Multimodal Level of Service Study

Draft Final Report

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MARICOPA ASSOCIATION of GOVERNMENTS

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1 Introduction

Complete Streets policies and implementation measures are increasingly gaining attention among local and regional jurisdictions as one method to address many complex issues, such as traffic congestion, greenhouse gas emissions, community health, and economic revitalization. The Maricopa Association of Governments (MAG) and its member agencies have made great strides over the last several years in producing complete streets policies, as well as vivid examples of the implementation of complete streets concepts.

However, the region has encountered challenges the language utilized when defining a "complete street" and the tradeoffs often required of the implementation of a complete streets corridor. This study seeks to mitigate some of the challenges experienced by planners, engineers and activists by introducing the concept of Multimodal Level of Service (MMLOS) and how it can be utilized as a planning and engineer tool for member agencies.

The study analyzes nine study corridors within the MAG region to as examples of how MMLOS is derived and can be utilized as part of a comprehensive planning process.

This report documents the process used to carry out a multimodal level of service analysis along nine study corridors in the MAG region. An existing conditions MMLOS analysis is presented, followed by a review of the multimodal design recommendations developed for each study corridor and their MMLOS analysis results. The final chapter summarizes lessons learned and potential next steps.

1.1 Local and Regional Complete Streets Strategies

Regional planning documents such as the *MAG Complete Streets Guide (2011),* the *MAG Pedestrian Policies and Design Guidelines (2005)*, the *MAG Pedestrian Plan (2000)*, *Designing for Transit Accessible Communities (2013),* and the *MAG Regional Bikeway Master Plan (2007)* all illustrate a growing commitment to multimodalism. However, these planning resources often lack performance measures or metrics necessary to support rigorous analyses comparable to the types carried out for planning vehicular systems.

Through the MAG MMLOS project, a regional framework for performing multimodal assessments was developed, based on a relatively new

methodology for analyzing urban streets. Outcomes of this planning process can also provide assistance to MAG and its member agencies through the development and presentation of the Regional Multimodal Focus Network, which provides potential guidance on where to focus future complete streets investments.

This project established study areas in nine jurisdictions within the MAG region, where one approximately 1-mile corridor in each jurisdiction was selected for multimodal analysis. Study corridors in nine jurisdictions were used for the purposes of the MAG MMLOS project.

Focus Jurisdictions:

- Avondale
- Gilbert
- Glendale
- Mesa
- Phoenix
- Queen Creek
- Scottsdale
- Surprise
- Tempe

Figure 1-1 displays the nine study cities within the MAG region.

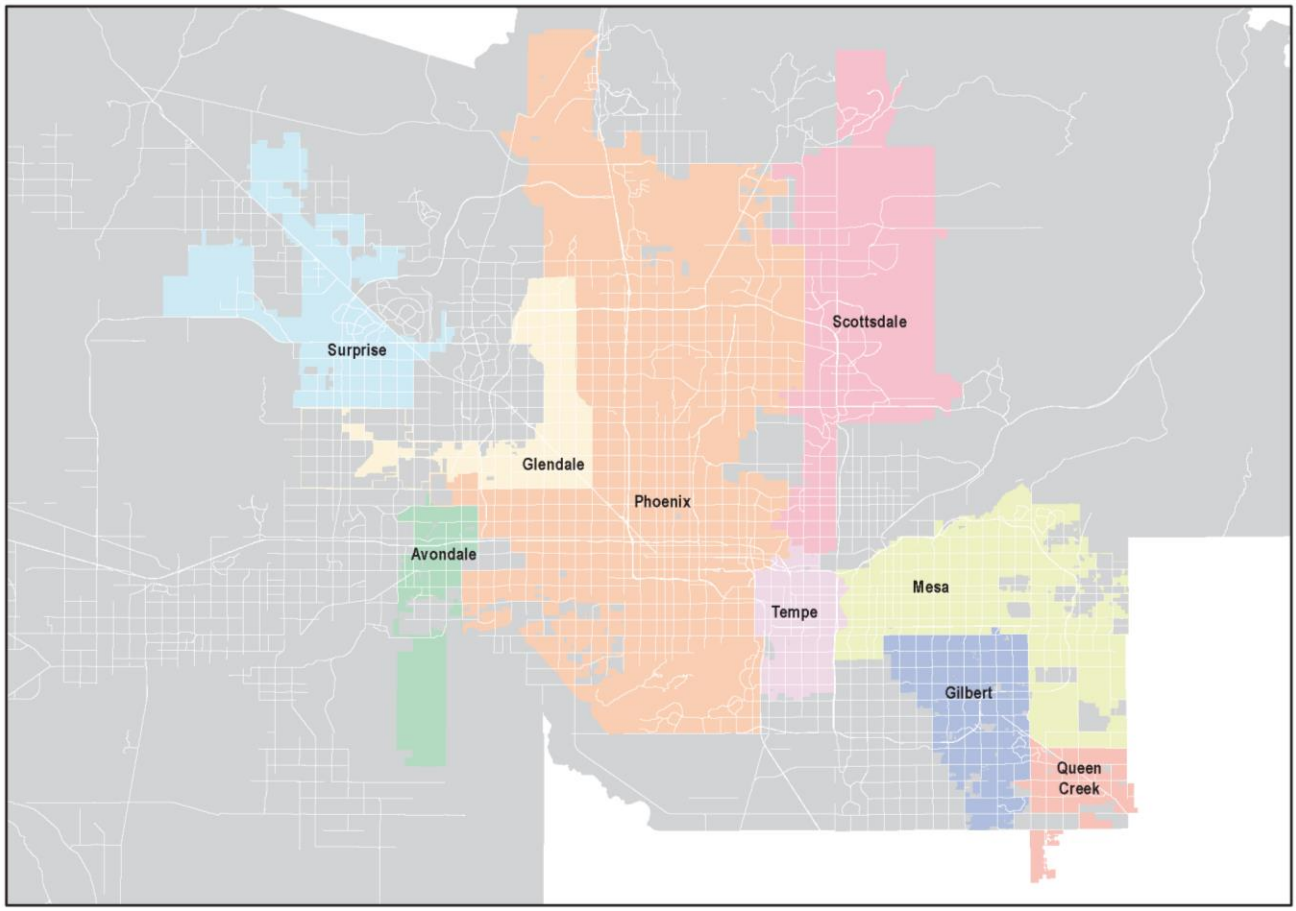


Figure 1-1 MAG MMLOS Focus Jurisdictions

1.2 Outreach to MAG Member Agencies

Input from MAG member agencies was solicited throughout the project through a combination of efforts. Technical Advisory Group (TAG) meetings established and guided the framework for MMLOS analysis in the MAG region, while Regional Workshops invited stakeholders to refine study corridors and future alternatives in each of the nine jurisdictions. In addition, individual meetings with the nine focus jurisdictions allowed each to provide direction for future conditions alternative development, as well as to review the MMLOS scores calculated throughout the analysis.

Technical Advisory Group Meetings

Technical Advisory Group meetings were held at key milestone events throughout the study.

The first TAG meeting, held on September 23, 2015, facilitated a discussion about the purpose of complete streets efforts, as well as how to overcome the major barriers that are known to exist when implementing complete streets policies and metrics. This TAG meeting also debuted the preliminary methodology for developing a Regional Multimodal Focus Network, which is discussed in detail in Appendix B.

The second TAG meeting, held on January 25, 2016, presented existing conditions MMLOS findings for review and feedback, and also included fairly

extensive discussion on improvement recommendations to consider in developing future alternatives.

The third and final TAG meeting will occur in January 2017, and will close out the project, present results, and explore future directions for MMLOS analysis and applicability in the MAG region.

Workshops

Two Regional Workshops were held, on October 13, 2015 and on April 5, 2016. Regional Workshop #1 presented the results of the Regional Multimodal Focus Network, study corridor selection methodology, and preliminary study corridors for each of the nine study jurisdictions. Workshop participants selected their top-three corridors in each city based on their local knowledge. After Regional Workshop #1, each study jurisdiction selected a final study corridor from the top-three list.

Regional Workshop #2 presented results of the MMLOS analyses under the existing and striping scenarios for review and feedback, and allowed members from each jurisdiction to participate in the development of a Customized alternative for further analysis.

Input from MAG and City Staff Members

Input from MAG staff, Valley Metro, and MAG member agencies was sought throughout the planning process, occurring between formal events such as TAG Meetings and Regional Workshops. Individual meetings with each study jurisdiction, held during the month of February 2016, allowed members of each city to provide specific feedback on the development of the striping and Customized alternatives, as well as on the results of the MMLOS analysis under existing conditions.

1.3 Plan Organization

After this introductory chapter, the report is organized with the following chapters:

Chapter 2 discusses existing and proposed cross-sections, analysis, and specific complete streets planning and implementation challenges faced along wide, high volume study corridors, as reflected by the Phoenix, Tempe, and Scottsdale study corridors

Chapter 3 presents existing and proposed cross-sections, analysis, and specific challenges faced along wide, low volume study corridors, as reflected by the Gilbert, Mesa, and Avondale study corridors.

Chapter 4 summarizes existing and proposed cross-sections for narrow, low-volume study corridors for the cities of Surprise, Glendale, and Queen Creek, and discusses specific challenges pertaining to this roadway typology.

Chapter 5 summarizes lessons learned throughout the project, especially related to complete streets planning and implementation, as well as outlines potential next steps to further our understanding and application of multimodal analysis techniques.

Regional Plan Guidance

Local, regional-scale planning documents reviewed for complete streets policy guidance include the following:

- Designing for Transit Accessible Communities (2013)
- MAG Complete Streets Guide (2011)
- MAG Regional Bikeway Master Plan (2007)
- MAG Pedestrian Policies and Design Guidelines (2005)
- MAG Pedestrian Plan (2000)

We are interested in seeing one of these projects be implemented, and seeing what results can be demonstrated.

-Workshop Participant

2 Multimodalism on Wide, High Volume Roadways (Phoenix, Tempe, and Scottsdale)

Wide roadways with high vehicular volumes, such as those found along the study corridors in Phoenix, Tempe, and Scottsdale, present unique implementation and analysis challenges. These challenges largely stem from constrained rights-of-way and insensitivities found in the analysis software and procedures.

The roadway space required for each mode to operate comfortably often exceeds available right-of-way, particularly since non-motorized travel modes require more separation from moving vehicles in order to achieve higher Level of Service (LOS). When conducting MMLOS analysis for this roadway typology, it was commonly noted that high vehicular volumes necessitated more buffer distance for pedestrians and cyclists than is possible to attain.

The *NCHRP Report* 616 (2008), which pioneered the MMLOS methodology used in this report, does not address certain facility types, such as dedicated transit lanes, shared bus/bike lanes, and raised cycle tracks, because it was published before these facilities became more commonly applied in the US. The project team encountered this problem during the current study, as many city staff were interested in assessing shared bus/bike lanes, cycle tracks and dedicated transit lanes. In addition, the MMLOS methodology also does not include an analysis procedure for multi-use paths.

A pedestrian and bike LOS score of "A" was therefore assumed for all multi-use paths, and a transit LOS A was assumed for all exclusive transit lanes, due to the software's inability to analyze these facility types.

From Top: Phoenix, Tempe, and Scottsdale Study Corridors

Shared bus-bike lanes and bikeable sidewalks (or raised cycle tracks), although an improvement over many existing configurations, were analyzed using the same inputs as general bike lanes and sidewalks, taking advantage of the increased buffer distances to yield the most accurate score possible.

Challenges to implementation became evident when factors known to improve LOS scores were not realistically feasible, such as closing driveways on popular commercial boulevards. Similarly, transit LOS was challenging to improve since the common ways of doing so – like increasing frequency, adding stop amenities, or installing a transit only lane – are either not considered in the possible menu of analysis inputs, or not weighted sufficiently to garner improved LOS. Other, less controllable inputs, such as aspects of the pedestrian and auto environment, oftentimes carried an insurmountable weight in the analysis results. Notable examples include traffic volumes and available buffer from vehicles.

2.1 Existing and Proposed Cross-Sections

Phoenix

Thomas Road is a 5- or 6-lane roadway with posted speeds of 35 miles per hour. There are seven different cross-sections along this study corridor, varying between 64' and 119'. Table 2-1 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit.

Table 2-1 Phoenix Study Corridor Characteristics – Thomas Road

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	16th Street	Children's Way	2	3	64'	Two-way left-turn lane	No	35
2	Children's Way	250 ft W of 20th Street	2	3	76-119'	Striped	No	35
3	250 ft W of 20th Street	20th Street	3	3	107'	Raised	No	35
4	20th Street	SR-51 NB Ramps	3	3	102'	Undivided	No	35
5	SR-51 NB Ramps	Greenfield Road	3	3	76-108'	Two-way left-turn lane	No	35
6	Greenfield Road	22nd Street	2	3	64'	Two-way left-turn lane	No	35
7	22nd Street	24th Street	2	3	64'	Two-way left-turn lane	No	35

Source: Chen Ryan Associates, January 2017

Segments 1 and 2, between 16th Street and 250 feet west of 20th Street, are 52' and 64', respectively, and differ in median type (two-way left turn lane vs striped median) although the number of travel lanes is similar. Segments 3 and 4 also have similar lane configurations and dimensions (107' and 102', respectively), but differ in median type (raised median vs undivided). Segments 6 and 7 have the same dimensions and characteristics, however, they were analyzed independently since they are separated by a signalized intersection which, in the Highway Capacity Software (HCS) program, necessitates separate analysis segments.

Thomas Road, Phoenix

Of the seven cross-sections along the study corridor, Segment 1, between 16th Street and Children's Way, was chosen for development of the Striping and Customized alternatives for further MMLOS analysis. **Figure 2-1** displays existing conditions, as well as Striping and Customized alternatives for Segment 1.

As shown, the existing 4-lane configuration is supplemented by 6-foot bike lanes in the Striping alternative through reductions of travel lane and median width. By comparison, the Customized alternative incorporates two Bus Rapid Transit exclusive lanes through a combination of additional right-of-way acquisition and repurposing sidewalks as multi-use paths.

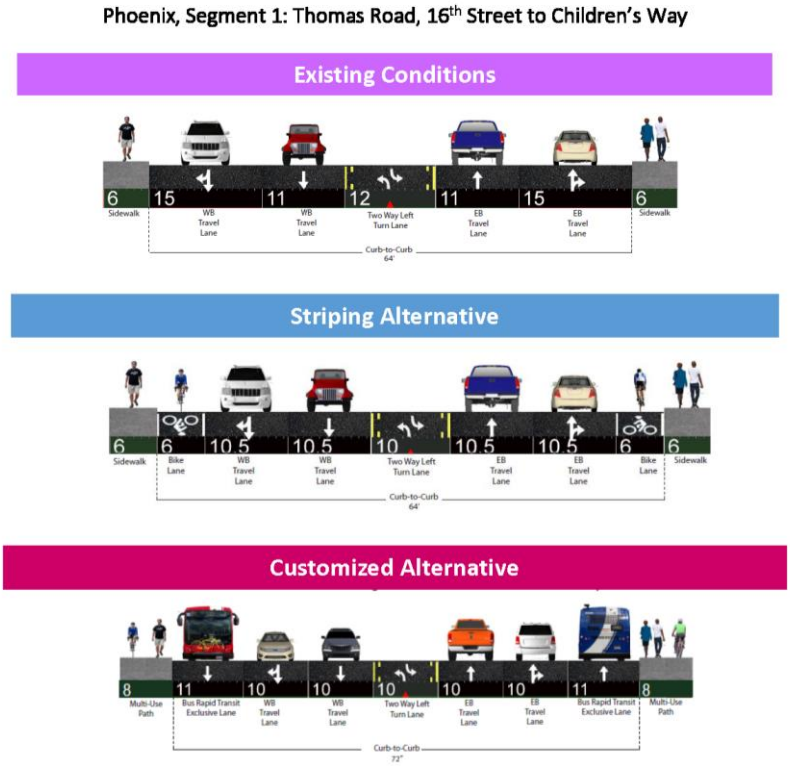


Figure 2-1 Phoenix Study Segment Alternatives

Tempe

Table 2-2 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. The cross-section width of the Tempe study corridor ranges from 82' to 94'. S. Rural Road is 6-lane roadway with posted speeds of 35 mph.

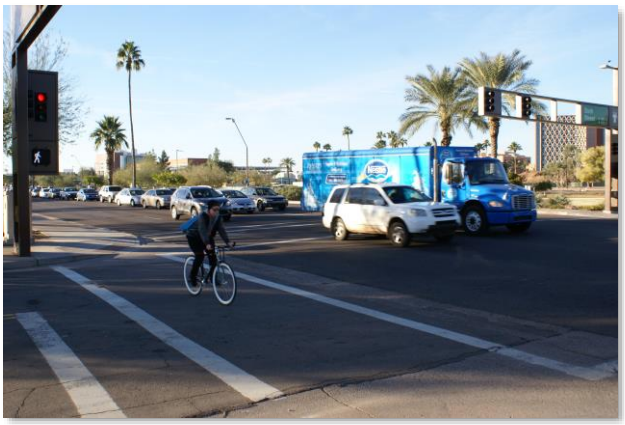
The entire study corridor has three travel lanes in each direction. A total of nine study segments, however, were analyzed since signalized intersections necessitate study segment breaks in the HCS software.

Of the nine cross-sections along the study corridor, Segment 7, between E. Apache Boulevard and E. Spence Avenue was chosen for development of the Striping and Customized alternatives for further MMLOS analysis.

Table 2-2 Tempe Study Corridor Characteristics – S. Rural Road

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Distance (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Rio Salado Parkway	6th Street	3	3	82'	Raised Median	No	35
2	6th Street	University Drive	3	3	94'	Raised Median	No	35
3	University Drive	Tyler Street/S. Terrace Road	3	3	93'	Raised Median	No	35
4	Tyler Street/S. Terrace Road	Terrace Mall	3	3	78'	Undivided	No	35
5	Terrace Mall	E. Lemon Street	3	3	78-91'	Two-way left turn lane	No	35
6	E. Lemon Street	E. Apache Boulevard	3	3	78-80'	Two-way left turn lane	No	35
7	E. Apache Boulevard	E. Spence Avenue	3	3	77-78'	Two-way left turn lane	No	35
8	E. Spence Avenue	E. Vista Del Cerro Drive	3	3	78'	Two-way left turn lane	No	35
9	E. Vista Del Cerro Drive	E. Broadway Road	3	3	78-79'	Two-way left turn lane	No	35

Source: Chen Ryan Associates, January 2017



S. Rural Road, Tempe

As shown, the current six travel lanes are reduced to four-lanes with dedicated bus-bike lanes in the Striping alternative. The Customized alternative includes bikeable sidewalks, 5.5-foot bike lanes, and allows for dedicated transit lanes. An additional seven feet of right-of-way needs to be acquired for the Customized alternative. Figure 2-2 displays the existing conditions, as well as Striping and Customized alternatives for Segment 7.

Scottsdale

Table 2-3 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. There are seven different cross-section widths, ranging from 55' to 88'. N. Scottsdale Road ranges between 4 and 6 lanes with posted speeds between 25 and 40 mph.

Figure 2-3 presents the seven cross-sections found along the study corridor. Segments 1 through 4 have the same number of lanes and median characteristics. However, these segments were analyzed separately since they are separated by signalized intersections which, in the HCS software, necessitates separate analysis segments. Segments 5 and 6 have similar lane configurations, but differ in median type (raised median vs two-way left turn lane).

Tempe, Segment 7: Rural Road, Apache Boulevard to Spence Avenue

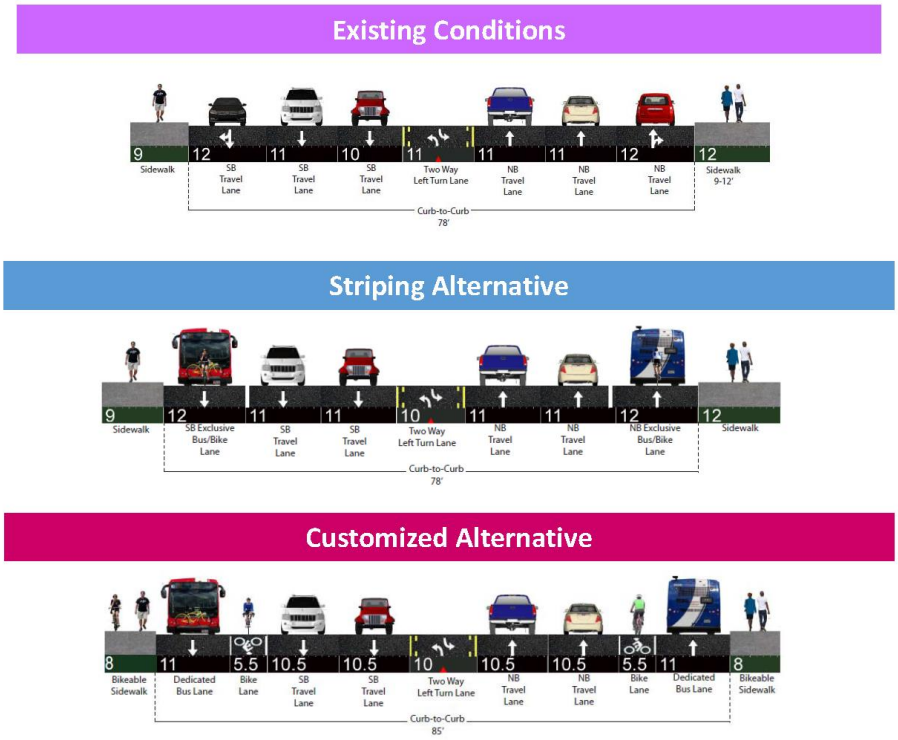


Figure 2-2 Tempe Study Segment Alternatives

Table 2-3 Scottsdale Study Corridor Characteristics – N. Scottsdale Road

Seg. ID	From	To	SB Lanes	NB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Indian School Road	Main Street	2	2	55-57’	Raised median	No	25
2	Main Street	1st Street	2	2	80’	Raised median	No	25
3	1st Street	2nd Street	2	2	70’	Raised median	No	25
4	2nd Street	Goldwater Boulevard	2	2	60’	Raised median	No	25
5	Goldwater Boulevard	Osborn Road	3	2	68-83’	Raised median	No	40
6	Osborn Road	Earll Drive	3	2	76-88’	Two-way left turn lane	No	40
7	Earll Drive	Thomas Road	3	3	86’	Two-way left turn lane	Yes	40

Source: Chen Ryan Associates, January 2017

N. Scottsdale Road, Scottsdale

Of the seven cross-sections along the study corridor, Segment 7, between Osborn Road and Earll Drive was chosen for development of further alternatives for MMLOS analysis. As shown in **Figure 2-3**, the City of Scottsdale opted for the creation of a singular, plan-view alternative, which includes the addition of bike facilities, and addesses the gap in bike facility.

Scottsdale, Segment 6: Scottsdale Road, Osborn Rd to Earll Dr

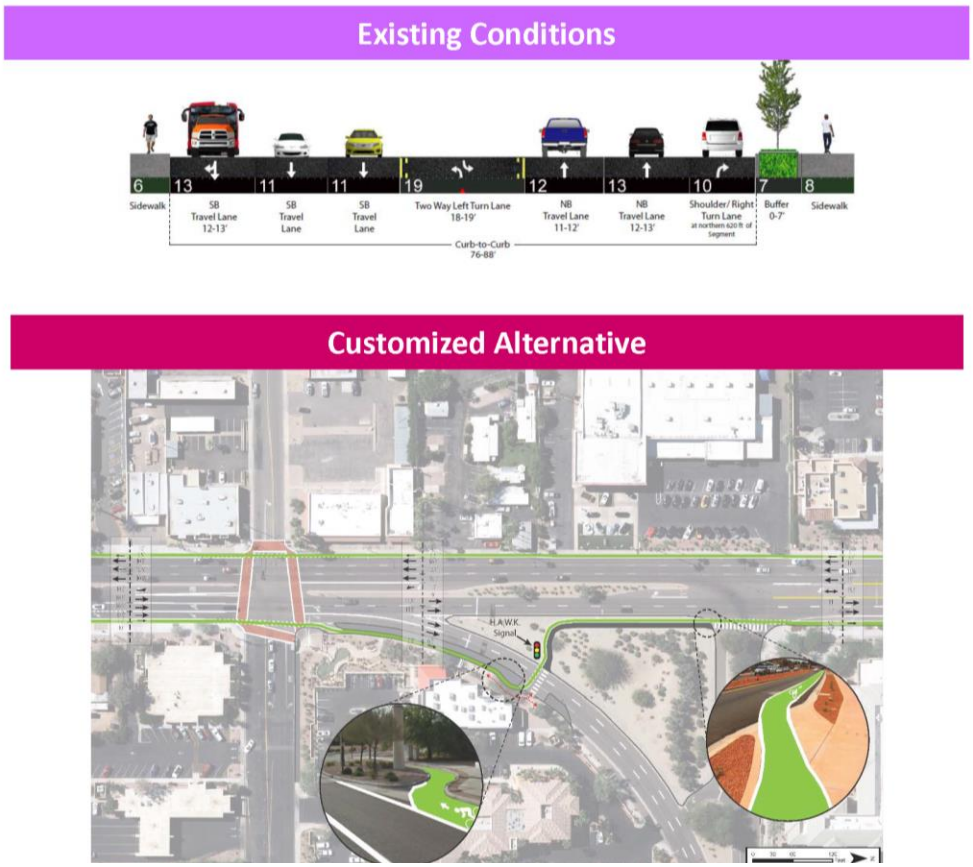


Figure 2-3 Scottsdale Study Segment Alternative

2.2 Analysis Results

MMLOS analyses were initially performed for each study corridor under existing conditions. Following this, a Striping alternative was developed for one segment along each study corridor and analyzed using HCS. City staff from each jurisdiction participated in a refinement and feedback meeting that aided the project team in developing the Customized alternative. The following sections summarize the results of the MMLOS analysis for each jurisdiction's Existing conditions, Striping, and Customized alternatives.

Phoenix

Following an existing conditions analysis, subsequent MMLOS analyses were performed for Segment 1, between 16th Street and Children's Way, under the Striping and Customized alternatives conditions. MMLOS scores for Segment 1 are summarized in Table 2-4.

As shown, small, incremental improvements to pedestrian, bike, and transit LOS are seen under the Striping alternative conditions, in some cases improving the score by one grade. Under the Customized alternative, the multi-use path and dedicated transit lane are reflected by LOS A scores for bike, pedestrians, and transit, due to the inability of the HCS MMLOS tool to analyze these improvement types. Each scenario's improvements result in virtually no change to auto LOS.

Table 2-4 Phoenix MMLOS Scores by Scenario – Thomas Road from 16th Street to Children's Way

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score			
Existing Conditions																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.42	B	2.26	D	3.76	D	3.89	F	5.31	F	5.09	D	3.55	C	2.99
PM	B	2.46	B	2.27	D	3.75	D	3.96	F	5.72	F	5.11	D	3.58	C	3.03
Striping Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.42	B	2.26	D	3.63	D	3.76	E	4.85	E	4.73	C	3.50	C	2.94
PM	B	2.45	B	2.27	D	3.62	D	3.83	F	5.26	E	4.75	D	3.53	C	2.98
Customized Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.42	B	2.26	A (Multi-Use Path)								A (Exclusive Transit Lane)			
PM	B	2.45	B	2.27												

Source: Chen Ryan Associates, January 2017

Tempe

Subsequent MMLOS analyses were performed for Segment 7, between E. Apache Boulevard and E. Spence Avenue, under Striping and Customized alternative conditions. These results are summarized in Table 2-5.

As shown, the travel lane reduction associated with the Striping and Customized alternatives results in a reduction in LOS for autos. Pedestrian conditions generally remain within the same letter grade between all scenarios, with the exception of the AM eastbound direction, which improves from LOS D to LOS C. Bicycle LOS improves between each alternative, with the PM westbound direction achieving a score of LOS C. Transit receives a score of LOS A due to its exclusive lane.

Scottsdale

An MMLOS analysis was performed for Segment 6, between E. Osborn Road and E. Earll Drive, under Customized alternative conditions. These results are displayed in Table 2-6.

As shown, the Customized alternative provides moderate improvements to pedestrian, bicycle, and transit modes without degradation of auto LOS. Note that portions of the bicycle and pedestrian infrastructure proposed in the Customized alternative make use of a multi-use path, which automatically garners a score of LOS A.

Table 2-5 Tempe MMLOS Scores by Scenario – Rural Road from E. Apache Boulevard to E. Spence Avenue

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score		
Existing Conditions															
	SB		NB		SB		NB		SB		NB		SB	NB	
AM	C	2.24	D	2.54	D	3.51	D	3.98	F	5.62	E	4.61	N/A (No Stops)	D	3.94
PM	C	2.38	F	3.00	D	3.56	D	3.78	F	6.02	E	4.50		D	4.01
Striping Alternative															
	SB		NB		SB		NB		SB		NB		SB	NB	
AM	C	2.25	E	2.57	C	3.34	D	4.11	E	4.96	D	4.08	A (Exclusive Lane)		
PM	C	2.42	F	2.99	D	3.58	D	3.80	F	5.82	D	3.89			
Customized Alternative															
	SB		NB		SB		NB		SB		NB		SB	NB	
AM	C	2.25	E	2.57	C	3.30	D	4.10	E	4.49	D	3.61	A (Exclusive Lane)		
PM	C	2.42	F	2.99	D	3.54	D	3.79	F	5.34	C	3.42			

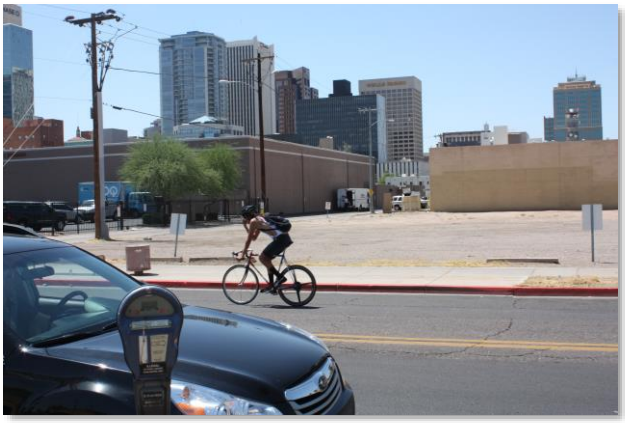
Source: Chen Ryan Associates, January 2017

Table 2-6 Scottsdale MMLOS Scores by Scenario – Scottsdale Road from E. Osborn Road to E. Earll Drive

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score			
Existing Conditions																
	SB		NB		SB		NB		SB		NB		SB		NB	
AM	A	2.15	B	2.28	C	3.42	D	4.12	E	4.39	E	4.79	C	2.97	C	3.32
PM	A	2.15	C	2.30	C	3.44	D	4.21	E	4.51	E	4.88	C	2.98	C	3.38
Customized Alternative																
	SB		NB		SB		NB		SB		NB		SB		NB	
AM	A	2.15	B	2.27	C	3.33	D	4.03	D	4.19	D	4.06	C	2.94	C	3.27
					A (On Multi-Use Path Portion)											
PM	A	2.15	C	2.30	C	3.36	D	4.13	E	4.26	D	4.15	C	2.95	C	3.35
					A (On Multi-Use Path Portion)											

Source: Chen Ryan Associates, January 2017

3 Multimodalism on Wide, Low Volume Roadways (Gilbert, Mesa, and Avondale)



Wide roadways with lower vehicular volumes, such as those found along the study corridors in Gilbert, Mesa, and Avondale, benefit from adequate space and a relatively calm traffic environment, but present certain challenges for pedestrians and cyclists due to the long crossing distances.

Of the three roadway typologies analyzed, the Wide, Low Volume typology generally responded most predictably, in terms of analysis results, to proposed improvements. The Striping alternatives were successful in providing minimal improvements to LOS scores, whereas the more aggressive Customized alternatives provided greater improvement to LOS scores. Roadway width for this typology generally allowed for the accommodation of adequate buffers. However, while roadway width was useful in treating conditions along the segments, it was noted that signal phase length, block length and crossing distances affected intersection performance, especially for pedestrians and cyclists.

Jurisdictions often wished to implement facilities that could not be analyzed by the HCS MMLOS software. A notable example was the installation of mid-block, high-visibility crossings to counterbalance the aforementioned block length issue. Since many high-visibility treatments postdate the MMLOS methodology, their benefits are not fully reflected in MMLOS scores.

Similar issues were apparent when analyzing cycle tracks, since the MMLOS tool predates this relatively new bicycle facility type. Thus, bike lane width and buffer inputs were used to simulate cycle track facilities in the MMLOS software. In reality, this facility should garner a greater score than was likely earned through this method of input, due to the vertical separation provided by the raised curbs and/or bollards used for cycle track improvements.

Jurisdictions with Wide, Low Volume typology roadways benefited from wide lateral buffers, which exposed a technical error in the MMLOS software. Lateral buffers above 5 feet had an unintended detrimental effect on MMLOS score. Although this information was forwarded to the manufacturer of the software, and may be fixed by the time of this writing, for this study, all buffers were capped to 5 feet when input to the MMLOS software to avoid an erroneous score reduction.

Finally, similar to the Wide, High Volume typology, an LOS score of “A” was substituted for all multi-use path facilities, since the MMLOS tool does not have the capability to analyze them.

3.1 Existing and Proposed Cross-Sections

Gilbert

Table 3-1 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. There are five different cross-section widths along this study corridor, which vary between 56' and 94'. Gilbert Road is a 4- or 6-lane roadway with posted speeds varying between 25 and 45 miles per hour.

Segments 1 and 2 differ only in median type (two-way left turn lane vs raised median). Segments 3 and 4, between Vaughn Road and Elliot Road, have the same characteristics. These segments were analyzed independently since they are separated by signalized intersections which, in the HCS software, necessitates separate analysis segments.

The Wide, Low Volume typology responded most predictably to proposed improvements.

Of the seven cross-sections along the study corridor, Segment 5, between Elliot Road and approximately 300 feet south of Hackamore Avenue, was chosen for development of Striping and Customized alternatives for further MMLOS analysis. Figure 3-1 displays existing conditions, as well as Striping and Customized alternatives for Segment 5.

As shown, reductions in the width of the center left-turn lane and southbound travel lanes provided space for a 1.5-foot buffer along the existing bike lane. In the Customized alternative, further reductions to the center left-turn lane allow for the addition of a 2-foot buffer to the bike lane facility, and additional right-of-way acquisition provides sufficient width for the installation of a multi-use path, which switches sides of the road at Misquite Street via a mid-block crossing.

From Top: Study Corridors in GIlbert, Mesa, and Avondale

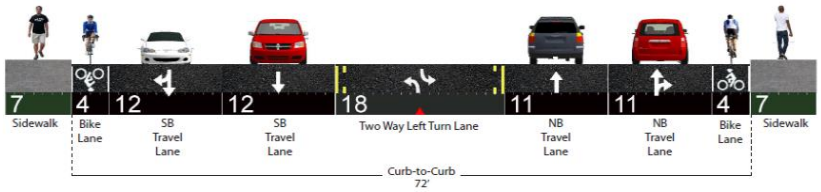
Table 3-1 Gilbert Study Corridor Characteristics – Gilbert Road

Seg. ID	From	To	SB Lanes	NB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Juniper Road	Gilbert Road Trail Crossings	2	2	63’	Two-way left-turn lane	No	25
2	Gilbert Road Trail Crossing	Vaughn Avenue	2	2	56’	Raised	No	25
3	Vaughn Avenue	Page Road	2	2	57’	Raised	No	25
4	Page Road	Elliot Road	2	2	56’	Raised	No	25
5	Elliot Road	300 ft South of Hackamore Avenue	2	2	72’	Two-way left-turn lane	Yes	35
6	300 ft South of Hackamore Avenue	Palomino Drive	3	2	92’	Two-way left-turn lane	Yes	45
7	Palomino Drive	Warner Road	3	3	94’	Two-way left-turn lane	Yes	45

Source: Chen Ryan Associates, January 2017

Gilbert, Segment 5: Gilbert Road, Elliott Road to 300 feet south of Hackamore Avenue

Existing Conditions



Striping Alternative

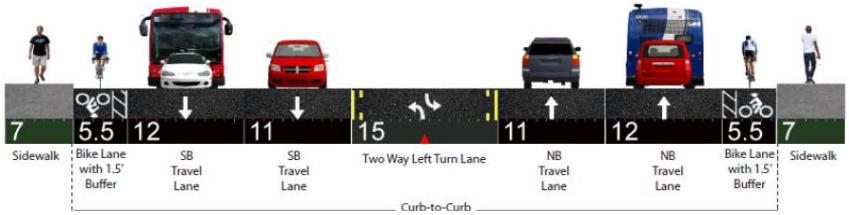


Figure 3-1a Gilbert Study Segment Alternatives

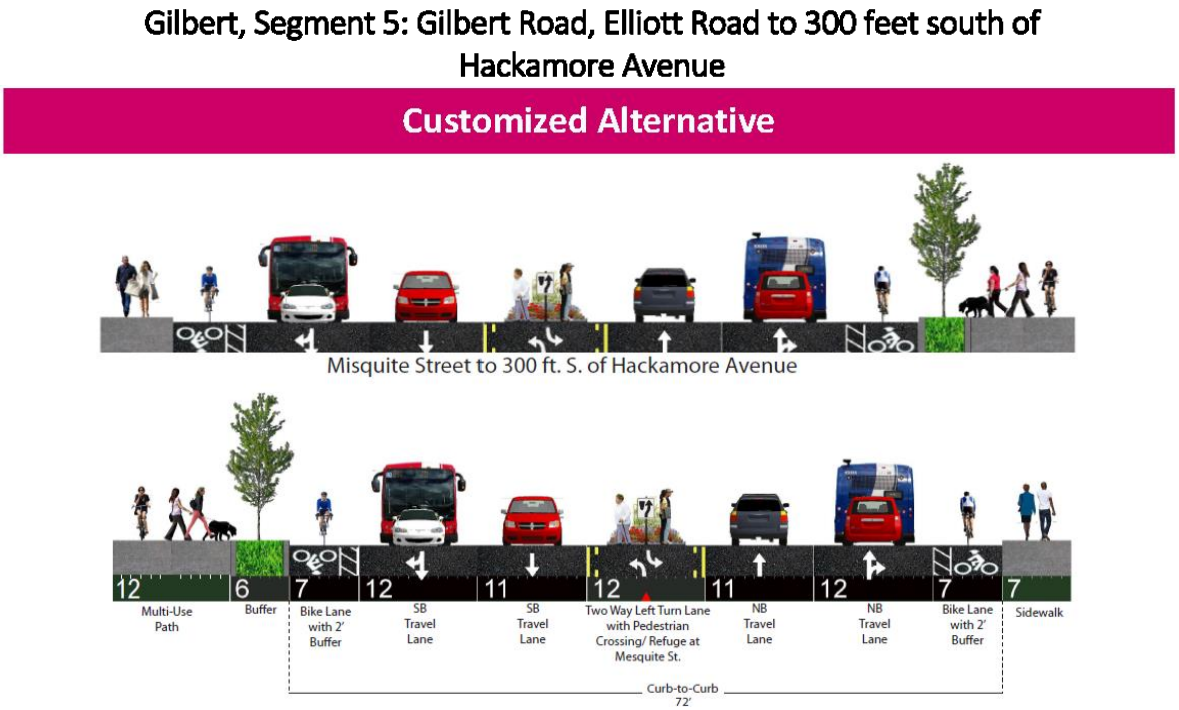


Figure 3-1b Gilbert Study Segment Alternatives

Mesa

Table 3-2 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. The cross-section along the entire study corridor is 64', with four travel lanes and a posted speed limit of 40 mph. Segments 1 and 2 have the same dimensions and characteristics, but were analyzed independently since they are separated by a signalized intersection.

Of the two cross-sections along the study corridor, Segment 1, between Alma School Road and Extension Road, was chosen for development of Striping and Customized alternatives for further MMLOS analysis. Figure 3-2 displays existing conditions, as well as the Striping and Customized alternatives for Segment 1. A reduction in travel lane and center left-turn lane width provides space for 6-foot bike lanes, as shown in the Striping alternative. In the Customized alternative, further right-of-way acquisition allows for an upgrade to cycle tracks.

Table 3-2 Mesa Study Corridor Characteristics – W. Broadway Road

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Alma School Road	Extension Road	2	2	64'	Two-way left-turn lane	No	40
2	Extension Road	Broadway Access Road	2	2	64'	Two-way left-turn lane	No	40

Source: Chen Ryan Associates, January 2017

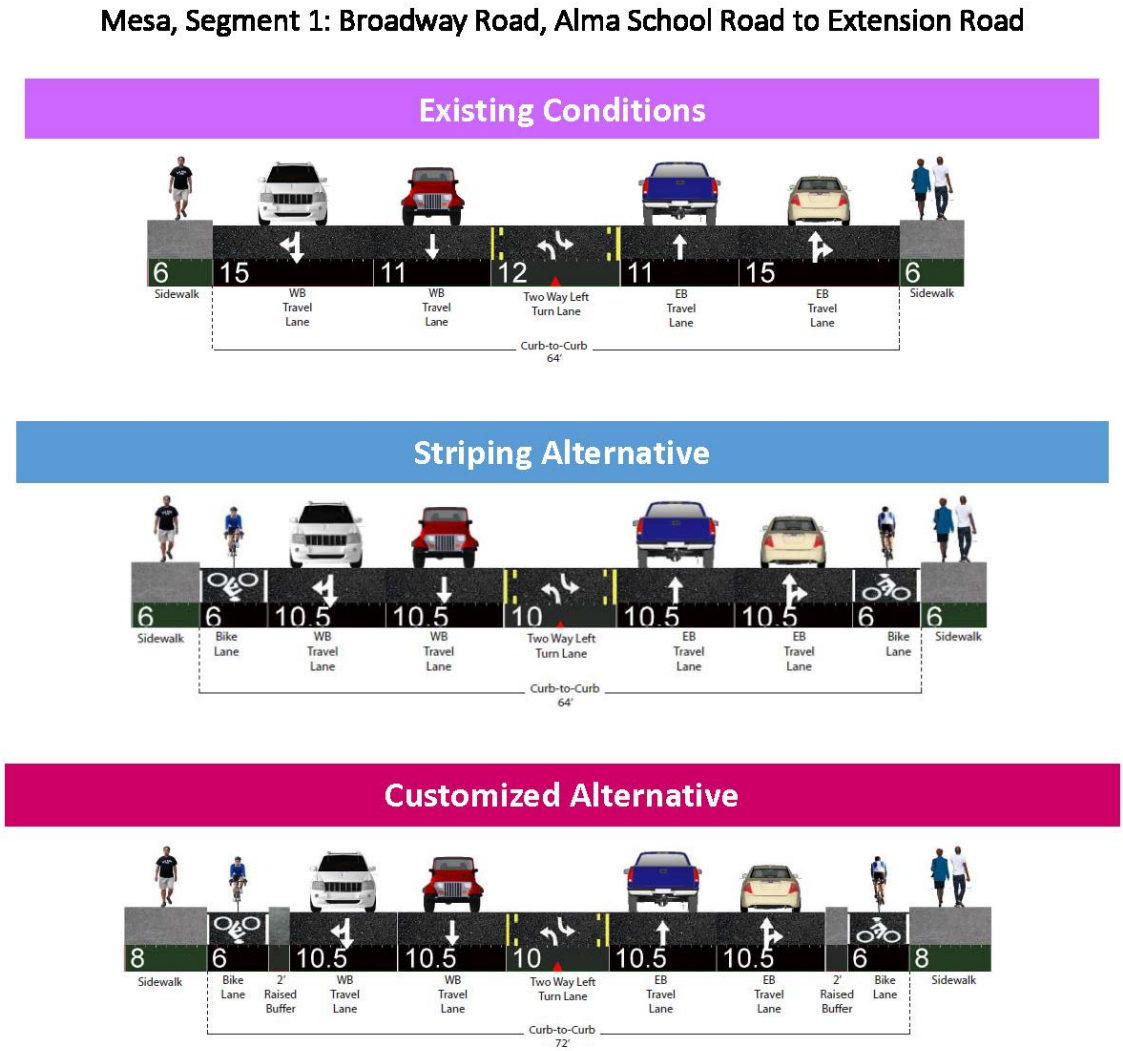


Figure 3-2 Mesa Study Segment Alternatives

Avondale

Table 3-3 displays key study corridor characteristics, including the number of travel lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. There are three different cross-section widths along the Avondale study corridor, ranging from 94' to 108'. McDowell Avenue is a 5- or 6-lane roadway with posted speeds of 45 mph. Segments 1 and 3 differ only in the type of median present. Of the four cross-sections along the study corridor, Segment 3, between 103rd Street and 101st St, was chosen for development of Striping and Customized alternatives for further MMLOS analysis. Figure 3-3 displays existing conditions, as well as the Striping and Customized alternatives for Segment 3.

As shown, reductions in the width of travel lanes provide sufficient room for the installation of 1-foot buffers along the existing bike lanes. The Customized alternative, by contrast, allows for the addition of two feet to the center raised median, while accomodating pedestrians and cyclists via a multi-use path, set back approximately 9 feet from the roadway.

Table 3-3 Avondale Study Corridor Characteristics – W. McDowell Avenue

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	107th Avenue	1,000 feet east of 107th Avenue	3	2	96’	2 Way Left Turn Lane	No	45
2	1,000 feet east of 107th Avenue	103rd Avenue	3	3	94-96’	2 Way Left Turn Lane	No	45
3	103rd Avenue	101st Avenue	3	3	96’	Raised	No	45
4	101st Avenue	99th Avenue	3	3	96-108’	Raised	No	45

Source: Chen Ryan Associates, January 2017

Avondale, Segment 3: McDowell Road, 103rd Ave to 101st Ave

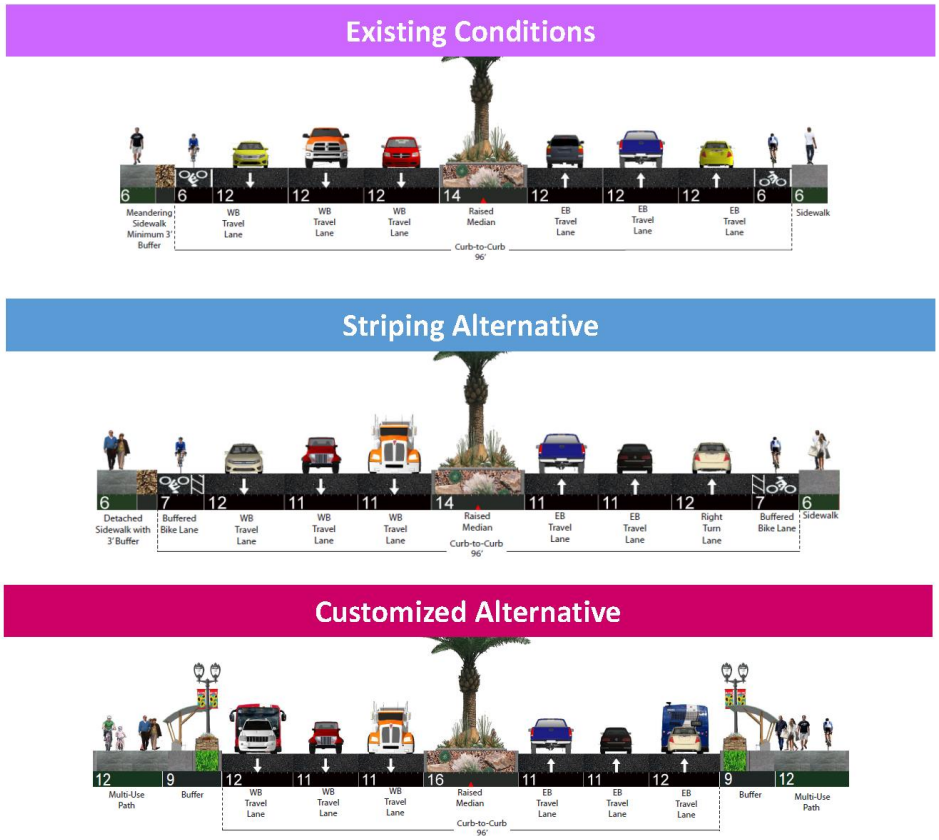


Figure 3-3 Avondale Study Corridor Alternatives

3.2 Analysis Results

MMLOS analyses were initially performed for each study corridor under existing conditions. Following this, a Striping alternative was developed for one segment along each study corridor and analyzed using HCS, in a manner similar to Wide, High Volume study corridors. City staff from each jurisdiction participated in a refinement and feedback meeting that aided the project team in developing the Customized alternative. The following sections summarize the results of the MMLOS analysis for each jurisdiction's Existing conditions, Striping, and Customized alternatives.

Gilbert

The results of MMLOS analyses performed for Segment 5, between Elliot Road and approximately 300 feet south of Hackamore Avenue, under Existing conditions, Striping and Customized alternative conditions are summarized in Table 3-4.

As shown, the Striping alternative provides moderate improvement to pedestrians, bicycles, and transit with no degradation to auto LOS. Similarly, the Customized alternative results in further MMLOS improvements for the segment.

Table 3-4 Gilbert MMLOS Scores by Scenario – Gilbert Road from Elliot Road to 300 Feet South of Hackamore Avenue

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score			
Existing Conditions																
	SB		NB		SB		NB		SB		NB		SB		NB	
AM	A	2.35	B	2.55	C	3.13	D	3.73	D	3.94	E	4.33	C	3.11	B	2.03
PM	A	2.35	C	2.57	C	3.26	D	3.90	D	3.98	E	4.42	C	3.16	B	2.19
Striping Alternative																
	SB		NB		SB		NB		SB		NB		SB		NB	
AM	A	2.35	B	2.55	C	3.12	D	3.69	D	3.77	D	4.23	C	2.80	B	2.01
PM	A	2.35	C	2.57	C	3.24	D	3.85	D	3.81	E	4.26	C	2.85	B	2.18
Customized Alternative																
	SB		NB		SB		NB		SB		NB		SB		NB	
AM	A	2.35	B	2.55	C	2.91	D	3.51	D	3.77	D	4.23	B	2.72	A	1.94
PM	A	2.35	C	2.57	C	3.03	D	3.67	D	3.81	E	4.26	C	2.77	B	2.10

Source: Chen Ryan Associates, January 2017

Mesa

MMLOS analyses were performed for Segment 1, between S. Alma School Road and S. Extension Road, under the Striping and Customized alternative conditions. These results are summarized in Table 3-5.

As shown, the Striping alternative provides moderate improvement to pedestrians, bicycles, and transit with no degradation to auto LOS. Similarly, the Customized alternative results in further MMLOS improvements for the segment for pedestrians, bikes, and transit.

Table 3-4 Mesa MMLOS Scores by Scenario – Broadway Road from S. Alma School Road to S. Extension Road

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score			
Existing Conditions																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	A	2.18	A	2.19	D	3.76	D	3.94	E	4.82	F	5.22	C	3.37	C	3.24
PM	B	2.19	A	2.19	D	4.03	D	3.95	F	5.04	F	5.22	C	3.49	D	3.23
Striping Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	A	2.18	A	2.19	D	3.67	D	3.85	E	4.52	E	4.61	C	3.33	C	3.21
PM	B	2.19	A	2.19	D	3.94	D	3.86	E	4.74	E	4.60	C	3.45	C	3.20
Customized Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	A	2.18	A	2.19	D	3.54	D	3.72	E	4.36	E	4.45	C	3.28	C	3.16
PM	B	2.19	A	2.19	D	3.81	D	3.73	E	4.58	E	4.44	C	3.41	C	3.15

Source: Chen Ryan Associates, January 2017

Avondale

MMLOS analyses were performed for Segment 3, between 103rd Avenue and 101st Avenue, under Striping alternative and Customized alternative conditions. These results are summarized in Table 3-5.

As shown, the Striping alternative provides moderate improvement to pedestrians, bicycles, and transit with no degradation to auto LOS. The Customized alternative provides a significant improvement to pedestrians and bikes through the introduction of a separate, multi-use path facilities.

Table 3-5 Avondale MMLOS Scores by Scenario – W. McDowell Road from 103rd Avenue to 101st Avenue

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score			
Existing Conditions																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.22	B	2.21	D	3.52	D	3.65	D	3.75	D	4.10	B	2.48	A	1.12
PM	B	2.26	B	2.24	D	3.72	D	3.70	D	3.88	E	4.45	B	2.61	A	1.24
Striping Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.22	B	2.21	C	3.45	D	3.57	C	3.39	D	3.74	B	2.45	A	1.10
PM	B	2.26	B	2.24	D	3.65	D	3.62	D	3.51	D	4.09	B	2.58	A	1.22
Customized Alternative																
	EB		WB		EB		WB		EB		WB		EB		WB	
AM	B	2.22	B	2.21	A (Multi-Use Path)								B	2.36	A	1.01
PM	B	2.26	B	2.24									B	2.49	A	1.13

Source: Chen Ryan Associates, January 2017

4 Multimodalism on Narrow, Low Volume Roadways (Surprise, Glendale, Queen Creek)

From Top: Surprise, Glendale, and Queen Creek Study Corridors.

Narrow roadways with low vehicular volumes, such as those found along the study corridors in Surprise, Mesa, and Queen Creek, are challenged by a lack of lateral separation or space for cyclists and pedestrians, but realize benefits from the low vehicular volumes.

Study corridors with this typology generally do not have transit service. Where transit exists, routes do not run the entire length of the corridor. The MMLOS tool generally assigns a score of LOS F in the absence of transit. However, it is possible that transit is not always appropriate for a particular roadway, such as when adjacent parallel roadways have transit service. Therefore, a score of "N/A" was substituted when no transit service was present.

On-street parking is generally present along roadways of this typology, and are often too narrow to accommodate parking and dedicated bicycle lanes without additional right-of-way acquisition. This presented a design challenge when attempting to improve MMLOS scores, since parking removal is often unrealistic. Although vehicular volumes are low, the presence of parked cars, which create a potential door conflict, and a lack of separate facility with lateral buffer, make it difficult to improve bike LOS for this roadway typology.

Adding to this difficulty are the analysis challenges posed by the positive LOS correlation between pedestrians and parked cars. Pedestrians receive protection from moving traffic by parked vehicles, therefore, in several cases, parking removal resulted in an improvement in bicycle LOS at the expense of a reduction in pedestrian LOS. Further innovative solutions were tested, such as examining the benefits of placing the bike lane between a parking lane and the sidewalk (preserving parking while

sheltering cyclists from parked cars). However, the MMLOS tool currently cannot distinguish between the two configurations.

The nature of the Narrow, Low Volume typology often means that these study corridors are secondary thoroughfares with many non-residential driveways. Since driveway closure is not possible in this context, the number of treatments available for LOS score improvement is limited.

Similar to roadways in other typologies, an LOS score of "A" was substituted for all multi-use paths, since the MMLOS tool is not designed to analyze them.

4.1 Existing and Proposed Cross-Sections

Surprise

Table 4-1 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. The cross-section width of the frontage road parallel to N.W. Grand Avenue selected for study is 30'. The corridor is a 2-lane roadway with no posted speed limit.

Each segment of the study corridor has the same dimensions and characteristics; however, they were analyzed separately since they are separated by stop-controlled intersections which, in the HCS software, necessitates separate analysis segments. Of the four cross-sections along the study corridor, Segment 2, between between the north driveway and Sunny Lane, was chosen for development of the Striping and Customized alternatives for MMLOS analysis. Figure 4-1 displays existing conditions, as well as Striping and Customized alternatives for Segment 2.

Removing on-street parking provides space to install bike lanes, as shown in the Striping alternative. The Customized alternative builds upon current plans from the City of Surprise to enclose the existing drainage channel to provide additional space for pedestrians and bicycles. Under this alternative, one side of on-street parking is retained and cyclists are accomodated with a multi-use path.

Table 4-1 Surprise Study Corridor Characteristics - N.W. Grand Frontage Road

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Northern Terminus	Driveway	1	1	30'	Undivided	No	Not Posted
2	Driveway	Sunny Lane	1	1	30'	Undivided	No	Not Posted
3	Sunny Lane	Driveway	1	1	30'	Undivided	No	Not Posted
4	Driveway	W Greenway Road	1	1	30'	Undivided	No	Not Posted

Source: Chen Ryan Associates, January 2017

Surprise, Segment 2: NW Grand Frontage Road, North Driveway to Sunny Lane

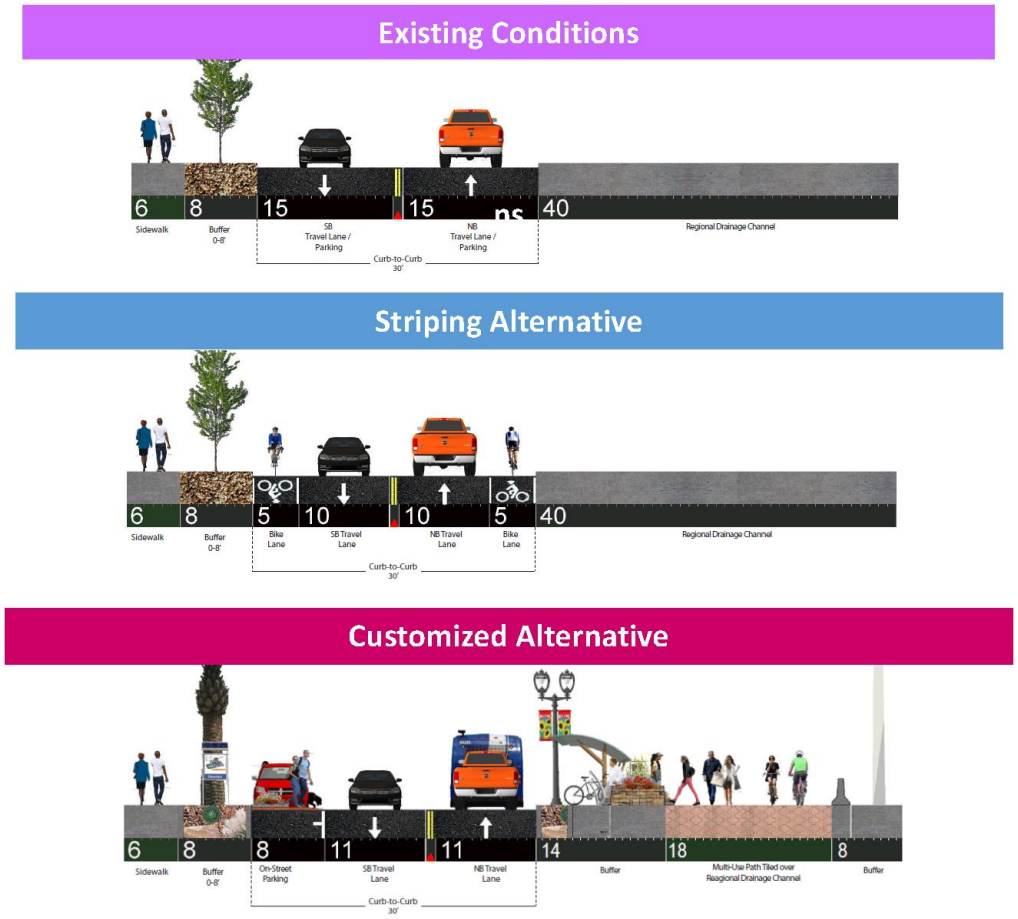


Figure 4-1 Surprise Study Corridor Alternatives

Glendale

Table 4-2 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. There are a total of three different cross-section widths along this study corridor, which varying between 32' and 44'. Gilbert Road is a 2- or 3-lane roadway with posted speeds of 25 miles per hour.

Along the Glendale study corridor, each segment is distinct in lane configuration, width, and median type.

Of the three cross-sections along the study corridor, Segment 3, between 59th Avenue and 51st Avenue, was chosen for development of the Striping and Customized alternatives for MMLOS analysis. Figure 4-2 displays existing conditions, as well as the Striping and Customized alternatives for Segment 3.

Table 4-2 Glendale Study Corridor Characteristics – W. Myrtle Avenue

Seg. ID	From	To	WB Lanes	EB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	62nd Avenue	Grand Avenue	1	1	40’	Two-way left-turn lane	No	25
2	Grand Avenue	59th Avenue	1	2	44’	Two-way left-turn lane	No	25
3	59th Avenue	51st Avenue	1	1	32’	Undivided	No	25

Source: Chen Ryan Associates, January 2017

Glendale, Segment 3: Myrtle Avenue, 59th Avenue to 51st Avenue

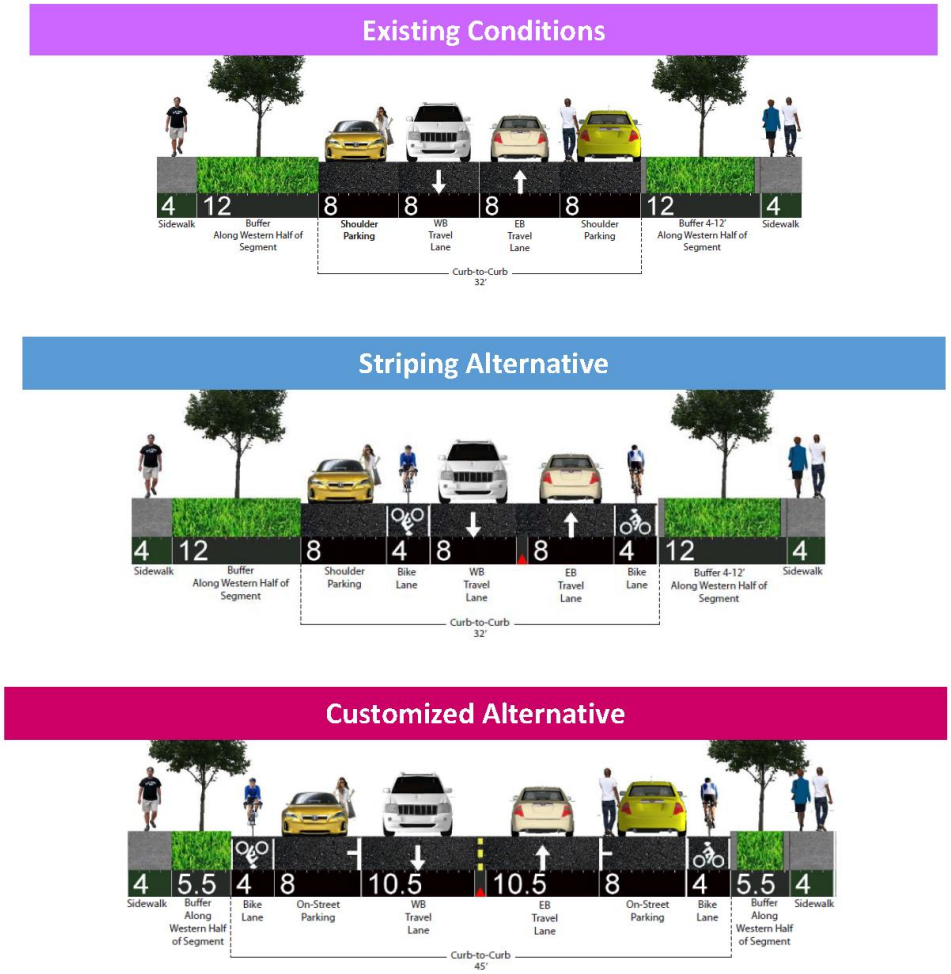


Figure 4-2 Glendale Study Corridor Alternatives

As shown in the Striping alternative, removal of on-street parking along one side of the roadway provides space for the installation of bike lanes. By constrast, the Customized alternative retains all on-street parking, and bike lanes are provided through acquisition of 6.5 additional feet of right-of-way along either side of the roadway, which is currently a landscaped buffer.

Queen Creek

Table 4-3 displays key study corridor characteristics, including the number of lanes, the curb-to-curb width, presence and type of median, presence of bike lane, and posted speed limit. There are three different cross-sections, ranging from 56' to 72'. E. Ellsworth Road is a 5- or 4-lane roadway with posted speeds between 25 and 35 miles per hour.

Segments 2 and 3, between Heritage Loop/Victoria Road and Sierra Park Boulevard, have the same number of travel lanes and median characteristics. However, these segments were analyzed independently since they are separated by a signalized intersection which, in the HCS software, necessitates separate analysis segments.

Table 4-3 Queen Creek Study Corridor Characteristics – E. Ellsworth Road

Seg. ID	From	To	SB Lanes	NB Lanes	Curb-to-Curb Width (ft)	Median Type	Bike Lane Present?	Posted Speed Limit (mph)
1	Rittenhouse Road	Heritage Loop/Victoria Road	2	2	72'	Raised median/Two-way left turn lane	Yes	35
2	Heritage Loop/Victoria Road	Ocotillo Road	1	1	58'	Two-way left turn lane	Yes	25
3	Ocotillo Road	Sierra Park Boulevard	1	1	56'	Two-way left turn lane	No	25

Source: Chen Ryan Associates, January 2017

Segment 3, between Ocotillo Road and Sierra Park Boulevard, was chosen for development of the Striping and Customized alternatives for MMLOS analysis. Figure 4-3 displays existing conditions, as well as Striping and Customized alternatives for Segment 1.

As shown, the Striping alternative includes bike lanes, using space gained from narrowing the shoulder of the roadway. The Customized alternative builds on this concept, by using approximately 6 feet of existing buffer along the northbound side of the roadway to create a multi-use path.

Queen Creek, Segment 3: Ellsworth Road, Ocotillo Road to Sierra Park Boulevard

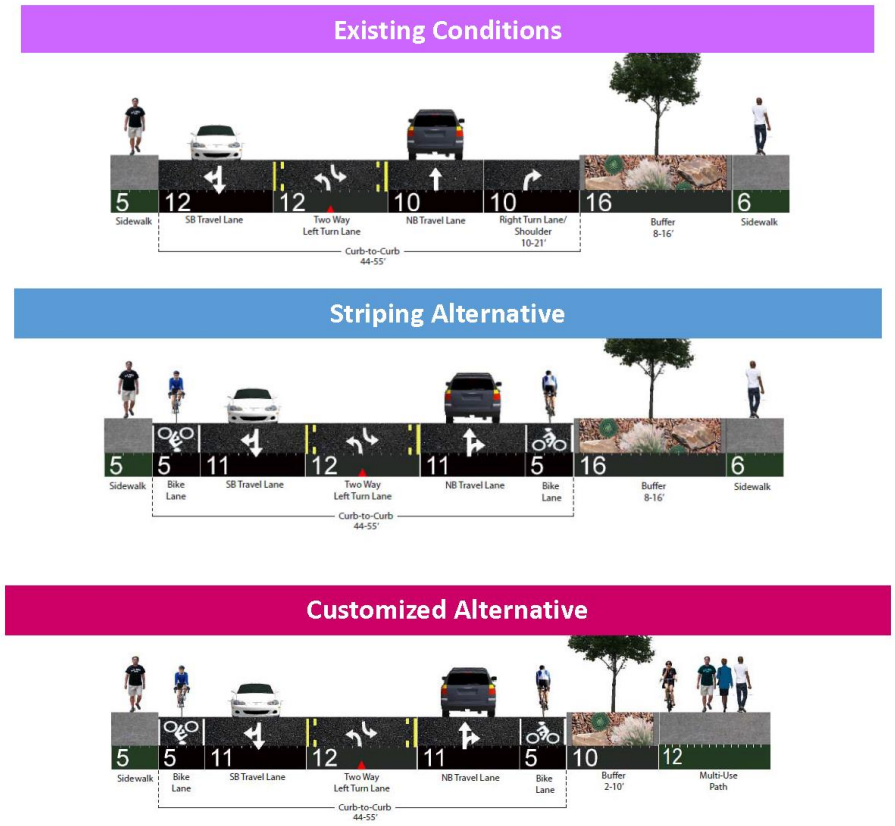


Figure 4-3 Queen Creek Study Corridor Alternatives

Of the three cross-sections along the study corridor, Segment 3, between Ocotillo Road and Sierra Park Boulevard, was chosen for development of the Striping and Customized alternatives for MMLOS analysis. Figure 4-3 displays existing conditions, as well as Striping and Customized alternatives for Segment 1.

As shown, the Striping alternative includes bike lanes, using space gained from narrowing the shoulder of the roadway. The Customized alternative builds on this concept, by using approximately 6 feet of existing buffer along the northbound side of the roadway to create a multi-use path.

4.2 Analysis Results

Surprise

MMLOS analyses were performed for Segment 2, between the north driveway and Sunny Lane, under the Striping and Customized alternative conditions. These results are summarized in Table 4-4.

As shown, MMLOS analysis for the Striping alternative shows a slight reduction in pedestrian LOS, due to the removal of on-street parking, but sees a marked improvement for bike LOS, particularly along the northbound side of the roadway, where few driveways exist. The reintroduction of on-street parking along the southbound side of the roadway, coupled with a multi-use path, as shown in the Customized

Table 4-4 Surprise MMLOS Scores by Scenario – NW Grand Avenue Frontage Road from North Driveway to Sunny Lane

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score	
Existing Conditions														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.35	A	2.35	C	2.79	N/A		F	5.24	D	3.52	N/A	
PM	A	2.34	A	2.36	C	2.79			F	5.19	D	3.53		
Striping Alternative														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.35	A	2.35	C	2.98	N/A		E	4.29	B	2.58	N/A	
PM	A	2.34	A	2.36	C	2.97			D	4.22	B	2.64		
Customized Alternative														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.35	A	2.35	B	2.73	A	Multi-Use Path	N/A		A	Multi-Use Path	N/A	
PM	A	2.34	A	2.36	B	2.72								

Source: Chen Ryan Associates, January 2017

alternative, results in LOS A or B scores for all modes analyzed.

Glendale

MMLOS analyses were performed for Segment 3, between 59th Avenue and 51st Avenue, under the Striping and Customized alternative conditions. These results are summarized in Table 4-5.

As shown, the narrow, 8-foot lanes, combined with the presence of on-street parking, result in low bike LOS. Although the Striping alternative slightly improves this LOS score, a reduction in pedestrian LOS occurs where on-street parking is removed, since parked cars create a protective barrier for pedestrians. In the Customized alternative, pedestrian LOS improves, but bike LOS still suffers due to the re-introduction of on-street parking and the potential car-door conflicts that may arise.

Table 4-5 Glendale MMLOS Scores by Scenario – Myrtle Avenue from 59th Avenue to 51st Avenue

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score	
Existing Conditions														
	EB		WB		EB		WB		EB		WB		EB	WB
AM	D	2.82	A	2.37	C	3.12	C	3.12	F	6.51	F	5.49	N/A	
PM	D	2.83	A	2.38	C	3.19	C	3.19	F	6.60	F	5.59		
Striping Alternative														
	EB		WB		EB		WB		EB		WB		EB	WB
AM	D	2.82	A	2.37	C	3.44	C	3.07	F	6.06	F	5.38	N/A	
PM	D	2.83	A	2.38	D	3.54	C	3.14	F	6.27	F	5.52		
Customized Alternative														
	EB		WB		EB		WB		EB		WB		EB	WB
AM	D	2.82	A	2.37	C	3.05	C	3.04	F	6.33	F	5.25	N/A	
PM	D	2.83	A	2.38	C	3.13	C	3.13	F	6.50	F	5.42		

Source: Chen Ryan Associates, January 2017

Queen Creek

MMLOS analyses were performed for Segment 6, between E. Ocotillo Road to E. Sierra Park Boulevard, under the Striping and Customized alternative conditions. These results are summarized in Table 4-6. As shown, MMLOS analysis under the Striping alternative yields scores for all modes within an acceptable LOS A through LOS D. These scores are further improved through the introduction of a multi-use path under the Customized alternative. Although bike LOS remains similar for users choosing to cycle along the on-street bike lane, users have the opportunity to choose a lower stress facility due to the presence of the multi-use path.

Table 4-6 Queen Creek MMLOS Scores by Scenario – S. Ellsworth Road from E. Ocotillo Road to E. Sierra Park Blvd

Period	Auto LOS/Score				Pedestrian LOS/Score				Bike LOS/Score				Transit LOS/Score	
Existing Conditions														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.25	B	2.49	C	3.29	C	3.22	D	4.11	D	4.24	N/A	
PM	A	2.25	C	2.58	C	3.30	C	3.29	E	4.31	D	4.13		
Striping Alternative														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.25	B	2.49	C	3.24	C	3.42	D	4.02	D	3.80	N/A	
PM	A	2.25	C	2.58	C	3.25	C	3.49	D	4.09	D	3.83		
Customized Alternative														
	SB		NB		SB		NB		SB		NB		SB	NB
AM	A	2.25	B	2.49	C	3.24	A	Multi-Use Path	D	4.02	D	3.80 (In Lane)	N/A	
PM	A	2.25	C	2.58	C	3.25			D	4.09	D	3.83 (In Lane)		

Source: Chen Ryan Associates, January 2017

5 Key Findings and Directions for Future Analysis

The end goal of this project is to leave the MAG member agencies with an improved understanding of multimodal mobility analysis processes that can support corridor studies and long-range transportation planning. To this end, the following section summarizes key considerations found during the course of the project that may be useful to agencies and jurisdictions that wish to carry out MMLOS analyses.

Limitations and Challenges

Design limitations are inherent in all complex analyses. This sections summarizes several key limitations and challenges that an analyst, or agency seeking to conduct an MMLOS analysis, should bear in mind throughout the process.

Data Intensive Inputs

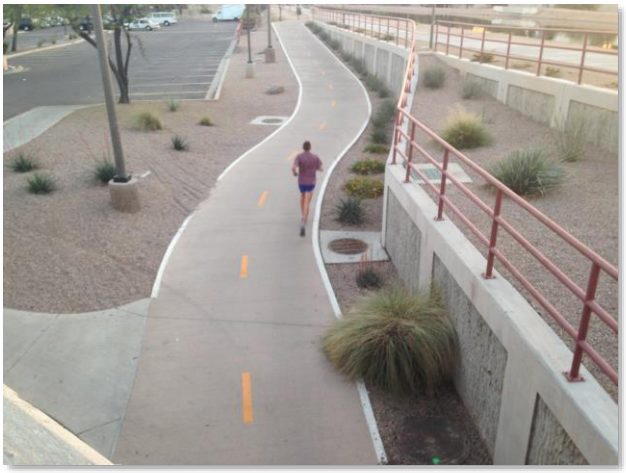
The formulas the underlie MMLOS analyses are complex and three-dimensional in their interrelatedness. A notable example, as summarized in Appendix A, is transit LOS, which partly relies on pedestrian LOS for score calculation. MMLOS software, such as the HCS2010 Streets software used for this analysis, clearly defines required inputs, and allows the data to be gathered and input in a straightforward manner. However, it must be understood that data collection in support of an MMLOS analysis is an intensive process. It is recommended that consideration be paid to the potential turnaround time needed by jurisdictions, transit agencies, and data collection staff, in order to ensure that the process is robust and timely.

Data Gathering and Availability of Information

Much of the data can be gathered virtually, from a combination of Google Earth aerial and street views. However, signal timing plans, transit service data, and turning movement counts are required, and must be gathered from agencies or collected separately. It is advisable to count data on days that best reflect and average day, and it is important to note that the quality of data available shall directly affect the accuracy of the calculated MMLOS score. For example, a lack of signal timing or count data surrounding minor intersections is likely to

Key MMLOS Findings

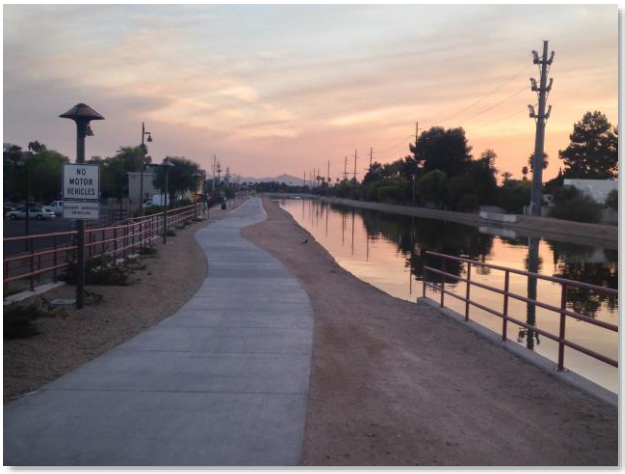
- Inputs are interrelated between modes – single features have the ability to improve or detract from the LOS scores of multiple modes.
- Much data can be collected through virtual methods, however vehicular LOS benefits from professional traffic counts and analysis via specific traffic analysis software.
- The roadway environment requires tradeoffs – each community's unique goals and modal priorities must be weighed carefully.
- Addressing corridor deficiencies requires an understanding of the limited toolbox of inputs that MMLOS analysis offers and the magnitude of their potential to impact and LOS score.



erroneously affect the MMLOS score of that intersection, as well as the downstream roadway segment adjacent to the intersection.

Additionally, transit data, such as average running speed, on-time performance, and load factors, are often collected and reported by transit agencies at the route level, rather than at individual stops. This data must often be applied to all roadway segments, thus possibly diluting individual segment performance.

Although HCS2010 MMLOS software provides vehicular intersection LOS scores, it was found to be advantageous to use professional traffic analysis software, such as SYNCHRO Studio, due to the fact that it offers a more robust roadway network analysis, particularly along longer, more complex study corridors. SYNCHRO Studio Intersection LOS was used to supplement the auto intersection LOS findings from HCS2010.



Modeled Versus Actual Data

At several points throughout the MMLOS process, it may become necessary to choose between using modeled or actual data. Reasons for using modeled data may include the availability, timeline or cost to collect actual data. Additionally, agencies may desire to perform future conditions analyses to gauge the performance of proposed complete streets in future traffic volume scenarios, necessitating the use of modeled data. In any case, analysts should remain mindful of the limitations of using theoretical, or modeled data, and results should be qualified within the proper context when non-actual data is used.

MMLOS Score Cutoffs

The MMLOS output includes a numerical and letter-grade score. Letter-grades are determined by predetermined thresholds set along the spectrum of potential scores, generally between 0 and 5. Since these letter-grade thresholds are absolute, it was seen as necessary to report both the numerical and letter-grade output in order to contextualize the MMLOS score, since considerable differences in roadway environment may be present within a single letter-grade.

Regional Differences

Although the MMLOS tool is designed to be used to analyze any roadway environment, the inherent differences between (or even within) a region can become apparent when selecting potential remedies to improve MMLOS scores. For example, if removal of commercial driveways or expansion of the corridor's right-of-way is not feasible, options for MMLOS score improvement may become limited. Similarly, regions with relatively higher or lower levels of bicycle or pedestrian activity are likely to see LOS score reductions or improvements based on the user-to-capacity ratio present.

Recent Complete Streets Developments

As complete streets policies and active transportation infrastructure continues to evolve, relevant analyses risk falling behind. A notable example is the creation of Cycle Tracks, which were not formally recognized in 2010 when the MMLOS methodology was last revised. Similarly, the proliferation of Multi-Use Paths in recent years, although in place in 2010, has exemplified the need for refined analysis of those facilities as well. Jurisdictions with a particular preference for these types of facilities may encounter issues when performing MMLOS analyses, and find it necessary to adopt measures in lieu of an MMLOS score.

Design Recommendations

Understanding the future goals for a corridor is imperative when determining design priorities. In some cases, tradeoffs are required, such as when lane diets or removal of on-street parking are considered. Since MMLOS and complete streets policies stress the importance of considering all users, these tradeoffs must be weighed carefully against each jurisdiction's unique goals and visions.

Future Conditions Analysis

Ensuring that future condition designs resolve current corridor deficiencies can be a complex process, as summarized in Sections 2.1, 3.1, and 4.1. Challenges often arise from design decisions that may not be realistically feasible, such as additional lateral buffer, removal of on-street parking, or closure of driveways. Understanding the limitations of what the MMLOS analysis tool can and cannot analyze, due to the constantly evolving toolbox of roadway design possibilities, may involve certain deviations or "work-arounds" from the MMLOS analysis process.

Understanding Tradeoffs in Multimodal Designs

The multimodal planning process is based on the principle of tradeoffs, since all modes of travel influence one another. An understanding of a roadway's modal priorities is necessary to determine how tradeoffs should be addressed, such as the dilemma of on-street parking's benefit to pedestrians and disadvantage to bicyclists.

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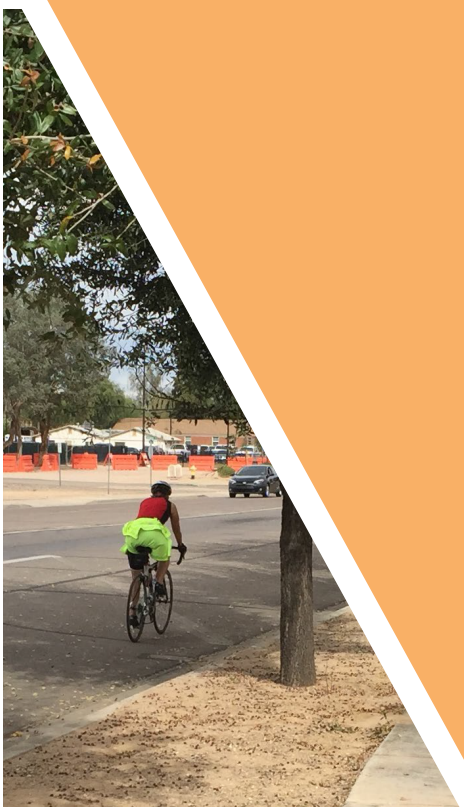

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