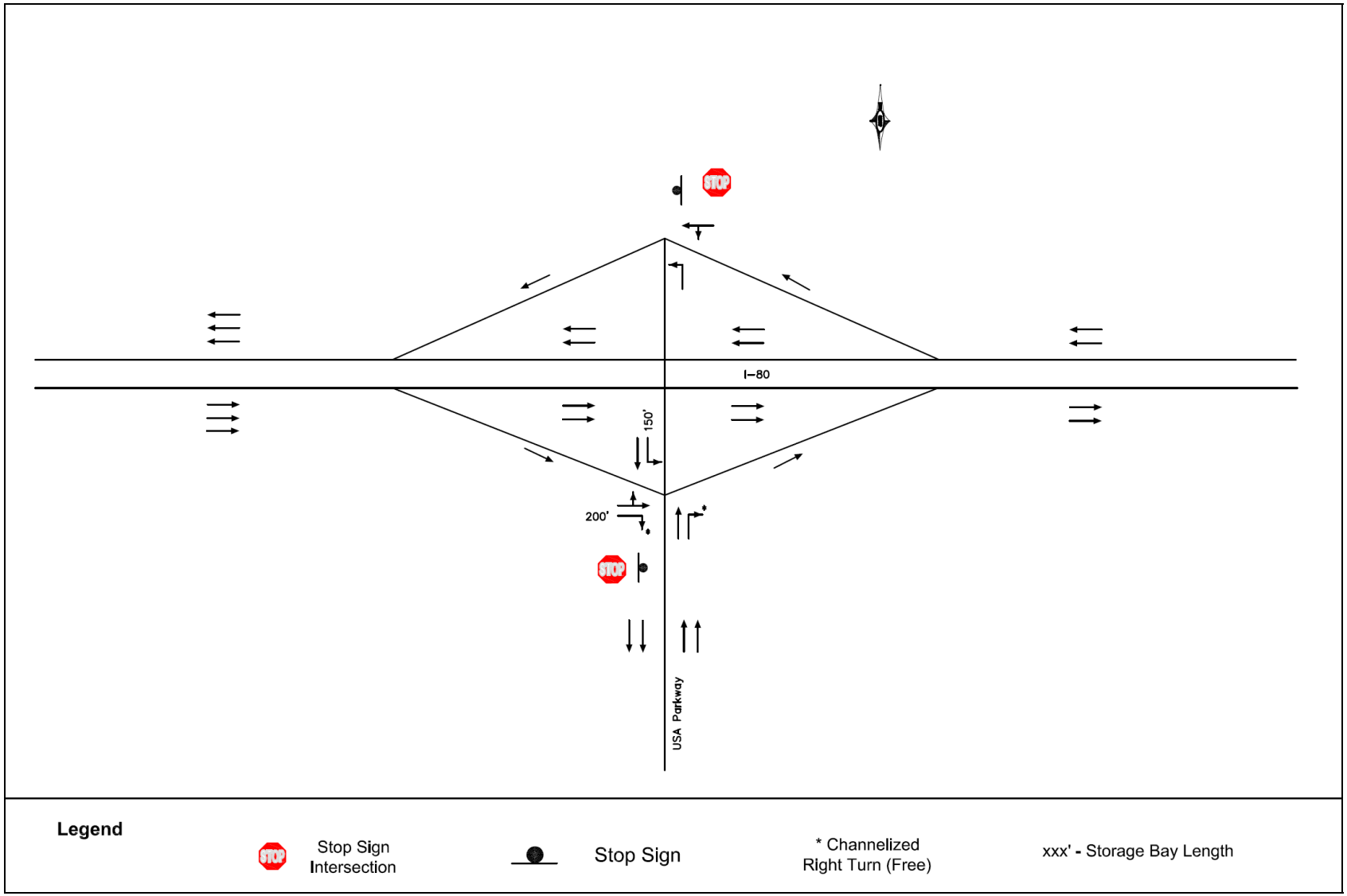


Figure 5-4: No-Action Alternative Geometry and Control at the I-80/USA Parkway Interchange



5.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 5-2. HCS analysis worksheets are provided in Appendix D 2.

Table 5-2: Year 2037 No-Action Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	>1,000	F	>1	>1,000	F	>1
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	137.6	F	0.13	799.1	F	0.57

The worst movement delay and the corresponding LOS and V/C are reported.

Source: Jacobs, 2012

Similar to the anticipated LOS in the general roadway network, the LOS at the study intersections are also anticipated to be worse in the design year 2037. The ramp terminal intersections are anticipated to operate at LOS F during both the AM and PM peak periods in the No-Action alternative.

5.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the No-Action alternative freeway merge and diverge analysis are shown in Table 5-3. HCS analysis worksheets are provided in Appendix E 2.

Table 5-3: Year 2037 No-Action Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	22.2	F*	17.4	F*
I-80 EB On-Ramp at USA Parkway	22.6	C	33.5	D
I-80 WB Off-Ramp at USA Parkway	23.9	C	20.4	C
I-80 WB On-Ramp at USA Parkway	26.7	C	42.7	F

* As per the HCM 2010 methodology, even though the density in the ramp influence area is less than the LOS F threshold, the demand flow rate on the ramp is greater than the capacity, resulting in LOS F.

Source: Jacobs, 2012

From Table 5-3, it can be seen that the I-80 EB off-ramp is anticipated to operate at LOS F during both the AM and PM peak periods, and I-80 WB on-ramp is anticipated to operate at LOS F during the PM peak period. These are the critical ramps carrying the most traffic during the peak periods. In addition, the I-80 EB on-ramp is anticipated to operate at LOS D. All these ramps are anticipated to operate at an LOS less than the desired operating level.

6. DESIGN YEAR 2037 BUILD ALTERNATIVE ANALYSIS

Build alternative represents the future conditions with the proposed project (extension of USA Parkway to US 50). The Build alternative also includes the planned improvements previously listed under the No-Action alternative to the general road network in the study area.

A brief description of the design year 2037 Build alternative is as follows:

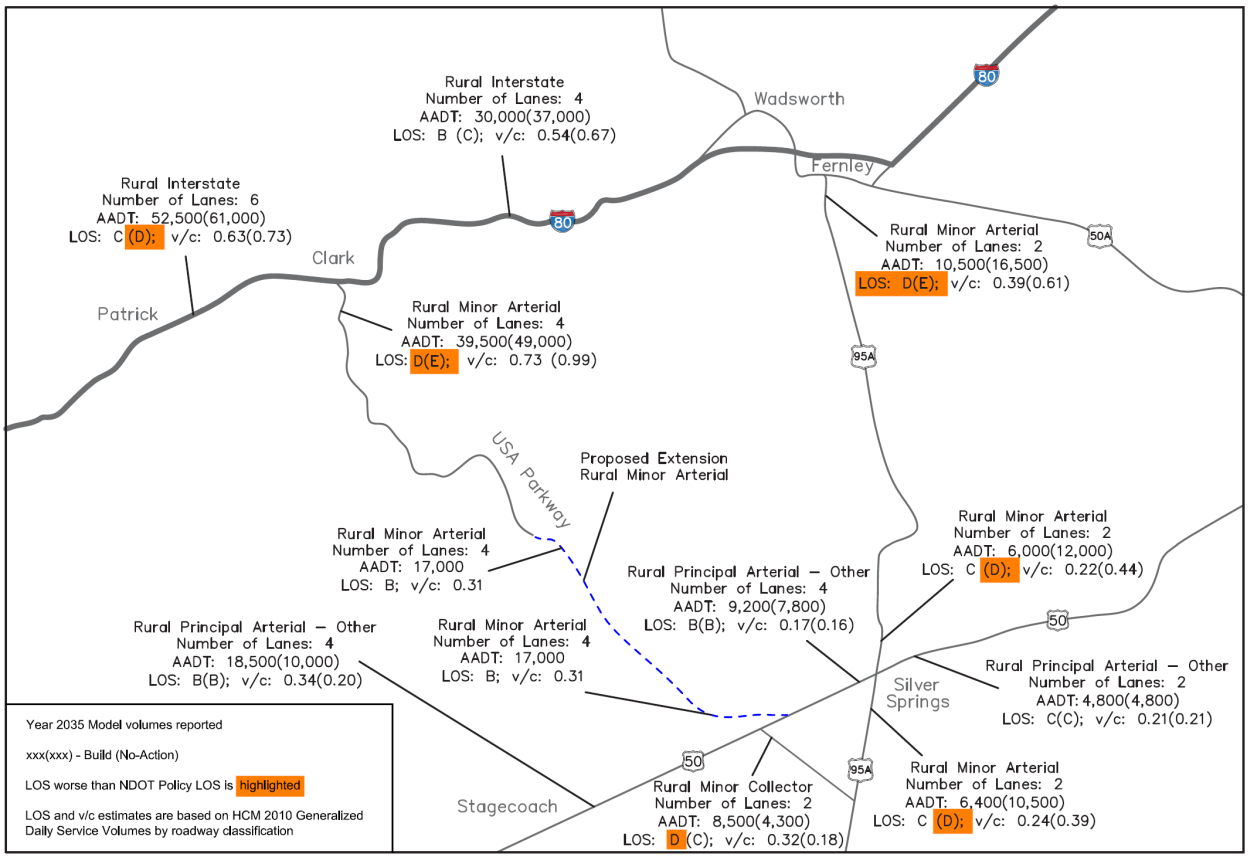
- Extension of the USA Parkway, southeast from Storey County into Lyon County to tie into US 50 in Silver Springs.
- I-80 is planned to be widened to a six-lane section west of USA Parkway.
- US 50 is planned to be widened to a four-lane section west of US 95A.

Figure 6-1 illustrates the conditions on the general project influence area roadway network for the Build alternative. Future number of lanes, NDOT functional classification, future year AADT, LOS and V/C are shown. LOS for the general project influence area roadway network was estimated (see Appendix C 3) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C; hence, LOS worse than C are highlighted.

Compared to the No-Action alternative, in the Build alternative, the roadways in the general study area operate at LOS C or better except for USA Parkway near the I-80/USA Parkway interchange, US 95A south of Fernley and Ramsey-Weeks Cutoff Road, all of which operate at LOS D. The presence of the proposed project in the Build alternative alleviates the problem of congestion on the area roadways. The following is a description of the conditions on the project influence area roadways for the Build alternative:

- USA Parkway near the I-80/USA Parkway interchange is anticipated to operate at an LOS of D in the Build alternative, compared to LOS E of the No-Action alternative. To achieve an LOS of C at this location, USA Parkway would need to be improved to a six-lane arterial (widen from the existing four-lane configuration) would be needed.
- Along I-80 west of USA Parkway, LOS is anticipated to be C and along I-80 east of USA Parkway, LOS is anticipated to be B (an improvement over the No-Action alternative LOS of D and C respectively).
- Along US 50 west of US 95A, LOS is anticipated to be B and along US 50 east of US 95A, LOS is anticipated to be C.
- Along US 95A south of Fernley, LOS is anticipated to be D and along US 95A north of Silver Springs, LOS is anticipated to be C. At both these locations, the LOS is expected to be better than the No-Action alternative. It should be noted that US 95A south of Fernley currently operates at LOS D as shown in Figure 4-1.
- Ramsey-Weeks Cut-off is anticipated to operate at LOS D compared to the LOS of C in the No-Action alternative. This is due to an increase in the number of through vehicles because of the USA Parkway connection between I-80 and US 50.

Figure 6-1: Build Alternative - Conditions on the General Project Influence Area Roadway Network



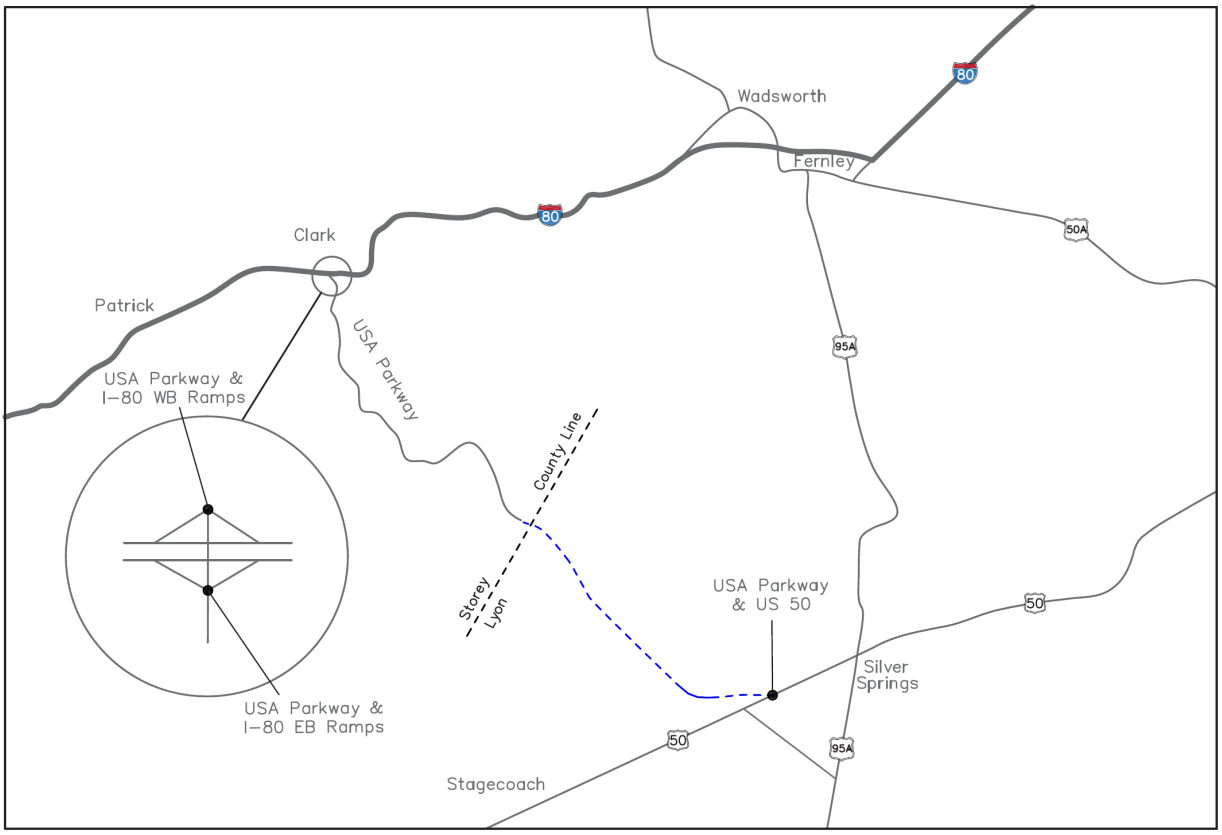
In the Build alternative, USA Parkway connects I-80 and US 50. This enables vehicles travelling to TRIC from the southern region of the study area to use USA Parkway instead of travelling east along US 50, north along US 95A and west along I-80 to reach the TRIC. This is reflected by the comparatively better LOS along these road segments in the Build alternative. Table 5-1 showed the reduction in travel distance and travel time with the Build alternative compared to the No-Action alternative.

The following analyses were completed for the Build alternative:

- Intersection traffic operations analysis of
    - Ramp terminal intersections at the I-80/USA Parkway interchange
    - USA Parkway and US 50 intersection
- Freeway merge and diverge analysis along I-80 for segments near USA Parkway
- Multilane highway analysis of proposed USA Parkway extension

Figure 6-2 shows the study intersections for the intersection analysis of the Build alternative. Figure 6-3 shows the design year 2037 peak hour volumes; and Figure 6-4 shows the design year 2037 turning movement volumes.

Figure 6-2: Study Intersections for Build Alternative Traffic Operations Analysis



As per the approved USA Parkway Traffic Analysis Methodology, LOS thresholds are defined as:

- HCM LOS D or better for the intersection of USA Parkway at US 50. It is noted that LOS C is desired for this intersection.
- LOS C or better at USA Parkway/I-80 Interchange.
- LOS E or better for each movement at intersections.
- Intersection V/C, including each movement, less than 1.0

6.1. Intersection Analysis

Analysis of the signalized intersections was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 6-1. The recommended geometry and traffic control to achieve these LOS is shown in Figure 6-5 and Figure 6-6. The proposed geometry and traffic control for new facilities and the proposed improvements to geometry and traffic control for existing facilities are listed in Section 6.4. For signalized intersections, the overall intersection control delay and intersection LOS are reported. HCS analysis worksheets are provided in Appendix D 3.

Figure 6-3: Build Alternative – Year 2037 Peak Hour Volumes

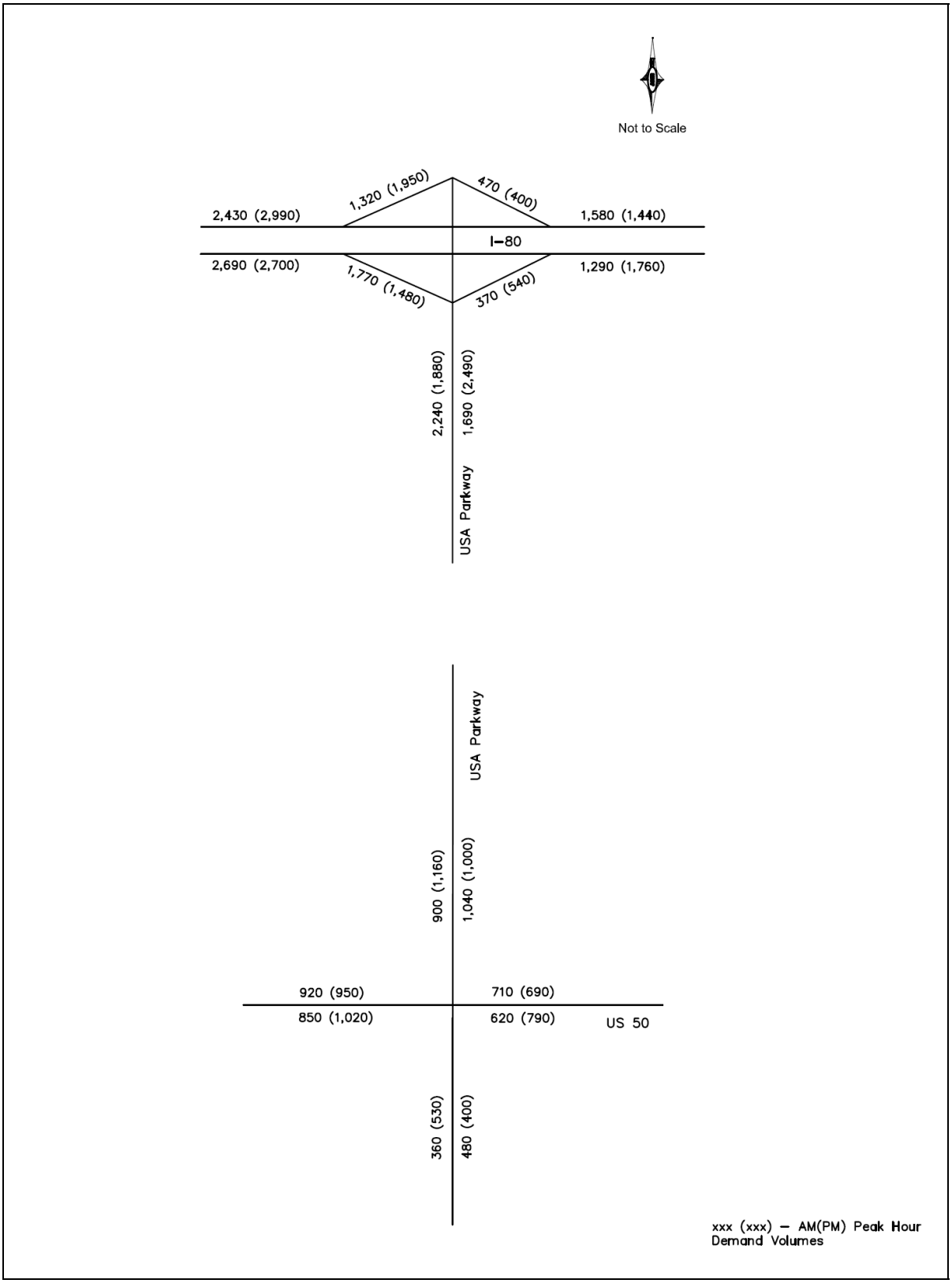


Figure 6-4: Build Alternative – Year 2037 Turning Movement Volumes

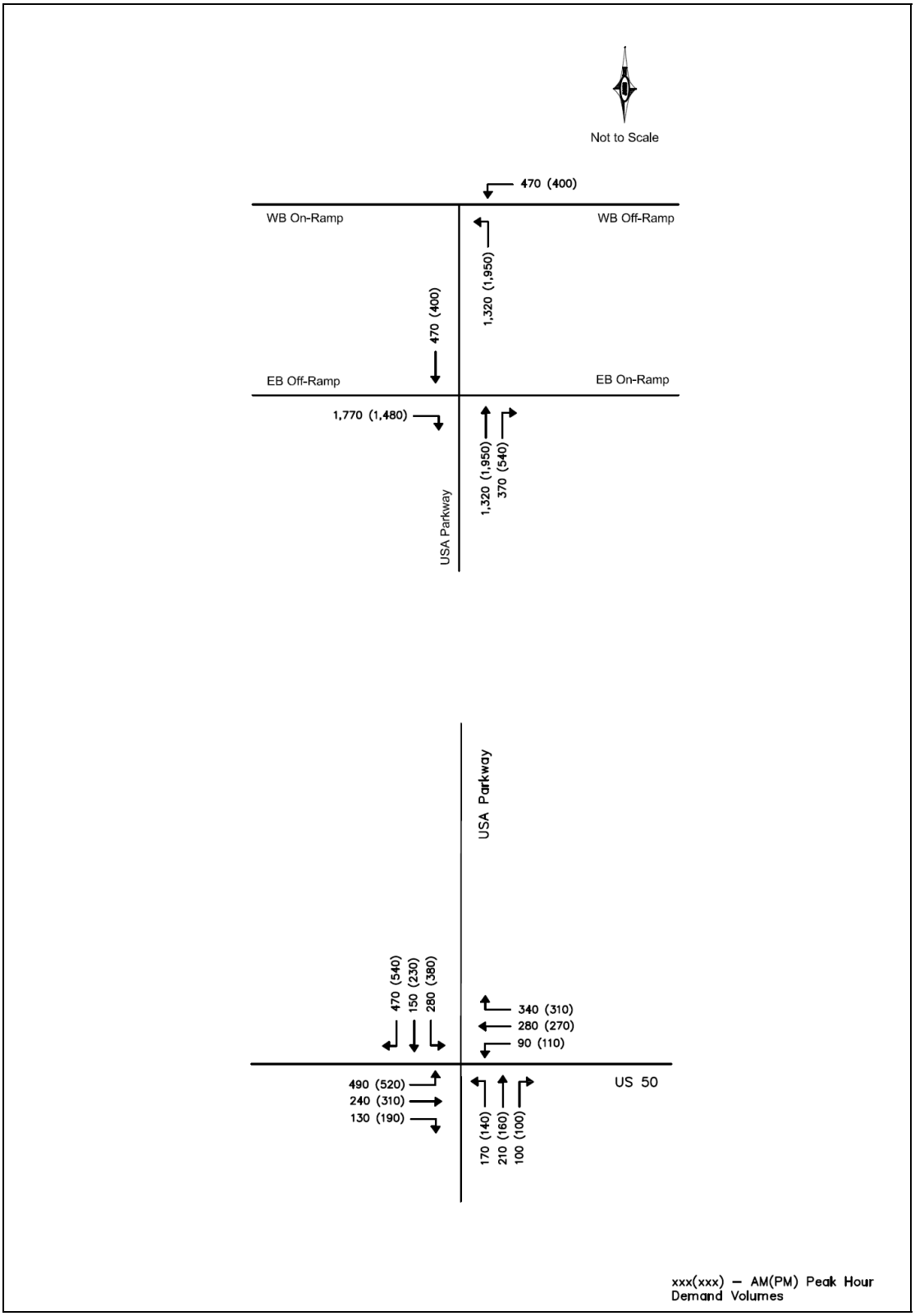


Figure 6-5: Build Alternative Recommended Geometry and Control at the I-80/USA Parkway Interchange

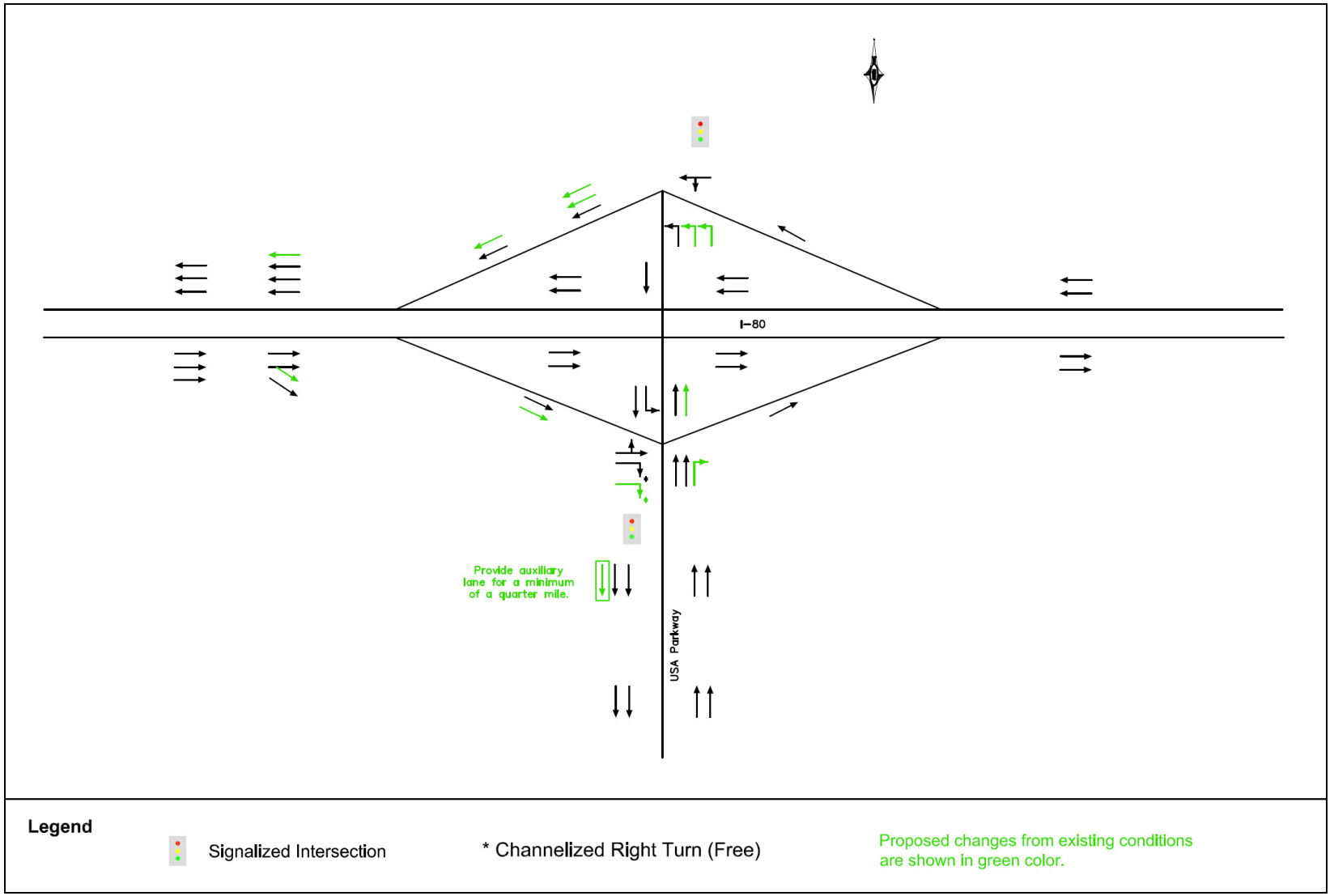


Figure 6-6: Recommended Geometry and Control along USA Parkway and at intersection of USA Parkway/US 50

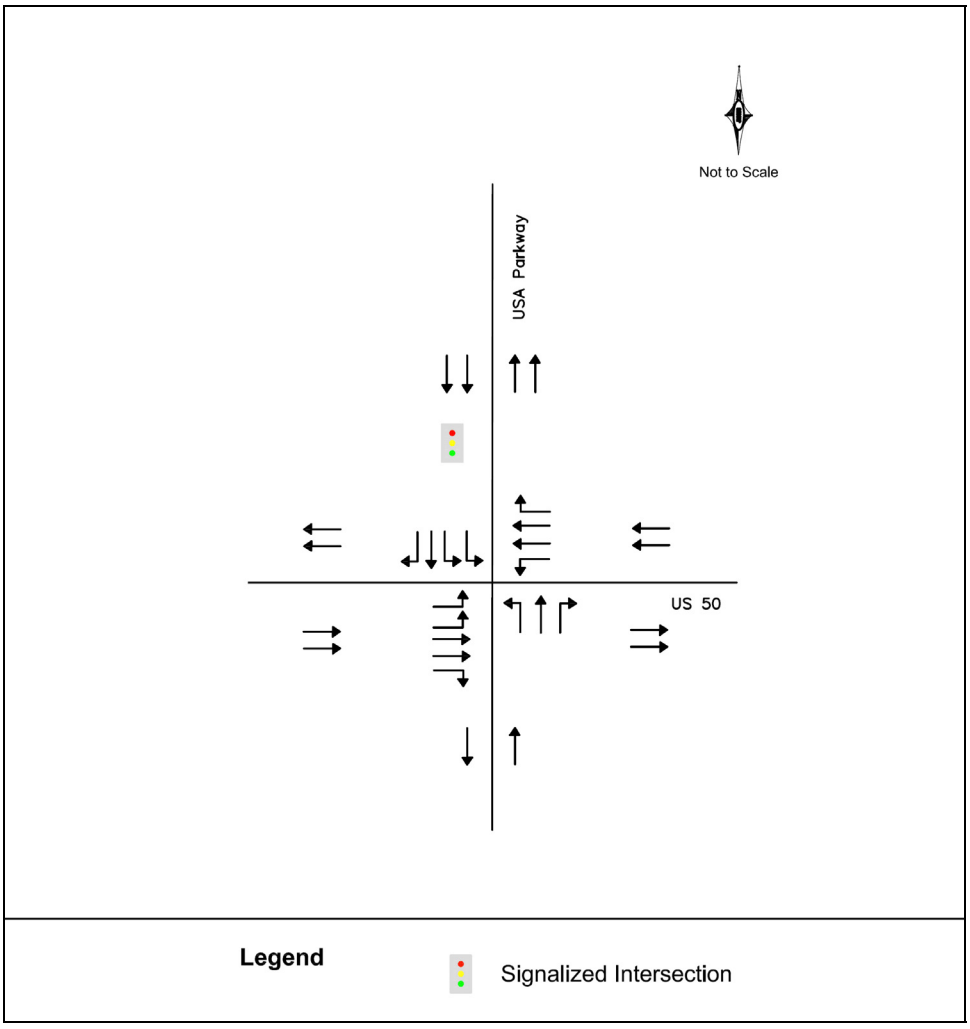


Table 6-1: Year 2037 Build Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour		PM Peak Hour	
		Control Delay (s)	HCM LOS	Control Delay (s)	HCM LOS
USA Parkway & US50	Signal	26.0	C	26.5	C
USA Parkway & WB On-Ramp/WB Off-Ramp	Signal	18.7	B	21.8	C
USA Parkway & EB Off-Ramp/EB On-Ramp	Signal	6.6	A	9.9	A

Control delay and LOS are reported for the overall intersection. HCM 2010 methodology does not provide an overall intersection V/C (HCM critical V/C), hence not reported. It was ensured that V/C for each movement is less than 1.0.

Source: Jacobs, 2012

Ramp terminal intersections of the I-80/USA Parkway interchange: The proposed improvements to geometry at these intersections resulted in an overall intersection LOS equal to or better than LOS C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0.

Intersection of USA Parkway and US 50: The proposed geometry at this intersection resulted in an overall intersection LOS of C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0. The traffic signal phasing and timing at this intersection accommodates anticipated pedestrian activity.

Table 6-2 gives the calculated length of the queues at the study intersections for the Build alternative. These queue lengths should be considered during the design of the storage bays.

Table 6-2: Year 2037 Build Alternative Intersection Queue Lengths

Intersection	Movements with storage bays	Number of lanes	95th Percentile Queue length (ft/ln) from HCS
USA Parkway and US 50	Southbound Left	2	210
	Northbound Right	1	105
	Northbound Left	1	175
	Westbound Right	1	245
	Westbound Left	1	140
	Eastbound Right	1	140
	Eastbound Left	2	245
USA Parkway & WB On-Ramp/WB Off-Ramp	Northbound Left	3	560
USA Parkway & EB Off-Ramp/EB On-Ramp	Southbound Left	1	35
	Northbound Right	1	105
	Eastbound Left/Through	1	35

Deceleration length and taper length should be added to the queue length for storage bay design. NDOT's typical lengths should be provided if the calculated total storage length is less than the typical.

A vehicle length of 35 ft was used to convert the HCS 2010 queue length result (veh/ln) to the reported queue length (ft/ln). 35 feet is higher than the typical lengths used to calculate storage lengths, which are 25 ft and 30 ft, however a higher value was selected due to high truck percentages.

Source: Jacobs, 2012

6.2. Freeway Merge and Diverge Analysis

The freeway merge and diverge analysis was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the freeway merge and diverge analysis are shown in Table 6-3. HCS analysis worksheets are provided in Appendix E 3.

From Table 6-3, it can be seen that all the merge and diverge segments operate satisfactorily for the proposed geometry and traffic control.

Table 6-3: Year 2037 Build Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	1.9	A	0.1	A
I-80 EB On-Ramp at USA Parkway	19.1	B	25.5	C
I-80 WB Off-Ramp at USA Parkway	19.4	B	17.8	B
I-80 WB On-Ramp at USA Parkway	14.8	B	24.2	C

Source: Jacobs, 2012

6.3. Multilane Highway Analysis

The forecast traffic volume suggests a four-lane arterial for the proposed USA Parkway extension. A multilane highway analysis of the proposed four-lane roadway was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. HCM LOS criteria for multilane highway analysis are shown in Table 6-4.

Table 6-4: HCM LOS Criteria for Multilane Highways

LOS	FFS (mi/h)	Density (pc/mi/ln)
A	All	>0-11
B	All	>11-18
C	All	>18-26
D	All	>26-35
E	60	>35-40
	55	>35-41
	50	>35-43
	45	>35-45
F	Demand exceeds capacity	
	60	>40
	55	>41
	50	>43
	45	>45

Source: Highway Capacity Manual 2010, Transportation Research Board

The following are the results of this analysis. HCS analysis worksheets are provided in Appendix F 1. The roadway is being designed to 60 mph. The proposed speed limit is 55 mph, therefore a 60 mph free flow speed was assumed for the analysis.

- During the AM analysis period, SB USA Parkway operates at LOS A (density of 9.8 pc/mi/ln) and the NB USA Parkway operates at LOS B (11.4 pc/mi/ln)
- During the PM analysis period, SB USA Parkway operates at LOS B (density of 12.7 pc/mi/ln) and the NB USA Parkway operates at LOS A (10.9 pc/mi/ln)

For the proposed geometry, USA Parkway operates satisfactorily within the desired thresholds of multilane highway operation.

6.4. Proposed Geometry and Improvements

The following is a description of the proposed geometry for new facilities and the proposed improvements to the existing geometry for existing facilities:

Proposed geometry for new facilities:

- Extension of USA Parkway, south through Lyon County is proposed to be completed as a four-lane rural arterial with a posted speed limit of 55mph.
- At the intersection of USA Parkway and US 50, an at-grade signalized intersection with the geometry shown in Figure 6-6 is proposed to be provided to achieve LOS C.

Recommended improvements to the existing geometry for existing facilities:

- EB off-ramp of the I-80/USA Parkway interchange is recommended to be improved to two lanes (widen from the existing one lane configuration).
- WB on-ramp of the I-80/USA Parkway interchange is recommended to be improved to two lanes (widen from the existing one lane configuration). Three receiving lanes need to be provided for the triple left turn lanes from the ramp terminal intersection.
- At the intersection of EB ramps and USA Parkway:
    - An EB free right-turn lane is to be added.
    - The existing NB free right turn-lane is to be converted to a through lane to provide two NB through lanes.
    - A NB right-turn lane is to be added.
- At the intersection of WB ramps and USA Parkway, two NB left turn lanes are proposed to be added to the existing single left-turn lane.

Figure 6-5 showed an illustration of these improvements.

7. OPENING YEAR 2017 NO-ACTION ALTERNATIVE ANALYSIS

A traffic operations analysis of the I-80/USA Parkway Interchange was completed for the year 2017 No-Action alternative as detailed in Section 7.1 and Section 7.2. Figure 7-1 shows the year 2017 peak hour volumes; and Figure 7-2 shows the year 2017 turning movement volumes at the I-80/USA Parkway interchange. The opening year 2017 intersection geometry and traffic control at the I-80/USA Parkway interchange is the same as the existing geometry and traffic control; Figure 4-3 shows this intersection geometry and traffic control.

Figure 7-1: No-Action Alternative – Year 2017 Peak Hour Volumes

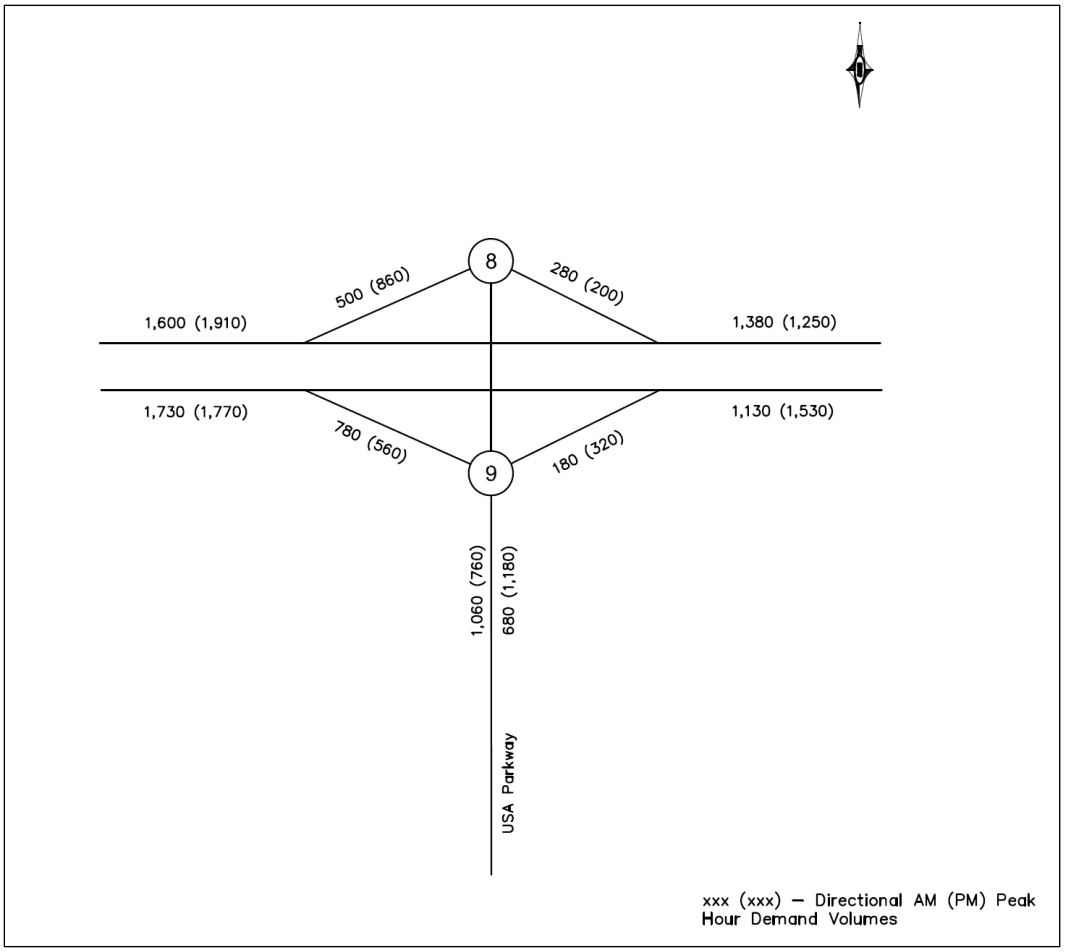
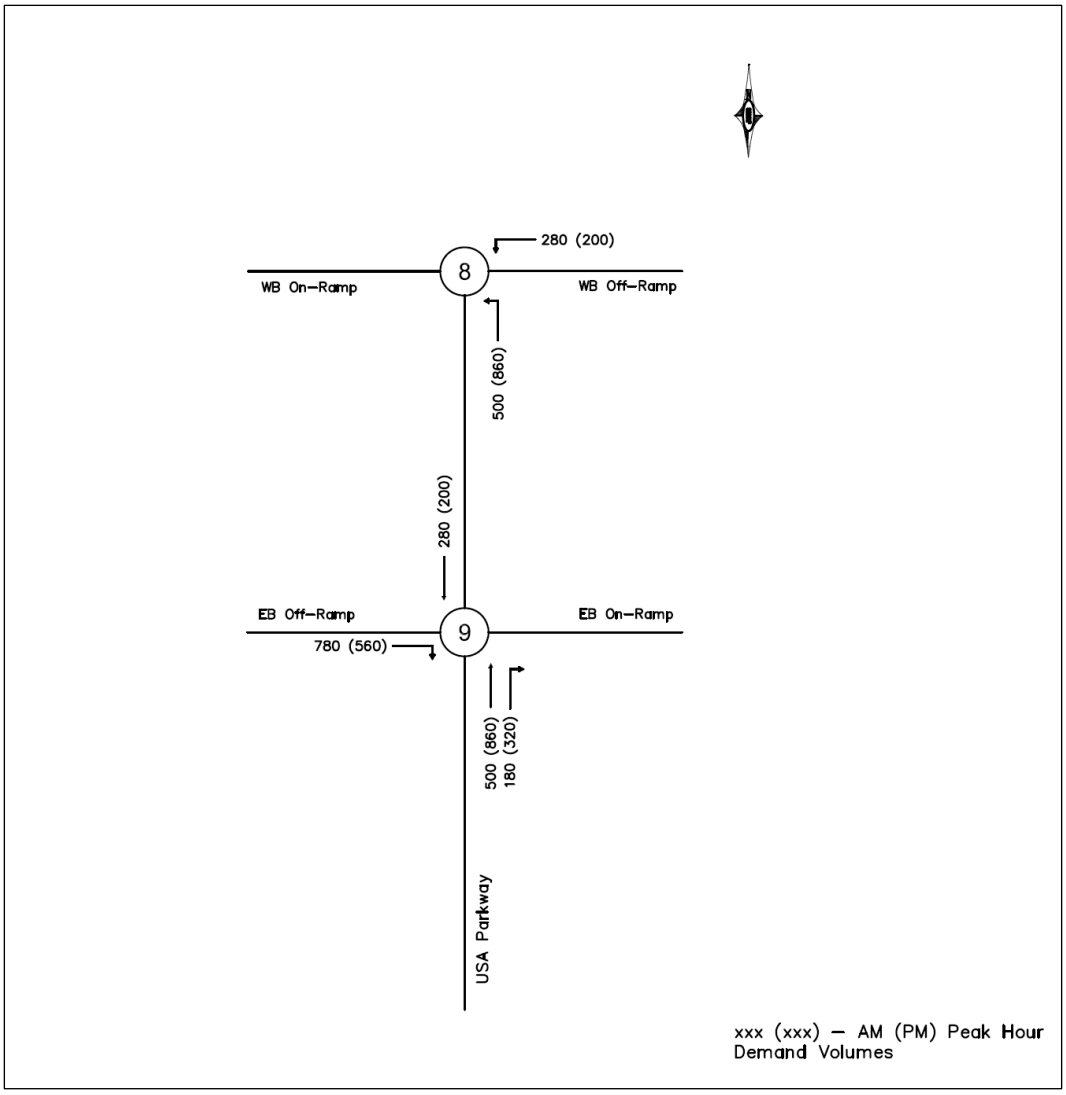


Figure 7-2: No-Action Alternative – Year 2017 Turning Movement Volumes



7.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 7-1. HCS analysis worksheets are provided in Appendix D 4. The LOS at the study intersections are anticipated to be worse in the No-Action alternative of the year 2017 compared to existing conditions.

Table 7-1: Year 2017 No-Action Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	615.2	F	>1	>1000	F	>1
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	17.5	C	0.01	27.0	D	0.02
The worst movement delay and the corresponding LOS and V/C are reported.							
Source: Jacobs, 2012							

7.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the No-Action alternative freeway merge and diverge analysis are shown in Table 7-2. HCS analysis worksheets are provided in Appendix E 4.

Table 7-2: Year 2017 No-Action Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	21.1	C	21.5	C
I-80 EB On-Ramp at USA Parkway	15.6	B	21.1	C
I-80 WB Off-Ramp at USA Parkway	17.1	B	15.6	B
I-80 WB On-Ramp at USA Parkway	22.6	C	29.2	D
Source: Jacobs, 2012				

From Table 7-2, it can be seen that the I-80 WB On-Ramp is anticipated to operate at LOS D during the PM peak period, which is worse than the desired operating level.

8. OPENING YEAR 2017 BUILD ALTERNATIVE ANALYSIS

A traffic operations analysis was completed for the opening year 2017 Build alternative. US 50 is planned to be widened to a four-lane section west of US 95A by year 2017. USA Parkway is proposed to be constructed to the design year conditions; hence USA Parkway would be a four lane roadway in the opening year.

The following analyses were completed for the opening year 2017 Build alternative:

- Intersection traffic operations analysis of
    - Ramp terminal intersections at the I-80/USA Parkway interchange
    - USA Parkway and US 50 intersection (a T-intersection configuration and a four-legged intersection configuration were analyzed)
- Freeway merge and diverge analysis along I-80 for segments near USA Parkway
- Multilane highway analysis of the proposed USA Parkway extension

Figure 8-1 shows the opening year 2017 peak hour volumes; and Figure 8-2 shows the opening year 2017 turning movement volumes.

As per the approved USA Parkway Traffic Analysis Methodology, LOS thresholds are defined as:

- HCM LOS D or better for the intersection of USA Parkway at US 50. It is noted that LOS C is desired for this intersection.
- LOS C or better at USA Parkway/I-80 Interchange.
- LOS E or better for each movement at intersections.
- Intersection V/C, including each movement, less than 1.0

8.1. Intersection Analysis

Intersection analysis was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 8-1. The recommended geometry and traffic control to achieve these LOS is shown in Figure 8-3 and Figure 8-4. The proposed geometry and traffic control for new facilities and the proposed improvements to geometry and traffic control for existing facilities are listed in Section 8.4. For unsignalized intersections, the worst movement delay and the corresponding LOS and V/C are reported. For signalized intersections, overall intersection control delay and intersection LOS are reported. HCS analysis worksheets are provided in Appendix D 5.

Figure 8-1: Build Alternative – Year 2017 Peak Hour Volumes

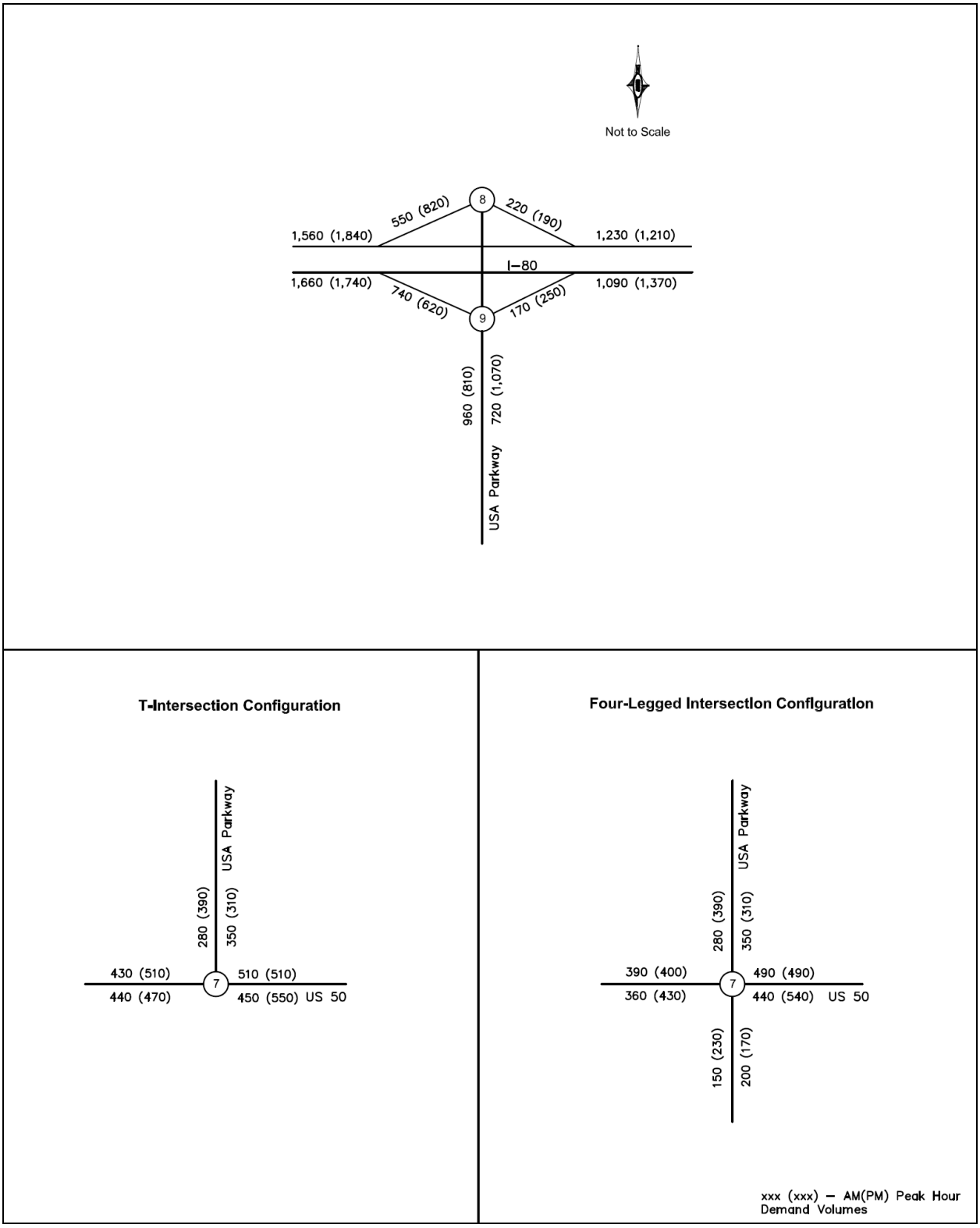


Figure 8-2: Build Alternative – Year 2017 Turning Movement Volumes

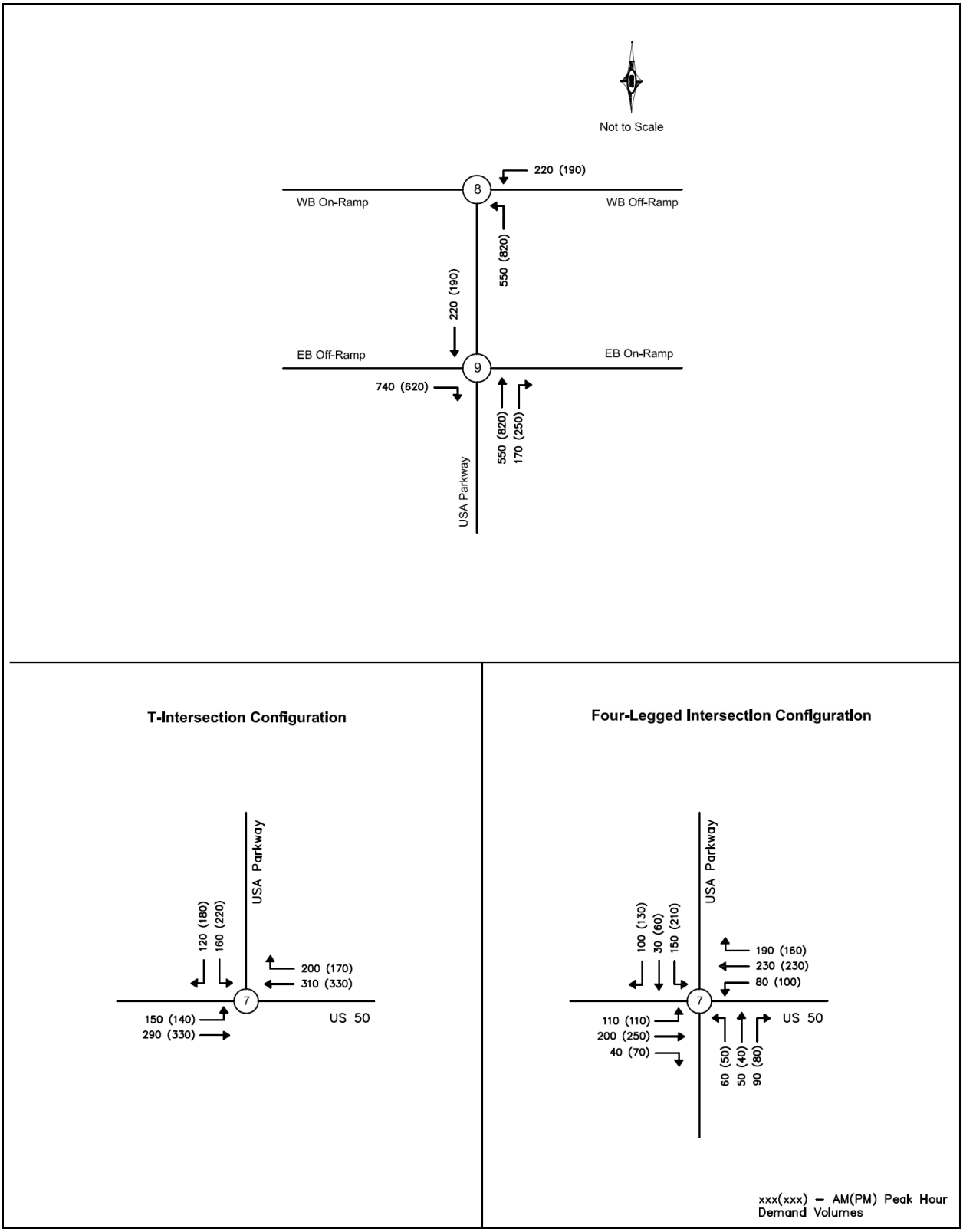


Figure 8-3: Build Alternative Recommended Geometry and Control at the I-80/USA Parkway Interchange

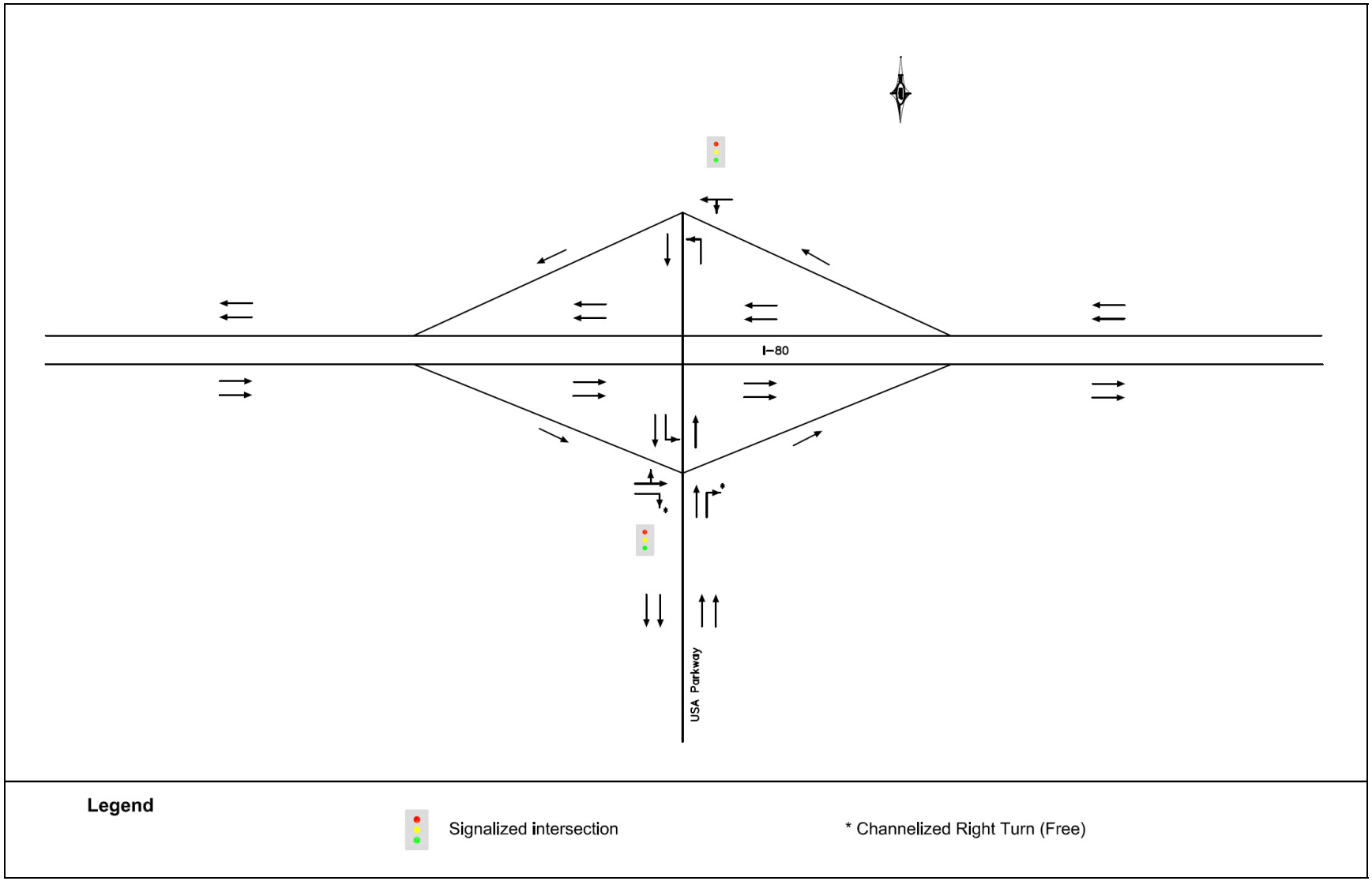


Figure 8-4: Recommended Geometry and Control along USA Parkway and at intersection of USA Parkway/US 50

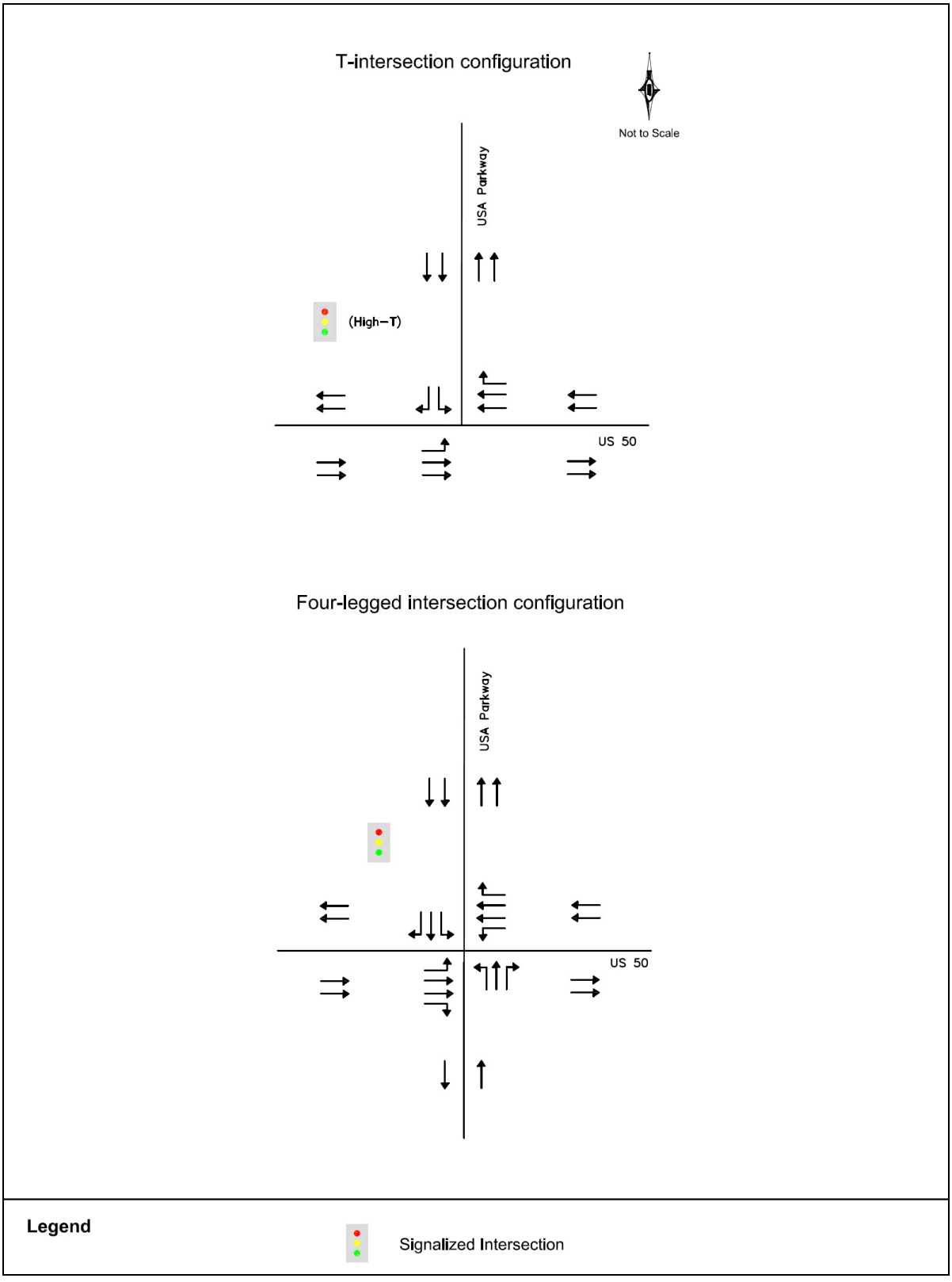


Table 8-1: Year 2017 Build Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & US50 (T-intersection configuration)	Signal (High-T)	15.4	B	-	15.8	B	-
	Stop (High-T)	27.0	D	0.53	38.1	E	0.72
USA Parkway & US50 (Four-legged intersection configuration)	Signal	20.8	C	-	21.9	C	-
USA Parkway & WB On-Ramp/WB Off-Ramp	Signal	17.5	B	-	23.5	C	-
USA Parkway & EB Off-Ramp/EB On-Ramp	Signal	6.8	A	-	12.8	B	-

For unsignalized intersections, the worst movement delay and the corresponding LOS and V/C are reported.

For signalized intersections, control delay and LOS are reported for the overall intersection. HCM 2010 methodology does not provide an overall intersection V/C (HCM critical V/C), hence not reported. It was ensured that V/C for each movement is less than 1.0.

Source: Jacobs, 2012

Ramp terminal intersections of the I-80/USA Parkway interchange: The proposed improvements to geometry at these intersections resulted in an overall intersection LOS equal to or better than LOS C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0.

Intersection of USA Parkway and US 50: Both a T-intersection configuration and a four-legged intersection configuration were analyzed.

For the T-intersection configuration, a stop controlled High-T intersection is expected to operate at LOS E or better for all movements. Alternately, this intersection (T-intersection configuration) may be signalized to operate as a signalized High-T intersection or as a signalized regular T-intersection. Among the three T-intersection options, the recommended traffic control and configuration is the signalized High-T for the following reasons:

1. A signalized High-T intersection is expected to meet signal warrants,
2. A large proportion of vehicles on USA Parkway is anticipated to be trucks (24%) and trucks require additional room to accelerate and merge, and
3. A signalized intersection is likely to operate more safely than an unsignalized intersection under the given conditions

For the four-legged intersection configuration, a two-way stop controlled intersection was found to operate at an LOS worse than the desired threshold; hence this intersection is proposed to be

signalized. The proposed geometry and traffic control resulted in an overall intersection LOS of C during both the AM and PM peak periods. LOS is E or better for each movement. The traffic signal phasing and timing at this intersection accommodates anticipated pedestrian activity.

8.2. Freeway Merge and Diverge Analysis

The freeway merge and diverge analysis was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the freeway merge and diverge analysis are shown in Table 8-2. HCS analysis worksheets are provided in Appendix E 5.

From Table 8-2, it can be seen that all the merge and diverge segments, except the I-80 WB on-ramp at USA Parkway (during the PM period), operate at LOS C or better. During the PM period, the operations at the I-80 WB on-ramp at USA Parkway are expected to be at the transitional phase between LOS C and LOS D. The LOS is anticipated to be just over the LOS C threshold.

8.3. Multilane Highway Analysis

A multilane highway analysis of the proposed four-lane roadway was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. HCS analysis worksheets are provided in Appendix F 2.

- During the AM analysis period, SB USA Parkway operates at LOS A (density of 3.0 pc/mi/ln) and the NB USA Parkway operates at LOS A (3.8 pc/mi/ln)
- During the PM analysis period, SB USA Parkway operates at LOS A (density of 4.3 pc/mi/ln) and the NB USA Parkway operates at LOS A (3.4 pc/mi/ln)

It should be noted that the proposed four-lane configuration is based on the design year conditions. The proposed USA Parkway extension is planned to be constructed in one phase to design-year conditions.

Table 8-2: Year 2017 Build Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	20.3	C	21.2	C
I-80 EB On-Ramp at USA Parkway	15.1	B	18.8	B
I-80 WB Off-Ramp at USA Parkway	15.4	B	15.2	B
I-80 WB On-Ramp at USA Parkway	22.6	C	28.1	D*

* The I-80 WB On-Ramp at USA Parkway operates at a LOS just over the LOS C threshold

Source: Jacobs, 2012

8.4. Proposed Geometry and Improvements

The following is a description of the proposed geometry for new facilities and the proposed improvements to the existing geometry for existing facilities. These proposed improvements ensure that the desired LOS thresholds are met in the opening year 2017.

Proposed geometry for new facilities:

- Extension of USA Parkway, south through Lyon County is proposed to be completed as a four-lane rural arterial with a posted speed limit of 55mph.
- At the intersection of USA Parkway and US 50, geometry and traffic control are proposed for both a T-intersection configuration and a four-legged intersection configuration. For the T-intersection configuration, a signalized High-T intersection is proposed, however a regular signalized T-intersection or a stop-controlled High-T intersection would also be an option. For the four-legged intersection configuration, the intersection is proposed to be signalized. The proposed geometry and traffic control for both these configurations are shown in Figure 8-4.

Recommended improvements to the existing geometry for existing facilities:

Both the ramp terminal intersections of the I-80/USA Parkway interchange are recommended to be signalized for opening year. Geometry improvements, however, are not required. Figure 8-3 illustrated these improvements.

9. CONCLUSION

This technical memorandum presented traffic operations analysis for the existing conditions, the design year 2037 No-Action alternative, the design year 2037 Build alternative, the opening year 2017 No-Action alternative and the opening year 2017 Build alternative of the USA Parkway extension project. This memorandum provides technical support for the USA Parkway EA.

The analysis showed that in the opening year, the No-Action alternative results in operations worse than desired for the study area roadways. The analysis also showed that in the design year, the No-Action alternative results in negative impacts to existing roadways in the vicinity and in operations worse than desired for the study area roadways. Section 6.4 identifies the geometry and improvements that are recommended for the design year 2037 Build alternative. Traffic operations analysis clearly indicates that the Build alternative is desirable to maintain the policy (and acceptable) LOS on study area roadways.

It is requested that NDOT approve the analysis documented in this memorandum. This will ensure that the analysis and methodologies that are acceptable to NDOT are incorporated in the USA Parkway EA document.