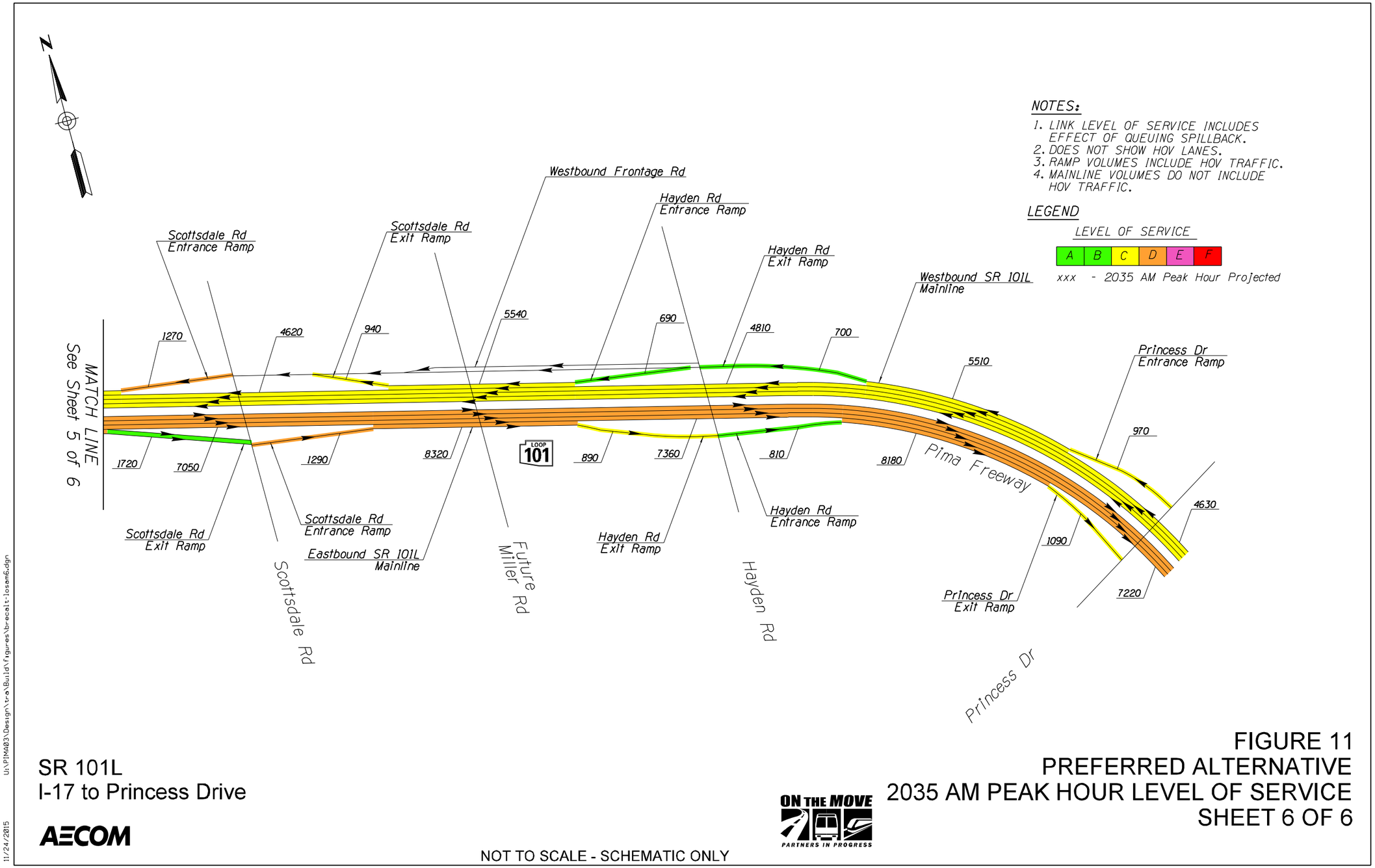


SR 101L
I-17 to Princess Drive

AECOM

NOT TO SCALE - SCHEMATIC ONLY

ON THE MOVE
PARTNERS IN PROGRESS

FIGURE 11
PREFERRED ALTERNATIVE
2035 AM PEAK HOUR LEVEL OF SERVICE
SHEET 6 OF 6

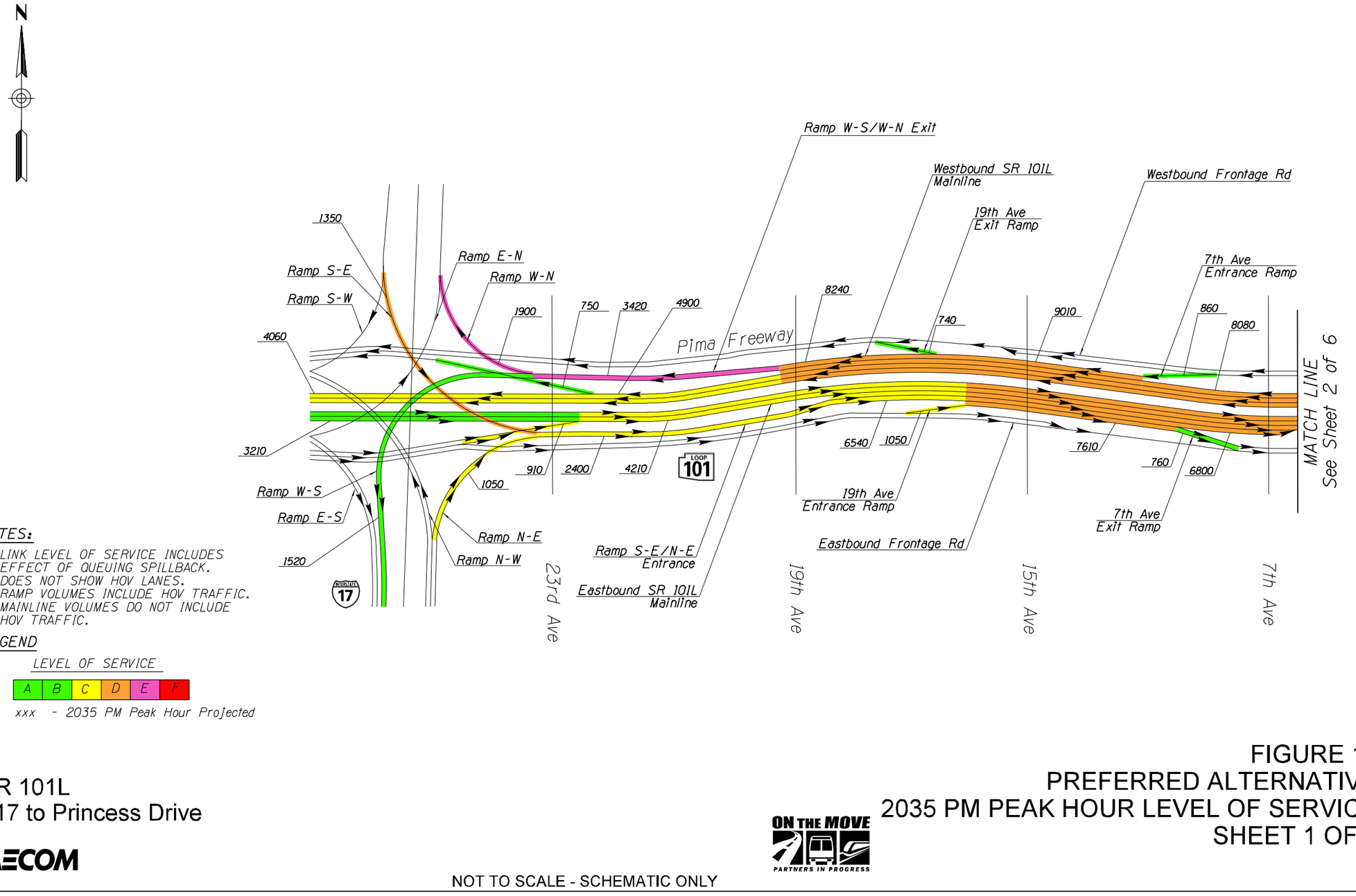
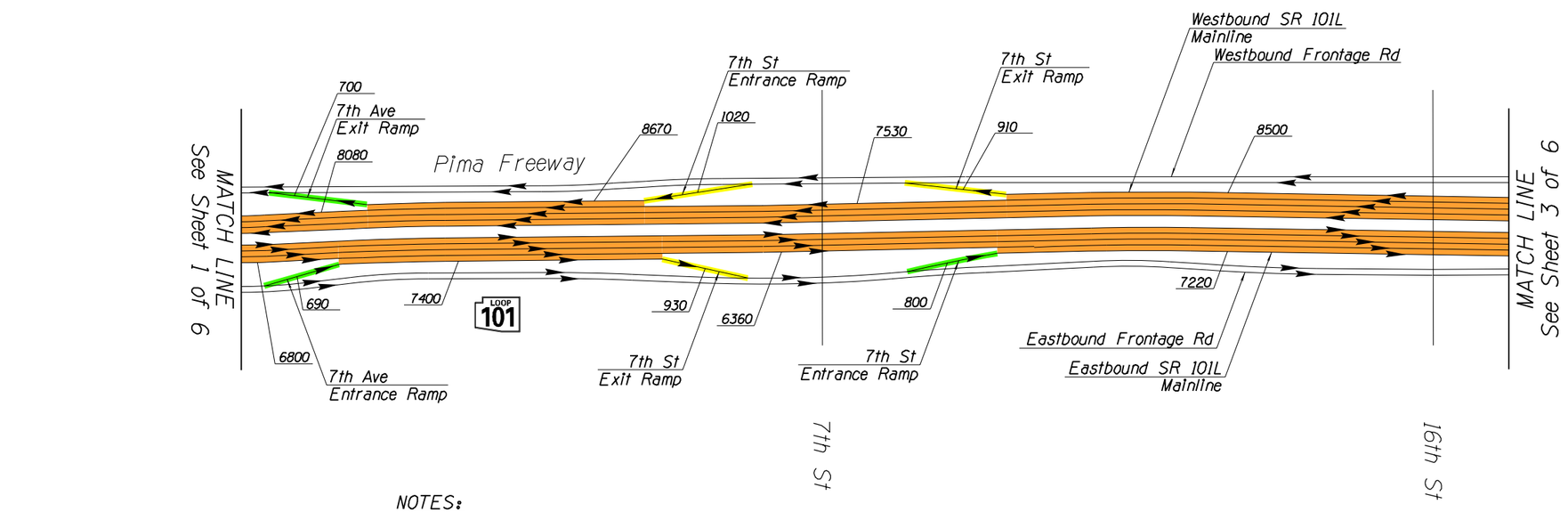


FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 1 OF 6



NOTES:

1. LINK LEVEL OF SERVICE INCLUDES EFFECT OF QUEUING SPILLBACK.
2. DOES NOT SHOW HOV LANES.
3. RAMP VOLUMES INCLUDE HOV TRAFFIC.
4. MAINLINE VOLUMES DO NOT INCLUDE HOV TRAFFIC.

LEGEND

LEVEL OF SERVICE

A	B	C	D	E	F

xxx - 2035 PM Peak Hour Projected

SR 101L
I-17 to Princess Drive

AECOM

ON THE MOVE
PARTNERS IN PROGRESS

FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 2 OF 6

NOT TO SCALE - SCHEMATIC ONLY

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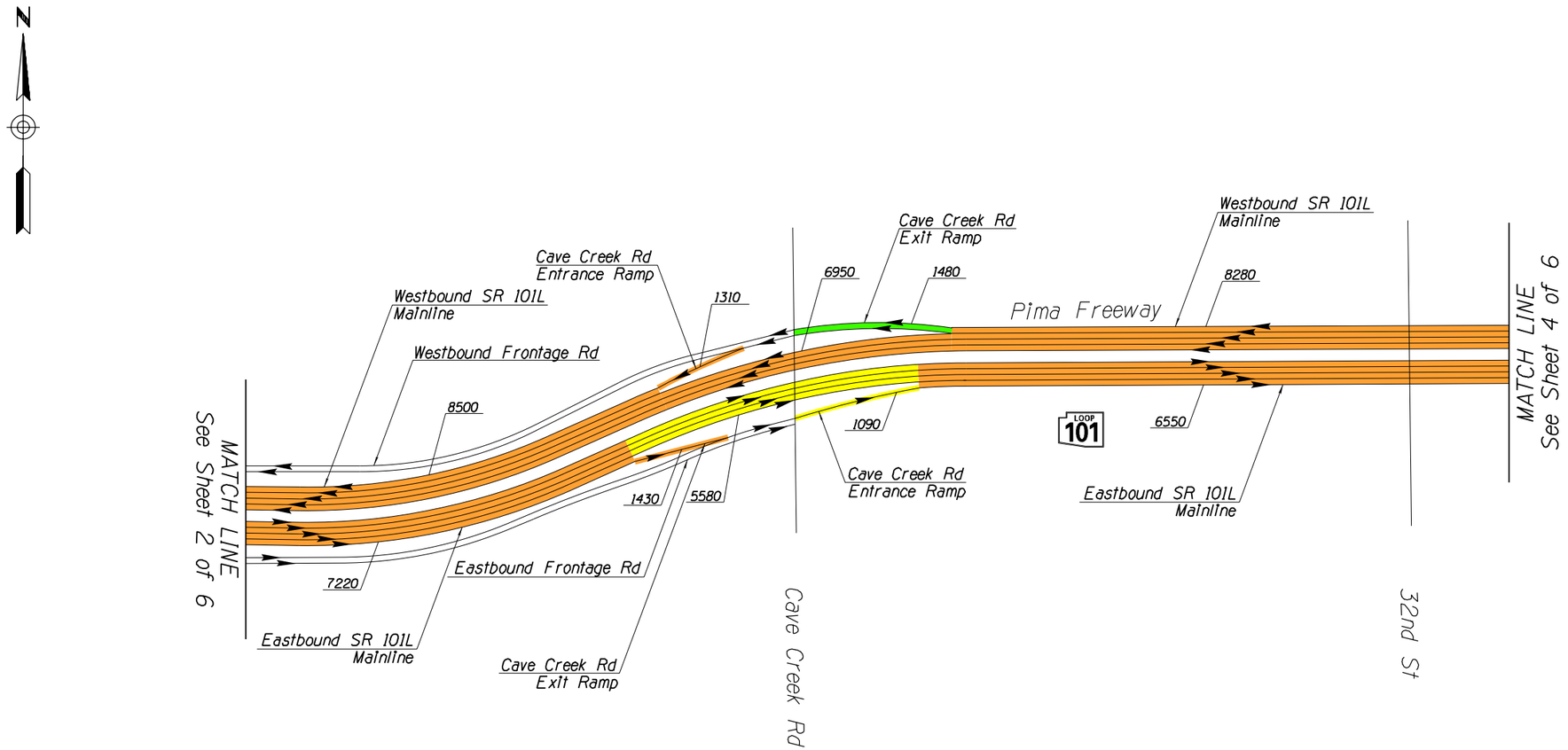

NOTES:

1. LINK LEVEL OF SERVICE INCLUDES EFFECT OF QUEUING SPILLBACK.
2. DOES NOT SHOW HOV LANES.
3. RAMP VOLUMES INCLUDE HOV TRAFFIC.
4. MAINLINE VOLUMES DO NOT INCLUDE HOV TRAFFIC.

LEGEND

LEVEL OF SERVICE

A	B	C	D	E	F

xxx - 2035 PM Peak Hour Projected

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11/24/2015

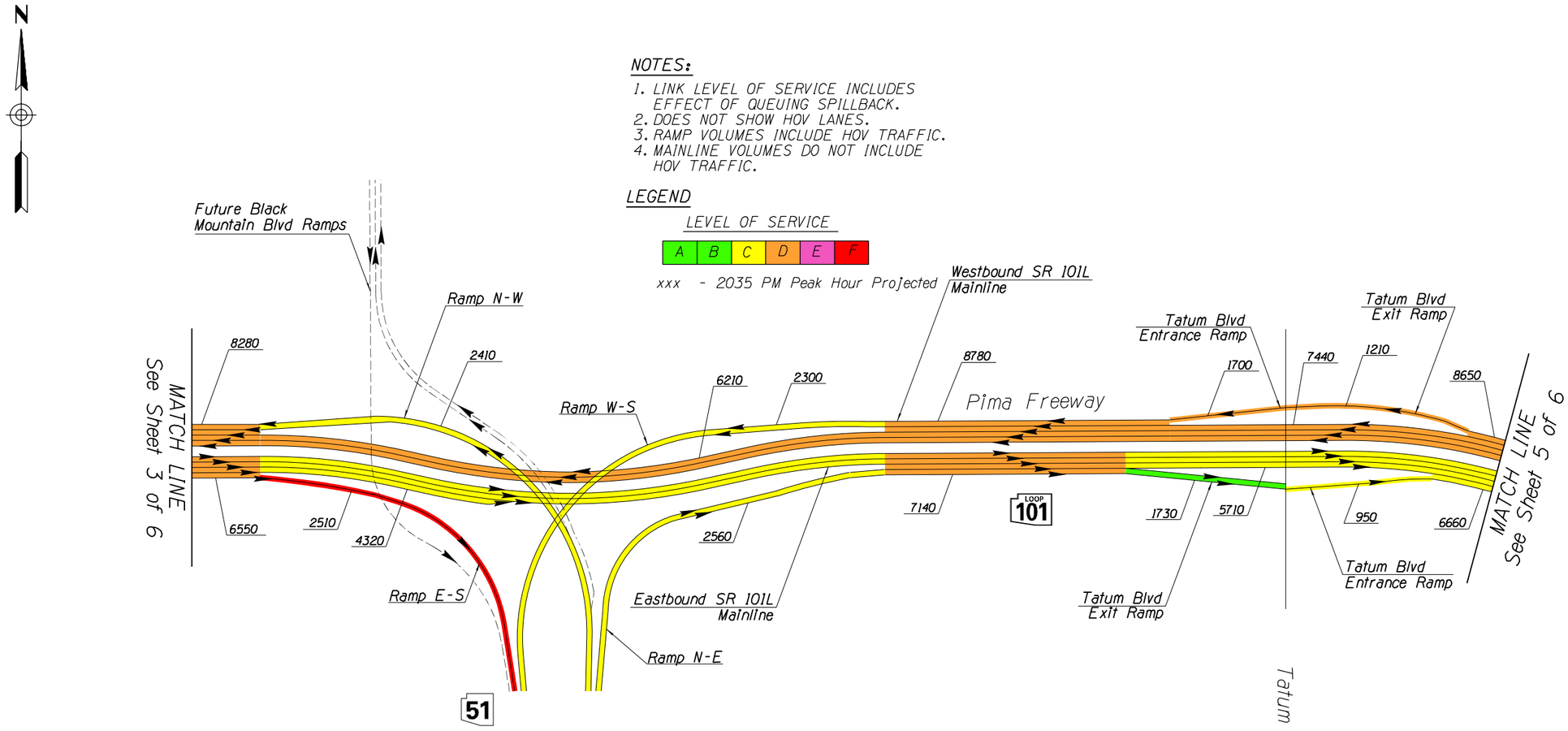
SR 101L
I-17 to Princess Drive

AECOM

FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 3 OF 6

ON THE MOVE
PARTNERS IN PROGRESS

NOT TO SCALE - SCHEMATIC ONLY



SR 101L
I-17 to Princess Drive

AECOM

FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 4 OF 6

ON THE MOVE
PARTNERS IN PROGRESS

NOT TO SCALE - SCHEMATIC ONLY

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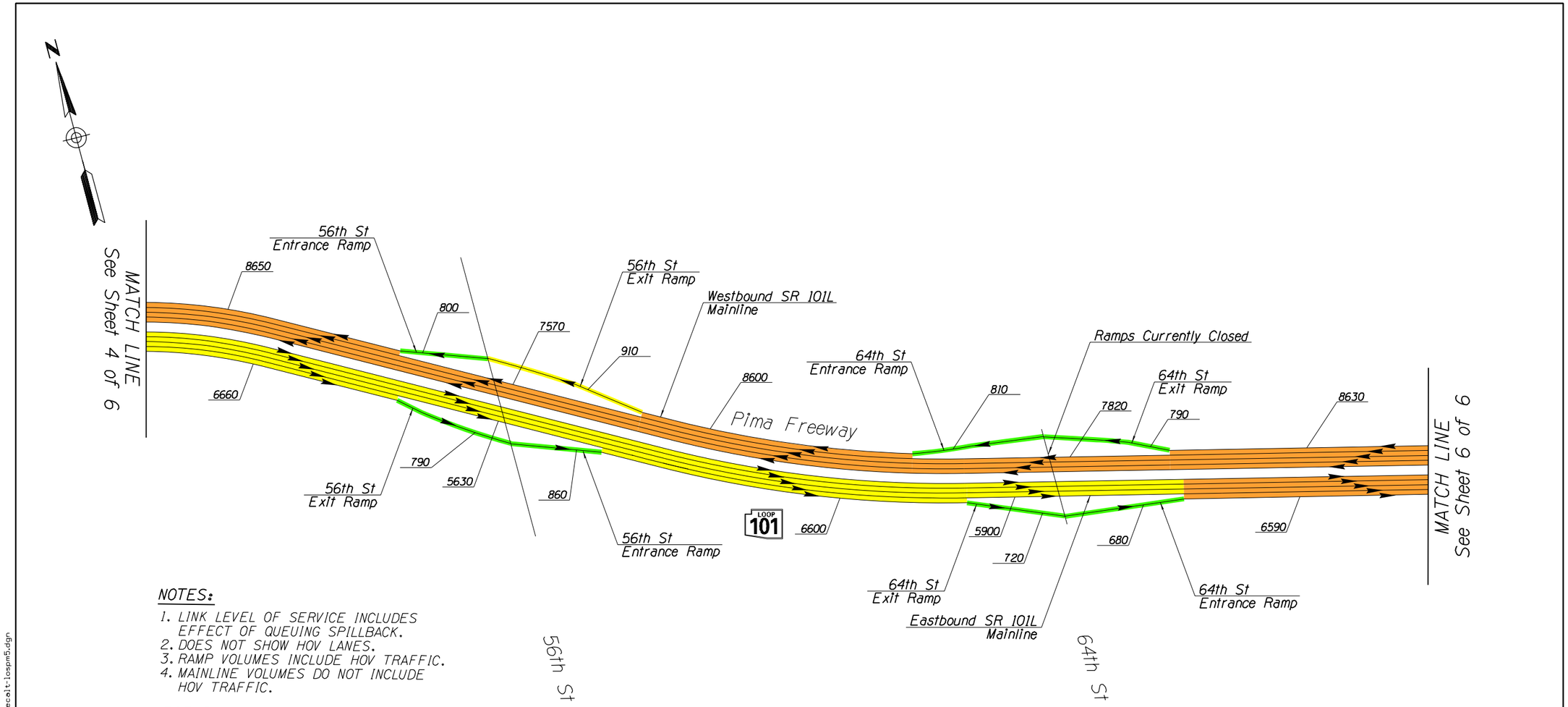

NOTES:

1. LINK LEVEL OF SERVICE INCLUDES EFFECT OF QUEUING SPILLBACK.
2. DOES NOT SHOW HOV LANES.
3. RAMP VOLUMES INCLUDE HOV TRAFFIC.
4. MAINLINE VOLUMES DO NOT INCLUDE HOV TRAFFIC.

LEGEND

LEVEL OF SERVICE

A	B	C	D	E	F

xxx - 2035 PM Peak Hour Projected

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11/24/2015

SR 101L
I-17 to Princess Drive

AECOM

NOT TO SCALE - SCHEMATIC ONLY

ON THE MOVE
PARTNERS IN PROGRESS

FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 5 OF 6

N

NOTES:
1. LINK LEVEL OF SERVICE INCLUDES EFFECT OF QUEUING SPILLBACK.
2. DOES NOT SHOW HOV LANES.
3. RAMP VOLUMES INCLUDE HOV TRAFFIC.
4. MAINLINE VOLUMES DO NOT INCLUDE HOV TRAFFIC.

LEGEND

LEVEL OF SERVICE

A	B	C	D	E	F

xxx - 2035 PM Peak Hour Projected

MATCH LINE
See Sheet 5 of 6

Westbound Frontage Rd
Hayden Rd Entrance Ramp
Scottsdale Rd Entrance Ramp
Scottsdale Rd Exit Ramp
Hayden Rd Exit Ramp
Westbound SR 101L Mainline
Princess Dr Entrance Ramp
Pima Freeway
LOOP 101
Scottsdale Rd Exit Ramp
Scottsdale Rd Entrance Ramp
Eastbound SR 101L Mainline
Future Miller Rd
Hayden Rd Exit Ramp
Hayden Rd Entrance Ramp
Hayden Rd
Princess Dr Exit Ramp
Princess Dr

1590 7170 1210 8350 880 7410 1120 8530 1250 7420 950 5190
1570 5130 1140 6250 790 5400 620 6030

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11/24/2015

SR 101L
I-17 to Princess Drive

AECOM

ON THE MOVE
PARTNERS IN PROGRESS

NOT TO SCALE - SCHEMATIC ONLY

FIGURE 12
PREFERRED ALTERNATIVE
2035 PM PEAK HOUR LEVEL OF SERVICE
SHEET 6 OF 6

2.5 ALTERNATIVE D AND ALTERNATIVE E TRAFFIC REDISTRIBUTION AND SERVICE INTERCHANGE ANALYSIS

2.5.1 Description

Alternative D and Alternative E would remove the existing 19th Avenue TI ramps (to/from the east). The removal of the 19th Avenue TI ramps would require the ramp traffic to re-route their trips to the adjacent interchanges, or utilize the eastbound and westbound frontage roads to access the 7th Avenue TI. Therefore, operational analyses were conducted to evaluate the impact of redistributed traffic on the 19th Avenue, 15th Avenue, and 7th Avenue signalized intersections. Based on the trends provided from the MAG model output and engineering judgment, the traffic from the ramps would be re-routed as follows:

- Eastbound 19th Avenue Entrance Ramp
  - Approximately 10% of the ramp traffic would utilize the arterial street system and enter the freeway prior to the 27th Avenue TI
  - Approximately 5% of the ramp traffic would utilize the arterial street system and enter the freeway at the 27th Avenue TI
  - Approximately 60% of the ramp traffic would utilize the arterial street system or the frontage road and enter the freeway at the 7th Avenue TI
  - Approximately 15% of the ramp traffic would utilize the arterial street system and enter the freeway east of the 7th Avenue TI
  - Approximately 10% of the ramp traffic would utilize the arterial street system and enter the freeway at some other location
- Westbound 19th Avenue Exit Ramp
  - Approximately 15% of the ramp traffic would exit the freeway prior to the 7th Avenue TI and utilize the arterial street system or the frontage road
  - Approximately 60% of the ramp traffic would exit the freeway at the 7th Avenue TI and utilize the arterial street system or the frontage road
  - Approximately 5% of the ramp traffic would exit the freeway at the 27th Avenue TI and utilize the arterial street system
  - Approximately 10% of the ramp traffic would exit the freeway west of the 27th Avenue TI and utilize the arterial street system
  - Approximately 10% of the ramp traffic would exit the freeway at some other location and utilize the arterial street system

Alternatives D and E are anticipated to have the same traffic redistribution and effect at the interchanges, so only one analysis was conducted to represent both of these alternatives.

2.5.2 Analysis Results

Traffic operational analyses were conducted using the Synchro computer program to evaluate the level-of-service (LOS) that would be provided for the Existing Conditions, the No-Build Conditions, the Preferred Alternative, and Alternatives D and E. The peak hour traffic volumes for this analysis were based on the 2035 traffic volume projections obtained from MAG as described in Section 2.4.1

2.5.2.1 Existing Conditions

The lane configurations and A.M. and P.M. peak hour traffic volumes for the Existing Conditions (2012) are depicted in Figure 13 (page 104). The results of the analysis are shown in Table 22 and indicate congestion is occurring at the following locations:

- A.M. Peak Hour
  - One approach to the 19th Avenue TI
  - One approach to the 7th Avenue TI

- P.M. Peak Hour
  - The overall 19th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

Congestion is currently occurring at the 19th Avenue and 7th Avenue TI's corridor during the A.M. and P.M. peak travel periods.

2.5.2.2 No-Build Conditions

The No-Build Alternative lane configurations and 2035 A.M. and P.M. peak hour traffic volume projections are shown in Figure 14 (page 105). The results of the analysis are shown in Table 22 and indicate that congestion would occur at the following locations:

- A.M. Peak Hour
  - The overall 19th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

- P.M. Peak Hour
  - The overall 19th Avenue TI
  - The overall 7th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

The projected growth in travel demand at the interchanges will result in increased congestion at the 19th Avenue and 7th Avenue TI's in the A.M. and P.M. peak travel periods.

2.5.3.2 Preferred Alternative

The Preferred Alternative lane configurations and 2035 A.M. and P.M. peak hour traffic volume projections are shown in Figure 15 (page 106). The results of the analysis are shown in Table 22 and indicate that congestion would occur at the following locations:

- A.M. Peak Hour
  - The overall 19th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

- P.M. Peak Hour
  - The overall 19th Avenue TI
  - The overall 7th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

The operational results for the Preferred Alternative are very similar to the No-Build Alternative since no improvements are planned at the 19th Avenue TI, the 15th Avenue intersections, or the 7th Avenue TI.

2.5.4.2 Alternatives D and E

The Alternatives D and E lane configurations and 2035 A.M. and P.M. peak hour traffic volume projections are shown in Figure 16 (page 107). The results of the analysis are shown in Table 22 and indicate that congestion would occur at the following locations:

- A.M. Peak Hour
  - The overall 7th Avenue TI
  - Two approaches to the 7th Avenue TI

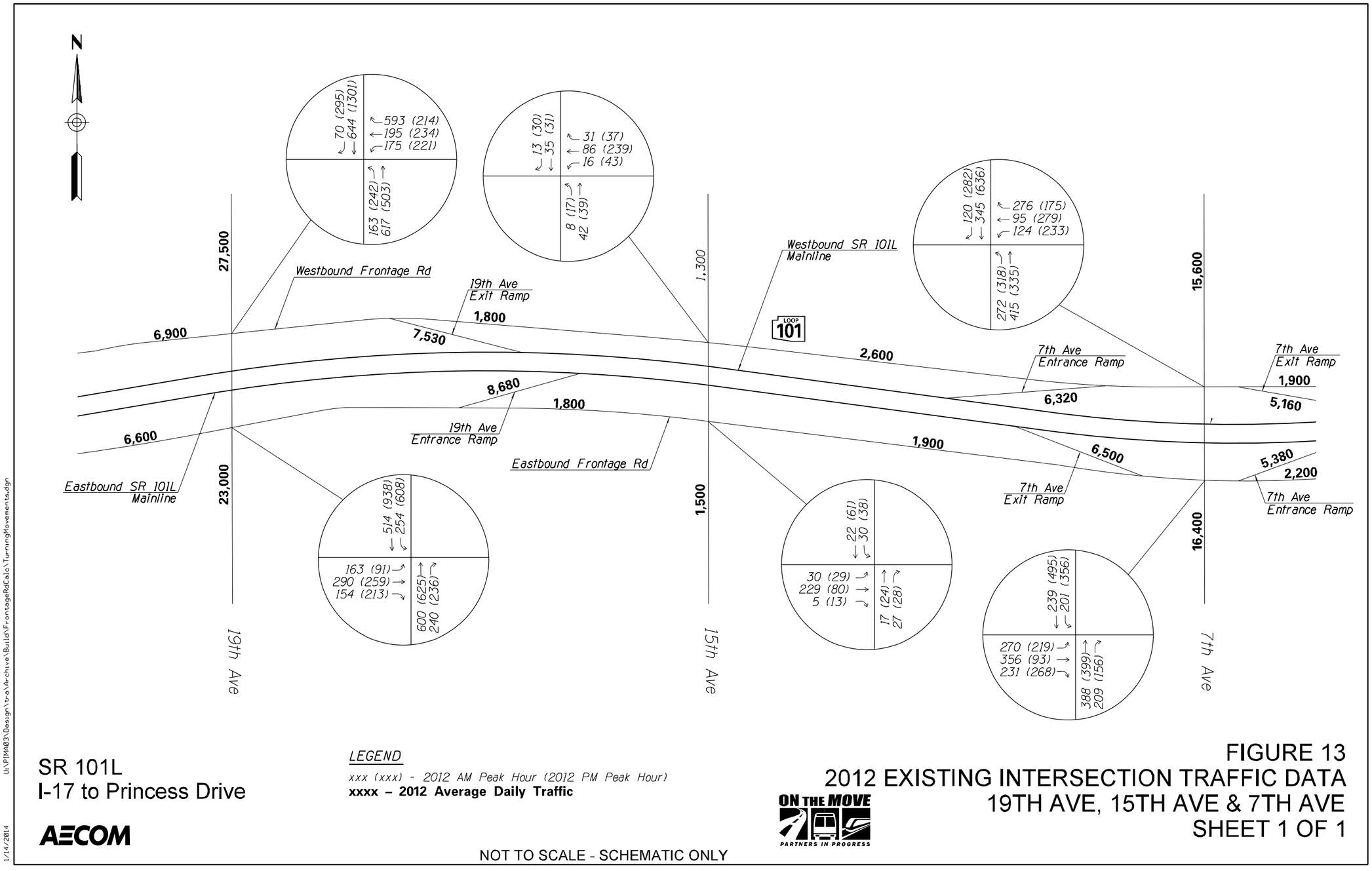
- P.M. Peak Hour
  - The overall 7th Avenue TI
  - One approach to the 19th Avenue TI
  - Two approaches to the 7th Avenue TI

The removal of the ramps at the 19th Avenue TI would result in the redistribution of traffic that would improve the operations of the 19th Avenue TI in the A.M. and P.M. peak travel periods. However, the redistribution of traffic would result in significantly increased congestion in the A.M. and P.M. peak travel periods at the 7th Avenue TI.

Table 22 – Traffic Interchange Analysis Results

Location	Existing Conditions	2035 No-Build	2035 Preferred Alternative	2035 Alternatives D and E
19th Avenue TI – A.M. Peak Hour				
Avg TI Delay (sec/veh)	51.1	54.6	55.0	40.7
Overall TI LOS	D	E	E	D
No. of approaches at LOS E or F	1	1	1	0
19th Avenue TI – P.M. Peak Hour				
Avg TI Delay (sec/veh)	67.3	161.8	166.4	48.4
Overall TI LOS	E	F	F	D
No. of approaches at LOS E or F	1	1	1	1
15th Avenue TI – A.M. Peak Hour				
Avg TI Delay (sec/veh)	34.9	34.4	34.8	34.4
Overall TI LOS	C	C	C	C
No. of approaches at LOS E or F	0	0	0	0
15th Avenue TI – P.M. Peak Hour				
Avg TI Delay (sec/veh)	35.7	35.0	35.4	35.1
Overall TI LOS	D	D	D	D
No. of approaches at LOS E or F	0	0	0	0
7th Avenue TI – A.M. Peak Hour.				
Avg TI Delay (sec/veh)	44.4	44.3	45.0	55.6
Overall TI LOS	D	D	D	E
No. of approaches at LOS E or F	1	2	2	2
7th Avenue TI – P.M. Peak Hour				
Avg TI Delay (sec/veh)	50.8	61.3	71.4	135.1
Overall TI LOS	D	E	E	F
No. of approaches at LOS E or F	2	2	2	2

(Text resumes on page 108)



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1/14/2014

SR 101L
I-17 to Princess Drive

AECOM

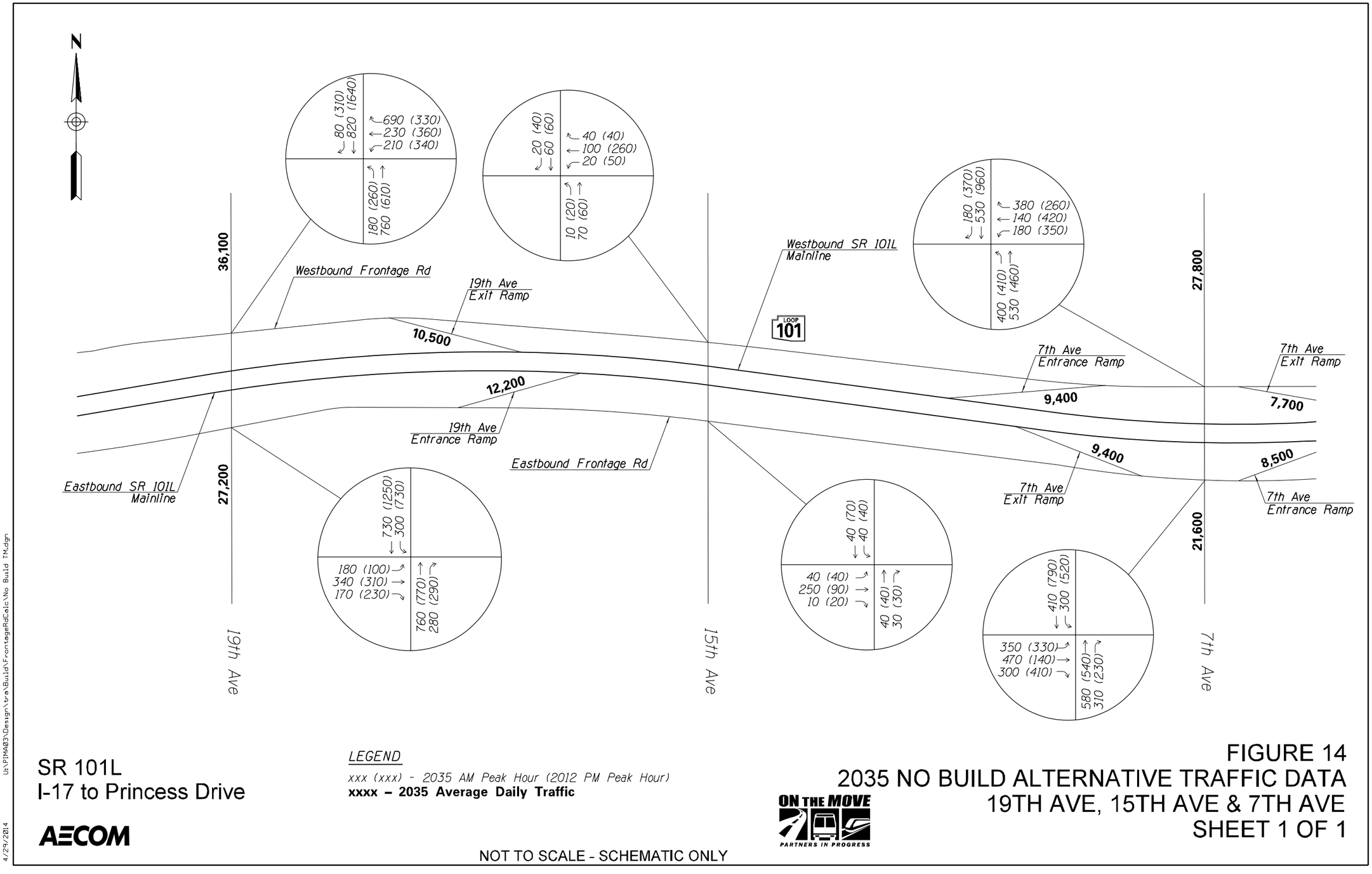
LEGEND

xxx (xxx) - 2012 AM Peak Hour (2012 PM Peak Hour)
xxxx – 2012 Average Daily Traffic

ON THE MOVE
PARTNERS IN PROGRESS

NOT TO SCALE - SCHEMATIC ONLY

FIGURE 13
2012 EXISTING INTERSECTION TRAFFIC DATA
19TH AVE, 15TH AVE & 7TH AVE
SHEET 1 OF 1



SR 101L
I-17 to Princess Drive

AECOM

LEGEND

xxx (xxx) - 2035 AM Peak Hour (2012 PM Peak Hour)
xxxx – 2035 Average Daily Traffic

ON THE MOVE
PARTNERS IN PROGRESS

NOT TO SCALE - SCHEMATIC ONLY

FIGURE 14
2035 NO BUILD ALTERNATIVE TRAFFIC DATA
19TH AVE, 15TH AVE & 7TH AVE
SHEET 1 OF 1

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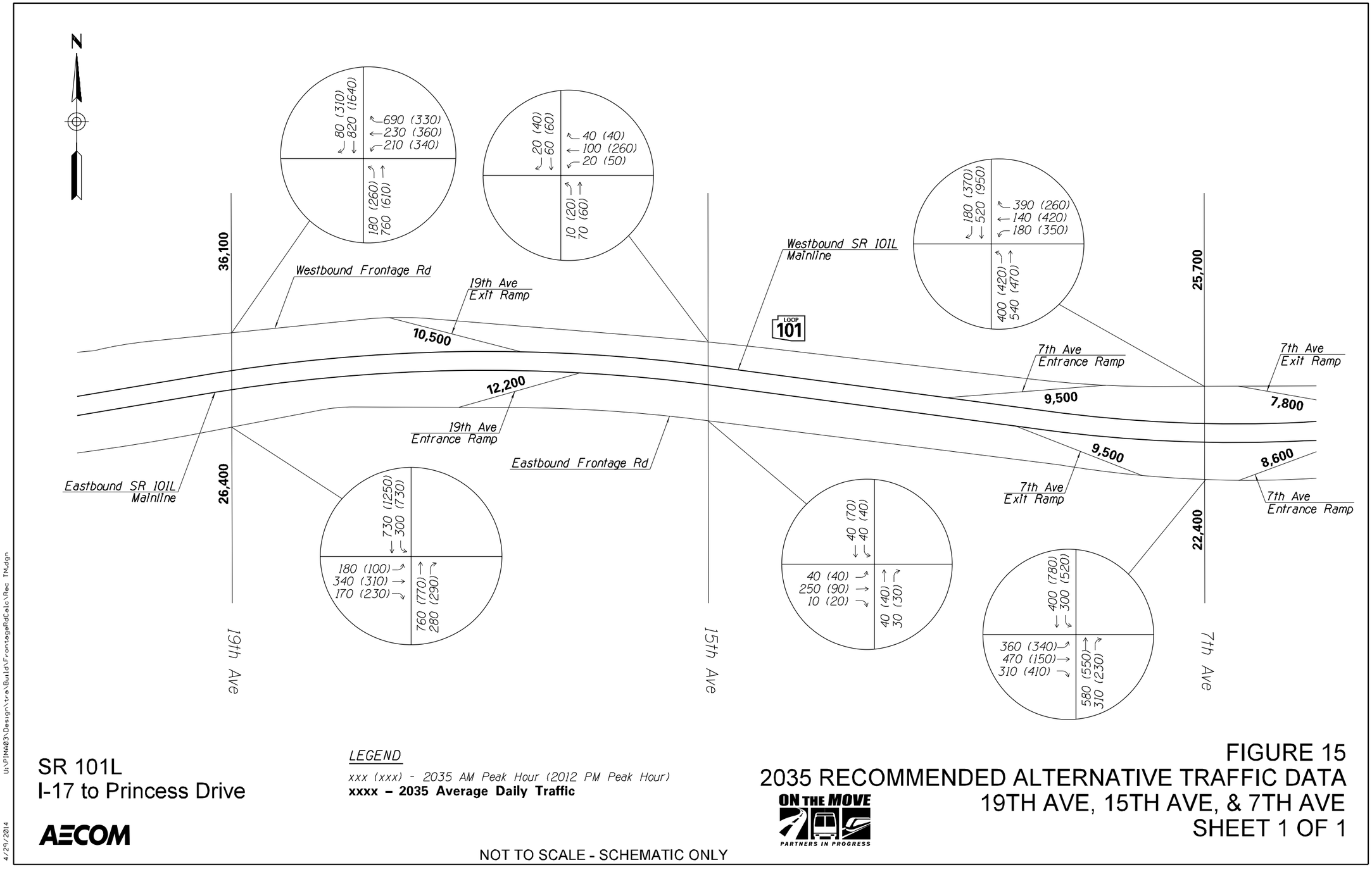

SR 101L
I-17 to Princess Drive

AECOM

LEGEND

xxx (xxx) - 2035 AM Peak Hour (2012 PM Peak Hour)
xxxx – 2035 Average Daily Traffic

ON THE MOVE
PARTNERS IN PROGRESS

FIGURE 15
2035 RECOMMENDED ALTERNATIVE TRAFFIC DATA
19TH AVE, 15TH AVE, & 7TH AVE
SHEET 1 OF 1

NOT TO SCALE - SCHEMATIC ONLY

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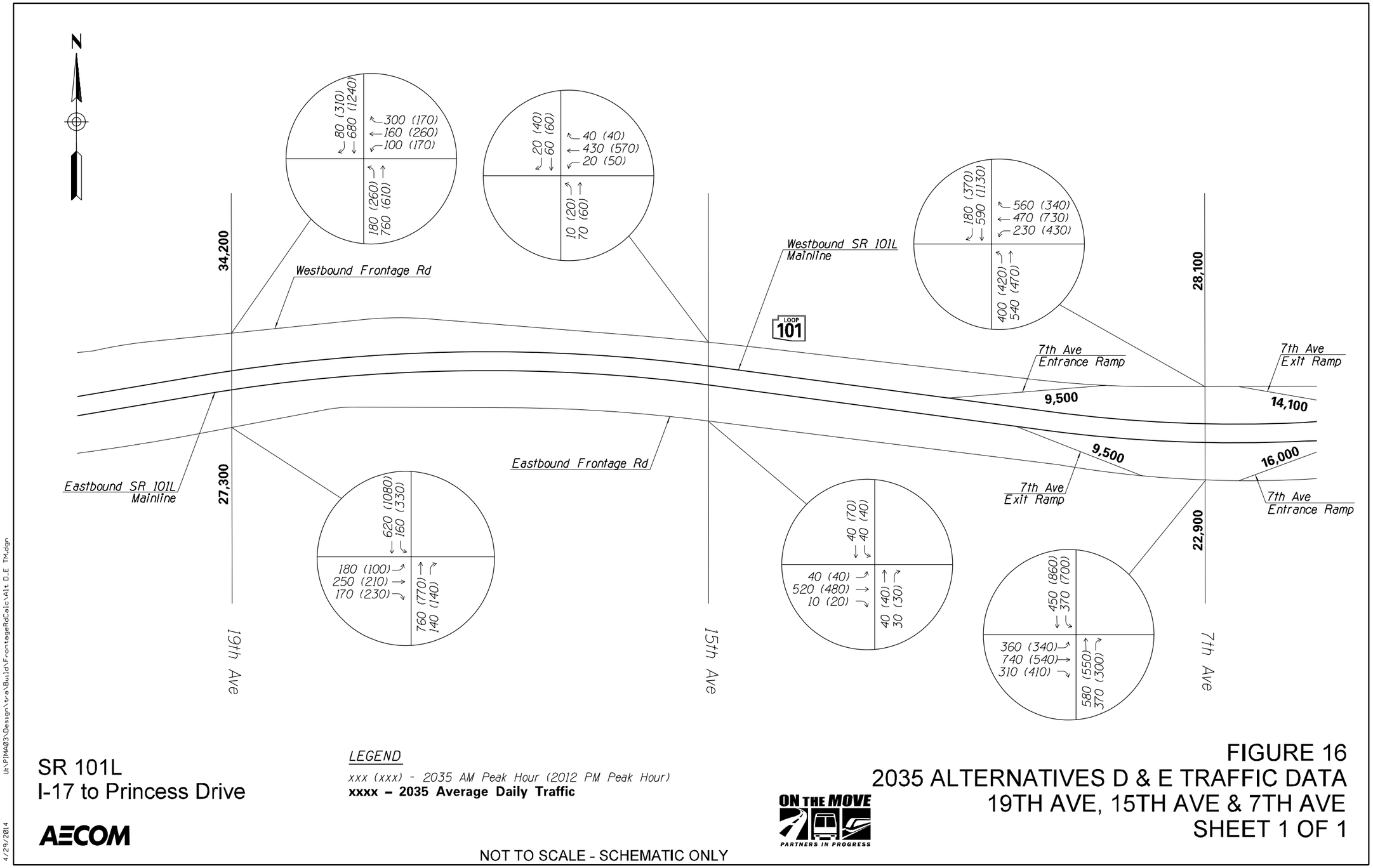

SR 101L
I-17 to Princess Drive

AECOM

LEGEND

xxx (xxx) - 2035 AM Peak Hour (2012 PM Peak Hour)
xxxx – 2035 Average Daily Traffic

ON THE MOVE
PARTNERS IN PROGRESS

FIGURE 16
2035 ALTERNATIVES D & E TRAFFIC DATA
19TH AVE, 15TH AVE & 7TH AVE
SHEET 1 OF 1

NOT TO SCALE - SCHEMATIC ONLY

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2.6 PROJECT IMPLEMENTATION EVALUATION

2.6.1 Description of Alternatives

ADOT recently completed a project to restripe the eastbound SR 101L mainline from 17th Avenue to 7th Avenue to provide one HOV lane, two general-purpose lanes, and two "add-lanes" from I-17/SR51 Ramp 'S-E/N-E' entrance. The 19th Avenue entrance ramp (1 lane) was designed with a parallel entrance configuration that transitions to an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit was configured as a mandatory exit from the auxiliary lane. The number of general-purpose lanes transition from four lanes to three lanes with an AASHTO lane-drop that occurs prior to the 7th Avenue entrance ramp gore.

An operational sensitivity analysis was conducted to estimate the year that these improvements would be expected to experience congestion. This evaluation would allow the project team to determine if a near-term roadway spot-improvement strategy could be implemented that could defer the need for the ultimate improvements identified with the Preferred Alternative.

In addition, a scenario was developed that would implement the Preferred Alternative for the segment of SR 101L between I-17 and SR 51, in conjunction with the No-Build Alternative for the segment of SR 101L between SR 51 and Princess Drive.

2.6.2 Operational Analysis

Traffic operational analyses were conducted using the CORSIM traffic simulation computer program following the methodology as described in Section 2.4.

2.6.2.1 Eastbound SR 101L Congestion Sensitivity Analysis to I-17

The results of the analysis indicated the recent striping modifications would reduce the congestion on the eastbound SR 101L mainline (and the directional ramps) between I-17 and 7th Street in the near term. However, congestion (LOS 'E' or 'F') would still occur on the eastbound SR 101L mainline between 7th Street and the Cave Creek Road TI exit ramp (see Appendix G).

Anticipated traffic growth would cause the eastbound SR 101L mainline to operate at level-of-service (LOS) 'F' between I-17 and the Cave Creek Road TI exit ramp by 2017. The addition of an auxiliary lane between the 7th Street entrance ramp and the Cave Creek Road exit ramp would improve the congested area to LOS 'E', with vehicle queuing that would extend between 7th Avenue and the Cave Creek Road TI exit ramp.

Based upon this evaluation, the improvements identified with the Preferred Alternative should be implemented as currently identified in the RTPFP.

2.6.2.2 Preferred Alternative (I-17 to SR 51) and No-Build (SR 51 - Princess Drive) Scenario

The Year 2035 traffic volume projections, lane diagrams, and level-of-service analysis results for the A.M. and P.M. peak hours are provided in Appendix G. The results of the analysis indicate significant congestion would occur on the SR 101L mainline at the following locations:

- A.M. Peak Hour:
  - Eastbound SR 101L mainline from the Cave Creek Road entrance ramp to the 64th Street entrance ramp
  - SR51/SR101L TI Ramp 'E-S'
  - SR51/SR101L TI Ramp 'N-E'

- P.M. Peak Hour:
  - Westbound SR 101L mainline from the SR51/SR101L TI Ramp 'W-S' exit to Princess Drive
  - SR51/SR101L TI Ramp 'E-S'

The analysis results reveal the proposed improvements identified with the Preferred Alternative are warranted in accordance with the projects identified within the RTPFP.

2.6.3 Summary and Recommendation

Both of the analysis indicate the SR 101L widening should be constructed in a manner that includes all of the roadway improvements identified with the Preferred Alternative.

2.7 EVALUATION OF RAMP METER QUEUE LENGTHS

2.7.1 Analysis Methodology

ADOT's Transportation Technology Group (TTG) recently published their *Ramp Metering Design Guide* (November 2013) which provides guidance to determine the vehicle storage length required on freeway entrance ramps in advance of ramp meters.
.
In accordance with the *Ramp Metering Design Guide* two ramp meter warrants must be met in order to justify the installation of a ramp meter, which include the following:

1. Freeway Right-lane and Entrance Ramp Flow Rate: During a typical 15-minute period, the combined flow rate of the entrance ramp and the right-most freeway lane is greater than 2,050 vehicles per hour; and during the same period the entrance ramp flow rate is greater than 400 vehicles per hour.
2. Freeway Speed: During a typical 15-minute period the vehicle speed within the freeway general-purpose lanes (not including HOV, auxiliary, and entrance ramp lanes) is less than 50 mph due to recurring congestion adjacent to or within 2 miles downstream of the entrance ramp.

Per the *Ramp Metering Design Guide*, the ramp meter vehicle storage distance is calculated as follows:

$$Queue = \left[\frac{(Rate_{ramp} - Rate_{meter}) \times Time \times \left(L_{car}\left(1 - \frac{T}{100}\right) + L_{trucks}\left(\frac{T}{100}\right)\right)}{Lanes}\right]$$

Where,

$Queue$: Queue storage distance (ft)
$Rate_{ramp}$: Entrance ramp design flow rate (vph).
$Rate_{meter}$: Design metering rate (vph) (840 vph is the typical design value)
Time: Design period that ramp metering operates at design metering rate (hour) (0.5 hr is the typical design value)
Lanes: Number of metered lanes
L_{car}: Average car plus gap length (ft/veh) (28 ft/veh is the typical design value)
L_{Truck}: Average truck plus gap length (ft/veh) (75 ft/veh is the typical design value)
T: Percentage of trucks in entrance ramp traffic (percent) (2% trucks may be used as a typical design value)

2.7.2 Analysis Results

Since all of the entrance ramps within the study area include a ramp meter, a ramp meter warrant analysis was not conducted for this project.

The ramp meter queue length evaluation was conducted for each entrance ramp along the SR 101L corridor using the 2035 Design Year peak hour volumes. The results of the analysis for each entrance ramp is shown in Tables 23 and 24.

Table 23 – Eastbound Entrance Ramp Meter Storage Length Calculations

Ramp	2035 Volume (vph)		% Trucks	No. of Lanes	Meter Rate (vph)	A.M. Peak Calculated Queue Length (ft)	P.M. Peak Calculated Queue Length (ft)
	A.M.	P.M.					
19th Avenue	650	1,050	2.0%	2	1,200	400	400
7th Avenue	770	690	2.0%	2	1,200	400	400
7th Street	1,040	800	2.0%	2	1,200	400	400
Cave Creek Road	1,490	1,090	2.0%	2	1,200	2,098	400
Tatum Boulevard	1,300	950	2.0%	2	1,200	724	400
56th Street	970	860	2.0%	2	1,200	400	400
64th Street	800	680	2.0%	2	1,200	400	400
Scottsdale Road	1,290	1,140	2.0%	2	1,200	651	400
Hayden Road	810	620	2.0%	2	1,200	400	400

Note: Queue lengths shown are per lane

2.7.3 Recommendations

The results of this analysis indicate three of the entrance ramps locations would not meet ramp meter storage length requirements. It is recommended the ramp meter timing be evaluated during final design, and that the ramps be monitored by the Traffic Operations Center to adjust the meter timing as the traffic demand varies over time.

Table 24 – Westbound Entrance Ramp Meter Storage Length Calculations

Ramp	2035 Volume (vph)		% Trucks	No. of Lanes	Meter Rate (vph)	A.M. Peak Calculated Queue Length (ft)	P.M. Peak Calculated Queue Length (ft)
	A.M.	P.M.					
Princess Drive	970	1,250	2.0%	2	1,200	400	400
Hayden Road	690	880	2.0%	2	1,200	400	400
Scottsdale Road	1,270	1,590	2.0%	2	1,200	506	2,822
64th Street	630	810	2.0%	2	1,200	400	400
56th Street	730	800	2.0%	2	1,200	400	400
Tatum Boulevard	1,550	1,700	2.0%	2	1,200	2,532	3,618
Cave Creek Road	1,220	1,310	2.0%	2	1,200	400	796
7th Street	810	1,020	2.0%	2	1,200	400	400
7th Avenue	670	860	2.0%	2	1,200	400	400

Note: Queue lengths shown are per lane

2.8 19TH AVENUE – 7TH AVENUE SAFETY ASSESSMENT

2.8.1. Introduction

A safety assessment was conducted to develop and evaluate predictive crash results for the Preferred Alternative and Alternative 'E' (removal of 19th Avenue ramps) along with the No-Build Alternative. The goal of this evaluation was to determine if retaining the 19th Avenue east ramps would introduce additional safety concerns between 19th Avenue and 7th Avenue.

2.8.2 Analysis Methodology

This safety assessment applies the predictive methods of the *Highway Safety Manual* (HSM) (AASHTO, 2010). The Enhanced Interchange Safety Analysis Tool (ISATe), Build 06.10 was used to conduct this safety assessment, which implements the crash prediction methodology and procedures of the HSM to evaluate safety and operational effects of highways based on geometric factors. Default crash modification factors (CMFs) coded into the software were used to output the predictive crash results for this analysis. There were no adjustments made to any crash modification factors or outputs.

To compare the predictive crash results of the Preferred Alternative and Alternative 'E' to the No-Build conditions, the crash prediction methodology was first applied to the No-Build Condition. Design measurements were made for the No-Build Condition from existing topographic information and coded into the No-Build Condition model. Geometric factors between mile posts (MP) 24.15 (SR 101L directional ramps to/from I-17) to 24.85 (7th Avenue west ramps) were collected for a total study area of 0.70 miles for both directions of travel.

Inputs for the Preferred Alternative and Alternative 'E' included full median shoulder widths, 12' outside shoulder widths, 12' general-purpose and HOV lanes, and 22' median widths. Horizontal alignment data was obtained from the roadway design plans, and a total of one horizontal curve was included into the model. Vertical alignment information was not used for this analysis.

The area type is Urban Freeway. Crash information obtained from the ADOT Traffic Studies Section was input into the model for years 2006-2010. The ISATe software is capable of projecting crash prediction information up to 15 years in the future. Therefore the analysis period for the alternatives is from Year 2015 to Year 2029. Historical AADT volumes from years 2006 to 2010 were obtained from ADOT's Multimodal Planning Division (MPD), as well as projected AADT volumes obtained from the Maricopa Association of Governments (MAG) regional traffic forecasting model (for year 2025) were coded into the ISATe software.

2.8.3 Analysis Results

The Enhanced Interchange Safety Analysis Tool software uses crash prediction methodology to output expected crashes per year, based on severity. The expected crash outputs are included in Table 25. A comparison of the Preferred Alternative and Alternative 'E' to the No-Build Condition is made in the right two columns of the table.

Table 25 – Predicted Crash Data

Crash Severity	Number of Crashes	Improvement from No-Build Condition	
		Percentage	Number
No-Build Condition			
Expected Fatal Crashes (K)	7.3	-	-
Expected Incapacitating Injury (A)	16.5	-	-
Expected Non-Incapacitating Injury (B)	113.0	-	-
Expected Possible Injury (C)	214.1	-	-
Property Damage Only (PDO)	1178.7	-	-
Total Crashes	1529.6	-	-
Preferred Alternative			
Expected Fatal Crashes (K)	5.2	28.77%	2.1
Expected Incapacitating Injury (A)	14.2	13.94%	2.3
Expected Non-Incapacitating Injury (B)	95.5	15.49%	17.5
Expected Possible Injury (C)	194.3	9.25%	19.8
Property Damage Only (PDO)	1090.8	7.46%	87.9
Total Crashes	1400.0	8.47%	129.6
Alternative E			
Expected Fatal Crashes (K)	5.1	30.14%	2.2
Expected Incapacitating Injury (A)	14	15.15%	2.5
Expected Non-Incapacitating Injury (B)	93.9	16.90%	19.1
Expected Possible Injury (C)	190.9	10.84%	23.2
Property Damage Only (PDO)	1070.7	9.16%	108.0
Total Crashes	1374.6	10.13%	155.0

Under the No-Build Condition, there could be approximately 1,529.6 crashes expected using the crash prediction methodology that include 7.3 fatal crashes and 16.5 incapacitating injury crashes.

The Preferred Alternative and Alternative 'E' both show a significant and nearly equivalent improvement in predicted crashes when compared to the No-Build Condition. The Preferred Alternative predicts a total of 1,400.0 crashes with only 5.2 fatal crashes and 14.2 incapacitating injury crashes. Alternative 'E' predicts a total of 1,374.6 crashes with only 5.1 fatal crashes and 14 incapacitating injury crashes.

In comparing the total number of crashes of the Preferred Alternative and Alternative 'E' to the No-Build Condition, the Preferred Alternative would provide an 8.47% reduction in total crashes and Alternative 'E' would provide a 10.13% reduction in total crashes

Retaining the east 19th Avenue TI ramps in the Preferred Alternative appears to provide nearly equal predicted crash results as in Alternative 'E'. Any additional crashes that result from maintaining the 19th Avenue access ramps appear to be very minor in severity that would not warrant the removal of the ramp connections to the arterial street system.

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3.0 DESIGN CONCEPT ALTERNATIVES AND SCREENING

3.1 INTRODUCTION

Design concepts were developed to provide one additional general-purpose lane in each direction on the SR 101L mainline between the I-17/SR101L TI and the SR51/SR101L TI, and between the SR51/SR101L TI and Princess Drive. The alternatives were developed to conform to the adopted regional transportation plans, improve traffic operational performance, achieve engineering design standards, minimize right-of-way acquisition and utility impacts, minimize environmental impacts, minimize project costs and obtain local agency and public support.

Public agencies that have been involved in the alternative development and evaluation process include ADOT, FHWA, MAG, CAWCD, BOR and the cities of Phoenix and Scottsdale.

3.2 EVALUATION CRITERIA

Six evaluation criteria were developed to evaluate the Build and No-Build Alternatives for the widening of SR 101L. Each of the evaluation criteria is described as follows:

- Conformance with Adopted Regional Transportation Plans: This criterion evaluated the ability of the alternatives to achieve the goals and objectives of the RTPFP.
- Traffic Operational Performance: The alternatives must provide a benefit to the operational performance and level-of-service of the SR 101L mainline within the study area. The SR 101L general-purpose lanes and auxiliary lanes should provide level-of-service (LOS) 'D' or better operational characteristics based on Design Year 2035 traffic volume projections provided by MAG.
- Ability to Achieve Engineering Standards: The alternatives must achieve AASHTO and ADOT geometric design standards to optimize highway safety and operational characteristics and minimize owner liability. AASHTO and ADOT geometric design standards are mandatory, unless a formal AASHTO design exception can be obtained from the FHWA, or an ADOT design variance can be obtained from ADOT's Roadway Group.
- Right-of-Way Requirements and Utility Impacts: The alternatives should minimize the need for new right-of-way and potential conflicts with existing public utilities.
- Environmental Considerations: This criterion evaluated the alternatives for its social and economic considerations, amount of disturbance to developed areas and vegetation, potential noise and air quality impacts, potential changes in visual character and quality, potential impacts to cultural and biological resources and hazardous materials issues. No environmental fatal-flaw issues should be identified that could not be mitigated with the project.
- Total Estimated Project Cost: The SR 101L widening alternatives operational and geometric design characteristics must be achieved in the most cost effective manner to obtain the necessary funding for the facility.
- Agency and Public Acceptance: The ability of the alternatives to obtain local agency and public acceptance is vital for project implementation.

3.3 DESIGN CONCEPT ALTERNATIVES CONSIDERED

3.3.1 Introduction

Six freeway widening alternatives were developed for SR 101L based on the features required to meet the operational goals for the projected traffic volumes and anticipated travel patterns. The SR 101L Widening Alternatives include the following:

- No-Build Alternative
- Alternative A: SR 101L Widening Alternative
  - Would provide one additional general-purpose lane in each direction between 7th Avenue and Princess Drive
  - Would prioritize the number of eastbound SR 101L mainline lanes (3 lanes) over the number of Ramp 'S-E/N-E' directional ramp lanes (1 lane) departing the I-17/SR101L TI
- Alternative B: SR 101L Widening Alternative
  - Would provide one additional general-purpose lane in each direction between 7th Avenue and Princess Drive
  - Would prioritize the number of I-17/SR101L TI eastbound directional ramp lanes (2 lanes) over the number of SR 101L mainline (2 lanes) departing the I-17/SR101L TI
- Alternative C: SR 101L Widening Alternative
  - Would provide one additional general-purpose lane in each direction between 7th Avenue and Princess Drive
  - Would provide all of the needed eastbound mainline general-purpose (3 lanes) and directional ramp lanes (2 lanes) departing the I-17/SR101L TI
- Alternative D: SR 101L Widening Alternative
  - Would provide one additional general-purpose lane in each direction between 7th Avenue and Princess Drive
  - Would provide all of the needed eastbound mainline general-purpose (3 lanes) and directional ramp lanes (2 lanes) departing the I-17/SR101L TI
  - Would remove the 19th Avenue TI ramps (to/from the east) from service
- Alternative E: SR 101L Widening Alternative
  - Would provide one additional general-purpose lane in each direction between 7th Avenue and Princess Drive
  - Would provide all of the needed eastbound mainline general-purpose (3 lanes) and directional ramp lanes (2 lanes) departing the I-17/SR101L TI
  - Would remove the 19th Avenue TI ramps (to/from the east) from service
  - Would revise 7th Avenue eastbound exit to a tapered exit configuration

Numerous design options were also evaluated for each alternative, particularly within the area between the I-17/SR101L TI and 7th Avenue. Each of the design options that were developed and evaluated within this area focused on the SR 101L mainline and I-17/SR101L TI directional ramp lane configurations approaching and departing the system interchange (to/from the east).

No changes would be proposed to the existing SR 101L mainline horizontal and vertical alignments. SR 101L would be widened to provide the additional mainline general-purpose and auxiliary lanes, and realign the existing service interchange ramps to coincide with the widened

mainline pavement. The existing roadway would generally be widened to provide a continuous 10' median shoulder, 12' HOV lane, 12' general-purpose and auxiliary lanes, and a 12' outside shoulder.

Each alternative would retain the existing HOV lanes to encourage carpooling and support the existing and planned Bus Rapid Transit (BRT) and express bus routes that use the HOV lanes.

This section of the report is divided into the specific freeway segments where various design options were evaluated for each alternative, which includes the following: the I-17/SR101L TI to 7th Avenue; 7th Avenue to 7th Street; 7th Street to Cave Creek Road; Cave Creek Road to the SR51/SR101L TI; the SR51/SR101L TI to Tatum Boulevard; and Tatum Boulevard to Princess Drive.

3.3.2 No-Build Alternative

The No-Build Alternative would not result in any of the improvements identified in the RTPFP. The current congested freeway conditions would be expected to worsen as the traffic demand continues to grow in the future.

3.3.3 Description of Alternatives between the I-17/SR101L TI and 7th Avenue

Five build alternatives with various design options were evaluated for this freeway segment. Each alternative (and design option) focused on the SR 101L mainline and I-17/SR101L TI directional ramp lane configurations approaching and departing the system interchange, and whether the traffic operational performance and geometric design goals could be achieved with/without the reconstruction of the 15th Avenue Underpass.

3.3.3.1 Alternative A (Design Option 1)

Description of Design Option

Alternative A (Design Option 1) is shown on Figure 17 on page 114. The configuration of the existing eastbound SR 101L mainline (three general-purpose lanes and one HOV lane) approaching I-17 would be extended to be continuous between I-17 and 7th Avenue. The 27th Avenue entrance ramp (1 lane) would be designed with a tapered entrance configuration that merges into the outside freeway lane to provide three general-purpose lanes and one HOV lane approaching the I-17/SR101L TI Ramp 'S-E/N-E' gore.

The Ramp 'S-E/N-E' entrance would be reconfigured to merge Ramp 'N-E' (1 lane) with Ramp 'S-E' (1 lane) to develop a one lane ramp that would enter the eastbound SR 101L mainline with a "lane-add" configuration. Four general-purpose lanes and one HOV lane would continue to the east to the 19th Avenue Ramp 'D' gore.

The 19th Avenue Ramp 'D' (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (1 lane) would be designed with a parallel exit configuration as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

Four general-purpose lanes and one HOV lane would be provided on the westbound SR 101L mainline approaching 7th Avenue. The 7th Avenue entrance ramp would be designed as a parallel entrance that transitions into an auxiliary lane that continues to the 19th Avenue exit. The 19th Avenue exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The I-17/SR101L TI Ramp 'W-S/W-N' exit (2 lanes) would remain a mandatory exit from the outside travel lane, and the second lane designed as an optional lane with the SR 101L though movement. Three general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

The horizontal and vertical alignments for the 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be similar to the existing conditions to minimize the reconstruction limits for these ramps. However, the length of the eastbound auxiliary lane would be reduced from 690' to approximately 480'.

The eastbound and westbound frontage roads would generally remain in their current configurations.

Traffic Operational Performance

The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance, and the total length of Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period.

Congestion on the directional ramps would be similar to the congestion experienced after the completion of the recent HOV lanes "design-build" project. The congestion experienced on the directional ramps resulted in the re-striping of the eastbound mainline (to a configuration similar to Alternative B) in 2013.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this alternative. The total estimated order-of-magnitude project cost for this scenario is $11,100,300.

3.3.3.2 Alternative A (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps and the service interchange ramps would be the same as Alternative A (Design Option 1). This design option is shown on Figure 18 on page 115.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to increase the length of the eastbound auxiliary lane to approximately 1,450' (compared to 480' with Design Option 1). The eastbound and westbound frontage roads would generally remain in their current configurations.

Traffic Operational Performance

The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance and the total length of Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this alternative. The total estimated order-of-magnitude project cost for this scenario is $11,382,900.

3.3.3.3 Alternative A (Design Option 3)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps and the service interchange ramps would be the same as Alternative A (Design Options 1 and 2). This design option is depicted on Figure 19 on page 116.

Roadway Geometry

The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to increase the length of the eastbound auxiliary lane to approximately 1,220' (compared to 690' existing conditions). However, the length of the westbound auxiliary lane would be reduced to approximately 815'.

The westbound frontage road would be realigned between approximately 17th Drive and 15th Avenue, and the eastbound frontage road would be realigned between 15th Avenue and 7th Avenue.

Traffic Operational Performance

The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance and the total length of Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The total estimated order-of-magnitude project cost for this scenario is $19,114,500 (excluding right-of-way).

(Text resumes on page 117)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

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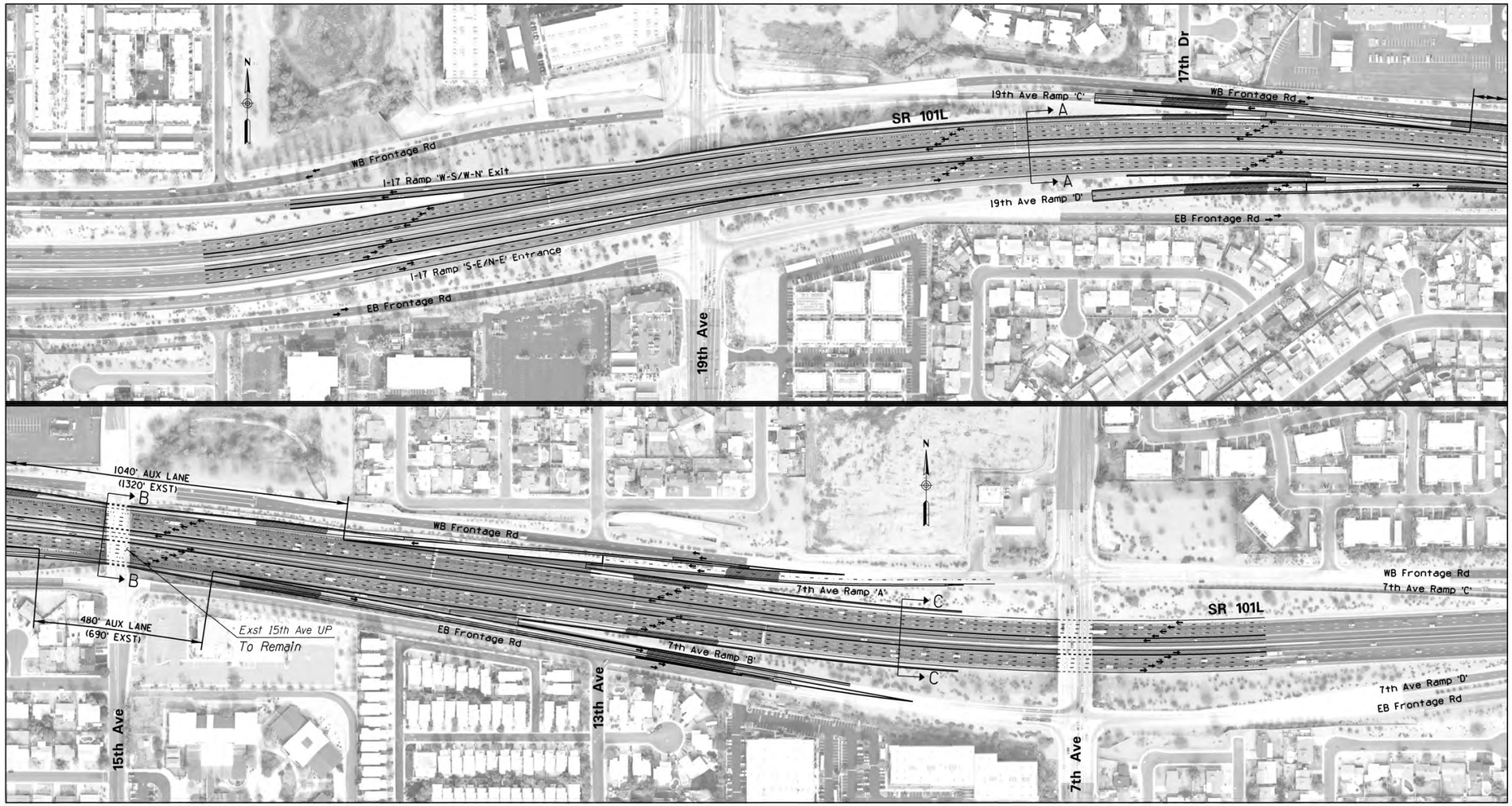

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
Varies 10' to 2' (a Bridge Only) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Aux Lane
10' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 17

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE A
DESIGN OPTION 1

DCR
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DWG NO.
___ OF ___

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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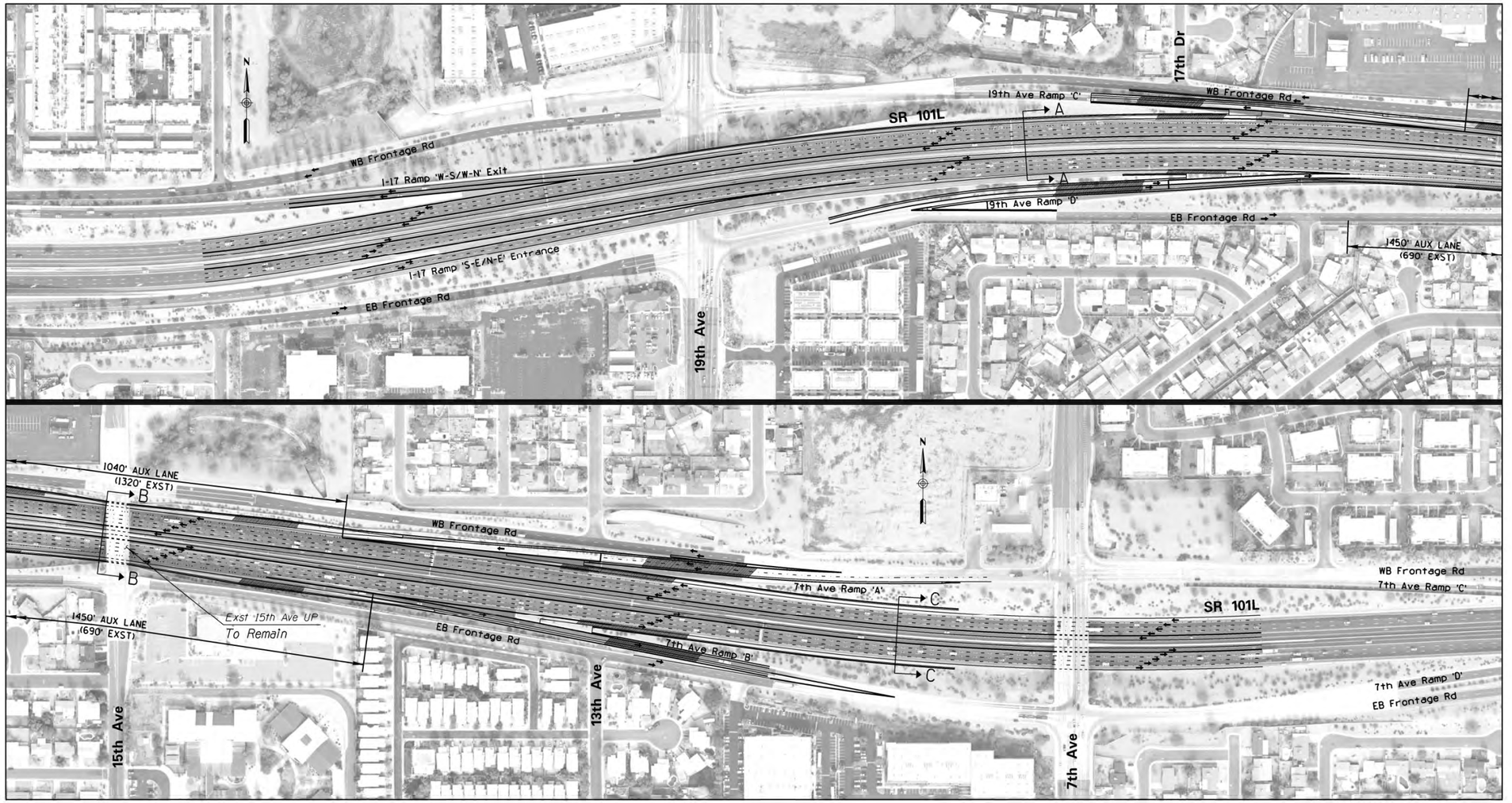
SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE



SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
Varies 10' to 2' (@ Bridge Only) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Aux Lane
10' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 18

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES
I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE A
DESIGN OPTION 2

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DWG NO.
___ OF ___

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE
TRACS NO. H8297 01L

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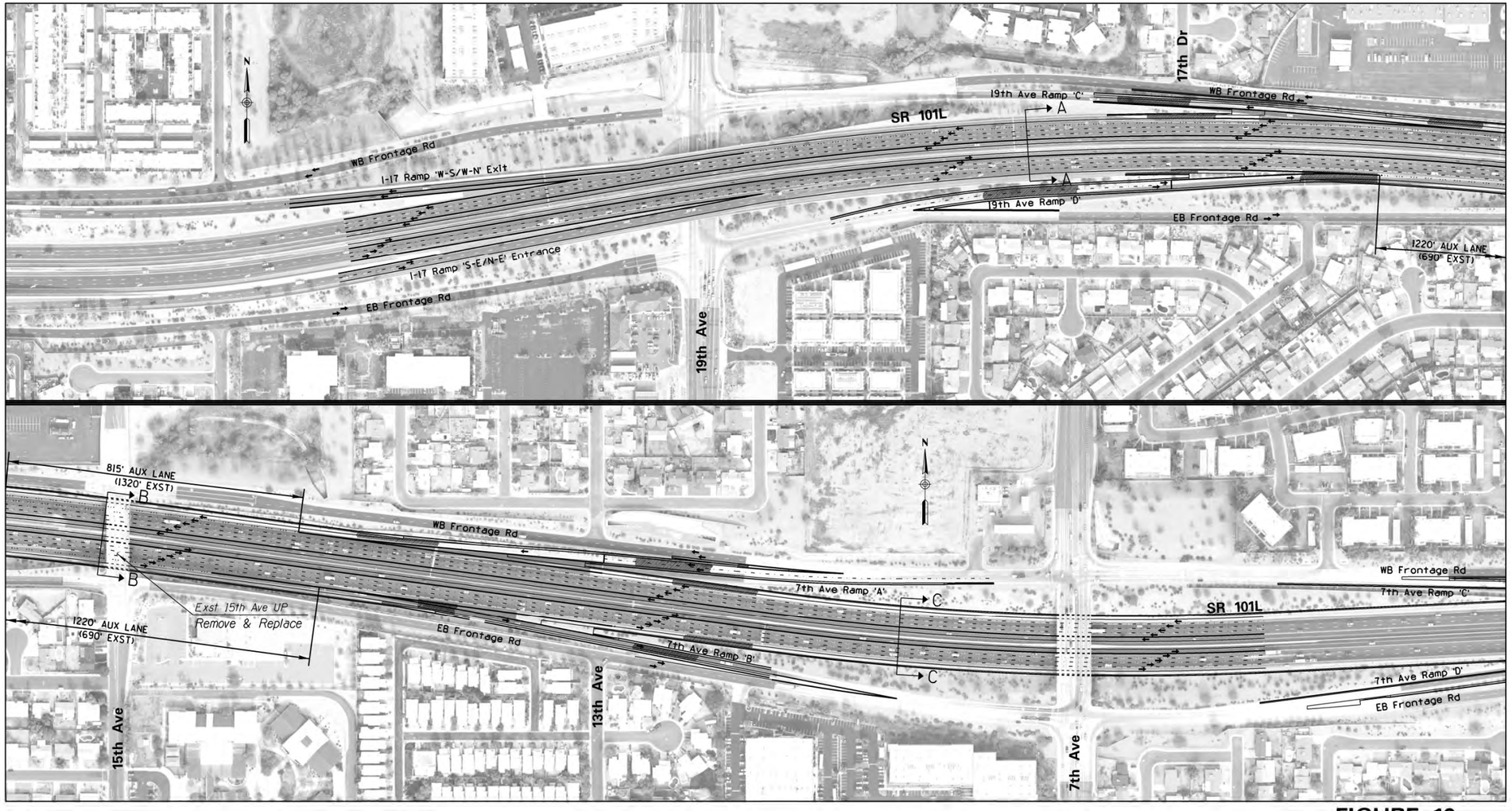

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr (8' @ Bridge Only)
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 19

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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2505 E. Camelback Rd. Suite 200
Phoenix, Arizona 85016
T 602 224 2794
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INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE A
DESIGN OPTION 3

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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DWG NO.
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3.3.3.4 Alternative B (Design Option 1)

Description of Design Option

Alternative B (Design Option 1) is shown on Figure 20 on page 118. The configuration of the existing eastbound SR 101L mainline (three general-purpose lanes and one HOV lane) approaching I-17 would be modified at the I-17/SR101L TI to provide two general-purpose lanes and one HOV lane approaching the Ramp 'S-E/N-E' gore. The Ramp 'S-E/N-E' entrance would be modified to allow each directional ramp lane (2 lanes) to enter the eastbound SR 101L mainline with a "lane-add" configuration (to provide four general-purpose lanes and one HOV lane between the I-17/SR101L TI and 7th Avenue).

The 19th Avenue Ramp 'D' (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (1 lane) would be designed with a parallel exit configuration as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

Four general-purpose lanes and one HOV lane would be provided on the westbound SR 101L mainline approaching 7th Avenue. The 7th Avenue entrance ramp would be designed with a "lane-add" configuration that would continue to the I-17/SR101L TI Ramp 'W-S/W-N' exit. The 19th Avenue westbound exit ramp would be designed with a tapered exit configuration from the outside general-purpose lane.

The I-17/SR101L TI Ramp 'W-S/W-N' exit ramp (2 lanes) would be designed as a mandatory two lane exit from the outside freeway lanes. Three general-purpose lanes and one HOV lane would continue to the west.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to develop additional weaving length for the auxiliary lane. The westbound frontage road (2 lanes) would be realigned between the 19th Avenue Ramp 'C' gore and 15th Avenue to support the conversion of the Ramp 'W-S/W-N" to a two lane mandatory exit configuration. The eastbound frontage road would generally remain in the current configuration.

Traffic Operational Performance

The analysis results indicate significant congestion would occur on the eastbound SR 101L mainline during the A.M. peak travel period. Vehicle queuing would be anticipated to extend to the west from the 19th Avenue entrance ramp well past the I-17/SR101L TI.

The Ramp 'W-S/W-N' reconfiguration into a two lane mandatory exit would improve the level-of-service on the westbound SR 101L mainline approaching the system interchange when compared to Alternative A.

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed along the westbound frontage road between 19th Avenue and 15th Avenue (approximately 0.36 acres) that potentially impact two residences. No fatal flaw environmental issues have been identified with this alternative. The total order-of-magnitude project cost for this scenario is $14,428,600 (excluding right-of-way).

3.3.3.5 Alternative B (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps, and the service interchange ramps would be the same as Alternative B (Design Option 1). This design option is depicted on Figure 21 on page 119.

Roadway Geometry

The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to develop additional weaving length for the auxiliary lane. The westbound frontage road (2 lanes) would be realigned between the 19th Avenue Ramp 'C' gore and 15th Avenue to support the conversion of the Ramp 'W-S/W-N" to a two lane mandatory exit configuration. The eastbound frontage road would generally remain in the current configuration.

Traffic Operational Performance

The analysis results indicate significant congestion would occur on the eastbound SR 101L mainline during the A.M. peak travel period. Vehicle queuing would be anticipated to extend to the west from the 19th Avenue entrance ramp well past the I-17/SR101L TI.

The Ramp 'W-S/W-N' reconfiguration into a two lane mandatory exit would improve the level-of-service on the westbound SR 101L mainline approaching the system interchange when compared to Alternative A.

(Text resumes on page 120)

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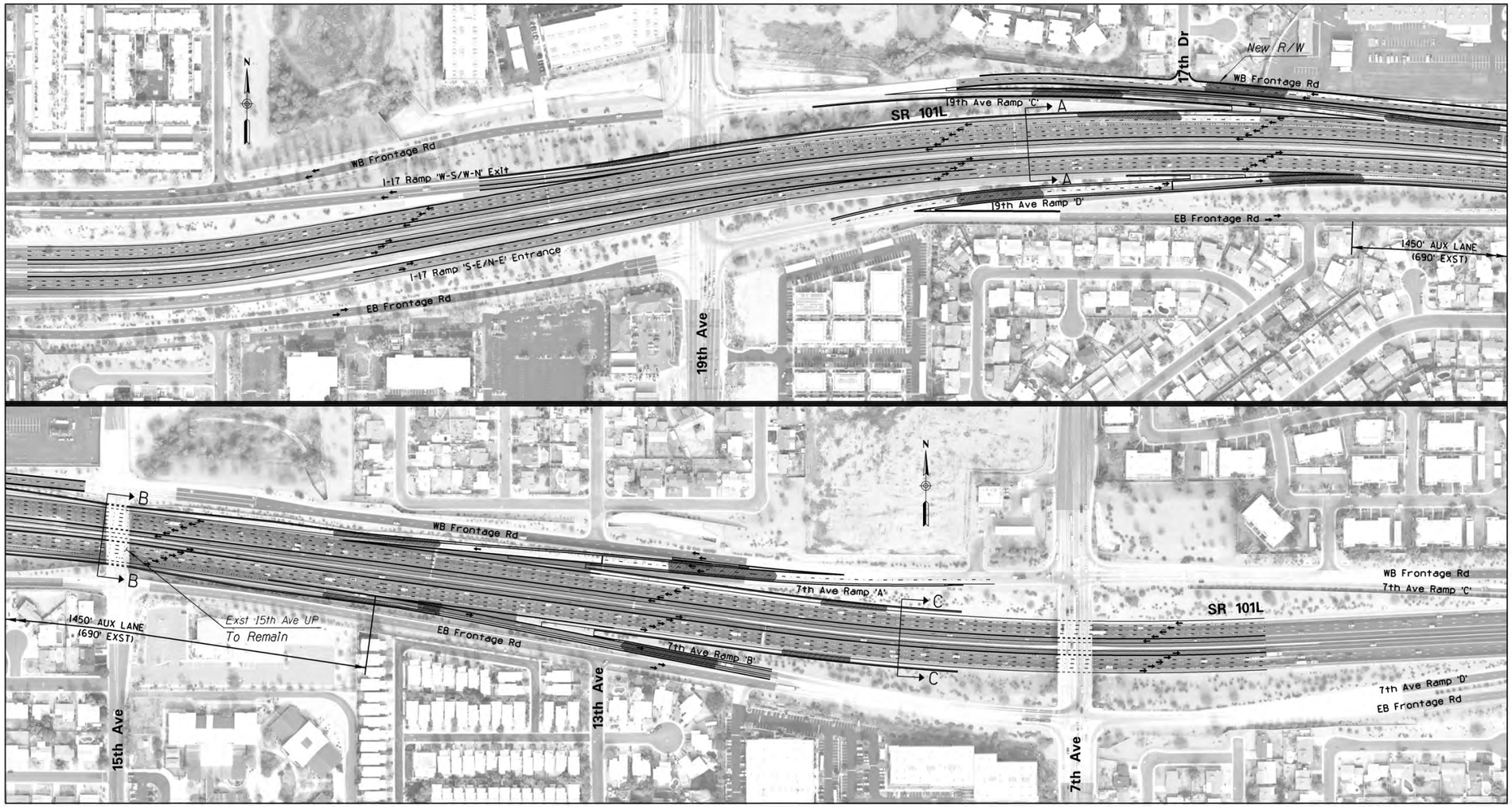

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
Varies 10' to 2' (@ Bridge Only) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Aux Lane
10' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 20

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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ROADWAY DESIGN SERVICES

I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE B
DESIGN OPTION I

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ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE
DWG NO.: ___ OF ___

TRACS NO. H8297 01L

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DATE: LOCATION: REVISIONS: FINISHED PLANS: SURVEY NO. DATE:

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9	ARIZ.				

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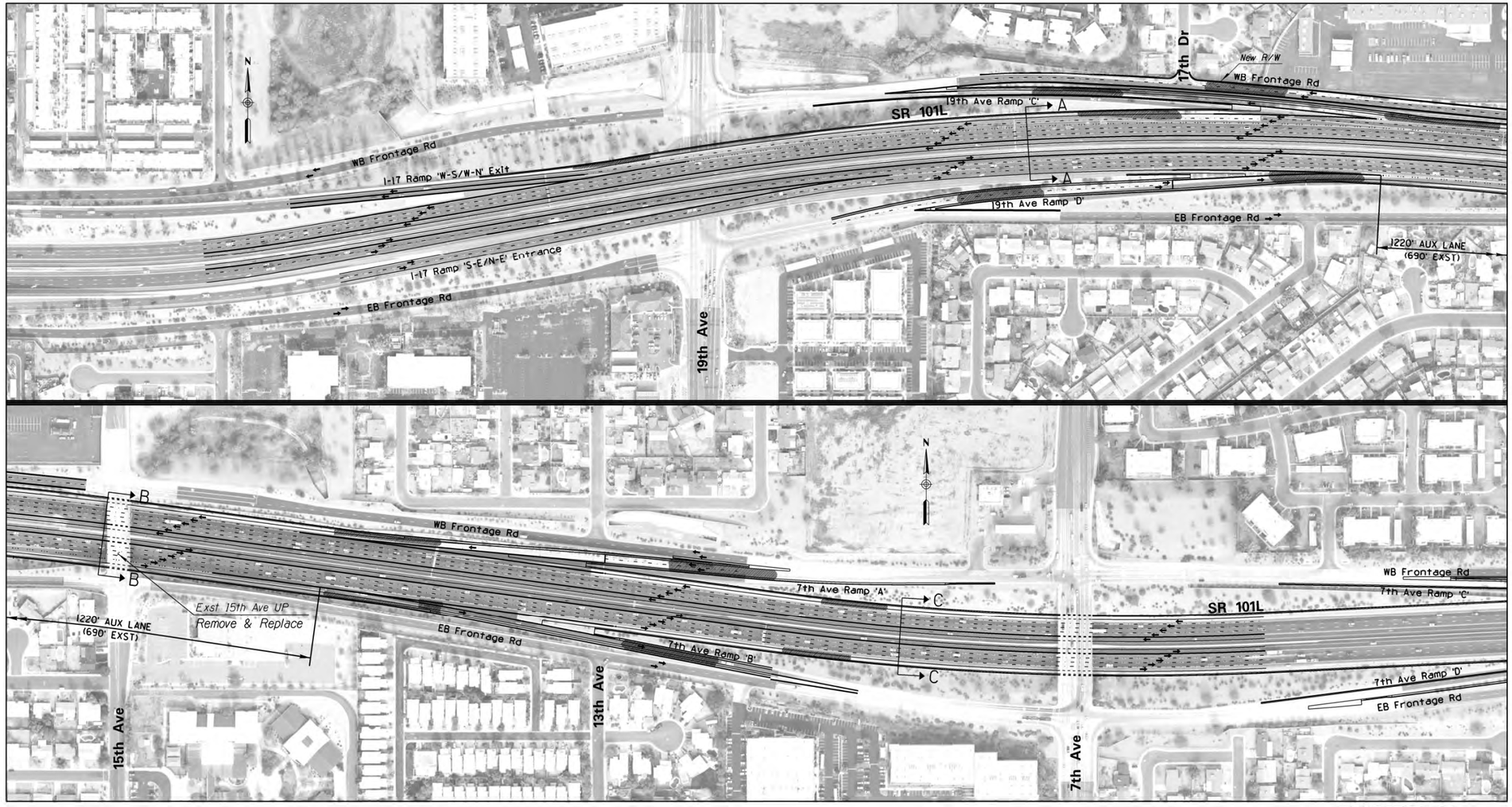
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr (8' @ Bridge Only)
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 21

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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TRANSPORTATION
AECOM TECHNICAL SERVICES, Inc.
2575 E. Camelback Rd., Suite 210
Phoenix, Arizona 85016
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INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE B
DESIGN OPTION 2

DCR
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE
DWG NO.
TRACS NO. H8297 01L
___ OF ___

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Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed with this design option along the westbound frontage road (approximately 0.36 acres) and potentially impact two residences. No fatal flaw environmental issues have been identified with this alternative. The total estimated order-of-magnitude project cost for this scenario is $22,401,800 (excluding right-of-way).

3.3.3.6 Alternative C (Design Option 1)

Description of Design Option

Alternative C is shown on Figure 22 on page 121. The eastbound SR 101L mainline would be modified at the I-17/SR101L TI to provide three general-purpose lanes and one HOV lane approaching the Ramp 'S-E/N-E' gore. The Ramp 'S-E/N-E' entrance would be modified to allow each directional ramp lane (2 lanes total) to enter the SR 101L mainline with a "lane-add" configuration (to provide 5 general-purpose lanes and 1 HOV lane between the I-17/SR101L TI and 7th Avenue).

The 19th Avenue Ramp 'D' (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Avenue exit. 7th Avenue exit ramp (2 lanes) would be designed with a mandatory exit from the auxiliary lane, and the second lane designed as an optional lane with the SR 101L though movement. The number of eastbound general-purpose lanes would transition from five lanes to four lanes with an AASHTO lane-drop that would occur prior to the 7th Avenue entrance ramp gore.

Four general-purpose lanes and one HOV lane would be provided on the westbound SR 101L mainline approaching 7th Avenue. The westbound 7th Avenue entrance ramp would be designed with a "lane-add" configuration that would continue to the I-17/SR101L TI Ramp 'W-S/W-N' exit. The 19th Avenue westbound exit ramp (1 lane) would be designed with a tapered exit configuration from the outside general-purpose lane.

The I-17/SR101L TI Ramp 'W-S/W-N' exit ramp (2 lanes) would be designed as a mandatory two lane exit from the outside lanes. Three general-purpose lanes and one HOV lane would continue to the west.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. In order to provide seven eastbound travel lanes (1 HOV lane, 5 general-purpose lanes, 1 auxiliary lane) departing the I-17/SR101L TI at the 15th Avenue Underpass, the median and outside shoulder widths would be reduced to 0.5' and the travel lane widths would be reduced to 11'. This design condition could induce safety and traffic congestion concerns due to the significant reduction in the lane and should widths at the 15th Avenue Underpass. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to develop additional weaving length within the eastbound auxiliary lane. The westbound frontage road would be realigned between the 19th Avenue Ramp 'D' gore and 15th Avenue, and the eastbound frontage road would be realigned between 15th Avenue and 7th Avenue.

Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed along the westbound frontage road between 17th Drive and 15th Avenue. New right-of-way would also be needed along the eastbound frontage road between 17th Avenue and 7th Avenue (approximately 0.56 acres and 7 potential residences total).

No fatal flaw environmental issues have been identified with this alternative. Due to the significant reduction in the lane and shoulder widths that would result with this Design Option, the study team recommends it be eliminated from further consideration. Therefore, an order-of-magnitude project cost estimate was not prepared for this scenario.

3.3.3.7 Alternative C (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps, and the service interchange ramps would be the same as Alternative C (Design Option 1). This design option is depicted on Figure 23 on page 122.

Roadway Geometry

The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

The 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be realigned to develop additional weaving length within the eastbound auxiliary lane. The westbound frontage road would be realigned between the 19th Avenue Ramp 'D' gore and 15th Avenue, and the eastbound frontage road would be realigned between 15th Avenue and 7th Avenue.

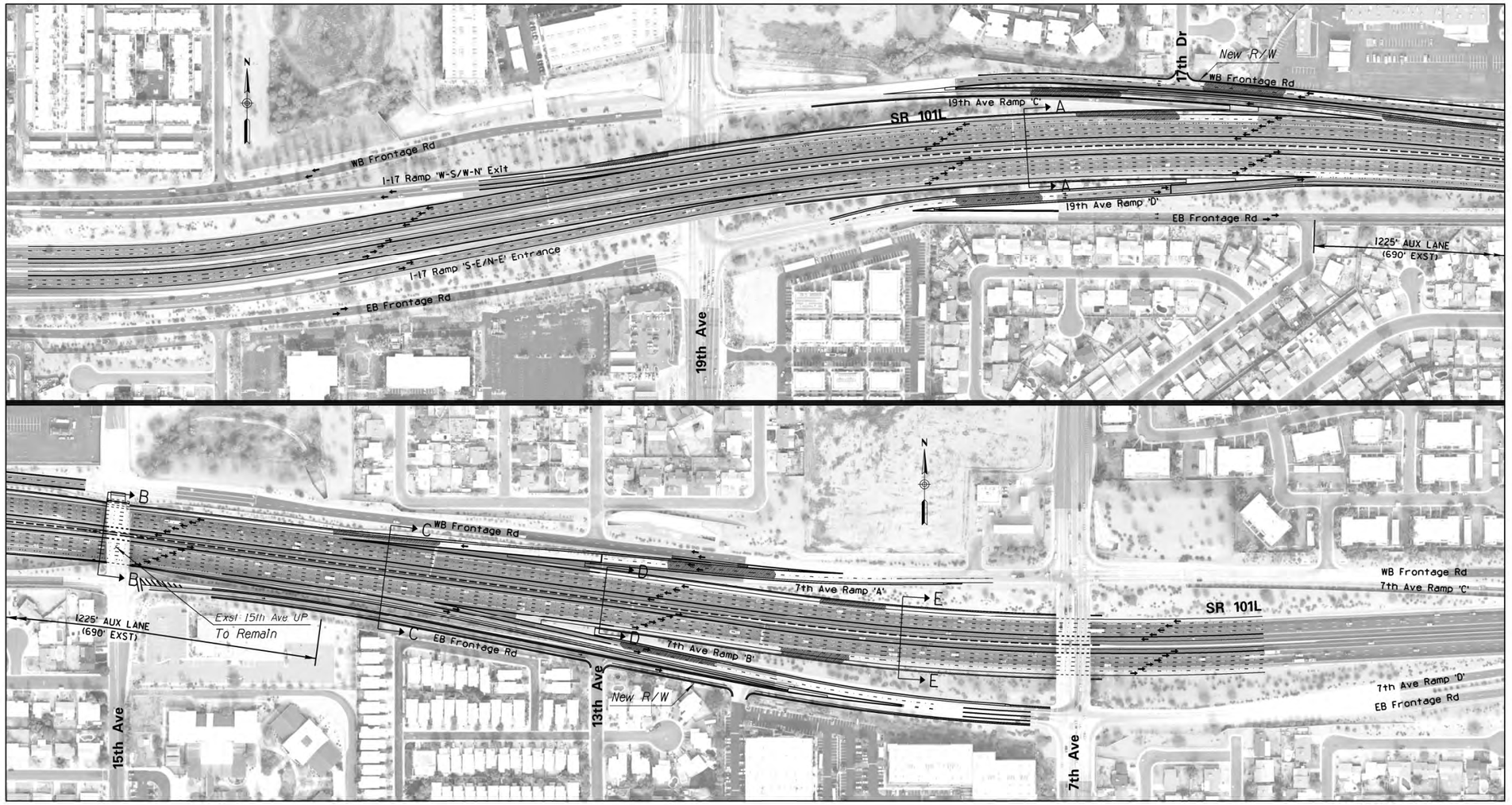
Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

(Text resumes on page 123)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23



SECTION A-A
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
EB ROADWAY SECTION
0.5' (3' Outside of Bridge Limits) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Aux Lane
0.5' Outside Shldr

SECTION C-C
EB ROADWAY SECTION
3' Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
12' Outside Shldr

SECTION D-D
EB ROADWAY SECTION
3' Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
12' Outside Shldr

SECTION E-E
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 22

	NAME	DATE
DESIGN	GJJ	05/14
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ROADWAY DESIGN SERVICES
I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE C
DESIGN OPTION 1

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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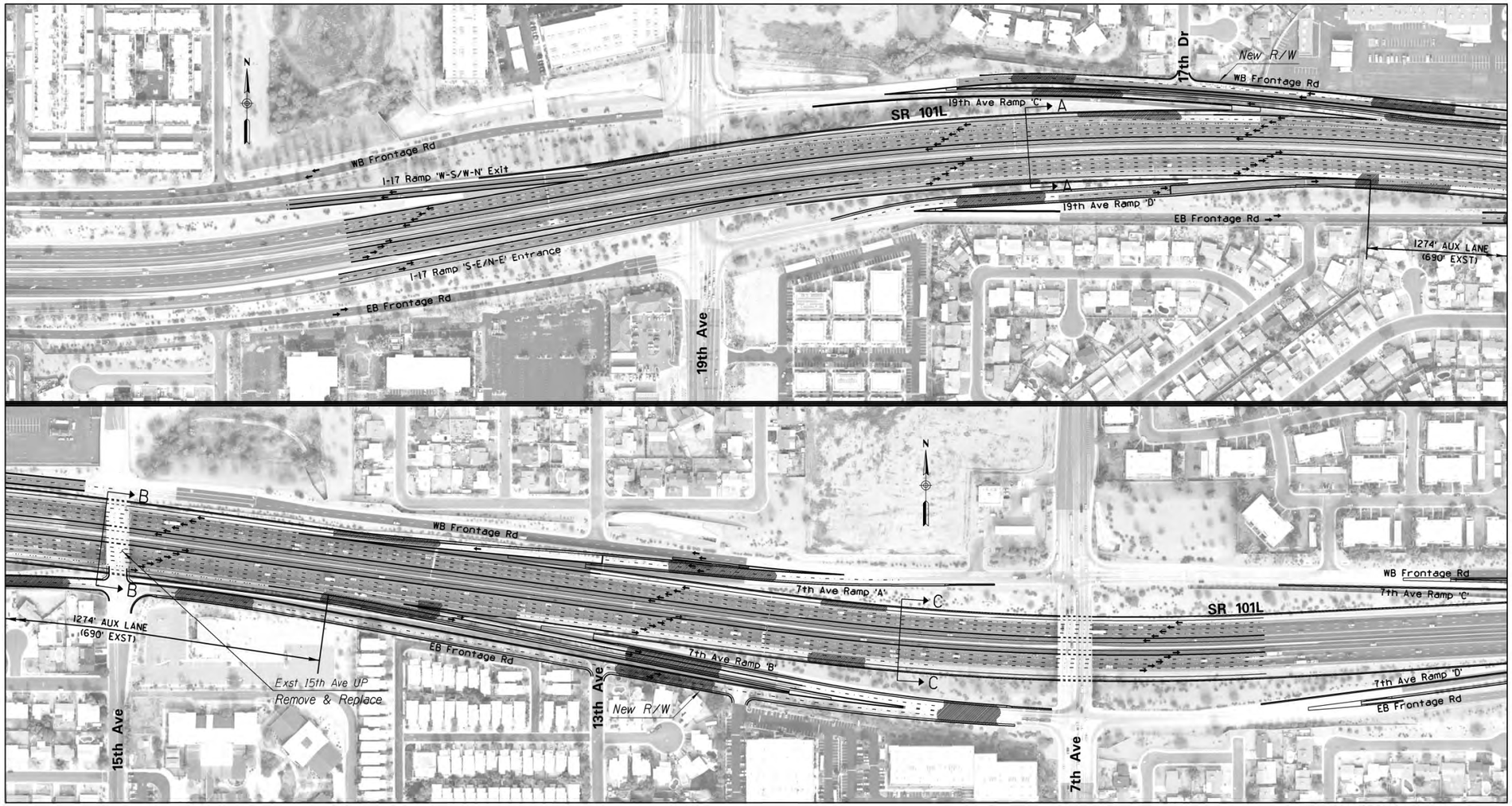

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr (8' @ Bridge Only)
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 23

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE C
DESIGN OPTION 2

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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SURVEY NO. | DATE | LOCATION | REVISIONS | FINISHED PLANS | SURVEY NO. | DATE

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed with this design option along the westbound frontage road between 17th Drive and 15th Avenue. New right-of-way would also be needed along the eastbound frontage road between 17th Avenue and 7th Avenue (approximately 1.18 acres and 7 potential residences total).

No fatal flaw environmental issues have been identified with this alternative. The total order-of-magnitude project cost for this scenario is $36,103,600 (excluding right-of-way).

3.3.3.8 Alternative D (Design Option 1)

Description of Design Option

Alternative D is shown on Figure 24 on page 124. The eastbound SR 101L mainline would provide three general-purpose lanes and one HOV lane approaching the Ramp 'S-E/N-E' gore. The Ramp 'S-E/N-E' entrance would allow each directional ramp lane (2 lanes total) to enter the SR 101L mainline with a "lane-add" configuration (to provide 5 general-purpose lanes and 1 HOV lane between the I-17/SR101L TI and 7th Avenue).

The 19th Avenue Ramp 'D' (1 lane) would be eliminated with this alternative. The 7th Avenue exit ramp (1 lanes) would be designed with a mandatory exit from the outside general-purpose lane Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

Four general-purpose lanes and one HOV lane would be provided on the westbound SR 101L mainline approaching 7th Avenue. The westbound 7th Avenue entrance ramp would be designed with a "lane-add" configuration that would continue to the I-17/SR101L TI Ramp 'W-S/W-N' exit. The 19th Avenue westbound exit ramp would be eliminated with this alternative.

The I-17/SR101L TI Ramp 'W-S/W-N' exit ramp (2 lanes) would be designed as a mandatory two lane exit from the outside lanes. Three general-purpose lanes and one HOV lane would continue to the west.

This alternative was developed to determine if the elimination of the 19th Avenue ramps would significantly improve the operational characteristics of the SR 101L mainline approaching and departing the I-17/SR101L TI, and if the number of freeway lanes required at the 15th Avenue Underpass would allow the existing structure to remain in-place.

The removal of the 19th Avenue TI ramps could eliminate one ramp access on the SR 101L mainline approaching and departing the I-17/SR101L TI. Traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

The eastbound frontage road would be realigned in the vicinity of 13th Avenue.

Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.11 acres) that could potentially impact four residences. No fatal flaw environmental issues have been identified with this alternative. The order-of-magnitude total project cost estimate for this design option is $13,087,900.

3.3.3.9 Alternative D (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps, and the service interchange ramps would be the same as Alternative D (Design Option 1). This design option is depicted on Figure 25 on page 125.

Roadway Geometry

The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

The eastbound frontage road would be realigned in the vicinity of 13th Avenue.

Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. However, the traffic currently

(Text resumes on page 126)

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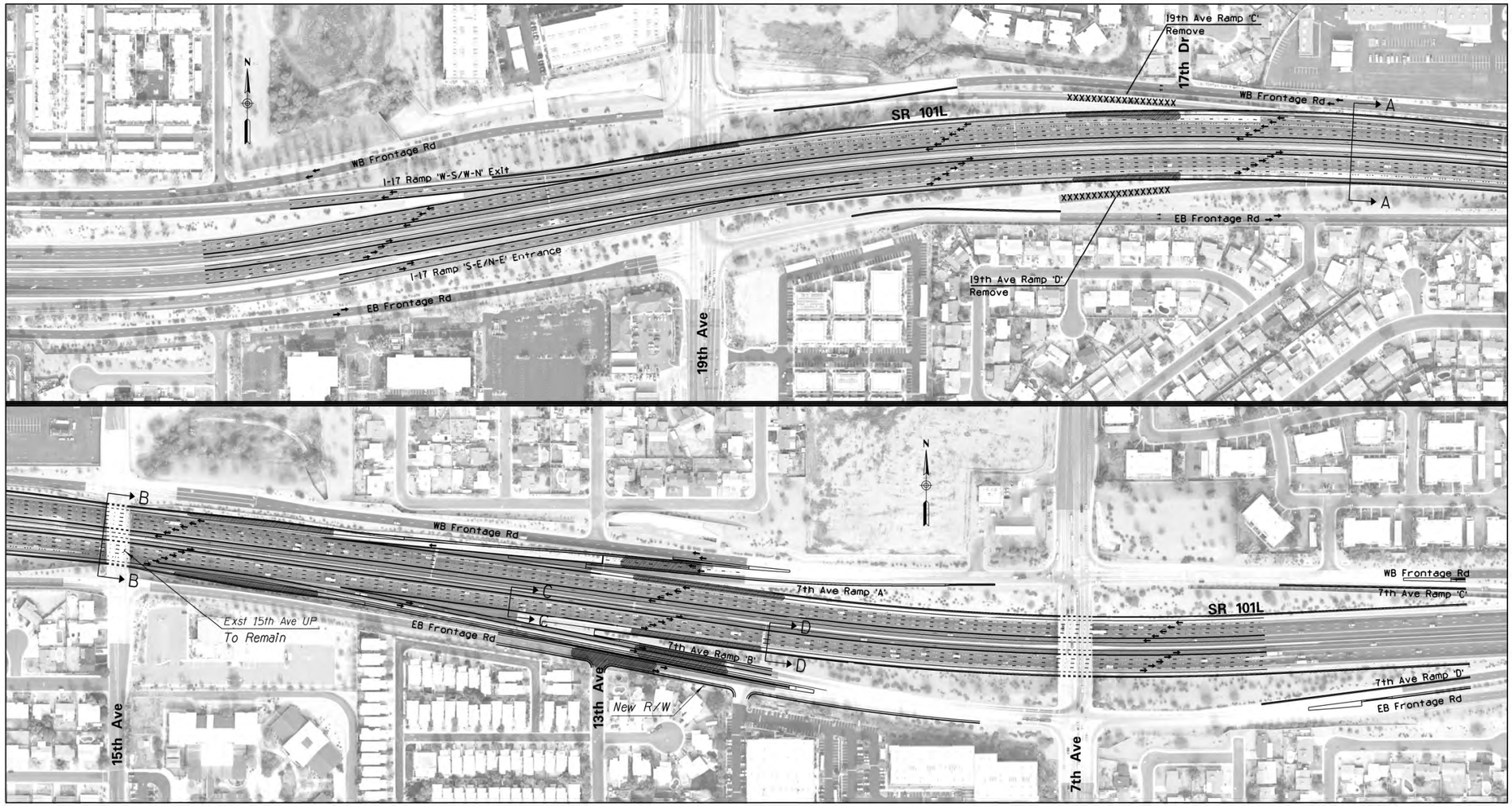

SECTION A-A
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
Varies 10' to 2' (@ Bridge Only) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Lane
10' Outside Shldr

SECTION C-C
EB ROADWAY SECTION
4' Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Lane
12' Outside Shldr

SECTION D-D
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 24

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE D
DESIGN OPTION 1

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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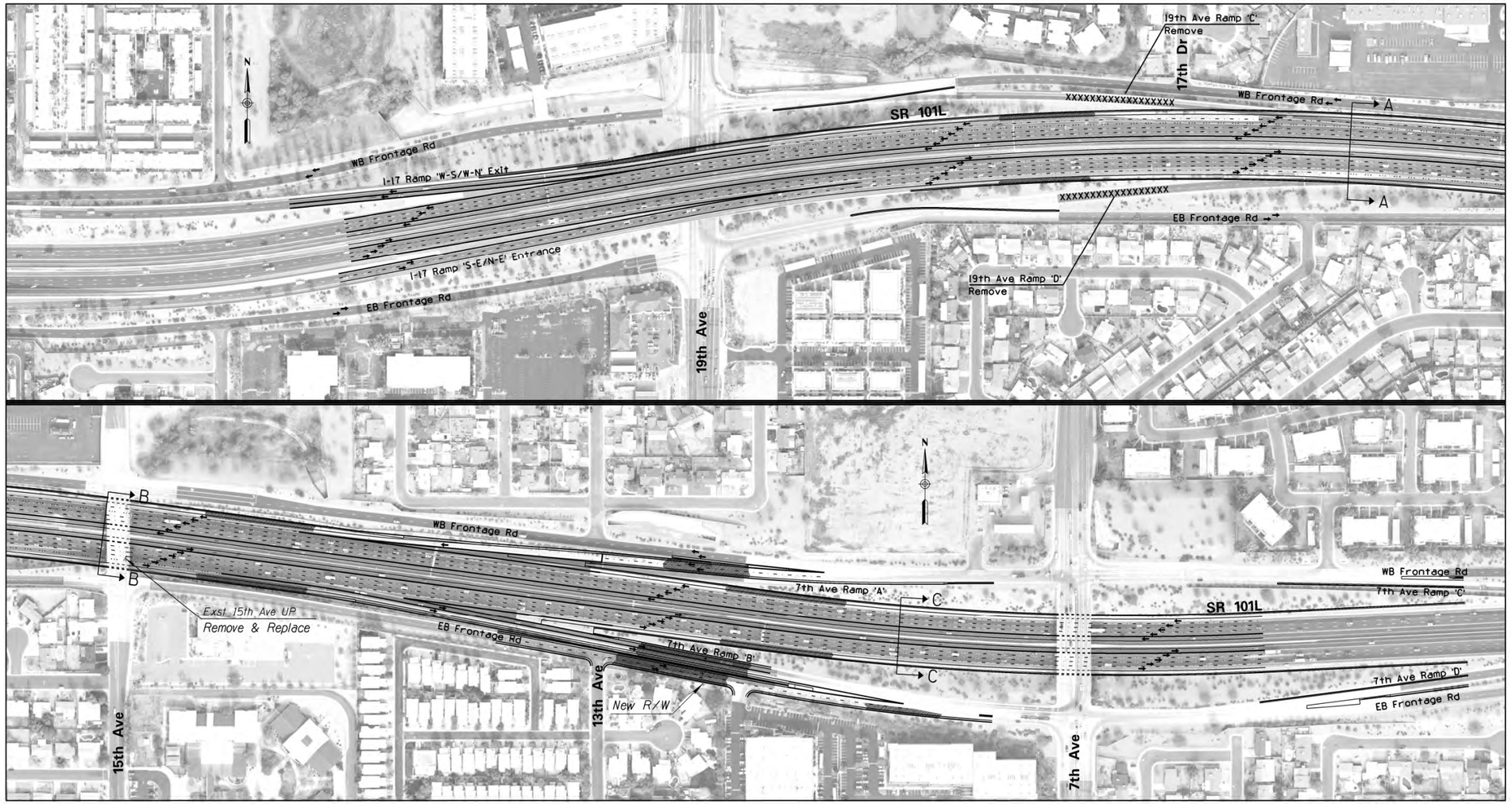

FIGURE 25

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr (8' @ Bridge Only)
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
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ROADWAY DESIGN SERVICES

I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE D
DESIGN OPTION 2

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

Elimination of the 19th Avenue ramps would not be anticipated to reduce the potential for vehicle crashes when compared to Alternatives A, B and C.

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.11 acres) that could potentially impact four residences. No fatal flaw environmental issues have been identified with this alternative. The order-of-magnitude total project cost estimate for this design option is $21,000,900.

3.3.3.10 Alternative E (Design Option 1)

Description of Design Option

Alternative E is generally the same as Alternative D, except the 7th Avenue eastbound exit ramp (1 lane) would be reconfigured as a tapered exit from the outside general-purpose lane as shown on Figure 26 on page 127. The eastbound mainline would then transition from five general-purpose lanes to four general-purpose lanes with an AASHTO lane drop that would occur in advance of the 7th Street entrance ramp gore.

Roadway Geometry

The existing 15th Avenue Underpass would be retained with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2’ median shoulder, 11’ travel lanes and a 10’ outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this alternative. The order-of-magnitude total project cost estimate for this design option is $15,296,000.

3.3.3.11 Alternative E (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline, the I-17/SR101L TI directional ramps, and the service interchange ramps is the same as Alternative E (Design Option 1). This design option is depicted on Figure 27 on page 128.

Roadway Geometry

The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

The eastbound frontage road would be realigned between 15th Avenue and 7th Avenue.

Traffic Operational Performance

By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

Elimination of the 19th Avenue ramps would not be anticipated to reduce the potential for vehicle crashes when compared to Alternatives A, B and C.

Right-of-Way Impacts, Environmental Issues and Project Costs

New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.03 acres) that could potentially impact four residences. No fatal flaw environmental issues have been identified with this alternative. The order-of-magnitude total project cost estimate for this design option is $25,448,400.

(Text resumes on page 129)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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SECTION A-A
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
Varies 10' to 2' (@ Bridge Only) Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Lane
10' Outside Shldr

SECTION C-C
EB ROADWAY SECTION
4' Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Lane
12' Outside Shldr

SECTION D-D
EB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION E-E
WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 26

	NAME	DATE
DESIGN	GJJ	05/14
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I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE E
DESIGN OPTION I

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE
TRACS NO. H8297 01L

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9	ARIZ.				

101L MA 23

FIGURE 27

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr (8' @ Bridge Only)
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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I-17/SR101L TI - 7TH AVENUE
ALTERNATIVE E
DESIGN OPTION 2

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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3.3.4 Description of Alternatives between 7th Avenue and 7th Street

All of the SR 101L Mainline Widening Alternatives (Alternatives A, B, C, D, E) would have the same lane configurations between 7th Avenue and 7th Street.

Two design options were developed and evaluated to determine if the 7th Avenue TI Ramp 'A' and Ramp 'B' bridges (over Cave Creek Wash) could be retained with the freeway widening, or if the existing bridges would be required to be removed and replaced with new ramp bridge structures.

3.3.4.1 Alternatives A, B, C, D, E (Design Option 1)

Description of Design Option

As shown on Figure 28 (on page 130), the eastbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the 7th Avenue Ramp 'D' gore. The 7th Avenue entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Street exit. The 7th Street exit ramp (1 lane) would be designed with a parallel exit configuration as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

The westbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the 7th Street Ramp 'A' gore. The 7th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (1 lane) would be designed with a parallel exit configuration as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline.

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would provide a 10' median shoulder; 12' HOV, general-purpose and auxiliary lanes; and a 12' outside shoulder. No design exceptions would be required with this design option.

The 7th Street Ramp 'A' and Ramp 'B' roadways would be realigned to coincide with the widened freeway pavement. The new ramp geometry would require the existing ramp bridges to be removed and replaced with new bridges that support the ramp alignments.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area. However, the traffic currently using the 7th Street TI west ramps to access the SR 101L mainline would be detoured to the 7th Avenue TI (via the eastbound and westbound frontage roads) during the ramp bridge reconstruction activities. Congestion would likely occur at the 7th Avenue TI signalized intersections for an extended period of time during the ramp bridge construction.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option, but it is anticipated a Section 404 Permit would be required for the new ramp bridges over Cave Creek Wash. The order-of-magnitude total project cost estimate for this design option is $13,003,700.

3.3.4.2 Alternatives A, B, C, D, E (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline and the service interchange ramps is the same as Design Option 1. This design option is depicted on Figure 28 on page 130.

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would generally provide a 10' median shoulder; 12' HOV, general-purpose and auxiliary lanes; and a 12' outside shoulder. However, the mainline would transition to provide a 10' median shoulder; 11' HOV, general-purpose and auxiliary lanes; and a 12' outside shoulder in the vicinity of the existing Cave Creek Wash overpasses. The 7th Street Ramp 'A' and Ramp 'B' roadways would be realigned to coincide with the widened freeway mainline, yet would preserve the existing ramp bridges over Cave Creek Wash.

A design exception would be required to reduce the travel lane widths to 11', and to reduce the superelevation rate from 0.027'/ft. to 0.020'/ft. for the initial 7th Street Ramp 'B' horizontal curve.

The project team has met with representatives of ADOT's Roadway Design Group and the FHWA to determine the viability of these design exceptions in order to preserve the existing ramp bridge structures. All parties have initially agreed these design exceptions would be acceptable at this location. FHWA later determined it would not be prudent to introduce reduced lane widths at this location.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area.
.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $8,463,700.

(Text resumes on page 131)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23

FIGURE 28

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION C-C
EB & WB ROADWAY SECTION
10' Median Shldr
11' HOV Lane
11' Lane
11' Lane
11' Lane
11' Lane
11' Aux Lane
12' Outside Shldr

SECTION D-D
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

7TH AVENUE - 7TH STREET
ALTERNATIVES A,B,C,D,E
DESIGN OPTIONS 1 & 2

ROUTE SR 101L
LOCATION I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

DCR

NOT FOR CONSTRUCTION OR RECORDING

DWG NO.

___ OF ___

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3.3.5 Description of Alternatives between 7th Street and Cave Creek Road

All of the SR 101L Mainline Widening Alternatives (Alternatives A, B, C, D, E) would have the same number of HOV and general-purpose lanes between 7th Street and Cave Creek Road.

Two design options were developed and evaluated to determine if an auxiliary lane would be warranted between the 7th Street TI east ramps and the Cave Creek Road TI west ramps.

3.3.5.1 Alternatives A, B, C, D, E (Design Option 1)

Description of Design Option

As shown on Figure 29 (on pages 132-133), the eastbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the 7th Street Ramp 'D' gore. The 7th Street entrance ramp (1 lane) would be configured as a parallel entrance that merges into the adjacent travel lane to provide four general-purpose lanes and one HOV lane approaching Cave Creek Road Ramp 'B' exit. The Cave Creek Road exit ramp (1 lane) would be designed with a tapered exit configuration from the outside travel lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

The westbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the Cave Creek Road Ramp 'A' gore. The Cave Creek Road entrance ramp (1 lane) would be configured as a parallel entrance that merges into the adjacent travel lane to provide four general-purpose lanes and one HOV lane approaching 7th Street Ramp 'C' exit. The 7th Street exit ramp (1 lane) would be designed with a tapered exit configuration from the outside lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline.

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. The 7th Street TI and Cave Creek Road TI ramps would be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

Traffic Operational Performance

The eastbound SR 101L mainline would operate with congestion during the A.M. peak travel period between the 7th Street entrance ramp and the Cave Creek Road exit ramp for Alternative A, Alternative B and Alternative C. The westbound SR 101L mainline would operate with congestion during the P.M. peak travel period between the 7th Street exit ramp and the Cave Creek Road entrance ramp for Alternative A, Alternative B and Alternative C.

This freeway segment would operate with an acceptable level-of-service during the A.M. and P.M. peak travel periods with Alternative D and Alternative E.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $31,819,700.

3.3.5.2 Alternatives A, B, C, D, E (Design Option 2)

Description of Design Option

The lane configurations on the SR 101L mainline and the service interchange ramps is the same as Design Option 1, except an auxiliary lane would be provided along the SR 101L mainline in each direction of travel between the 7th Street TI east ramps and the Cave Creek Road TI west ramps. This design option is depicted on Figure 30 (on pages 134-135).

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. The 7th Street TI and Cave Creek Road TI ramps would be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

The eastbound frontage road would be realigned between 20th Street and Cave Creek Road, and a short segment of the westbound frontage road would be realigned west of Cave Creek Road.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $38,897,700.

(Text resumes on page 136)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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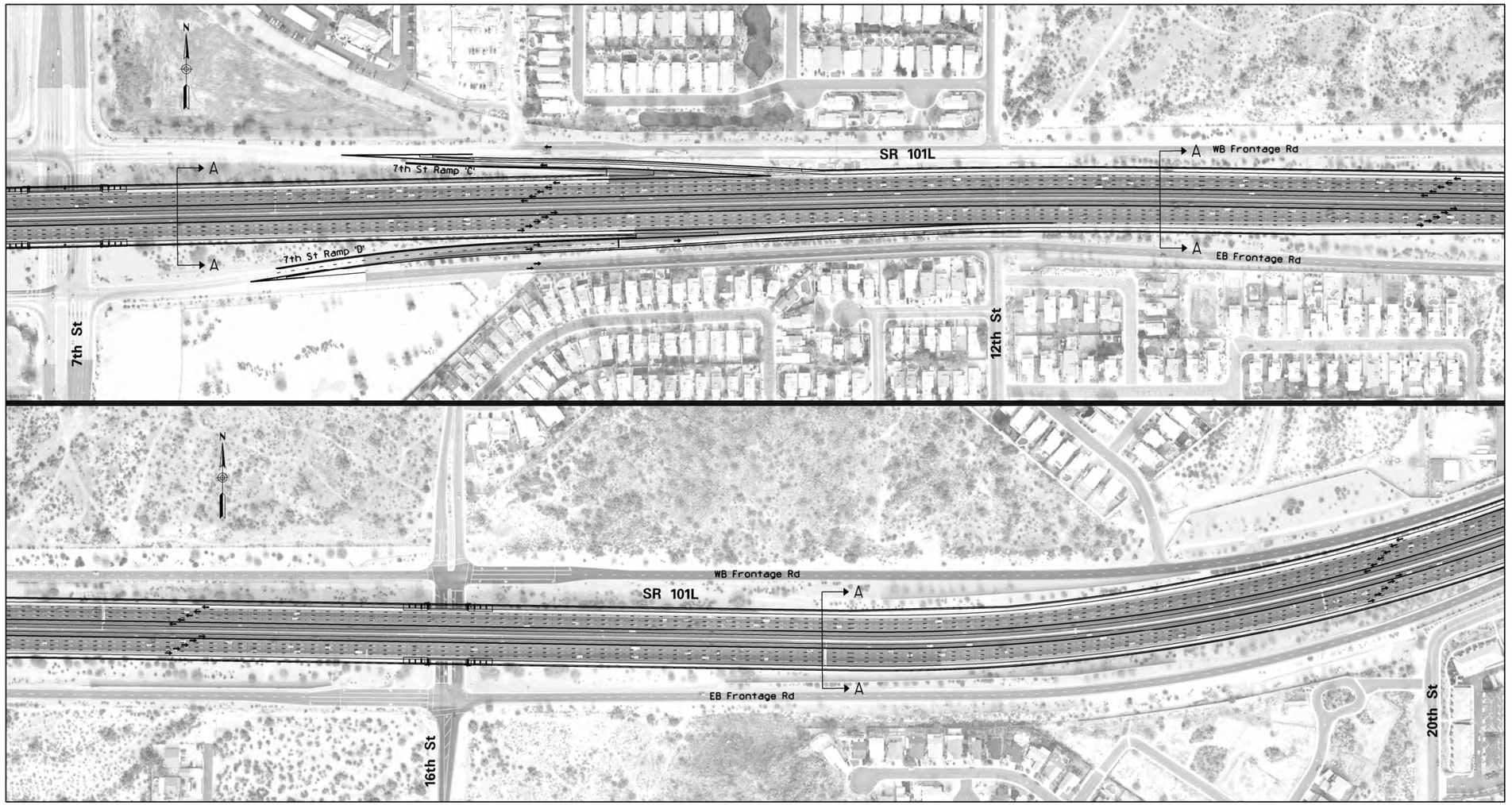
101L MA 23

DATE: | LOCATION: | REVISIONS: | FINISHED PLANS: | SURVEY NO.



SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 29
(SHEET 1 OF 2)

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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AECOM TECHNICAL SERVICES, Inc.
3003 N. Central Ave. Suite 600
Phoenix, AZ 85012-2913
T 602 371 1100
AECOM
www.aecom.com

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

7TH STREET - CAVE CREEK ROAD
ALTERNATIVE A,B,C,D,E
DESIGN OPTION 1

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

DCR
NOT FOR CONSTRUCTION OR RECORDING
DWG NO.
___ OF ___

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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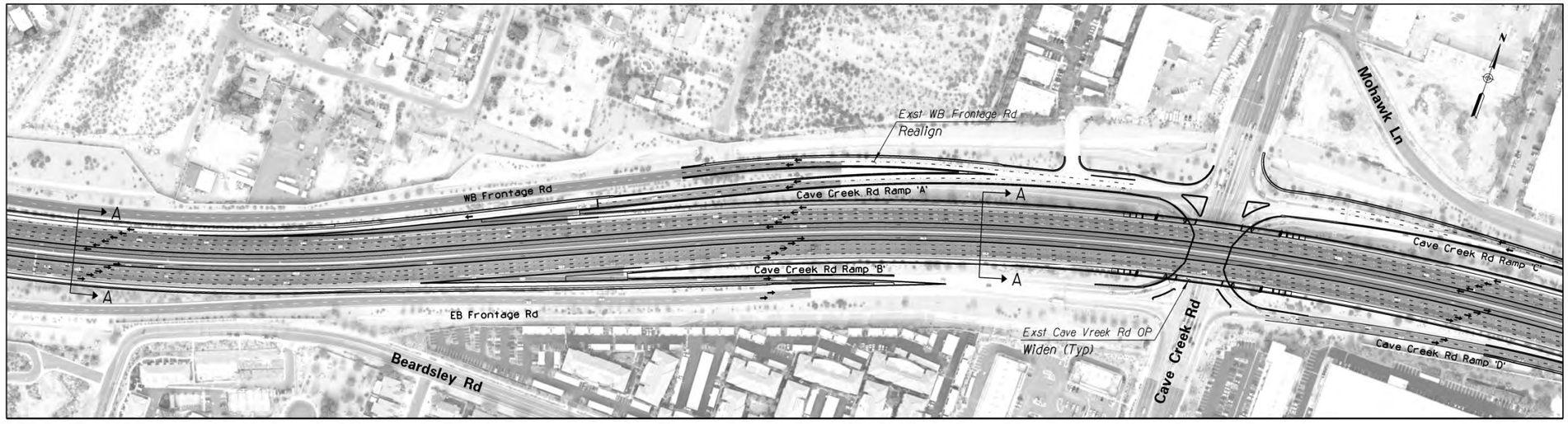
101L MA 23



SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 29
(SHEET 2 OF 2)

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

ARIZONA DEPARTMENT OF TRANSPORTATION
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ROADWAY DESIGN SERVICES

7TH STREET - CAVE CREEK ROAD
ALTERNATIVE A,B,C,D,E
DESIGN OPTION 1

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ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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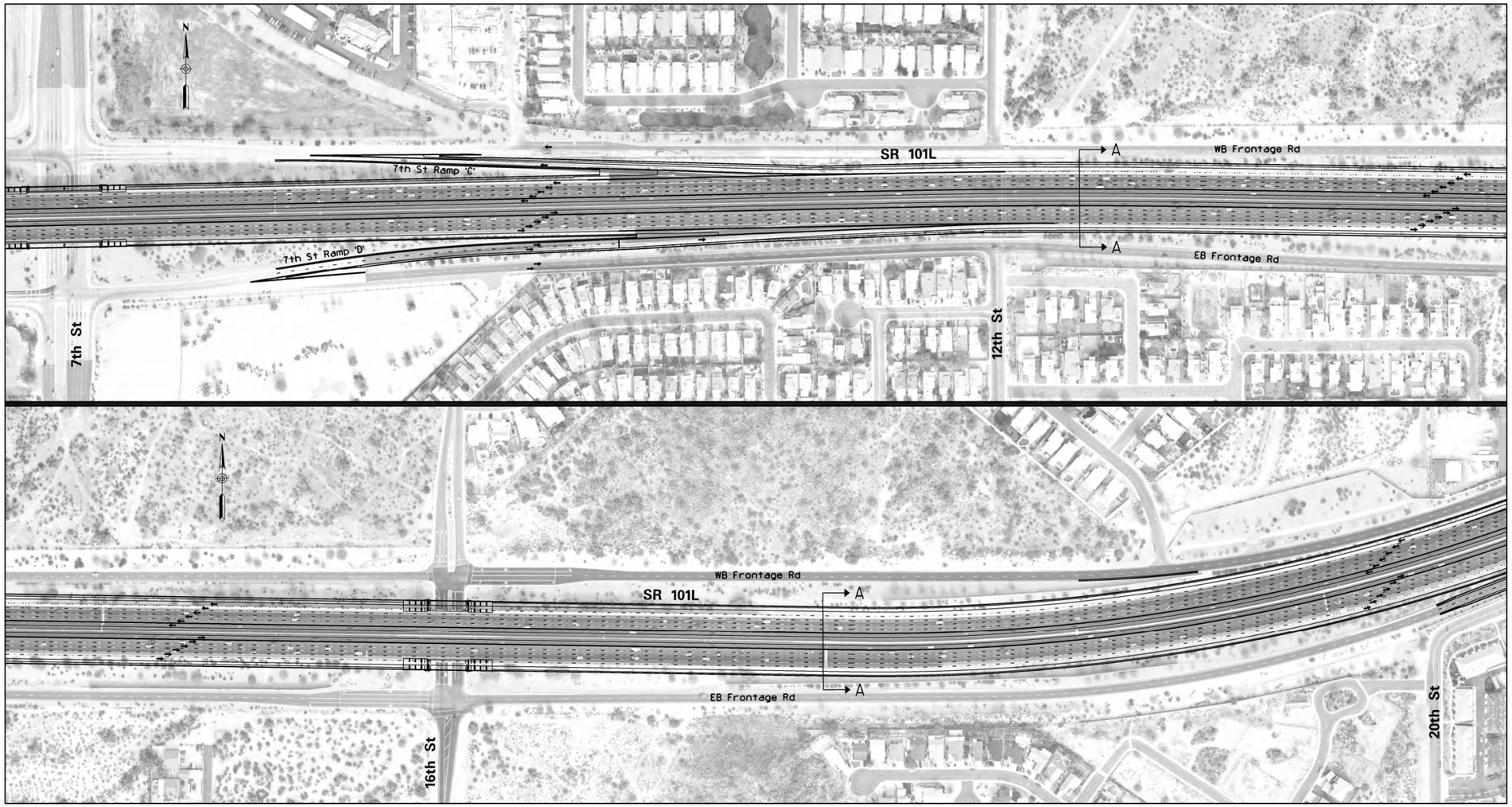

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

FIGURE 30
(SHEET 1 OF 2)

	NAME	DATE
DESIGN	GJJ	05/14
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CHECKED	RR	05/14

TRANSPORTATION
AECOM TECHNICAL SERVICES, Inc.
7720 N. Dobson Road, Suite 201
Scottsdale, Arizona 85256
T 480.209.3700
AECOM
www.aecom.com

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

7TH STREET - CAVE CREEK ROAD
ALTERNATIVE A,B,C,D,E
DESIGN OPTION 2

DCR

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DWG NO.

___ OF ___

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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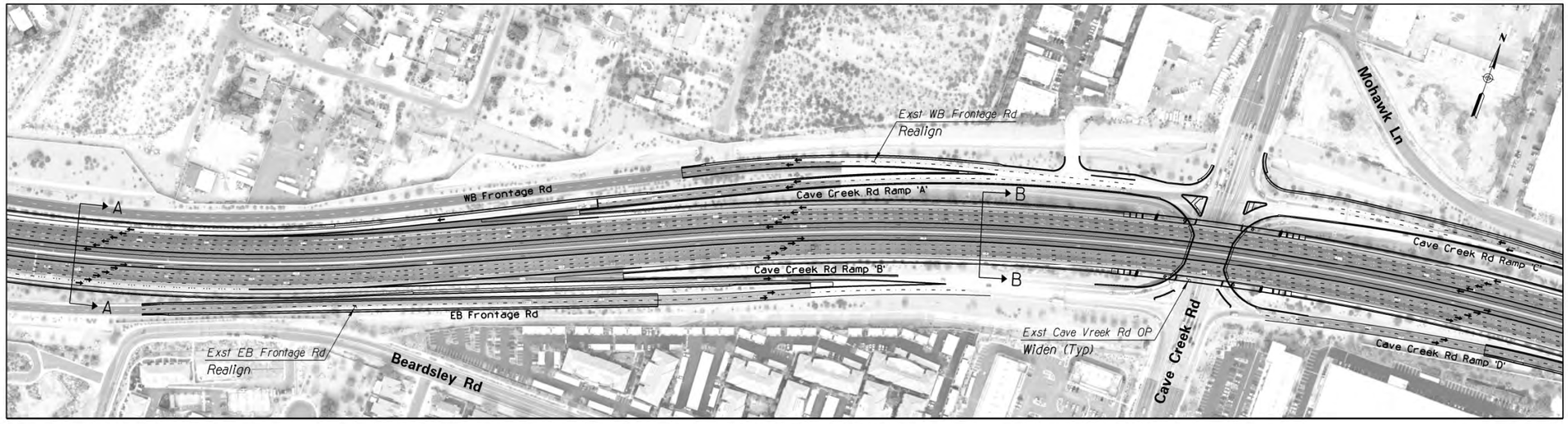

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 30
(SHEET 2 OF 2)

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ROADWAY DESIGN SERVICES

7TH STREET - CAVE CREEK ROAD
ALTERNATIVE A,B,C,D,E
DESIGN OPTION 2

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ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

3.3.6 Description of Alternatives between Cave Creek Road and the SR51/SR101L TI

All of the SR 101L Mainline Widening Alternatives (Alternatives A, B, C, D, E) would have the same lane configurations between Cave Creek Road and the SR51/SR101L TI. Only one design option was developed that is shown on Figure 31 on page 137.

3.3.6.1 Alternatives A, B, C, D, E (Design Option 1)

Description of Design Option

The eastbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the Cave Creek Road Ramp 'D' gore. The Cave Creek Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the SR51/SR101L Ramp 'E-S' exit. Ramp 'E-S' (1 lane) would be configured as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline. East of the Ramp 'E-S' exit, the number of general-purpose lanes would transition from four to three with an AASHTO lane drop that would occur prior to the SR51/SR101L TI Ramp 'N-W' bridge.

The westbound SR 101L mainline would include three general-purpose lanes and one HOV lane approaching the SR51/SR101L Ramp 'N-W' gore. Ramp 'N-W' (2 lanes) would be configured as a parallel entrance to develop one auxiliary lane, four general-purpose lanes and one HOV lane approaching the Cave Creek Road exit ramp. The Cave Creek Road exit ramp (2 lanes) would be designed as a mandatory exit from the auxiliary lane, and the second lane designed as an optional lane with the SR 101L through movement. Four general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline.

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. The Cave Creek Road TI and SR51/SR101L TI ramps will be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $34,837,400.

3.3.7 SR51/SR101L TI to Tatum Boulevard

All of the SR 101L Mainline Widening Alternatives (Alternatives A, B, C, D, E) would have the same number of HOV and general-purpose lanes between the SR51/SR101L TI and Tatum Boulevard.

Two design options were developed and evaluated for the westbound the SR 101L mainline and SR51/SR101L TI Ramp 'W-S' exit.

3.3.7.1 Alternatives A, B, C, D, E (Design Option 1)

Description of Design Option

The westbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the Tatum Boulevard Ramp 'A' gore as shown on Figure 32 on page 140. The Tatum Boulevard entrance ramp (1 lane) would be configured as parallel entrance that transitions into an auxiliary lane that continues to the SR51/SR101L TI Ramp 'W-S' exit. Ramp 'W-S' (2 lanes) would be designed as a mandatory two lane exit from the outside travel lanes. Three general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline through the system interchanges.

No improvements would be made to the eastbound SR 101L mainline. The Tatum Boulevard Ramp 'B' (2 lanes) would be widened to provide the full shoulder and lane widths needed to support a two lane exit ramp.

Roadway Geometry

The westbound SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. The Tatum Boulevard Ramp 'B' would be widened to provide the full shoulder widths needed for a two lane ramp. Tatum Boulevard Ramp 'A' and the SR51/SR101L TI Ramp 'W-S" would be realigned in support of the widened freeway mainline. No design exceptions would be required with this design option.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $10,836,100.

(Text resumes on page 138)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

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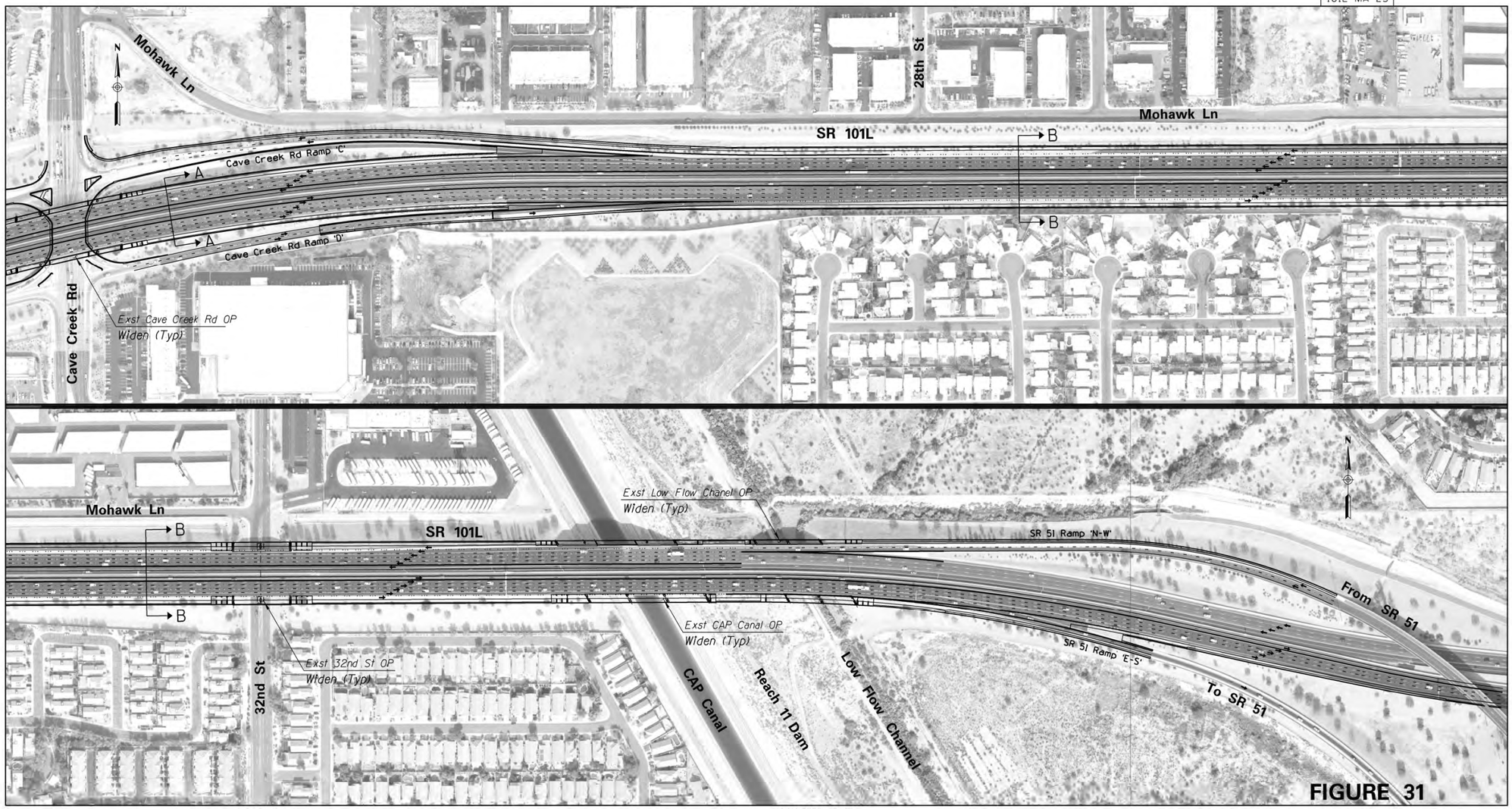

FIGURE 31

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ROADWAY DESIGN SERVICES

CAVE CREEK RD - SR51/SR101L TI
ALTERNATIVES A,B,C,D,E
DESIGN OPTION 1

ROUTE: SR 101L | LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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3.3.7.2 Alternatives A, B, C, D, E (Design Option 2)

Description of Design Option

The lane configuration on the SR 101L mainline and the service interchange ramps is the same as Design Option 1. The SR51/SR101L TI Ramp 'W-S' exit (2 lanes) would be modified to provide a mandatory exit from the auxiliary lane, and the second lane as an optional lane with the freeway through movement. The number of westbound SR 101L general-purpose lanes would transition from four lanes to three lanes with an AASHTO lane drop that would occur prior to the Ramp 'W-S' overpass. Three general-purpose lanes one HOV lane would continue to the west through the system interchange. This design option is also shown on Figure 32 on page 140.

Roadway Geometry

The westbound SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. Tatum Boulevard TI Ramp 'A' and the SR51/SR101L TI Ramp 'W-S" would be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $12,705,100.

3.3.8 Description of Alternatives Between Tatum Boulevard and Princess Drive

All of the SR 101L Mainline Widening Alternatives (Alternatives A, B, C, D, E) would have the same lane configuration between Tatum Boulevard and Princess Drive as shown on Figure 33 (on pages 141-143).

3.3.8.1 Alternatives A, B, C, D, E (Design Option 1)

Description of Design Option

The eastbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the Tatum Boulevard Overpass. The existing AASHTO lane drop would be removed to allow the fourth general-purpose lane to be extended to the east. The Tatum Boulevard entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 56th Street exit. The 56th Street exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline to Princess Drive.

The 56th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 64th Street exit. The 64th Street exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The 64th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Scottsdale Road exit. The Scottsdale Road exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The Scottsdale Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Hayden Road exit. The Hayden Road exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The Hayden Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Princess Drive exit. The Princess Drive exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline.

The westbound SR 101L mainline would include four general-purpose lanes and one HOV lane approaching the Princess Drive Overpass. The Princess Drive entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Hayden Road exit. The Hayden Road exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east on the SR 101L mainline to the SR51/SR101L TI.

The Hayden Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Scottsdale Road exit. The Scottsdale Road exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The Scottsdale Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 64th Street exit. The 64th Street exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The 64th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 56th Street exit. The 56th Street exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

The 56th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Tatum Boulevard exit. The Tatum Boulevard exit ramp (1 lane) would be configured as a mandatory exit from the auxiliary lane.

Roadway Geometry

The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. No design exceptions would be required with this design option.

Traffic Operational Performance

The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

Right-of-Way Impacts, Environmental Issues and Project Costs

No new right-of-way would be needed with this design option. No fatal flaw environmental issues have been identified with this design option. The order-of-magnitude total project cost estimate for this design option is $42,355,600.

3.4 EVALUATION OF THE SR 101L MAINLINE WIDENING ALTERNATIVES

The No-Build and Build alternatives were evaluated in terms of their technical merits and environmental impacts when compared with the evaluation criteria. The results of the evaluation is summarized in Tables 25 and 26 (on page 155).

3.4.1 No-Build Alternative

The following is a summary of the No-Build Alternative when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative does not achieve the goals and objectives of the voter-approved Regional Transportation Plan.

- Traffic Operational Performance: This alternative results in the lowest performing traffic operations as discussed in Chapter 2.0. The freeway currently operates at deficient levels-of-service during the A.M. and P.M. peak travel periods and will continue to degrade over time.

- Ability to Achieve Engineering Standards: This alternative does not include any changes to the existing roadway. The existing deficient roadway width areas (near 15th Avenue, and between Cave Creek Road and the SR51/SR101L TI west ramps) would remain in their existing configuration.

- Right-of-Way and Utility Impacts: This alternative does not result in any right-of-way or utility impacts.

- Environmental Considerations: This alternative results in the fewest environmental impacts. However, with increased congestion levels, the potential for higher levels of mobile source air toxins would increase.

- Total Estimated Project Cost: The No-Build Alternative does not result in any project related costs. However, there is potential for higher costs associated with maintenance.

Based on the evaluation of the traffic operational performance of the existing roadway, the non-conformance with the RTP, and an evaluation of the current roadway conditions, the No-Build Alternative has been determined to be inadequate and was eliminated from further consideration.

3.4.2 Evaluation of Alternatives between the I-17/SR101L TI and 7th Avenue

3.4.2.1 Alternative A (Design Option 1)

Evaluation of Alternative

The following is a summary of Alternative A (Design Option 1) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance and on the total length of Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period. Therefore, Alternative A (Design Option 1) would not achieve the traffic operational goals established for this project.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

  The horizontal and vertical alignments for the 19th Avenue Ramp 'D' and 7th Avenue Ramp 'B' roadways would be similar to the existing conditions to minimize the reconstruction limits for these ramps. However, the length of the eastbound auxiliary lane would be reduced from 690' to approximately 480'.

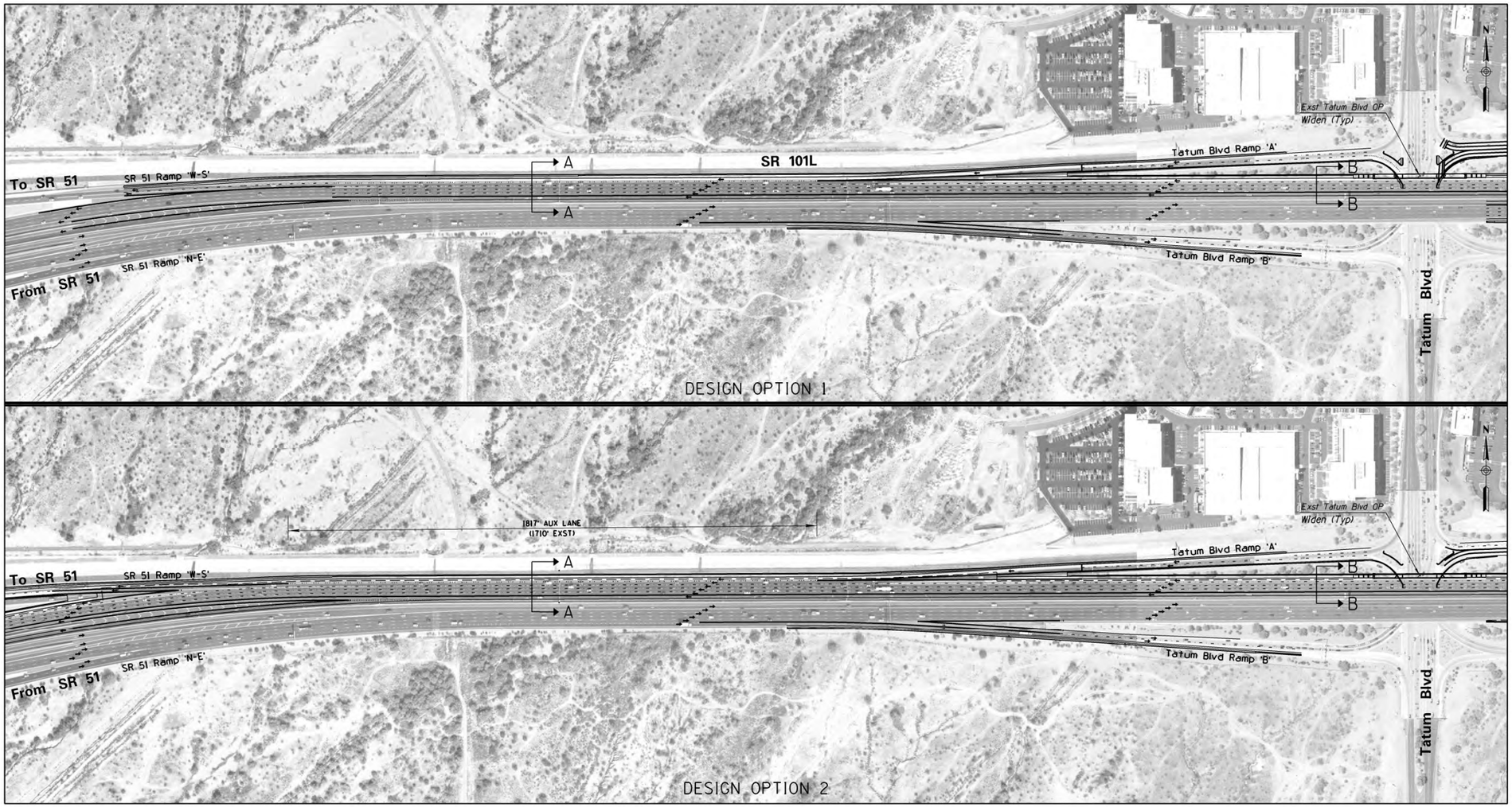
  Alternative A (Design Option 1) would not achieve the minimum design standards for the travel lane and shoulder widths, and for the length of the eastbound auxiliary lane. Therefore, this scenario would not achieve the engineering design standards required for this project.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

(Text resumes on page 144)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23



SECTION A-A
WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

FIGURE 32

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

TRANSPORTATION
AECOM TECHNICAL SERVICES, Inc.
AECOM

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES
SR51/SR101L TI - TATUM BLVD
ALTERNATIVES A,B,C,D,E
DESIGN OPTIONS 1 & 2

DCR
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE
DWG NO.
TRACS NO. H8297 01L
___ OF ___

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SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

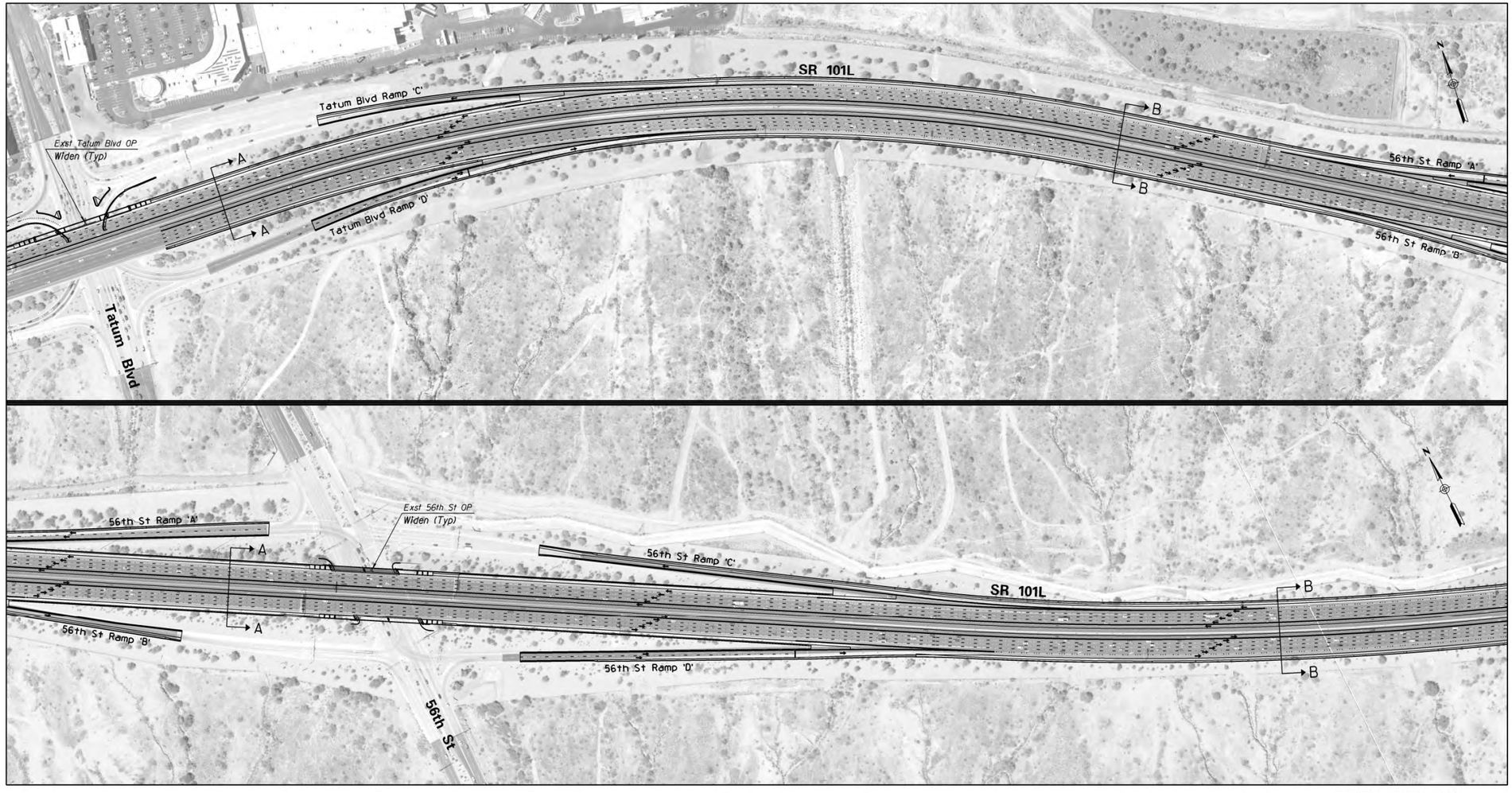

FIGURE 33
(Sheet 1 of 3)

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

TATUM BLVD - PRINCESS DRIVE
ALTERNATIVES A,B,C,D,E
DESIGN OPTION 1

DCR
NOT FOR CONSTRUCTION OR RECORDING
DWG NO.
___ OF ___

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE
TRACS NO. H8297 01L

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23

FIGURE 33
(Sheet 2 of 3)

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

TRANSPORTATION
AECOM TECHNICAL SERVICES, Inc.
7720 N. 16th Street, Suite 200
Phoenix, Arizona 85020
T 602.371.1100 F 602.371.1615
AECOM
www.aecom.com

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

TATUM BLVD - PRINCESS DRIVE
ALTERNATIVES A,B,C,D,E
DESIGN OPTION 1

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

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NOT FOR CONSTRUCTION OR RECORDING
DWG NO.
___ OF ___

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SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

101L MA 23

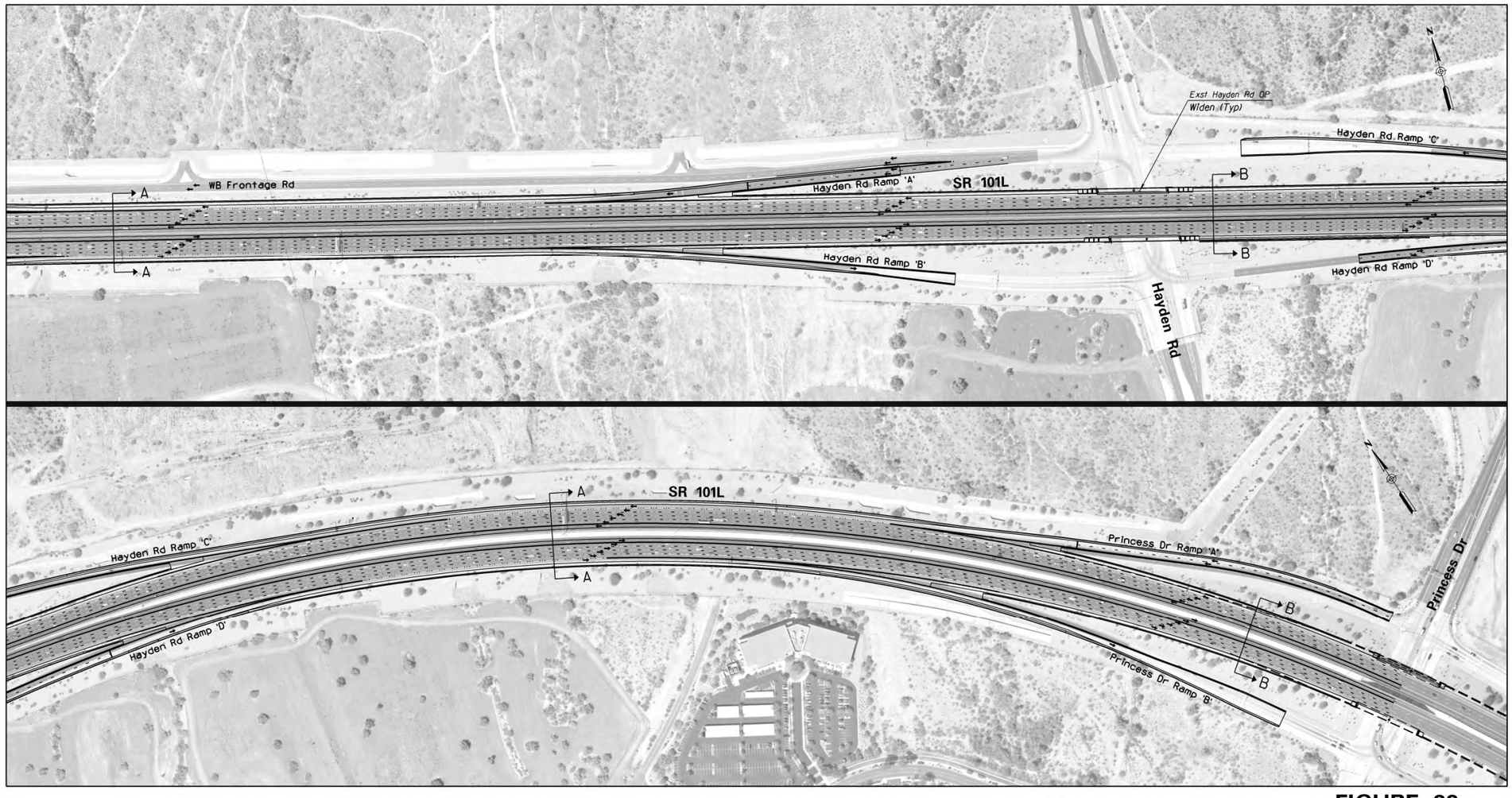

FIGURE 33
(Sheet 3 of 3)

SECTION A-A
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Aux Lane
12' Outside Shldr

SECTION B-B
EB & WB ROADWAY SECTION
10' Median Shldr
12' HOV Lane
12' Lane
12' Lane
12' Lane
12' Lane
12' Outside Shldr

	NAME	DATE
DESIGN	GJJ	05/14
DRAWN	WBE	05/14
CHECKED	RR	05/14

TRANSPORTATION: AECOM TECHNICAL SERVICES, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

TATUM BLVD - PRINCESS DRIVE
ALTERNATIVES A,B,C,D,E
DESIGN OPTION 1

ROUTE: SR 101L
LOCATION: I-17 - PRINCESS DRIVE

TRACS NO. H8297 01L

DCR
NOT FOR CONSTRUCTION OR RECORDING
DWG NO.
___ OF ___

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SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE | SURVEY NO.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $11,100,300.

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the traffic operational performance goals, and would not meet the required design standards, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative A (Design Option 1) would not achieve the traffic operational goals established for this project, and would not achieve the required engineering design standards, the project team recommends this scenario be eliminated from further consideration.

3.4.2.2 Alternative A (Design Option 2)

Evaluation of Alternative

The following is a summary of Alternative A (Design Option 2) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance and on the total length of the Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period. Therefore, Alternative A (Design Option 2) would not achieve the traffic operational goals established for this project.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

  Alternative A (Design Option 2) would not achieve the minimum design standards required for the travel lane and shoulder widths, and for the length of the eastbound auxiliary lane. Therefore, this scenario would not achieve the engineering design standards required for this project.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $11,382,900.

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the traffic operational performance goals, and would not meet the required design standards, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative A (Design Option 2) would not achieve the operational goals established for this project, and would not achieve the required engineering standards, the project team recommends this scenario be eliminated from further consideration.

3.4.2.3 Alternative A (Design Option 3)

Evaluation of Alternative

The following is a summary of Alternative A (Design Option 3) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The operational analysis results indicate significant congestion would occur on the I-17/SR101L TI Ramp 'S-E/N-E' entrance and on the total length of Ramp 'S-E' (which would likely queue back into the southbound I-17 mainline) during the A.M. peak travel period. Therefore, Alternative A (Design Option 3) would not achieve the traffic operational goals established for this project.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline widening with full shoulder and lane widths. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way impacts. Existing utility lines that are located within the 15th Avenue Underpass (electric) and the eastbound frontage road (water, electric service, telecommunications) would need to be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $19,114,500.

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the traffic operational performance goals established for this project, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative A (Design Option 3) would not achieve the traffic operational goals established for this project, the project team recommends this scenario be eliminated from further consideration.

3.4.2.4 Alternative B (Design Option 1)

Evaluation of Alternative

The following is a summary of Alternative B (Design Option 1) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The analysis results indicate significant congestion would occur on the eastbound SR 101L mainline during the A.M. peak travel period. Vehicle queuing would be anticipated to extend to the west on the SR 101L mainline from the 19th Avenue entrance ramp well past the I-17/SR101L TI. Therefore, Alternative B (Design Option 1) would not achieve the traffic operational goals established for this project.

  The reconfiguration of Ramp 'W-S/W-N' into a two lane mandatory exit would improve the level-of-service on the westbound SR 101L mainline approaching the system interchange when compared to Alternative A.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

  Alternative B (Design Option 1) would not achieve the minimum design standards for travel lane and shoulder widths. Therefore, this scenario would not achieve the engineering design standards required for this project.

- Right-of-Way and Utility Impacts: New right-of-way would be needed along the westbound frontage road between 19th Avenue and 15th Avenue (approximately 0.36 acres) that would potentially impact two residences. No significant utility impacts are anticipated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $14,428,600 (excluding right-of-way).

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the traffic operational performance goals, and would not meet the required design standards, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative B (Design Option 1) would not achieve the traffic operational goals established for this project, and would not achieve the required engineering standards, the project team recommends this scenario be eliminated from further consideration.

The project team recommends the reconfiguration of Ramp 'W-S/W-N' into a two lane mandatory exit based upon the improvement in the traffic operations on the westbound SR 101L mainline approaching the system interchange.

3.4.2.5 Alternative B (Design Option 2)

Evaluation of Alternative

The following is a summary of Alternative B (Design Option 2) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The analysis results indicate significant congestion would occur on the eastbound SR 101L mainline during the A.M. peak travel period. Vehicle queuing would be anticipated to extend to the west on the SR 101L mainline from the 19th Avenue entrance ramp well past the I-17/SR101L TI. Therefore, Alternative B (Design Option 2) would not achieve the traffic operational goals established for this project.

  The reconfiguration of Ramp 'W-S/W-N' into a two lane mandatory exit would improve the level-of-service on the westbound SR 101L mainline approaching the system interchange when compared to Alternative A.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline with full shoulder and lane widths. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: New right-of-way would be needed along the westbound frontage road between 19th Avenue and 15th Avenue (approximately 0.36 acres) that would potentially impact two residences. Existing utility lines that are located within the 15th Avenue Underpass (electric) and the frontage road would need to be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $22,401,800.

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the traffic operational performance goals established for this project, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative B (Design Option 2) would not achieve the traffic operational goals established for this project, the project team recommends this scenario be eliminated from further consideration.

The project team recommends the reconfiguration of Ramp 'W-S/W-N' into a two lane mandatory exit based upon the improvement in the traffic operation on the westbound SR 101L mainline approaching the system interchange.

3.4.2.6 Alternative C (Design Option 1)

Evaluation of Alternative

The following is a summary of Alternative C (Design Option 1) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. In order to provide seven eastbound travel lanes (1 HOV lane, 5 general-purpose lanes, 1 auxiliary lane) departing the I-17/SR101L TI at the 15th Avenue Underpass, the median and outside shoulder widths would be reduced to 0.5', and the travel lane widths would be reduced to 11'. An AASHTO design exception would be required for the reduced lane and shoulder widths.

  Alternative C (Design Option 1) would not achieve the minimum design standards for travel lane and shoulder widths. Therefore, this scenario would not achieve the engineering design standards required for this project.

- Right-of-Way and Utility Impacts: New right-of-way would be needed along the westbound frontage road between 17th Drive and 15th Avenue. New right-of-way would also be needed along the eastbound frontage road between 17th Avenue and 7th Avenue (approximately 0.56 acres and 7 potential residences total).

  Existing utility lines that are located within the eastbound frontage road (water, electric service, telecommunications) would be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: Due to the significant safety and operational issues that could result from the implementation of this Alternative and Design Option, an order-of-magnitude project cost estimate was not prepared for this scenario.

- Agency and Public Acceptance: Since this Alternative and Design Option would not achieve the required design standards, the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

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Recommendation

The project team recommends Alternative C (Design Option 1) be eliminated from further consideration because it would not achieve the engineering standards required for this project.

3.4.2.7 Alternative C (Design Option 2)

Evaluation of Alternative

The following is a summary of Alternative C (Design Option 2) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

  Since the majority of the crashes experienced on SR 101L have been rear-end crashes due to freeway congestion, the combination of the proposed freeway widening and added auxiliary lane length (between 19th Avenue and 7th Avenue) is anticipated to reduce the rate of crashes within this area.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline widening with full shoulder and lane widths. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: New right-of-way would be needed with this design option along the westbound frontage road between 17th Drive and 15th Avenue. New right-of-way would also be needed along the eastbound frontage road between 17th Avenue and 7th Avenue (approximately 1.18 acres and 7 potential residences total).

  Existing utility lines that are located within the 15th Avenue Underpass (electric) and the frontage roads (water, electric service, telecommunications) would be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $36,103,600.

- Agency and Public Acceptance: Since this Alternative and Design Option would achieve the traffic operational performance goals established for this project, and would achieve all ADOT and FHWA design standards requirements, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Since Alternative C (Design Option 2) would achieve the traffic operational goals and engineering design standards requirements established for this project, the project team recommends this scenario be carried forward with the overall Preferred Alternative.

3.4.2.8 Alternative D (Design Option 1)

Evaluation of Alternative

The following is a summary of Alternative D (Design Option 1) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

  However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2’ median shoulder, 11’ travel lanes and a 10’ outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

  Alternative D (Design Option 1) would not achieve the minimum design standards for lane and shoulder widths. Therefore, this scenario would not achieve the engineering standards required for this project.

- Right-of-Way and Utility Impacts: New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.11 acres) that would potentially impact four residences. No impacts to existing utilities are anticipated.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $13,087,900.

- Agency and Public Acceptance: The City of Phoenix has indicated they would not support any alternative that would remove the 19th Avenue TI ramps from service. The public concurred with this recommendation.

Recommendation

Alternative D (Design Option 1) would not achieve the minimum engineering standards required for this project, would eliminate the 19th Avenue TI ramp connections to the SR 101L mainline, and would not be supported by the local agencies and the public. Therefore, the project team recommends this scenario be eliminated from further consideration.

3.4.2.9 Alternative D (Design Option 2)

Evaluation of Alternative

The following is a summary of Alternative D (Design Option 2) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. The elimination of the 19th Avenue ramps would be anticipated to reduce the rate of crashes between 19th Avenue and 7th Avenue.

  However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline widening with full shoulder and lane widths. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.11 acres) that would potentially impact four residences. Existing utilities lines that are located within the 15th Avenue Underpass (electric) and the frontage road (water, electric services, telecommunications) would be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $21,000,900.

- Agency and Public Acceptance: The City of Phoenix has indicated they would not support any alternative that would remove the 19th Avenue TI ramps from service. The public concurred with this recommendation.

Recommendation

Alternative D (Design Option 2) would achieve the traffic operational goals and engineering design standard requirements established for this project. The elimination of the 19th Avenue ramps would be anticipated to reduce the rate of crashes between 19th Avenue of the 7th Avenue, but would likely not provide a significant benefit over Alternative C (Design Option 2).

The removal of the 19th Avenue TI ramps would eliminate freeway access between a regional arterial street and the freeway system, which would negatively impact the local residents and businesses along 19th Avenue. Therefore, local agency and public support is not anticipated for Alternative D. The project team recommends Alternative D (Design Option 2) be eliminated from further consideration.

3.4.2.10 Alternative E (Design Option 1)

Evaluation of Alternative

The following is a summary of Alternative E (Design Option 1) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area.

  However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via

the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would remain with this scenario. Similar to the existing conditions, the SR 101L eastbound and westbound roadways would transition from full travel lane and shoulder widths to a typical section that includes a 2' median shoulder, 11' travel lanes and a 10' outside shoulder. An AASHTO design exception would be required for the reduced lane and shoulder widths at this location.

  Alternative E (Design Option 1) would not achieve the minimum design standards for lane and shoulder widths. Therefore, this scenario would not achieve the engineering design standard required for this project.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $15,296,000.

- Agency and Public Acceptance: The City of Phoenix has stated they would not support any alternative that would remove the 19th Avenue TI ramps from service. The public concurred with this recommendation.

Recommendation

Since Alternative E (Design Option 1) would not achieve the minimum engineering standards required for this project, would eliminate the 19th Avenue TI ramp connections to the SR 101L mainline, and would not be supported by the local agencies and the public. Therefore, the project team recommends this scenario be eliminated from further consideration.

3.4.2.11 Alternative E (Design Option 2)

Evaluation of Alternative

The following is a summary of Alternative E (Design Option 2) when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: By implementing all of the improvements identified with this alternative, the SR 101L mainline would operate with an acceptable level-of-service through this area. The elimination of the 19th Avenue ramps would be anticipated to reduce the rate of crashes between 19th Avenue and 7th Avenue.

  However, the traffic currently using the 19th Avenue TI to access the freeway would be re-routed to other arterial streets, or would use the existing frontage roads to access SR 101L via the 7th Avenue TI. The 7th Avenue TI level-of-service would be negatively impacted due to the increased volume of traffic on the frontage roads.

- Ability to Achieve Engineering Standards: The existing 15th Avenue Underpass would be removed and replaced with a new bridge with sufficient span lengths to support the SR 101L mainline widening with full shoulder and lane widths. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: New right-of-way would be needed with this design option along the eastbound frontage road (approximately 0.03 acres) that would possibly impact four residents. Existing utility lines that relocated within the 15th Avenue Underpass (electric) and the frontage roads (water, electric service, telecommunications) would be relocated with this scenario.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this alternative. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $25,448,400.

- Agency and Public Acceptance: The City of Phoenix has stated they would not support any alternative that would remove the 19th Avenue TI ramps from service. The public concurred with this recommendation.

Recommendation

Alternative E (Design Option 2) would achieve the traffic operational goals and engineering design standard requirements established for this project. The elimination of the 19th Avenue ramps would be anticipated to reduce the rate of crashes between 19th Avenue of the 7th Avenue, but would likely not provide a significant benefit over Alternative C (Design Option 2).

The elimination of the 19th Avenue TI ramp connections to the SR 101L mainline would likely not be supported by the local agencies and the public. Traffic would also be redistributed from the 19th Avenue ramps to the frontage roads and adjust interchanges, which could negatively impact the level-of-service on those facilities. Therefore, the project team recommends this scenario be eliminated from further consideration.

3.4.3 Evaluation of Alternatives between 7th Avenue and 7th Street

3.4.3.1 Alternatives A, B, C, D, E (Design Option 1)

Evaluation of Alternative

The following is a summary of Design Option 1 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area. Traffic currently using the 7th Street TI west ramps would be required to be detoured to the eastbound and westbound frontage roads to use the 7th Avenue TI to access SR 101L during the ramp bridge reconstruction activities. The additional traffic detoured through the 7th Avenue TI would likely introduce congestion at this interchange for a significant length of time.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. No design exceptions would be required with this design option.

  The 7th Street Ramp 'A' and Ramp 'B' roadways would be realigned to coincide with the widened freeway mainline. Due to the freeway widening and current ramp design standard requirements, the existing ramp bridges over Cave Creek Wash would be removed and replaced with structures that support the new ramp alignments.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option, but a Section 404 Permit would be required for the construction of the new ramp bridges over Cave Creek Wash. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $13,003,700.

- Agency and Public Acceptance: The City of Phoenix has indicated they would prefer the existing ramps not be closed to traffic for the length of time required for the new bridge construction activities. The detoured traffic on the frontage roads could induce significant congestion at the 7th Avenue TI. The public acceptance of this design option will be evaluated after a review of the comments received at the public meetings.

Recommendation

Design Option 1 would achieve the traffic operational goals and design standard requirements established for this project. However, the removal and replacement of the 7th Street TI ramp bridges over Cave Creek Wash would introduce additional project costs and significant inconvenience to the public during the bridge reconstruction activities. The project team recommends this scenario be carried forward with the Preferred Alternative.

3.4.3.2 Alternatives A, B, C, D, E (Design Option 2)

Evaluation of Alternative

The following is a summary of Design Option 2 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area. Since the existing 7th Street TI ramp bridges over Cave Creek Wash would be retained, traffic detours would only be required for realignment of the ramp at the mainline connections.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would generally provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. However, the mainline would transition to provide a 10' median shoulder, 11' travel lanes, and a 12' outside shoulder in the vicinity of the Cave Creek Wash overpasses.

  The 7th Street Ramp 'A' and Ramp 'B' roadways would be realigned to coincide with the widened freeway mainline, yet would preserve the existing ramp bridges over Cave Creek Wash.

  A design exception would be required to reduce the travel lane widths to 11', and to reduce the roadway superelevation rate from 0.027'/ft to 0.020'/ft within the 7th Street Ramp 'B' gore area in order to match the existing bridge geometry.

  The project team has met with representatives of ADOT's Roadway Design Group and the FHWA to explore the viability of these design exceptions to preserve the existing ramp bridge structures. All parties originally agreed these design exceptions would be acceptable at this location. The FHWA later determined it would not be prudent to introduce reduced lane widths at this location.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $8,463,700.

- Agency and Public Acceptance: The City of Phoenix has indicated they would prefer the existing ramps not be closed to traffic for the duration required for the new bridge construction activities but understand the need to retain the existing lane widths on the SR 101L mainline. The public concurred with this recommendation.

Recommendation

Design Option 2 would achieve the traffic operational goals established for this project. A design exception request would have been required for the mainline travel lane widths in the vicinity of the existing Cave Creek Wash overpasses, Representatives of ADOT and FHWA originally indicated they would approve the design exception to preserve the existing ramp bridges and minimize the maintenance of traffic impacts during the ramp realignment activities, but later determined it would not be prudent to introduce reduced lane widths at this location. Therefore, the project team recommends this scenario be eliminated from further consideration.

3.4.4 Evaluation of Alternatives between 7th Street and Cave Creek Road

3.4.4.1 Alternatives A, B, C, D, E (Design Option 1)

Evaluation of Alternative

The following is a summary of Design Option 1 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The eastbound SR 101L mainline would operate with congestion during the A.M. peak travel period between the 7th Street entrance ramp and the Cave Creek Road exit ramp for Alternatives A, B and C. The westbound SR 101L mainline would operate with congestion during the P.M. peak travel period between the 7th Street exit ramp and the Cave Creek Road entrance ramp for Alternatives A, B and C.

  This freeway segment would operate with an acceptable level-of-service during the A.M. and P.M. peak travel periods with Alternatives D and E.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10’ median shoulder, 12’ travel lanes and a 12’ outside shoulder throughout this freeway segment. Auxiliary lanes would not be provided between the 7th Street TI east ramps and the Cave Creek Road west ramps. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $31,819,700.

- Agency and Public Acceptance: Since this Design Option would not achieve the traffic operational performance goals for this project for all of the alternatives that preserve the 19th Avenue TI ramps (Alternatives A - C), the local agency stakeholders do not support this scenario. The public concurred with this recommendation.

Recommendation

Since Design Option 1 would generally not achieve the traffic operational goals established for this project, the project team recommends this scenario be eliminated from further consideration.

3.4.4.2 Alternatives A, B, C, D, E (Design Option 2)

Evaluation of Alternative

The following is a summary of Design Option 2 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose and auxiliary lanes in a manner that would provide a 10’ median shoulder, 12’ travel lanes and a 12’ outside shoulder throughout this freeway segment. The 7th Street TI and Cave Creek Road TI ramps would be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

  The eastbound frontage road would be realigned between 20th Street and Cave Creek Road, and a short segment of the westbound frontage road would be realigned west of Cave Creek Road.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $38,897,000.

- Agency and Public Acceptance: Since this Design Option would achieve the traffic operational performance goal and would meet all ADOT and AASHTO design standards, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Since Design Option 2 would achieve the traffic operational goals and engineering standards requirements established for this project, the project team recommends this scenario be carried forward with the overall Preferred Alternative.

3.4.5 Evaluation of Alternatives between Cave Creek Road and the SR51/SR101L TI

3.4.5.1 Alternatives A, B, C, D, E (Design Option 1)

Evaluation of Alternative

The following is a summary of Design Option 1 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10’ median shoulder, 12’ travel lanes and a 12’ outside shoulder throughout this freeway segment. The Cave Creek Road TI and SR51/SR101L TI ramps will be realigned to coincide with the widened freeway mainline. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $34,837,400.

- Agency and Public Acceptance: Since this Design Option would achieve the traffic operational performance goals and design standards required for this project, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Since Design Option 1 would achieve the traffic operational goals and engineering standards requirements established for this project, the project team recommends this scenario be carried forward with the overall Preferred Alternative.

3.4.6 Evaluation of Alternatives between the SR51/SR101L TI and Tatum Boulevard

3.4.6.1 Alternatives A, B, C, D, E (Design Option 1)

Evaluation of Alternative

The following is a summary of Design Option 1 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

- Ability to Achieve Engineering Standards: The westbound SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10’ median shoulder, 12’ travel lanes and a 12’ outside shoulder throughout this freeway segment. The Tatum Boulevard Ramp ‘B’ would be widened to provide full shoulder widths for a two lane exit ramp. The Tatum Boulevard Ramp ‘A’ and the SR51/SR101L TI Ramp ‘W-S” would be realigned in support of the widened freeway mainline. No design exceptions would be required with this design option.
- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $10,836,100.

- Agency and Public Acceptance: Since this Design Option would achieve the traffic operational performance goals and would meet all design standards requirements, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Design Option 1 would achieve the traffic operational goals and engineering standards requirements established for this project. This design option would also provide the SR51/SR101L TI Ramp 'W-S' exit with a two lane mandatory exit from the outside travel lanes, which is the preferred configuration by the Department. This design option would also minimize impacts to the north drainage channel when compared with Design Option 2, along with a lower total project cost. Therefore, the project team recommends Design Option 1 be carried forward with the overall Preferred Alternative.

3.4.6.2 Alternatives A, B, C, D, E (Design Option 2)

Evaluation of Alternative

The following is a summary of Design Option 2 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

- Ability to Achieve Engineering Standards: The westbound SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. The Tatum Boulevard Ramp 'B' would be widened to provide full shoulder widths for a two lane exit ramp. The Tatum Boulevard Ramp 'A' and the SR51/SR101L TI Ramp 'W-S" would be realigned in support of the widened freeway mainline. No design exceptions would be required with this design option.

- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $12,705,100.

- Agency and Public Acceptance: Since this Design Option would achieve the traffic operational performance goals, and would meet all design standard requirements, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Design Option 2 would achieve the traffic operational goals and engineering standards goals established for this project. However, this design option would provide the SR51/SR101L TI Ramp 'W-S' exit with as a mandatory exit from the outside travel lane, with the second lane optional with the mainline through movement, which is not currently the preferred exit configuration by the Department for directional ramps.

This design option would also introduce additional impacts to the north drainage channel when compared with Design Option 1, along with a higher total project cost. Therefore, the project team recommends Design Option 2 be eliminated from further consideration.

3.4.7 Tatum Boulevard to Princess Drive

3.4.7.1 Alternatives A, B, C, D, E (Design Option 1)

Evaluation of Alternative

The following is a summary of Design Option 1 when compared to the evaluation criteria:

- Conformance with Adopted Regional Transportation Plans: This alternative is consistent with the goals and objectives of the voter-approved Regional Transportation Plan. This alternative would add an additional general-purpose lane in each direction of travel along SR 101L.

- Traffic Operational Performance: The SR 101L mainline would operate with an acceptable level-of-service through this area for all SR 101L mainline widening alternatives.

- Ability to Achieve Engineering Standards: The SR 101L mainline would be widened to provide the additional general-purpose lanes in a manner that would provide a 10' median shoulder, 12' travel lanes and a 12' outside shoulder throughout this freeway segment. No design exceptions would be required with this design option.
- Right-of-Way and Utility Impacts: This design option would not result in any right-of-way or utility impacts.

- Environmental Considerations: No fatal flaw environmental issues have been identified with this design option. New noise walls would be placed at locations warranted by the noise technical study.

- Total Estimated Project Cost: The total estimated order-of-magnitude project cost for this scenario is $42,355,600.

- Agency and Public Acceptance: Since this Design Option would achieve the traffic operational performance goals and would meet all ADOT and FHWA design standard requirements, the local agency stakeholders support this scenario. The public concurred with this recommendation.

Recommendation

Since Design Option 1 would achieve the traffic operational goals and engineering standards goals established for this project, the project team recommends this scenario be carried forward with the overall Preferred Alternative.

3.5 SUMMARY AND OVERALL RECOMMENDATION

In summary, the project team recommends the overall Preferred Alternative for the total study area include the following for each segment of the project:

- I-17/SR101L TI to 7th Avenue: Alternative C (Design Option 2)
- 7th Avenue to 7th Street: Alternatives A-E (Design Option 2)
- 7th Street to Cave Creek Road: Alternatives A-E (Design Option 1)
- Cave Creek Road to the SR51/SR101L TI: Alternatives A-E (Design Option 1)
- SR51/SR101L TI to Tatum Boulevard: Alternatives A-E (Design Option 1)
- Tatum Boulevard to Princess Drive: Alternatives A-E (Design Option 1)

The Preferred Alternative would achieve the traffic operational goals and engineering standard requirements established for this project. In addition, the project team also recommends the eastbound and westbound frontage roads transition from two lanes to one lane between 19th Avenue and 7th Avenue to minimize right-of-way acquisition from adjacent properties.

The order-of-magnitude total project cost estimate for the Preferred Alternative is approximately $176,034,100 based on the Tier 1 estimates developed for all the alternatives and design options. Refinements to the design of the Preferred Alternative has resulted in an updated total project cost estimate of approximately $155,225,300 as shown in Section 5.0. The project budget for the total length of the project (I-17 to Princess Drive) is $138,300,000.

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Table 26 – Alternative Analysis Matrix (I-17 to 7th Avenue)

Evaluation Criteria	Alternative Number (with Design Option)										
	Alternative A: Prioritize Eastbound I-17 GP Lanes (3 lanes) versus Ramp 'S-E'/'N-E' Lanes (1 lane)			Alternative B: Prioritize Ramp 'S-E' Lanes (2 lanes) versus Eastbound I-17 GP Lanes (2 lanes)		Alternative C: Provide Lanes for Eastbound I-17 GP Lanes (3 lanes) and Ramp 'S-E'/'N-E' (2 lanes)		Alternative D: Provide Lanes for Eastbound I-17 GP Lanes (3 lanes) and Ramp 'S-E'/'N-E' (2 lanes); Eliminate 19th Ave. Ramps		Alternative D: Provide Lanes for Eastbound I-17 GP Lanes (3 lanes) and Ramp 'S-E'/'N-E' (2 lanes); Eliminate 19th Ave. Ramps	
	Design Option 1 (15th Ave. U.P. to Remain)	Design Option 2 (15th Ave. U.P. to Remain)	Design Option 3 (Replace 15th Ave. U.P.)	Design Option 1 (15th Ave. U.P. to Remain)	Design Option 2 (Replace 15th Ave. U.P.)	Design Option 1 (15th Ave. U.P. to Remain)	Design Option 2 (Replace 15th Ave. U.P.)	Design Option 1 (15th Ave. U.P. to Remain)	Design Option 2 (Replace 15th Ave. U.P.)	Design Option 1 (15th Ave. U.P. to Remain)	Design Option 2 (Replace 15th Ave. U.P.)
Conformance with Adopted Regional Transportation Plans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Traffic Operational Performance (LOS 'D' or better?)	No	No	No	No	No	Yes	Yes	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Ability to Achieve Engineering Standards ("No" if any Design Exceptions are required)	No	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Right-of-Way Requirements	None	None	None	0.36 Acres, 2 Residences	0.36 Acres, 2 Residences	0.56 Acres, 7 Residences	1.18 Acres, 7 Residences	0.11 Acres, 4 Residences	0.11 Acres, 4 Residences	None	0.03 Acres, 4 Residences
Utility Impacts (Minor/Significant)	None	None	Minor	None	Minor	None	Minor	None	Minor	None	Minor
Environmental Considerations (Any Fatal Flaws?)	No	No	No	No	No	No	No	No	No	No	No
Total Estimated Project Cost (excluding R/W)	$11,100,300	$11,382,900	$19,114,500	$14,428,600	$22,401,800	N/A	$36,103,600	$13,087,900	$21,000,900	$15,296,000	$25,448,400
Agency and Public Acceptance (Low, Medium, High)	Low	Low	Low	Low	Low	Low	High	Low[2]	Low[2]	Low[2]	Low[2]
Recommendation:	**Eliminate**	**Eliminate**	**Eliminate**	**Eliminate**	**Eliminate**	**Eliminate**	**Recommend**	**Eliminate**	**Eliminate**	**Eliminate**	**Eliminate**

Notes: (1) The SR 101L mainline would operate acceptably, but the 7th Avenue TI would operate at LOS 'F' due to the re-routed 19th Ave TI ramp traffic
(2) The City of Phoenix has stated they would not support the elimination of the 19th Avenue TI ramps

Table 27 – Alternative Analysis Matrix (7th Avenue to Princess Drive)

Evaluation Criteria	SR 101L Freeway Segment							
	7th Avenue to 7th Street		7th Street to Cave Creek Rd.		Cave Creek Rd. to SR51/SR101L TI	SR51/SR101L TI to Tatum Blvd.		Tatum Blvd. to Princess Dr.
	Design Option 1 (Reconstruct Cave Creek Road Ramp Bridges)	Design Option 2 (Retain Cave Creek Road TI Ramp Bridges)	Design Option 1 (No Auxilary Lanes)	Design Option 2 (Provide Auxiliary Lanes)	Design Option 1	Design Option 1 (Ramp 'W-S' Mandatory Two Lane Exit)	Design Option 2 (Ramp 'W-S' Optional Two Lane Exit)	Design Option 1 (Add One GP Lane)
Conformance with Adopted Regional Transportation Plans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Traffic Operational Performance (LOS 'D' or better?)	Yes	Yes	No[1]	Yes	Yes	Yes	Yes	Yes
Ability to Achieve Engineering Standards ("No" if any Design Exceptions are required)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Right-of-Way Requirements	None	None	None	None	None	None	None	None
Utility Impacts (Minor/Significant)	None	None	None	None	Minor	None	None	Minor
Environmental Considerations (Any Fatal Flaws?)	Section 404 Permit	No	No	No	Section 404 Permit	No	No	None
Total Estimated Project Cost (excluding R/W)	$13,003,700	$8,463,700	$31,819,700	$38,897,700	$34,837,400	$10,836,100	$12,705,100	$42,355,600
Agency and Public Acceptance (Low, Medium, High)	Low	High	Low	High	High	High	Medium	High
Recommendation:	**Recommend**	**Eliminate**	**Eliminate**	**Recommend**	**Recommend**	**Recommend**	**Eliminate**	**Recommend**

Notes: (1) Traffic operational performance would be acceptable for Alternatives D and E

4.0 MAJOR DESIGN FEATURES OF THE PREFERRED ALTERNATIVE

4.1 DESIGN CONTROLS

SR 101L is classified as an Urban Principal Freeway/Expressway. A summary of the design controls for the SR 101L mainline is provided in Table 28. A summary of the design controls for the system and service interchange ramps are provided in Tables 29 and 30. The design controls for the frontage roads is provided in Table 31.

Table 28 – Design Controls for SR 101L Mainline

Description Of Criteria	Values For Design
Design Year:	2035
Design Speed (Existing):	65 mph
Superelevation:	Match existing (0.06 ft/ft maximum)
Cross Slope:	2.0%
Lane Width:	12 ft.
Shoulder Width:	
- Median:	10 ft.
- Outside:	12 ft.
Maximum Horizontal Curve:	3 degree, 27 minutes
Maximum Gradient:	Not applicable, match existing
Taper Rate:	65:1
Slope Standards:	
- Median:	Varies, 3:1 maximum
- Fill slopes:	Varies, 3:1 maximum
Minimum Vertical Clearance:	
- Highway structure.	16.5 ft.
- Pedestrian Overpass	17.5 ft.

Table 29 – Design Controls for System Interchange Ramps

Description Of Criteria	Values For Design
Design Year:	2035
Design Speed:	55 mph
Superelevation:	Match Existing (0.06 ft/ft maximum)
Cross Slope:	2.0%
Pavement Width:	
- Single lane ramps:	28 ft.
- Two lane ramps:	36 ft., plus 2 ft. offset to barrier
Lane Width:	12 ft.
Shoulder Width:	
- Inside shoulder:	4 ft., plus 2 ft. offset to barrier
- Outside shoulder:	8 ft., plus 2 ft. offset to barrier
Maximum Horizontal Curvature:	5 degree, 15 minute
Maximum Gradient:	+4%, -5%
Slope Standards:	
- Cut slopes:	Varies, 3:1 maximum
- Fill slopes:	Varies, 3:1 maximum
Minimum Vertical Clearance::	
- Highway structure:	16.5 ft.
- Pedestrian Overpass	17.5 ft.

Table 30 – Design Controls for Service Interchange Ramps

Description Of Criteria	Values For Design
Design Year:	2035
Design Speed:	
- Nose of gore (exit ramps):	60 mph
- Nose of gore (entrance ramps):	55 mph
- Ramp body:	50 mph
- Ramp terminal:	35 mph
Superelevation:	Match Existing (0.06 ft/ft max.)
Pavement Width:	
- Single lane exit ramp:	22 ft., plus 2 ft. offset to barrier
- Two lane exit ramp:	34 ft., plus 2 ft. offset to barrier
- Entrance ramp:	28 ft., plus 2 ft. offset to barrier
Lane Width:	12 ft.
Maximum Horizontal Curve:	6 degree, 45 minute
Maximum Gradient:	+4%, -5%, +/- 3% at crossroad
Slope Standards:	
- Cut slopes:	Varies, 3:1 maximum
- Fill slopes:	Varies, 3:1 maximum
Minimum Vertical Clearance:	
- Highway structure:	16.5 ft.
- Pedestrian Overpass	17.5 ft.

Table 31 – Design Controls for Frontage Roads

Description Of Criteria	Values For Design
Design Year:	2035
Design Speed:	45 mph
Superelevation:	Match Existing (0.06 ft/ft max.)
Pavement Width:	
- Single lane exit ramp:	22 ft., plus 2’ offset to barrier
- Two lane exit ramp:	24 ft., plus 2’ offset to barrier
- Entrance ramp:	28 ft., plus 2’ offset to barrier
Lane Width:	12’
Maximum Horizontal Curve:	8 degrees, 55 minutes
Maximum Gradient:	+4%, -5%, +/- 3% of crossroad
Slope Standards:	
- Cut slopes:	Varies, 3:1 maximum
- Fill slopes:	Varies, 3:1 maximum
Minimum Vertical Clearance:	
- Highway structure:	16.5 ft.
- Pedestrian Overpass	17.5 ft.

4.2 SR 101L WIDENING ROADWAY CONFIGURATION

A design concept was developed to construct one additional general-purpose lane in each direction on the SR101L mainline from the I-17/SR101L TI and the SR51/SR101L TI, and from the SR51/SR101L TI to Princess Drive as presented in Appendix H.

Eastbound SR 101L Mainline

The existing configuration of the SR 101L mainline (three general-purpose lanes and one HOV lane) approaching I-17 would be extended to be continuous between I-17 and Princess Drive. The 27th Avenue entrance ramp would be designed with a tapered entrance configuration that merges into the outside freeway lane to retain this mainline lane configuration approaching the I-17/SR101L TI Ramp 'S-E/N-E' entrance gore.

This alternative would improve the eastbound SR 101L mainline departing the system interchange by retaining the Ramp 'S-E/N-E' entrance (2 lanes) to allow each directional ramp to enter the mainline with a "lane-add" design. This two lane ramp entrance, combined with the eastbound SR 101L mainline (3 general-purpose lanes and one HOV lane), would provide five general-purpose lanes and one HOV lane departing the system interchange.

The 19th Avenue entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (2 lanes) would be a parallel exit configuration with a mandatory exit from the auxiliary lane, and the second lane designed as an optional lane with the SR 101L through movement. Five general-purpose lanes and one HOV lane would continue to the east.

An AASHTO lane drop would be utilized east of the 7th Avenue underpass to reduce the number of general-purpose lanes from five lanes to four lanes prior to the 7th Avenue entrance ramp gore. Four general-purpose lanes and one HOV lane would continue to the east to the SR51/SR101L TI.

The 7th Avenue entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 7th Street exit. The 7th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 7th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Cave Creek Road exit. The Cave Creek Road exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The Cave Creek Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the SR51/SR101L TI Ramp 'E-S' exit. The full median shoulder and travel lane widths would be provided within this area. The SR51/SR101L TI Ramp 'E-S' would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

An AASHTO lane drop would be utilized east of the SR51/SR101L TI Ramp 'E-S' exit to reduce the number of general-purpose lanes from four lanes to three lanes prior to the SR51/SR101L TI Ramp 'N-W' bridge. Three existing general-purpose lanes and one HOV lane would continue to the east through the system interchange.

The SR51/SR101L TI Ramp 'N-E' (2 lanes) would enter the SR 101L mainline and continue to the east to Tatum Boulevard to provide five general-purpose lanes and one HOV lane within this area. No roadway improvements are proposed to the mainline within this area. The Tatum Boulevard exit ramp (2 lanes) would be widened to provide a parallel exit configuration with a mandatory exit from the outside lane, and the second lane designed as an optional lane with the SR 101L through movement. Four existing general-purpose lanes and one HOV lane would continue to the east.

This alternative would improve the eastbound SR 101L mainline east of the Tatum Boulevard Overpass by extending the fourth general-purpose lane to Princess Drive. The Tatum Boulevard entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 56th Street exit. The 56th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 56th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 64th Street exit. The 64th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 64th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Scottsdale Road exit. The Scottsdale Road exit ramp (2 lanes) would be widened to provide a parallel exit configuration with a mandatory exit from the auxiliary lane, and the second lane designed as an optimal lane with the SR 101L through movement.

However, the 64th Street TI is currently not open to traffic. The exit ramp, entrance ramp and auxiliary lanes would remain closed until this interchange is opened to traffic in the future.

The Scottsdale Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Hayden Road exit. The Hayden Road exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The Hayden Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Princess Drive exit. The Princess Drive exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane. Four general-purpose lanes and one HOV lane would continue to the east to match the planned freeway improvements for the remainder of the route.

Westbound SR 101L Mainline

Four general-purpose lanes and one HOV lane is currently planned for westbound SR 101L between Princess Drive and the SR51/SR101L TI. The Princess Drive entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Hayden Road exit. The Hayden Road exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The Hayden Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Scottsdale Road exit. The Scottsdale Road exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The Scottsdale Road entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the 64th Street exit. The 64th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 64th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to 56th Street exit. The 56th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

However, the 64th Street TI is currently not open to traffic. The exit ramp, entrance ramp and auxiliary lanes would remain closed until this interchange is opened to traffic in the future.

The 56th Street entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the Tatum Boulevard exit. The Tatum Boulevard exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The Tatum Boulevard entrance ramp (1 lane) would be configured as a parallel entrance that transitions into an auxiliary lane that continues to the SR51/SR101L TI Ramp 'W-S' exit. The SR51/SR101L TI Ramp 'W-S' exit ramp (2 lanes) would be reconfigured to provide a two lane mandatory exit from the outside freeway lanes. Three general-purpose lanes and one HOV lane would continue to the west through the system interchange.

The SR51/SR101L TI Ramp 'N-W' would be reconfigured to a two lane ramp that would enter the SR 101L mainline with a "lane-add" design. Five general-purpose lanes and one HOV lane would depart the system interchange.

The Cave Creek Road exit ramp (2 lanes) would be a parallel exit configuration with a mandatory exit from the outside lane, and the second lane designed as an optional lane with the SR 101L through movement. Four general-purpose lanes and one HOV lane would continue to the west to the I-17/SR101L TI.

The Cave Creek Road entrance ramp would be designed as a parallel entrance ramp that transitions into an auxiliary lane that continues to the 7th Street exit. The 7th Street exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 7th Street entrance ramp would be designed as a parallel entrance ramp that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 7th Street entrance ramp would be designed as a parallel entrance ramp that transitions into an auxiliary lane that continues to the 7th Avenue exit. The 7th Avenue exit ramp (1 lane) would be a parallel exit configuration with a mandatory exit from the auxiliary lane.

The 7th Avenue entrance ramp would be designed as a parallel entrance that transitions into an additional lane that continues to the I-17/SR101L TI Ramp 'W-S/W-N' exit. The 19th Avenue exit ramp (1 lane) would be a tapered exit configuration from the outside travel lane. The I-17/SR101L TI Ramp 'W-S/W-N' exit ramp (2 lanes) would be reconfigured to provide a two lane mandatory exit from the outside freeway lanes. Three general-purpose lanes and one HOV lane would continue to the west on the SR 101L mainline.

Frontage Roads

In an effort to minimize the new right-of-way requirements for this project, the number of lanes on the eastbound and westbound frontage roads would be reduced from two lanes to one lane in the vicinity of 15th Avenue. The eastbound and westbound frontage roads would be realigned to support the new general-purpose lanes and auxiliary lanes west of Cave Creek Road.

4.3 HORIZONTAL AND VERTICAL ALIGNMENTS

Plan and profile sheets are provided in Appendix H. The plans include the horizontal and vertical alignments for the existing SR 101L mainline, system and service interchange ramps, and arterial streets. No modifications are proposed to the existing horizontal and vertical alignments for the SR 101L mainline and crossroads.

4.4 ACCESS CONTROL

Access control already exists and will be maintained in accordance with ADOT and FHWA Access Control Policy requirements.

4.5 RIGHT-OF-WAY

Acquisition of new right-of-way within the project limits is anticipated at two general locations as shown in Appendix H. Approximately 0.06 acre of new right-of-way is anticipated along the westbound frontage road east of 17th Drive, and approximately 0.09 acre is anticipated along the eastbound frontage road east of 13th Avenue.

Noise walls may be warranted at numerous locations, which could require maintenance agreements with adjacent residential properties. Temporary Construction Easements (TCE's) will be required for the construction of the Preferred Alternative. The TCE locations and limits will be finalized during final design.

4.6 STRUCTURES

This section describes the features of the structural elements needed to support the Preferred Alternative under consideration. This section also includes recommendations for the new bridge structures, widening of existing bridge structures, retaining walls and noise walls.

4.6.1 Introduction

Thirteen mainline overpass bridge crossings would be widened to accommodate the additional new general-purpose lanes and auxiliary lanes associated with the Preferred Alternative. The overpasses that would be widened include:

- 19th Avenue TI Overpass (Structure No. 2130 & 2131, MP 24.21)
- Cave Creek Wash Bridge (Structure No. 1490 & 1491, MP 25.90)
- 7th Street TI Overpass (Structure No. 1826 & 2469, MP 26.19)
- 16th Street TI Overpass (Structure No. 1690 & 2470, MP 27.17)
- Cave Creek Road TI Overpass (Structure No. 1479 & 2471, MP 28.22)
- 32nd Street Overpass (Structure No. 2472 & 2540, MP 29.19 & 29.22, respectively)
- CAP Canal Bridge (Structure No. 2473 & 2541, MP 29.39 & 29.42, respectively)
- Low Flow Channel Bridge (Structure No. 2474, MP 29.51)
- CAP Basin No. 1 Bridge (Structure No. 2542, MP 29.54)
- Tatum Boulevard TI Overpass (Structure No. 2475 & 2476, MP 31.31)
- 56th Street TI Overpass (Structure No. 2543 & 2544, MP 32.39)
- Scottsdale Road TI Overpass (Structure No. 1457, MP 34.52)
- Hayden Road TI Overpass (Structure No. 1458, MP 35.55)

In addition to the general-purpose lane widenings, the 15th Avenue Underpass (Structure No. 2464, MP 24.66), Cave Creek Wash Ramp 7SA (Structure No. 1466, MP 25.90), and Cave Creek Wash Ramp 7SB (Structure No. 1486, 25.90) structures would be removed and replaced to accommodate the additional general-purpose and auxiliary lanes approaching and departing the I-17/SR101L TI.

The existing bridges consist of either cast-in-place post-tensioned concrete box girders, precast prestressed AASHTO girders, or three-span cast-in-place post-tensioned concrete box girders with drop-in AASHTO girders located in the second span. A summary of the existing bridge structures is provided on Table 5 (page 13).

This study included an evaluation of potential alternatives to widen the existing bridges. The evaluation examined numerous issues including the ability to maintain minimum vertical clearances during construction, minimum vertical clearances for the widened bridge structures, maintenance of traffic during construction, constructability of the widened portion of the bridge, potential impacts to the existing ramps and ramp intersections, aesthetics, and construction costs. While this document is not intended to select the final bridge configuration at each location, the anticipated and feasible structure type(s) are discussed for each location.

4.6.2 Widening of Existing Bridge Structures

Structural Considerations

Cast-in-Place Post-Tensioned Concrete Box Girder

Post-tensioned structures are utilized extensively throughout the Regional Freeway System. The advantages of utilizing post-tensioned box girders for the widening of the existing structures include the following:

- This superstructure configuration would be consistent with the majority of the existing bridges that would be widened with the project and could match the aesthetics of the existing bridges.
- A similar superstructure configuration as the existing bridge would match the existing structural behavior.
- This superstructure configuration would accommodate various roadway geometric situations that occur at interchange ramp taper and gore areas.
- The widened portion of the bridge can be built on falsework above traffic. If the required falsework vertical clearance is not available, the superstructure could be built at the elevation needed to provide the minimum construction vertical clearance and then hydraulically lowered into the final position. Alternatively, a through-girder concept could be utilized to gain additional temporary clearance.

The disadvantages of utilizing post-tensioned box girders constructed on falsework for the widening of existing structures include:

- Reduced vertical clearances: A minimum vertical clearance of 16’ is desired over existing roadways during construction. The falsework clearance has been reduced below this limit on previous projects by using overhead crash beams. However, the use of crash beams for sites with reduced vertical clearance is now discouraged due to safety and operational concerns. The minimum falsework clearance could be mitigated by constructing the widened portion of the bridge on falsework at an elevation higher than the existing bridge, and then lowering the superstructure onto the abutments and piers with hydraulic jacks. However, this bridge construction method would add complexity to the bridge design and construction and increases the cost of the bridge.
- Traffic impacts during construction: The use of falsework may require additional falsework towers that would reduce the number of travel lanes that are open to traffic during construction. Precast elements used in conjunction with cast-in-place alternatives can provide increased spans and reduce the number of or eliminate falsework towers. Typical falsework spans are generally limited to a maximum opening of 60’. Increasing the falsework spans beyond 60’ is feasible; larger spans may require larger falsework girders that may not be readily available to the contractor, which could increase the project cost and construction duration. This type of bridge construction would also have an increased number of construction closures.

- Construction costs: Post-tensioned structures are typically more cost effective if constructed on soffit fill. Several of the bridge structures on this project support freeway crossings over arterial streets which preclude a soffit fill construction method. At these locations, the widening of the existing bridge structures with this superstructure configuration would require the use of falsework, increasing the cost of construction.
- Reduced safety: More construction activities will occur over and adjacent to traffic, thereby reducing worker and public safety.
- Construction duration: A cast-in-place post-tensioned superstructure would generally exceed the duration required for precast girder bridge construction by approximately 30 to 60 days. The construction duration would also be increased by approximately 60 days to allow for creep and shrinkage in the post-tensioned, widened structures to occur prior to placing a concrete deck closure pour. The total increase in construction duration by utilizing a post-tensioned box girder option for the bridge structure widening compared to precast girders would be approximately 90 days.
- Falsework: Multi-span bridges make the construction of falsework and lowering the superstructure into place by hydraulic jacking problematic. The hydraulic jacking of the superstructure must be sequenced carefully to ensure that the unintentional redistribution of forces does not lead to overstressing the superstructure.
- Steel Through-Girders: The use of steel through-girders to mitigate temporary construction clearances would add additional cost to the bridge construction, because additional fabrication will be required for non-standard, welded steel plate girders.
- Matching the new and existing bridge decks: Many variables must be considered that affect the long and short term camber of a bridge including temperature, creep and shrinkage. Techniques that can be utilized to ensure the existing and new bridge deck elevations will match at the interface include larger closure pours, the placement of additional deck thickness with subsequent deck milling, placement of an asphalt overlay, developing more detailed camber calculations, providing additional creep and shrinkage testing of the concrete mix, providing additional post-tensioning that can be tensioned or de-tensioned to adjust the bridge structure widening profile, using high performance concrete to reduce creep and shrinkage effects and providing higher construction quality control.

Precast Prestressed Concrete Girders

A significant number of precast, prestressed concrete girder bridge structure widenings have been constructed throughout the Regional Freeway System. AASHTO girders or precast prestressed box beams are an excellent alternative structure type for the widening of both CIP post-tensioned concrete box girder and precast girder bridges.

The advantages of utilizing precast sections include the following:

- Reduced construction duration: The majority of the creep and shrinkage that would occur in the precast girders would be completed prior to the erection of the girder. Therefore, the widened portion of the bridge deck can be placed with one pour, eliminating the need for a closure pour.
- Falsework: The use of precast girders would eliminate the need for falsework, thereby reducing the impacts to traffic during the construction of the bridge. Crossroad closures would be required during the erection of the girders, placement of stay-in-place deck forms (if applicable) and concrete placement of the deck.

The disadvantages of utilizing precast sections include the following:

- Depth of superstructure: A precast girder bridge would generally require a deeper superstructure section, which could impact the vertical clearance over the crossroad.
- Roadway geometry: A precast girder superstructure is not as conducive as post-tensioned box girder bridges to accommodate unique roadway geometry situations that occur at traffic interchange ramp connections. Therefore, additional deck area (that would not be used to support traffic) may be necessary at certain locations.

Steel Girders

Steel girders were considered for the bridge structure widenings associated with this project. However, steel girders react to temperature changes more abruptly than concrete structures. All of the structures that would be widened were originally constructed with precast, prestressed concrete girders and/or post-tensioned concrete box girders. Therefore, steel girders may experience greater expansion and contraction than concrete girders in a given day. This may lead to compatibility issues between the existing and widened structure. In addition, steel girders are not typically cost competitive in Arizona, require a long fabrication and delivery schedule, and require additional maintenance. Therefore, steel girder superstructure alternatives for the widening of existing concrete superstructures were conceptually eliminated from consideration.

4.6.3 Design and Constructability Requirements

The bridge design and constructability issues were discussed extensively with representatives of ADOT's Bridge Group, Phoenix Construction District, and representatives of the local agencies. Therefore, the initial evaluation of alternatives for the widening of the existing bridge structures included the items shown below.

Vertical Clearance

A minimum vertical clearance of 16'-0", or the existing vertical clearance (whichever is less), over active traffic lanes is desirable during construction. The falsework clearance can be reduced below this limit with the approval of ADOT Bridge Group and Phoenix Construction District and with the use of crash beams. However, the use of crash beams for sites with reduced vertical clearance is now discouraged due to safety and operational concerns. Therefore, the development of alternative bridge widening configurations for this study was based on maintaining a 16'-0" minimum vertical clearance or the existing vertical clearance.

ADOT Bridge Group has requested that the bridge widening alternatives provide 16'-6" vertical clearance over the crossroads in the final condition. If the overpass currently provides less than 16'-6" vertical clearance, then the existing clearance should be maintained for the widened portion of the overpass where practical.

Bridge Barriers

All of the SR 101L mainline bridges within the project limits would use ADOT Standard 34" height F-shaped half barriers at the edge of the bridge deck. These bridges do not warrant the use of a 44" F-shape barrier as they do not pass over another freeway.

Concrete Strength

The bridge practice guidelines limit the maximum 28-day compressive strength of concrete to 6,500 psi for precast girders and 6,000 psi for cast-in-place post-tensioned concrete box girders constructed within the Phoenix Metropolitan area. If needed, the final designer may consider higher concrete strengths with approval from ADOT Bridge Group.

Design Codes

ADOT Bridge Group's current policy is that Load and Resistance Factor Design (LRFD), as amended by the *ADOT Bridge Design Guidelines,* will be required for the design of the widening of existing bridges that were previously designed using the *AASHTO Standard Specifications*. Any new bridge structures shall be designed in accordance with the most current ADOT *Bridge Design Guidelines*.

Design Loads

All of the existing bridge structures were originally designed for HS-20 loading, with provisions for an additional 25 pounds per square foot of deck area for a future wearing surface. The widened structures should be designed utilizing the HL-93 live load and additional dead load conditions.

Maintenance of Traffic Operations

Minimizing impacts to the traveling public will be an important consideration in the bridge widening type selection.

Condition of Existing Bridges

The condition of the existing bridge structures is summarized in the bridge evaluation request form included in the AASHTO Controlling Criteria Report in Appendix C.

4.6.4 Evaluation of Bridge Widening Alternatives

The initial alternative consideration for the widening of each bridge is discussed in this section of the report. A summary of the bridge widenings is presented in Table 32 (page 171) following the site-specific discussions. A preliminary feasible alternative was selected at each location for cost estimating purposes and is based upon the information known at the time of this report. A detailed structure evaluation and selection process will be performed during the next design phase of the project.

Unless noted otherwise, it is anticipated that all or part of the existing concrete deck overhangs on the existing bridges would be removed to allow the widened portion of the bridge to be connected to the existing superstructure.

4.6.4.1 19th Avenue TI Overpass (Structure No. 2130 & 2131, MP 24.21)

Existing Bridge Configuration

The existing bridges are single span, cast-in-place post-tensioned concrete box girder structures that pass over 19th Avenue. Both bridges have spans of 169.36' with a total structure length (measured along the construction centerline) of 174.92'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a crest vertical curve and on a horizontal curve with a 8° 29' 36" skew to the crossroad. The bridges are superelevated at a variable rate (2.3% maximum) that slopes down toward the outside shoulder for the eastbound roadway and down toward the median shoulder for the westbound roadway.

The 19th Avenue Overpasses were recently widened to the inside to accommodate HOV lanes within the median. The existing westbound clear roadway width is 81.38'. The existing eastbound clear roadway width varies from 100.08' at the west end of the bridge to 96.70' at the east end of the bridge. The widening of the westbound structure would provide one additional travel lane resulting in a clear roadway width of 93.38'.

Foundation Type

The existing substructures for the bridges consist of partial-height abutments founded on drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration for the existing bridge.

Feasible Structure Types and Traffic Control Requirements

Two structural options would be feasible for the widening of the westbound structure. The first option would be to widen the existing bridge using a cast-in-place post-tensioned concrete box girder configuration that would be constructed above the existing structure's finished grade on falsework (to achieve a minimum 16' temporary vertical clearance that is higher than the existing structure's clearance of 15.15') and then hydraulically lowered into final position. Since the structure would be widened toward the high side of the superelevated roadway, a shallower post-tensioned box is not anticipated to address the low vertical clearance of the existing structure. It is anticipated partial closures of the crossroad through lanes would be needed for the placement of the falsework towers that would be needed to support the superstructure construction activities.

The second option would utilize precast concrete tub sections that are spliced and post-tensioned together utilizing falsework towers. This option could reduce the required number of falsework towers and eliminate the need for hydraulic jacking. However, the design complexities involving concrete creep and shrinkage would increase, and higher concrete strengths are typically needed with this option.

Site Specific Issues

There are no other site-specific issues that would require consideration at this location.

Vertical Clearance

The existing minimum vertical clearance at these structures is 15.15'. The final vertical clearance for the widened superstructure would not reduce the vertical clearance further since the superstructure will be widened on the high side of the westbound roadway.

Initial Recommendation

The post-tensioned box girder option was used for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.2 Cave Creek Wash Bridge (Structure No. 1490 & 1491, MP 25.90)

Existing Bridge Configuration

The existing bridges are two span, precast prestressed AASHTO Type III concrete girder structures that pass over Cave Creek Wash. Both structures have two equal spans of 71.90' with a total structure length of 148.39'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a vertical tangent and on a horizontal tangent with a 1^{o} 06' 38" skew to the Cave Creek Wash centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders on each bridge.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths are 68.73' for each bridge. The widening of these structures would add one general-purpose lane in each direction of travel, resulting in clear roadway widths of 81.52'. The improvements to the mainline bridges will require the removal and replacement of the existing 7^{th} Street TI Ramp A and Ramp B bridges (Structure No. 1466 and 1486, respectively) over Cave Creek Wash.

Foundation Type

The existing substructures for the bridges consist of stub abutments founded on drilled shaft foundations that are located outside of Cave Creek Wash behind cement-stabilized alluvium bank protection. The existing piers consist of round columns and equal diameter drilled shaft foundations. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing bridges. The first option would be to widen the existing bridges with AASHTO Type III girders, matching the existing superstructure configuration.

Another feasible option would utilize side-by-side precast prestressed concrete box beams. However, AASHTO I-girders are typically more cost effective.

Site Specific Issues

Even though the proposed substructure would line up with the existing abutments and piers, a hydraulic analysis for Cave Creek Wash should be conducted during the next design phase.

Vertical Clearance

The existing clearance noted in the as-built plans between the bottom of the superstructure and the channel invert is 3.59 meters (11.77'). Supplemental field survey may be required to verify the final vertical clearance of the widened structure.

Initial Recommendation

The AASHTO Type III girder option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.3 7^{th} Street TI Overpass (Structure No. 1826 & 2469, MP 26.19)

Existing Bridge Configuration

The existing bridges are two span, cast-in-place post-tensioned concrete box girder structures that pass over 7^{th} Street. Both structures have two equal spans of 100.07' with a total structure length of 206.04'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a crest vertical curve and on a horizontal tangent with a 1^{o} 05' 26" skew to the 7^{th} Street construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders on each bridge.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths are 68.73' on each bridge. The widening of these structures would add one general-purpose lane in each direction of travel resulting in clear roadway widths of 81.52'.

Foundation Type

The existing substructures for the bridges consist of partial-height abutments founded on drilled shaft foundations. The existing piers consist of bladed columns individually supported on a shaft cap founded on four drilled shaft foundations. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges, except that a narrower column on a large diameter drilled shaft may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box

girder configuration. Although the existing minimum vertical clearance is over 19.54', the superstructure could be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position (if required to maximize the falsework spans in order to minimize crossroad lane closures). It is anticipated partial closures of the crossroad through lanes would be needed for the placement of the falsework towers that would be needed to support the superstructure construction activities.

Another feasible option would utilize precast prestressed concrete box beams. This option would allow the superstructure construction to occur without the use of falsework, thereby reducing traffic impacts on the crossroad. A preliminary analysis indicates a release concrete strength of 5,700 psi would be required to make this option feasible (if supplementary survey reveals that a precast box beam structure is necessary). ADOT Bridge Group has indicated the use of 5,700 psi release strength would be acceptable for this design option.

Site Specific Issues

There are no site specific issues at this crossing.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 19.54'. The final vertical clearance for the widened superstructure would be approximately 19.20'.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.4 16th Street TI Overpass (Structure No. 1690 & 2470, MP 27.17)

Existing Bridge Configuration

The existing bridges consist of a single span, cast-in-place post-tensioned concrete box girder structures that pass over 16th Street. Both structures have spans of 106.96' and a total structure length of 112.86'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a crest vertical curve and on a horizontal tangent with a 0° 54' 18" skew to the 16th Street construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulder on each bridge.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths are 68.73' on each bridge. The widening of these structures would add one general-purpose lane and one auxiliary lane in each direction of travel, resulting in clear roadway widths of 93.52' on each bridge.

Foundation Type

The existing substructures for the bridges consist of full-height abutments founded on spread footings. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box girder configuration that would be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position. It is anticipated partial closures of the crossroad through lanes would be needed for the placement of the falsework towers that would be needed to support the superstructure construction activities.

Another feasible option would utilize precast prestressed concrete box beams. This option would allow the superstructure construction to occur without the use of falsework, thereby reducing crossroad traffic impacts. A preliminary analysis indicates a release concrete strength of 5,700 psi would be required with this option (if supplementary survey reveals that a precast box beam structure is necessary). ADOT Bridge Group has indicated the use of 5,700 psi release strength would be acceptable for this design option.

Site Specific Issues

Temporary shoring may be required at the abutments during construction to allow traffic to continue to use 16th Street during the bridge construction activities.

Vertical Clearance

The existing minimum vertical clearance at the structures is approximately 17.28'. The final vertical clearance for the widened superstructure would be approximately 16.90'.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.5 Cave Creek Road TI Overpass (Structure No. 1479 & 2471, MP 28.22)

Existing Bridge Configuration

The existing bridges consist of three span, cast-in-place post-tensioned concrete box girder structures cantilevering over the piers with "drop-in" precast prestressed AASHTO Type VI Modified concrete girders over Cave Creek Road. The eastbound structure has spans of 75.76', 181.76', and 75.17' with a total structure length of 336.72'. The westbound structure has spans of 75.73', 181.68', and 75.14' with a total structure length of 336.56'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a crest vertical curve and on a horizontal curve with an instantaneous tangent skew of 11° 52' 18" to the Cave Creek Road construction centerline. The bridges are superelevated at a maximum 2.8% that slopes down toward the outside shoulder for the eastbound roadway and down toward the median shoulder for the westbound roadway.

Both structures were originally constructed using metric units. Therefore, the existing clear roadway widths are both 68.73'. The widening of these structures would add one general-purpose lane in each direction of travel, resulting in a clear roadway width of 81.52' on each bridge.

Foundation Type

The existing substructures for the bridges consist of partial-height abutments founded on drilled shaft foundations. The piers consist of bladed columns founded spread footings. It is anticipated that the substructures for the bridge widening would match the configuration for the existing bridges, except that a narrower column on a large diameter drilled shaft foundation may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

It is anticipated that the superstructure widening would match the existing structure in-kind. Alternative superstructure configurations are not anticipated due to the complexities and structural incompatibilities that would be encountered with structures that do not utilize hinged joints cantilevered from both piers.

Site Specific Issues

The SPUI ramp intersection radius returns would be realigned to accommodate the new piers that would be required to support the widened structure.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 15.95'. However, the bridge inspection reports indicate this vertical clearance was measured to the bottom of the underdeck light fixtures and not the bottom of the superstructure. Supplemental survey is recommended at this bridge to determine the existing vertical clearance and verify the bridge widening configuration.

Initial Recommendation

The widening the existing structure "in-kind" with cast-in-place post-tensioned concrete box girders and drop-in AASHTO girders was assumed for cost estimating purposes. A shallower superstructure with drop-in AASHTO Type V girders should be considered if additional vertical clearance is needed over Cave Creek Road.

4.6.4.6 32nd Street Overpass (Structure No. 2472 & 2540, MP 29.19 & 29.22, respectively)

Existing Bridge Configuration

The existing bridges are two span, cast-in-place post-tensioned concrete box girder structures that pass over 32nd Street. Both structures have spans of 83.99' and 91.86' with a total structure length of 181.76'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a vertical tangent and on a horizontal tangent with a 0° 05' 51" skew to the 32nd Street construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders on each bridge.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths are both 68.73'. The widening of these structures would add one general-purpose lane and one auxiliary lane in each direction of travel, resulting in a clear roadway width of 93.52' on each bridge.

Foundation Type

The existing substructures for the bridges consist of stub abutments founded on drilled shaft foundations. The piers consist of bladed columns founded on spread footings. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges, except that a narrower column on a large diameter drilled shaft foundation may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box girder configuration. Although the existing structure's vertical clearance is over 20.72', the structure could be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position. It is anticipated partial closures of the crossroad through lanes would be needed for the placement of the falsework towers needed to support the superstructure construction activities.

Another feasible option would utilize precast prestressed concrete box beams. This option would allow for the superstructure construction to occur without the use of falsework, therefore minimizing traffic impacts on the crossroad. A preliminary analysis indicates a release concrete strength of 5,700 psi would be required for this option. ADOT Bridge Group has indicated the use of 5,700 psi release strength would be acceptable for this design option.

Site Specific Issues

There are no site-specific issues at this crossing.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 20.72'. The final vertical clearance for the widened superstructure would be approximately 20.00'.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.7 CAP Canal Bridge WB (Structure No. 2473, MP 29.39)

Existing Bridge Configuration

The existing westbound bridge consists of a three span, cast-in-place post-tensioned concrete box girder structure cantilevering over the piers with "drop-in" precast prestressed AASHTO Type VI concrete girders over the CAP Canal. The westbound structure has spans of 85.83', 193.37', and 85.83' with a total structure length of 371.80'.

The bridge supports the westbound SR 101L roadway and is constructed within a crest vertical curve and on a horizontal tangent with a 29^{o} 23' 27" skew to the CAP Canal centerline. The cross-slope on the bridge is 2.0% that slopes down toward the outside shoulder.

This structure was originally constructed using metric units. Consequently, the existing clear roadway width is 80.57'. The widening of this structure would add one general-purpose lane resulting in a clear roadway width of 93.52'.

Foundation Type

The existing bridge substructure consists of stub abutments founded on drilled shaft foundations. Cement stabilized alluvium was placed where Abutment 2 is founded on the west side of the Reach 11 dam. The piers consist of round columns founded on drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration for the existing bridge.

Feasible Structure Types

It is anticipated that the superstructure widening would match the existing structure in-kind. Alternative superstructure configurations are not anticipated due to the complexities and structural incompatibilities that would be encountered with structures that do not utilize hinged joints cantilevered from both piers.

Site Specific Issues

The bridge spans over the CAP Canal and Abutment 2 are founded on the west side of the Reach 11 dam. The existing structure utilized a special "gap slab" detail and continuously reinforced concrete pavement (CRCP) between the CAP Canal and Low Flow (i.e., CAP Basin No. 1) Channel structures. A similar design approach would be included for the bridge widening.

Existing CAP Canal maintenance roads are located along each of the CAP Canal banks. An additional maintenance road provides access to the top of the Reach 11 dam. The dam maintenance road transitions to the bottom of the dam to pass under SR 101L between Pier 2 and Abutment 2.

The CAP Canal and Bureau of Reclamation has the following requirements for the CAP Canal and Reach 11 dam crossings:

- The vertical clearance for the Operation and Maintenance (O&M) roads shall not be less than 14'-6", including clearance associated with any bridge construction activities that would use falsework;
- One O&M road shall remain open for maintenance equipment access at all times;
- No excavation will be permitted to penetrate the Reach 11 dam geomembrane (located in the center of the Reach 11 dam embankment;
- Excavation into the Reach 11 dam embankment for abutment and wingwall construction shall be as minimal as possible. Excavation specifications and construction details used with the previous bridge construction projects would be acceptable but must be approved by CAP and BOR;
- An existing CAP Canal fiber optic communications line is located in the "canal-right" maintenance road. This line must remain operational at all times;
- Any embankment placed within the Reach 11 dike flood reservoir must be offset by the same amount of excavation within the reservoirs;
- Any bridge crossing of the Reach 11 dam reservoir shall not impact the hydraulic characteristics of the existing bridge crossing.

Close coordination will be required with CAP and BOR in subsequent design phases. Co-ordination will also be required with the City of Phoenix to provide for public access through the bridge construction area for their Reach 11 trail.

Vertical Clearance

No vertical clearance is noted on the as-built plans or ADOT's bridge maintenance records. The minimum vertical clearance requirements included in the CAP and BOR design requirements shall be used for the design of the CAP Canal and low-flow channel crossings.

Initial Recommendation

The widening of the existing structure "in-kind" with cast-in-place post-tensioned concrete box girders and drop-in AASHTO girders was assumed for cost estimating purposes.

4.6.4.8 CAP Canal Bridge EB (Structure No. 2541, MP 29.42)

Existing Bridge Configuration

The existing bridge is a three span, precast prestressed AASHTO Type VI concrete girder structure that passes over the CAP Canal. The eastbound structure has spans of 125.06', 115.73', and 125.06' with a total structure length of 372.64'.

The bridge supports the eastbound SR 101L roadway and is constructed within a crest vertical curve and on a horizontal tangent with a 29° 23' 27" skew to the CAP Canal centerline. The cross-slope on the bridge is 2.0% that slopes down toward the outside shoulder.

This structure was originally constructed using metric units. Consequently, the existing clear roadway width is 68.73'. The widening of this structure would add one general-purpose lane and one auxiliary lane resulting in clear roadway width of 93.52'.

Foundation Type

The existing substructure consists of stub abutments founded on drilled shaft foundations. Abutment 2 is founded on the west side of the Reach 11 dam. No cement stabilized alluvium was noted in the as-built plans. The piers consist of round columns founded on drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration of the existing bridge.

Feasible Structure Types

It is anticipated that the superstructure widening would match the existing structure in-kind.

Site Specific Issues

The same site specific issues discussed for the westbound bridge crossing also apply at this location.
A memorial plaque is located on the Pier 1 cap that is shown in Figure 34. The widening of the eastbound structure shall include the relocation of the plaque to the outside of the new pier cap.

Vertical Clearance

No vertical clearance is noted on the as-built plans or ADOT's bridge maintenance records. The minimum vertical clearance requirements included in the CAP and BOR design requirements shall be used for the design of the CAP Canal and low-flow channel crossings.

Initial Recommendation

The widening of the existing structure "in-kind" with precast prestressed concrete AASHTO girders was assumed for cost estimating purposes.

Figure 34 – Memorial Plaque on Pier 1 of CAP Canal Overpass (EB)

4.6.4.9 Low Flow Channel Bridge [WB] (Structure No. 2474, MP 29.51)

Existing Bridge Configuration

The existing westbound bridge is a two span, precast prestressed AASHTO Type V modified concrete girder structure passing over the Reach 11 dam low flow channel (also referred to as CAP Basin No. 1). The westbound structure has spans of 101.39' and 102.44' with a total structure length of 209.97'.

The bridge supports the westbound SR 101L roadway and is constructed within a crest vertical crest curve and on a horizontal curve with an instantaneous tangent skew of 31° 17' 33" at the pier centerline. The bridge is superelevated at 3.1% that slopes down toward the median shoulder.

This structure was originally constructed using metric units and the existing clear roadway width varies from 80.55' to 85.39'. The widening of this structure would add one general-purpose lane

resulting in a clear roadway width that varies from 93.52’ to 97.57’ between Abutments 1 and 2, respectively.

Foundation Type

The existing substructure consists of stub abutments and a pier founded on drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration of the existing bridge.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to match the existing superstructure configuration by widening the existing bridge with AASHTO Type V Modified girders.

Another design option would use side-by-side precast prestressed concrete box beams. However, AASHTO I-girders are typically more cost effective and precast prestressed concrete box beams offer no significant advantages as an alternative.

Site Specific Issues

The same site specific issues discussed for the westbound CAP Canal Bridge (Section 4.6.4.7) also apply at this location.

The Reach 11 dam maintenance road passes under SR 101L between Abutment 1 and Pier 1. The maintenance road must remain open during the bridge construction activities.

Vertical Clearance

A minimum vertical clearance of 14’-6” shall be provided beneath the bridge for the maintenance road.

Initial Recommendation

The AASHTO Type V Modified girder option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.10 CAP Basin No.1 Bridge EB (Structure No. 2542, MP 29.54)

Existing Bridge Configuration

The existing bridge is a two span, precast prestressed AASHTO Type V modified concrete girder structure passing over the Reach 11 dam low flow channel (also referred to as CAP Basin No. 1). The eastbound structure has spans of 101.82’ and 102.91’ with a total structure length of 210.88’

The bridge supports the eastbound SR 101L roadway and is constructed within a crest vertical curve and on a horizontal curve with an instantaneous tangent skew of 31^{o} 17’ 34” at the pier centerline. The bridge is superelevated at 3.1% that slopes down toward the outside shoulder.

This structure was originally constructed using metric units. Consequently, the existing clear roadway width is 68.73’. The widening of this structure would add one general-purpose lane and one auxiliary lane resulting in a clear roadway width of 93.52’.

Foundation Type

The existing substructure for the bridge consists of stub abutments and a pier founded on drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration for the existing bridge.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to match the existing superstructure configuration by widening the existing bridge with AASHTO Type V Modified girders.

A second design option would use side-by-side precast prestressed concrete box beams. However, AASHTO I-girders are typically more cost effective and precast prestressed concrete box beams offer no significant advantages as an alternative.

Site Specific Issues

The same site specific issues discussed for the westbound CAP Canal Bridge (Section 4.6.4.7) also apply at this location.

The Reach 11 dam maintenance road passes under SR 101L between Abutment 1 and Pier 1. The maintenance road must remain open during the bridge construction activities.

Vertical Clearance

A minimum vertical clearance of 14’-6” shall be provided beneath the bridge for the maintenance road.

Initial Recommendation

The AASHTO Type V Modified girder option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.11 Tatum Boulevard TI Overpass (Structure No. 2475 & 2476, MP 31.31)

Existing Bridge Configuration

The existing bridges consist of three span, cast-in-place post-tensioned concrete box girder structures cantilevering over the piers with "drop-in" precast prestressed AASHTO Type VI Modified concrete girders over Tatum Boulevard. Both structures have spans of 72.18', 170.60', and 72.18' with a total structure length of 320.05'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a crest vertical curve and on a horizontal tangent with no skew to the Tatum Boulevard construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths are 80.54' and 68.73' in the eastbound and westbound directions, respectively. The widening of the westbound structure would add one general-purpose lane resulting in a clear roadway width of 81.52'.

Foundation Type

The existing substructures for the bridges consist of stub abutments founded on drilled shaft foundations. The piers consist of bladed columns founded spread footings. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridge, except that a narrower column on a large diameter drilled shaft foundation may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

It is anticipated that the superstructure widening would match the existing structure in-kind. Alternative superstructure configurations are not anticipated due to the complexities and structural incompatibilities that would be encountered with structures that do not utilize hinged joints cantilevered from both piers.

Site Specific Issues

The SPUI ramp intersection radius returns would be realigned to accommodate the new piers that would be required to support the widened structure.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 17.23'. The final vertical clearance for the widened superstructure would be approximately 16.70'.

Initial Recommendation

The widening the existing structure "in-kind" with cast-in-place post-tensioned concrete box girders and drop-in AASHTO Type VI Modified girders was assumed for cost estimating purposes.

4.6.4.12 56th Street Overpass (Structure No. 2543 & 2544, MP 32.39)

The existing bridges are two span, cast-in-place post-tensioned concrete box girder structures that pass over 56th Street. Both structures have two equal spans of 104.33' with a total structure length of 215.54'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a vertical tangent and on a horizontal tangent with a skew of 29° 15' 31" to the 56th Street construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders.

Both structures were originally constructed using metric units. Consequently, the existing clear roadway widths on eastbound and westbound SR 101L are both 68.73'. The widening of these structures would add one general-purpose lane in each direction of travel, resulting in clear roadway widths of 81.52'.

Foundation Type

The existing substructures consist of stub abutments founded on drilled shaft foundations that are located immediately behind full-height MSE walls (see Figure 35). The piers consist of bladed columns founded on individual drilled shaft foundations. It is anticipated that the substructure for the bridge widening would match the configuration of the existing substructures, except that a narrower column may need to be utilized due to site constraints.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box girder configuration. The structure could be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position (to maximize the falsework span lengths in order to minimize lane closures on the crossroad). It is anticipated that partial closures of the crossroad through lanes would be needed for the placement of the falsework towers needed to support the superstructure construction activities.

A second option would use precast prestressed concrete box beams. This option would allow the superstructure construction to occur without the use of falsework, thereby minimizing impacts to traffic on the crossroad. A preliminary analysis indicates a release concrete strength of 5,700 psi would be required with this option (if supplementary survey reveals that a precast box beam structure is necessary). ADOT Bridge Group has indicated the use of 5,700 psi release strength would be acceptable for this design option.

Figure 35 – MSE Walls At 56th Street Overpass

Site Specific Issues

The MSE walls at the abutments fan out radially on either side of the abutment (see Figure 35). To widen the abutments, the existing MSE walls will likely be required to be removed to facilitate the construction of the substructure elements.

In addition, the MSE wall panels located at the acute corners of the bridge may need to be braced since the straps would likely project into the excavated prism with new non-standard walls likely needed in front of the existing MSE walls at this location.

There is also a high voltage power line that crosses the freeway near Abutment 2. Special requirements may be necessary for the safety of construction personnel and equipment during the bridge construction activities.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 17.06'. However, the bridge inspection reports indicate this vertical clearance was measured to the bottom of the underdeck light fixtures and not the bottom of the superstructure. Supplemental survey is recommended at this bridge to determine the existing vertical clearance and verify the bridge widening configuration.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.13 Scottsdale Road TI Overpass (Structure No. 1457, MP 34.52)

The existing bridges are two span, cast-in-place post-tensioned concrete box girder structures that pass over Scottsdale Road. Both structures have equal spans of 115.00' with a total structure length of 236.19'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a vertical tangent and on a horizontal tangent with a skew of 14^{o} 00' 06" to the Scottsdale Road construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders.

The existing clear roadway width on the eastbound and westbound bridges is 67.69'. The widening of these structures would add one general-purpose lane in each direction of travel, resulting in clear roadway widths of 81.52'.

Foundation Type

The existing substructures for the bridges consist of stub abutments founded on drilled shaft foundations. The piers consist of bladed columns founded on spread footings. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges, except that a narrower column on a large diameter drilled shaft foundation may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box girder configuration. The structure could be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position (to maximize the falsework span lengths in order to minimize lane closures on the crossroad). It is anticipated that partial closures of the crossroad through lanes would be needed for the placement of the falsework towers needed to support the superstructure construction activities.

A second option would use precast prestressed concrete box beams. This option would allow for superstructure construction to occur without the use of falsework, thereby minimizing impacts to traffic on the crossroad. A preliminary analysis indicates a release concrete strength of 5,800 psi

and a 28-day concrete strength of 6,700 psi would be required with this option. ADOT Bridge Group has indicated the use of 5,800 psi release strength and 6,700 28-day strength would be acceptable for this design option.

Site Specific Issues

There are no site-specific issues at this structure.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 15.32'. However, the bridge inspection reports indicate this vertical clearance was measured to the bottom of the underdeck light fixtures and not the bottom of the superstructure. Supplemental survey is recommended at this bridge to determine the existing vertical clearance and verify the bridge widening configuration.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.14 Hayden Road TI Overpass (Structure No. 1458, MP 35.55)

The existing bridges are two span, cast-in-place post-tensioned concrete box girder structures that passes over Scottsdale Road. Both structures have two spans of 115.00' and 105.00' with a total structure length of 226.19'.

The bridges support the eastbound and westbound SR 101L roadways and are constructed within a vertical tangent and on a horizontal tangent with a skew of 13^{o} 57' 38" to the Hayden Road construction centerline. The cross-slope on the bridges is 2.0% that slopes down toward the outside shoulders.

The existing clear roadway width on the eastbound and westbound bridges is 67.69'. The widening of these structures would add one general-purpose lane in each direction of travel, resulting in clear roadway widths of 81.52'.

Foundation Type

The existing substructures consist of stub abutments founded on drilled shaft foundations. The piers consist of bladed columns founded on spread footings. It is anticipated that the substructures for the bridge widening would match the configuration of the existing bridges, except that a narrower column on a large diameter drilled shaft foundation may be considered at the piers to minimize impacts to traffic during the pier construction activities.

Feasible Structure Types

Two structural options would be feasible for the widening of the existing structures. The first option would be to widen the existing bridges using a cast-in-place post-tensioned concrete box girder configuration. The structure could be constructed above the existing structure's finished grade on falsework (to achieve a minimum temporary vertical clearance of 16') and then hydraulically lowered into final position (if required to maximize the falsework span lengths to minimize the lane closures on the crossroad). It is anticipated that partial closures of the crossroad through lanes would be needed for the placement of falsework towers during the superstructure construction activities

Another option would use precast prestressed concrete box beams. This option would allow for superstructure construction to occur without the use of falsework, thereby minimizing impacts to traffic on the crossroad. A preliminary analysis indicates a release concrete strength of 5,800 psi and a 28-day concrete strength of 6,700 psi would be required to make this option feasible. ADOT Bridge Group has indicated the use of 5,800 psi release strength and 6,700 psi 28-day strength would be acceptable for this design option.

Site Specific Issues

There are no site-specific issues at this structure.

Vertical Clearance

The existing minimum vertical clearance at these structures is approximately 15.32'. However, the bridge inspection reports indicate this vertical clearance was measured to the bottom of the underdeck light fixtures and not the bottom of the superstructure. Supplemental survey is recommended at this bridge to determine the existing vertical clearance and verify the bridge widening configuration.

Initial Recommendation

The precast prestressed concrete box beam option was assumed for cost estimating purposes. However, both structural alternatives should be evaluated in the next design stage.

4.6.4.15 Summary Of Preliminary Widening Concepts

The initial bridge widening configurations used for the Order of Magnitude project cost estimates are summarized in Table 32.

Table 32 – Bridge Structure Widening Concepts for the Preferred Alternative

Bridge Description	Bridge Length	Number of Spans	C_L-C_L Span Lengths	Approx Width of Widening[1]	Proposed Superstructure Depth[2]	Existing Superstructure Type	Proposed Widening Concept
19th Avenue Overpass (WB)	172.23'	1	169.36'	11.83'	7'-6"	7.50' cast-in-place post-tensioned concrete box girders	Match existing
Cave Creek Wash Bridge (EB & WB)	148.39'	2	71.90', 71.90'	12.79' EB; 12.79' WB	4'-7 ½"	4.62' precast prestressed AASHTO Type III concrete girders	Match existing
7th Street TI Overpass (EB & WB)	206.04'	2	100.07', 100.07'	12.93' EB; 12.93' WB	4'-2"	4.27' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams
16th Street TI Overpass (EB & WB)	112.86'	1	106.96'	24.93' EB; 24.93' WB	4'-5"	5.25' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams
Cave Creek Road TI Overpass (EB & WB)	336.72' EB; 336.56' WB	3	75.76', 181.76', 75.17' (EB); 75.73', 181.68', 75.14' (WB)	12.76' EB; 12.76' WB	7'-0"	6.99' combination cast-in-place post-tensioned /drop-in precast prestressed AASHTO Type VI Modified concrete girders	Match existing
32nd Street Overpass (EB & WB)	181.76'	2	83.99', 91.86'	24.63' EB; 24.63' WB[3]	3'-11"	3.94' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams
CAP Canal Bridge (WB)	371.80'	3	85.83', 193.37', 85.83'	12.82'	7'-0½"	7.05' combination cast-in-place post-tensioned /drop-in precast prestressed AASHTO Type VI concrete girders	Match existing
CAP Canal Bridge (EB)	372.64'	3	125.06', 115.73', 125.06'	24.76'[3]	7'-0"	6.97' precast prestressed AASHTO Type VI concrete girders	Match existing
Low Flow Channel Bridge (WB)	209.97'	2	101.39', 102.44'	Varies (12.87'at Abutment 1; 12.32' at Abutment 2)	6'-6¼"	6.53' precast prestressed AASHTO Type V modified concrete girders	Match existing
CAP Basin No. 1 Bridge (EB)	210.88'	2	101.82', 102.91'	24.84'	6'-3"	6.27' precast prestressed AASHTO Type V modified concrete girders	Match existing
Tatum Boulevard TI Overpass (WB)	320.05'	3	72.18', 170.60', 72.18'	12.63'	6'-9¼"	6.77' combination cast-in-place post-tensioned /drop-in precast prestressed AASHTO Type VI modified concrete girders	Match existing

(1) Structural widening does not include the width associated with the partial removal of the existing deck, but does include amount required to provide full 12'-0" lanes and outside shoulders on bridges where 3.6 meter lanes (11.81') and outside shoulders were previously provided, where applicable.
(2) Proposed superstructure depths are approximate and are subject to refinement during the next design phase.
(3) Wider structure may be required in the EB direction to support sound walls. Further evaluation shall be performed during the next design stage.

Table 32 – Bridge Structure Widening Concepts for the Preferred Alternative (Cont.)

Bridge Description	Bridge Length	Number of Spans	C_L-C_L Span Lengths	Approx Width of Widening[1]	Proposed Superstructure Depth[2]	Existing Superstructure Type	Proposed Widening Concept
56th Street TI Overpass (EB & WB)	215.54'	2	104.33', 104.33'	12.62'	4'-2"	4.27' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams
Scottsdale Road TI Overpass (EB & WB)	236.19'	2	115.00', 115.00'	13.83'	4'-5"	4.75' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams
Hayden Road TI Overpass (EB & WB)	226.19'	2	115.00', 105.00'	13.83'	4'-5"	4.75' cast-in-place post-tensioned concrete box girders	Precast prestressed concrete box beams

(1) Structural widening does not include the width associated with the partial removal of the existing deck, but does include amount required to provide full 12'-0" lanes and outside shoulders on bridges where 3.6 meter lanes (11.81') and outside shoulders were previously provided, where applicable.
(2) Proposed superstructure depths are approximate and are subject to refinement during the next design phase.
(3) Wider structure may be required in the EB direction to support sound walls. Further evaluation shall be performed during the next design stage.

4.6.5 15th Avenue Underpass Replacement

The existing 15th Avenue Underpass bridge structure (Structure No. 2464, MP 24.66) will need to be removed and replaced to accommodate the general purpose and auxiliary lane improvements.

Existing 15th Avenue Underpass

The existing bridge is a two span, 3.93' (1.2 meter) deep cast-in-place post-tensioned concrete box girder structure with two equal spans of 85.96' with a total structure length of 177.87'. The bridge supports 15th Avenue traffic over the eastbound and westbound SR 101L roadways. A portion of the bridge is constructed on a vertical tangent and enters a crest vertical curve in the second span. The bridge is on a horizontal tangent with an instantaneous skew of 7° 32' 28" to the SR 101L construction centerline.

The existing underpass was originally constructed using metric units. The bridge is symmetric about the 15th Avenue construction centerline and consists of a 0.98' wide rail/fence, 4.92' sidewalk, one 13.78' through lane, and one 11.81' left-turn lane in each direction of travel with an overall out-to-out bridge width of approximately 62.99'. The existing structure supports APS power conduits which will require placement in the replacement bridge structure.

The existing minimum vertical clearance for the 15th Avenue Underpass is noted as 17.67' over westbound SR 101L (according to ADOT Bridge Maintenance records) not including the AR-ACFC overlay. Supplemental survey is recommended at the next design stage to establish the existing roadway elevations for a more refined vertical clearance calculation of the bridge replacement.

The substructure for the existing underpass consists of two full-height abutments on spread footings and bladed columns founded on spread footings at the pier. Existing soil nail walls tie into the front face of both abutments on both sides of SR 101L (see plan view on Figure 36).

Conceptual Replacement For 15th Avenue Underpass

A feasible concept for the 15th Avenue Underpass would utilize precast prestressed concrete box beams to eliminate falsework construction over the SR 101L mainline traffic. The new bridge structure would consist of two spans that are approximately 102'-7" (over westbound SR 101L) and 114'-6" (over eastbound SR 101L) with a total structure length of approximately 224'-8". The vertical profile would match the existing 15th Avenue profile grade to minimize impacts to the frontage roads.

In order to maximize the shoulder width in the vicinity of the reconstructed 15th Avenue median pier, the median pier would be detailed to be in-line with the vertical faces of a modified median roadway barrier in the vicinity of the underpass (3'-6" wide). The pier would be required to resist vehicular impact loads per AASHTO LRFD specifications.

The new bridge structure would be designed with English units for all roadway elements, and using the current ADOT bridge parapet/sidewalk details. The new bridge width would include a 6'-0" sidewalk, 14'-0" through lane, and 12'-0" left-turn lane in each direction of travel for an overall out-to-out bridge width of 66'-4".

A preliminary analyses for the utilization of precast prestressed concrete box beams indicate that the second span could feasibly be supported by 48" wide by 48" deep side-by-side precast prestressed concrete box beams with a release strength of 5,300 psi and a 28-day strength of 7,000 psi. ADOT Bridge Group has indicated the use of 5,800 psi release strength and 7,000 psi 28-day strength would be acceptable for this design option.

While the first span could structurally be spanned with the same cross-section, the final vertical clearance for the first span may be lower than 16'-6" due to the superelevated SR 101L roadway section in the westbound direction. To address this concern, a 48" wide by 42" deep precast prestressed superstructure would be proposed for the first span with an expansion joint at the pier to eliminate continuity issues with disparate structural depths. Both spans would utilize a 5" thick cast-in-place concrete deck and would result in approximate structure depths of 4'-3" in the first span and 4'-9" in the second span. Special design details will be required for accommodating the sidewalk curb returns as part of the abutment diaphragm details.

A feasible concept for the substructure would consist of stub abutments located immediately behind new soil nail walls (see Figure 36). Even though soil nail walls could provide lateral restraint, large diameter drilled shaft foundations were assumed to limit deflections of the abutments during the phased construction activities. The pier would consist of new pier columns on spread footings. The barrier separation at the SR 101L median construction centerline should be sufficient to accommodate a drop-down pier cap and would not pose vertical clearance issues as a result.

The construction of the 15th Avenue underpass would require a phased construction approach to minimize impacts to the traveling public (see Figures 36 and 37). The following sequence of construction is proposed:

- Remove the existing 15th Avenue superstructure and pier foundations. The existing 15th Avenue underpass abutments would remain in place for the next construction phase.
- With the existing 15th Avenue abutment substructures in place, construct the new drilled shaft foundations and stub abutments behind the existing abutments.
- Excavation (and simultaneous removal of the existing soil nail walls on either side of the existing 15th Avenue underpass abutments) would occur in relatively narrow sections (say 20' maximum) along the frontage roads to minimize stability issues. Excavation depths and 15th Avenue underpass abutment removals would be limited to the depth necessary to install the first series of soil nails. Construction of the new pier foundation could occur concurrently.
- Construct new superstructure and finalize curb returns at frontage roads.

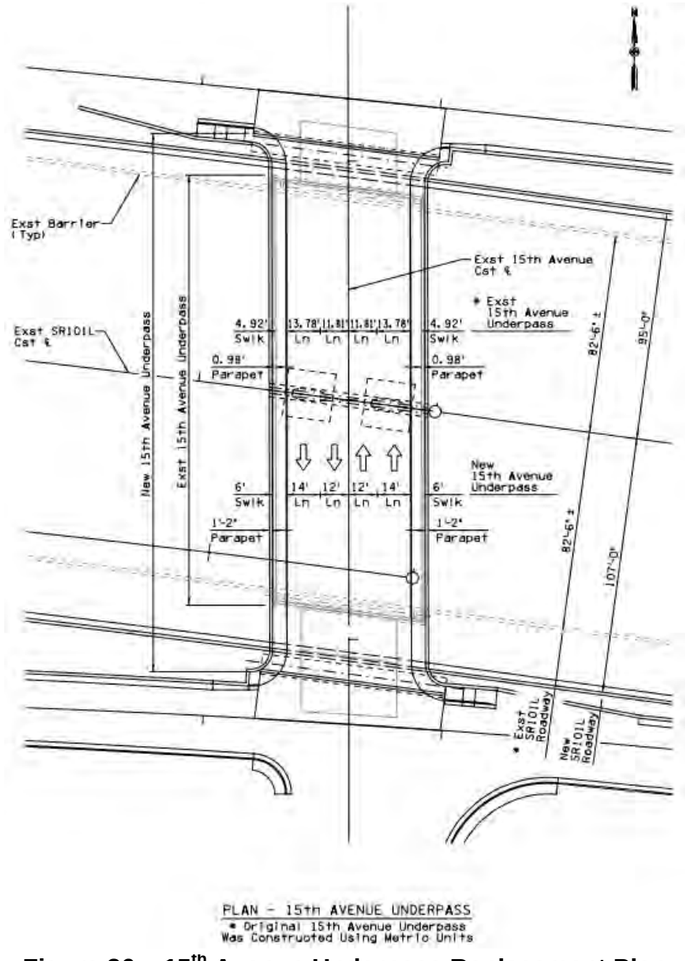


Figure 36 – 15th Avenue Underpass Replacement Plan

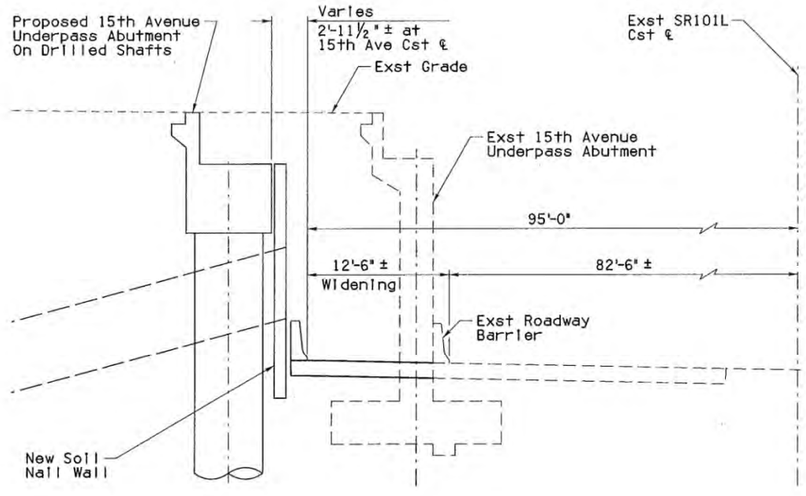


Figure 37 – 15th Avenue Underpass Replacement Section

Closure of at least one frontage road lane in each direction of travel is recommended along with the use of temporary concrete barrier to provide room for the construction of the new underpass. Full frontage road closures may be periodically be required to construct the drilled shaft foundations and erect precast box beams. However, temporary paved access must be provided at all times for existing residences and businesses located along the frontage roads.

During the next design stage, it is recommended that the existing pier columns and spread footings be evaluated along with the available soil data to determine whether or not they could be incorporated into the new bridge structure. The existing footings have experienced settlement and should be evaluated against the new design loading condition to determine how much differential settlement may occur between the existing underpass loads and the new underpass loads. However, for the purpose of this design concept report, it was assumed that shoring and new pier columns/footings would be required and is reflected in the cost estimate. Other alternatives in the next design stage should also consider the use of drilled shaft foundations at the pier to minimize traffic impacts.

4.6.6 Cave Creek Wash 7th Street TI Ramp A and Ramp B Structures

The proposed mainline improvements will require horizontal and vertical adjustments to the 7th Street ramp bridges over Cave Creek Wash requiring the replacement of both ramp structures. (Structure Nos. 1466 and 1486).

Existing Bridges

The existing bridges are two span, precast prestressed AASHTO Type III concrete girder bridges. Both structures were originally constructed using metric units. The Ramp A structure consists of two equal spans of 72.21' with a total length of 149.03'. The Ramp B structure consists of two equal spans of 72.12' with a total structure length of 148.85'. Both structures were constructed on horizontal tangents with skew of 5° 27' 01" and 4° 38' 57" for Ramps A and B, respectively.

The substructure for both bridges consists of stub abutments and pier columns founded on drilled shafts. There are short retaining walls between the mainline SR 101L Cave Creek Wash overpass and the ramp structures that are place in-line with the abutments. There are also short retaining walls parallel to the ramp centerlines on the north and south sides of the ramps.

Conceptual Bridge Replacement For Cave Creek 7th Street TI Ramp A and Ramp B Bridges

The existing ramp structures would be removed to accommodate the horizontal and vertical placement of the new ramp bridges. It is anticipated that the bridge replacements for both ramps would utilize a similar superstructure and substructure configuration as the existing bridges. The new abutment and pier locations would line up with the existing ramp, mainline and frontage road piers to minimize hydraulic impacts to Cave Creek Wash.

New drilled shaft foundations for the abutments and piers should be placed as far away as practical from the existing ramp shafts. Coordination will be required with ADOT Materials and Bridge Design Sections to develop any special axial reduction factors for the drilled shaft foundations placed in close proximity to the existing shafts, if applicable.

It is also anticipated that temporary shoring and bracing may be required along the SR 101L mainline to accommodate the reconstruction of the short walls located between the ramp structures and the mainline bridge. The cost of the wall reconstruction is included n the lump sum cost of the bridge replacements.

The Ramp A structure would consist of two equal spans of 72.13' with a total structure length of 148.88'. The Ramp B structure would consist of two equal spans of 72.03' with a total structure length of 148.66'. Both structures would be constructed on horizontal tangents with skews of 4° 47' 01" and 3° 39' 19" for Ramps A and B, respectively.

Ramp closures would be required to accommodate the reconstruction of both ramp bridges.

4.6.7 Retaining Walls

New retaining walls would be required throughout the corridor to accommodate the roadway widening for the Preferred Alternative. The retaining wall alternatives that could be considered for this project are cantilevered walls on spread footings, cantilevered walls on drilled shaft foundations, mechanically stabilized earth (MSE) walls, soil nailed walls, and soldier/tieback walls. The design of the walls will utilize the current AASHTO LRFD Specifications and the ADOT *Bridge Design Guidelines*.

The new retaining walls may require special design considerations due to the proximity of new walls to existing walls, new walls in close proximity to existing or proposed right-of-way, new walls in close proximity to existing drainage channels, or new walls in close proximity to the end of box culverts. At these locations, the following alternatives should be evaluated during final design:

- Offset the new wall from the existing wall to provide sufficient area to construct a new spread footing.
- Provide a specialty wall design that could be founded on:
  - L-shape spread footings.
  - Single or multiple rows of drilled shaft foundations utilizing a shaft cap to transfer the loads from the wall to the shafts.
  - Footings that are doweled into existing box culvert structures. Roadway barriers adjacent to these new walls would be founded on independent moment slabs.
- Tie-back or soil nail walls may be considered. However, the existing roadway embankment may not be suitable for lateral restraint.
- MSE walls.

An evaluation will be required during final design to determine the feasibility of each wall alternative. The evaluation criteria should include right-of-way constraints, construction access availability, the ability to maintain traffic during construction, and estimated construction costs.

Preliminary Recommendations for Retaining Walls

For the purpose of this report, retaining walls are divided into three categories including standard cast-in-place walls, specialty walls, and combination walls. A summary of the retaining walls used for cost estimating purposes is provided in Table 33. Any walls not requiring special treatment are designated as standard walls. Standard walls are anticipated to be either ADOT standard cast-in-place walls or walls founded on similarly configured spread footing foundations. Walls that would require an unusual footing shape or would be founded on drilled shaft foundations; or are tie-back, soil nail, or MSE walls are designated as specialty walls. Other retaining walls may require additional height to provide noise mitigation if indicated in the preliminary noise analysis. These walls are identified as combination walls. Unless specified as a combination/specialty wall, combination walls are also anticipated to be founded on spread footings. A detailed analysis shall be performed during final design.

Table 33 – New Retaining Wall Summary for General-Purpose Lane Widening

Wall No.	Description	Approximate Station Limits	Approx. Wall Length (ft.)	Average Wall Height(1)	Max. Wall Height(1)	Wall Type
R1	South edge of SR101L, East of 19th Avenue	SR101L Station 1314+02 to SR101L Station 1321+00	705	12	16	Standard Wall
R2	South edge of SR101L, Passes under 15th Avenue	SR101L Station 1331+00 to SR101L Station 1334+50	350	8	9	Specialty Wall (Soil Nail)
		SR101L Station 1334+50 to 7th Avenue Ramp B Station 20+50	1690	19	27	Specialty Wall (Soil Nail Behind Existing Soil Nail Wall)
		7th Avenue Ramp B Station 20+50 to 7th Avenue Ramp Station 22+00	150	7	9	Specialty Wall (Soil Nail)
R3	South edge of SR101L, Under 7th Avenue	SR101L Station 1360+00 to SR101L Station 1366+00	600	9	11	Specialty Wall (Soil Nail)
R4	South edge of SR101L, East of 7th Street	SR101L Station 1422+00 to SR101L Station 1431+00	900	8	11	Standard Wall
R5	South edge of SR101L, West of 16th Street	SR101L Station 1461+00 to SR101L Station 1467+10	610	11	22	Standard Wall
R6	South edge of SR101L, East of 16th Street	SR101L Station 1468+37 to SR101L Station 1481+50	1313	10	25	Combination Wall
		SR101L Station 1481+50 to SR101L Station 1482+00	50	3	4	Standard Wall
R7	South edge of SR101L, West of Cave Creek Road	SR101L Station 1510+00 to SR101L Station 1517+00	700	10	18	Standard Wall
		SR101L Station 1517+00 to SR101L Station 1521+40	440	21	23	Specialty Wall (L-shape)
R8	South edge of SR101L, East of Cave Creek Road	SR101L Station 1524+77 to SR101L Station 1531+00	623	14	17	Combination Wall
		SR101L Station 1531+00 to SR101L Station 1536+00	500	6	9	Standard Wall
R9	South edge of SR101L, West of 32nd Street	SR101L Station 1560+00 to SR101L Station 1575+01	1501	10	14	Combination Wall
R10	South edge of SR101L, East of 32nd Street	SR101L Station 1576+77 to SR101L Station 1586+08	931	11	21	Combination Wall
R11	South edge of SR101L, West of SR51	SR101L Station 1590+85 to SR101L Station 1592+27	142	10	13	Combination Wall
R12	South edge of SR51 Ramp E-S	SR101L Station 1594+36 to SR101L Station 1597+50	314	10	12	Combination Wall
		SR101L Station 1597+50 to SR101L Station 1600+00	250	7	9	Standard Wall
R13	South edge of SR101L, East of Tatum Boulevard	SR101L Station 1688+73 to SR101L Station 1693+00	435	11	12	Standard Wall

(1) For combination walls, height shown reflects retained height only.

Table 33 – New Retaining Wall Summary for General-Purpose Lane Widening (Cont.)

Wall No.	Description	Approximate Station Limits	Approx. Wall Length (ft.)	Average Wall Height[(1)]	Max. Wall Height[(1)]	Wall Type
R13	South edge of SR101L, East of Tatum Boulevard	SR101L Station 1688+73 to SR101L Station 1693+00	435	11	12	Standard Wall
R14	South edge of SR101L, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1776+00 to SR101L Station 1777+00	100	6	6	Standard Wall
R15	South edge of 64th Street Ramp B, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1782+50 to SR101L Station 1783+50	100	6	6	Standard Wall
R16	South edge of 64th Street Ramp B, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1785+00 to SR101L Station 1786+00	100	7	7	Standard Wall
R17	South edge of 64th Street Ramp B, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1787+50 to SR101L Station 1789+00	150	5	6	Standard Wall
R18	South edge of 64th Street Ramp D, East of 64th Street, over existing box culvert	64th St Ramp D Station 30+00 to 64th Street Ramp D Station 31+00	100	3	6	Specialty Wall (Over Box Culvert See Section 4.6.8)
R19	South edge of SR101L, Between 64th Street & Scottsdale Road, over existing box culvert	SR101L Station 1826+50 to SR101L Station 1828+00	150	6	6	Standard Wall
R20	South edge of Scottsdale Road Ramp D, East of Scottsdale Road, over existing box culvert	Scottsdale Road Ramp D Station 22+00 to Scottsdale Road Ramp D Station 23+50	150	4	7	Standard Wall
L1	North edge of SR101L, East of 19th Avenue	SR101L Station 1312+38 to SR101L Station 1316+00	368	12	14	Standard Wall
L2	North edge of 19th Avenue Ramp C, between 19th Avenue & 15th Avenue	19th Avenue Ramp C Station 16+96 to 19th Avenue Ramp C Station 22+80	584	6	7	Combination Wall
L3	North edge of 19th Avenue Ramp C, between 19th Avenue & 15th Avenue	SR101L Station 1328+00 to SR101L Station 1330+78	278	8	12	Specialty Wall (See Special Considera-tions For Specific Wall Locations)
L4	North edge of SR101L, Under 15th Avenue	SR101L Station 1335+10 to SR101L Station 1337+69	259	22	25	Specialty Wall (Soil Nail Behind Existing Soil Nail Wall)
L5	South edge of WB Frontage Road, West of 7th Avenue	7th Avenue Ramp A Station 17+09 to 7th Avenue Ramp A Station 21+00	342	12	17	Specialty Wall (Soil Nail Behind Existing Soil Nail Wall)
		7th Avenue Ramp A Station 21+00 to 7th Avenue Ramp A Station 21+46	96	6	6	Specialty Wall (Soil Nail Wall)
L6	North edge of SR101L, West of 7th Street	SR101L Station 1411+50 to SR101L Station 1414+60	310	7	7	Standard Wall

(1) For combination walls, height shown reflects retained height only.

Table 33 – New Retaining Wall Summary for General-Purpose Lane Widening (Cont.)

Wall No.	Description	Approximate Station Limits	Approx. Wall Length (ft.)	Average Wall Height[(1)]	Max. Wall Height[(1)]	Wall Type
L7	North edge of SR101L, East of 7th Street	SR101L Station 1417+01 to SR101L Station 1422+00	499	7	7	Standard Wall
L8	North edge of SR101L, West of 16th Street	SR101L Station 1458+00 to SR101L Station 1460+50	250	9	11	Standard Wall
		SR101L Station 1460+50 to SR101L Station 1467+07	657	13	22	Combination Wall
L9	North edge of SR101L, East of 16th Street	SR101L Station 1468+35 to SR101L Station 1470+35	200	7	10	Standard Wall
		SR101L Station 1470+35 to SR101L Station 1478+00	765	12	24	Combination Wall
L10	North edge of SR101L, Between 16th Street & Cave Creek Road	SR101L Station 1478+00 to SR101L Station 1500+00	2200	9	11	Specialty Wall (Soil Nail)
L11	North edge of SR101L, West of Cave Creek Road	SR101L Station 1507+50 to SR101L Station 1520+00	1250	12	18	Standard Wall
		SR101L Station 1520+00 to SR101L Station 1521+80	180	20	22	Specialty Wall (L-shape)
L12	North edge of SR101L, East of Cave Creek Road	SR101L Station 1525+09 to SR101L Station 1529+75	466	12	21	Combination Wall
L13	North edge of Cave Creek Road Ramp C, East of Cave Creek Road	Cave Creek Road Ramp C Station 12+00 to Cave Creek Road Ramp C Station 15+00	300	9	11	Standard Wall
		Cave Creek Road Ramp C Station 15+00 to Cave Creek Road Ramp C Station 21+00	600	8	9	Combination Wall
L14	North edge of SR101L, Between Cave Creek Road & 32nd Street	SR101L Station 1544+00 to SR101L Station 1553+00	900	5	6	Specialty (Modified Concrete Barrier Wall)
L15	North edge of SR101L, West of 32nd Street	SR101L Station 1559+00 to SR101L Station 1575+01	1601	10	13	Combination Wall
L16	North edge of SR101L, East of 32nd Street	SR101L Station 1576+77 to SR101L Station 1585+00	823	10	13	Standard Wall
L17	North edge of SR101L, East of Canal	SR101L Station 1589+75 to SR101L Station 1590+97	122	8	11	Standard Wall
L18	North edge of SR51 Ramp N-W	SR51 Ramp N-W Station 40+00 to SR51 Ramp N-W Station 51+20	1120	7	13	Standard Wall
L19	North edge of SR101L, East of SR51	SR101L Station 1646+00 to SR101L Station 1657+75	1231	11	15	Specialty Wall (Standard Wall With Temporary Shoring)

(1) For combination walls, height shown reflects retained height only.

Table 33 – New Retaining Wall Summary for General-Purpose Lane Widening (Cont.)

Wall No.	Description	Approximate Station Limits	Approx. Wall Length (ft.)	Average Wall Height[(1)]	Max. Wall Height[(1)]	Wall Type
L20	North edge of Tatum Boulevard Ramp A, West of Tatum Boulevard	Tatum Road Ramp A Station 10+34 to Tatum Road Ramp A Station 23+50	1316	12	21	Specialty Wall (Standard Wall With Temporary Shoring)
L21	North edge of SR101L, West of Tatum Boulevard	SR101L Station 1675+00 to SR101L Station 1684+86	986	11	17	Standard Wall
L22	North edge of SR101L, East of Tatum Boulevard	SR101L Station 1688+01 to SR101L Station 1692+00	399	11	14	Standard Wall
L23	North edge of SR101L, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1769+25 to SR101L Station 1770+25	100	6	7	Specialty Wall (Over Box Culvert See Section 4.6.8)
L24	North edge of SR101L, Between 56th Street & 64th Street, over existing box culvert	SR101L Station 1775+00 to SR101L Station 1778+00	300	6	7	Standard Wall
L25	North edge of 64th Street Ramp A, West of 64th Street, over existing box culvert	SR101L Station 1785+00 to SR101L Station 1786+50	150	6	7	Specialty Wall (Over Box Culvert See Section 4.6.8)
L26	North edge of SR101L, Between 64th Street & Scottsdale Road, over existing box culvert	SR101L Station 1826+75 to SR101L Station 1829+00	225	6	7	Specialty Wall (Over Box Culvert See Section 4.6.8)

(1) For combination walls, height shown reflects retained height only.

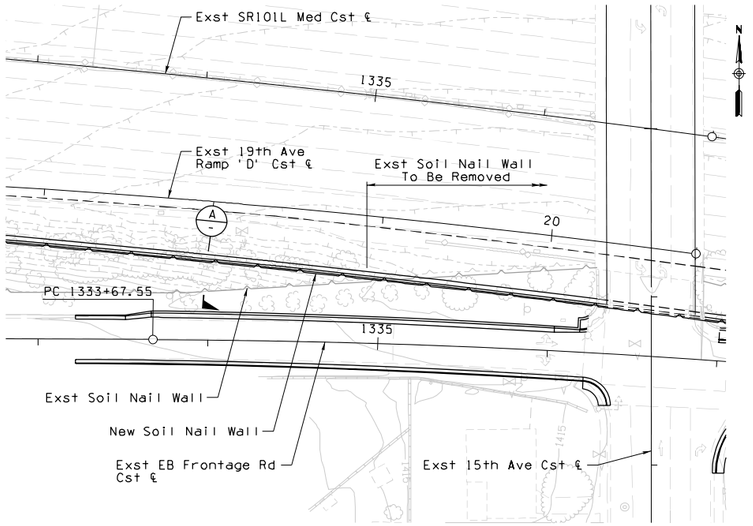
Special Consideration for Specific Wall Locations

Site-specific challenges for the construction of new retaining walls occur in the vicinity of 15th Avenue, 7th Avenue, and along the westbound frontage road between 15th Avenue and 17th Drive. These site-specific challenges are discussed herein.

15th Avenue Retaining Wall Concept

A new soil nail wall would need to be constructed in front of an existing soil nail wall to accommodate the widened general purpose lanes in the vicinity of the 15th Avenue Underpass (south and west of the bridge) as shown on Figure 38.

This soil nail wall will need to consider the surcharge from the existing soil nail wall as part of its design. Construction of the soil nail wall behind the existing soil nail wall would likely be conducted in a manner similar to the soil nail wall located in front of the new 15th Avenue Underpass abutments (see Section 4.6.5).



SOIL NAIL WALL AT SOUTH WEST CORNER OF 15th AVENUE UNDERPASS STRUCTURE

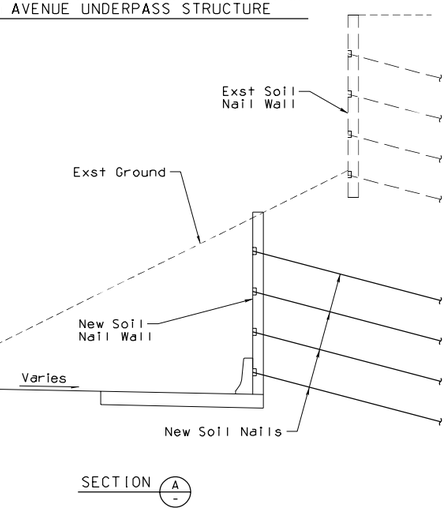


Figure 38 – 15th Avenue Soil Nail Wall Concept

Westbound Frontage Road – 15th Avenue and 17th Drive Retaining Wall Concept

A storm drain line located approximately 20’ to 30’ below existing grades along the westbound frontage road would be relocated away from proposed walls L2 and L3. Wall L3, located between 15th Avenue and 17th Drive, would be an L-shaped wall to facilitate future access to the storm drain pipe. Temporary shoring and/or excavation with laid back slopes would be required to construct wall L3 behind an existing soil nail wall.

7th Avenue Retaining Wall Concept

A new soil nail wall at 7th Avenue will need to be constructed in front of the existing bridge abutment to accommodate the general purpose lane widening. To address global stability concerns, the following sequence of construction shown in Figure 39 is proposed:

- Tiebacks would be installed through the existing abutment to stabilize the abutment during soil nail wall excavation. A new fascia wall could be cast against the existing abutment for aesthetic purposes.
- Excavation would occur in relatively narrow sections (say 20' maximum) along the abutment face to minimize stability issues. Excavation depth would be limited to the depth necessary to install the first series of soil nails.
- Once the soil nails are installed for the first section, the excavation step would be repeated until the first row of soil nails are installed.
- The same procedure would be followed to install subsequent rows of soil nails, as needed.

The special provisions would need to stress the importance of meeting these requirements to guarantee bridge stability.

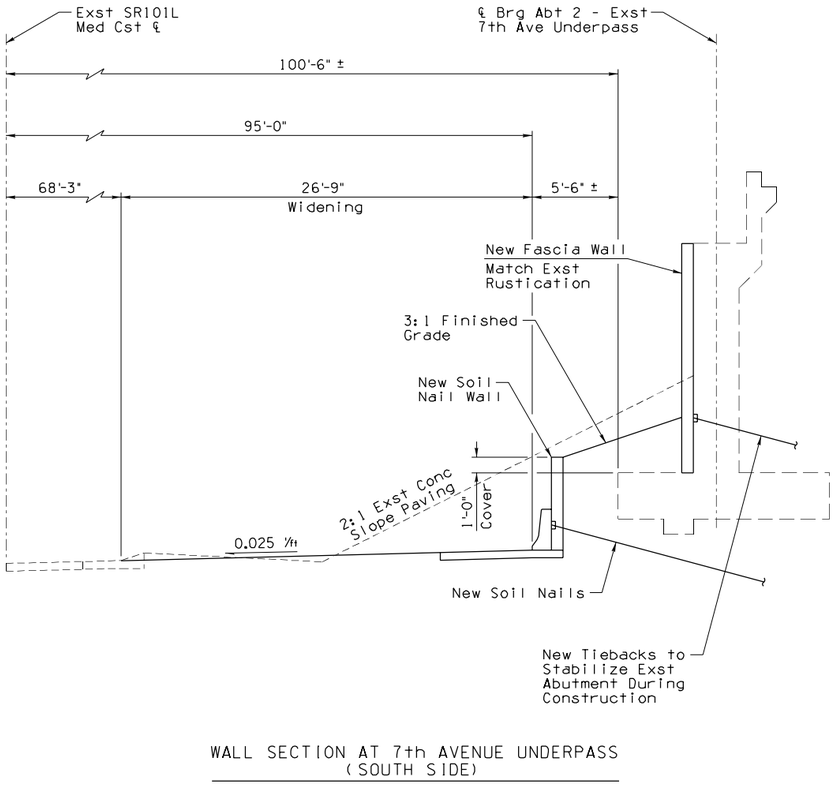


Figure 39 – 7th Avenue Soil Nail Wall Concept (South Side)

Preliminary Recommendations for Existing Walls to Be Removed

Some existing retaining and noise walls would be removed to accommodate the general-purpose lane widening. A summary of the walls to be removed is provided in Table 34.

Table 34 – Existing Wall Removal Summary for General-Purpose Lane Widening

Description	Approximate Station Limits[(1)]	Approximate Wall Removal Length (Ft.)	Existing Wall Type
South edge of SR101L, West of 15th Avenue	SR101L Station 1335+16 to Station 1336+42	127	Soil Nail
North edge of Eastbound Frontage Road, East of 15th Avenue	SR101L Station 1337+39 to Station 1342+70	532	Noise Wall on Barrier
South edge of SR101L, East of 15th Avenue	SR101L Station 1337+06 to Station 1349+80	1,277	Soil Nail
South edge of SR 101L and 7th Avenue Ramp D	7th Avenue Ramp D Station 9+94 to SR101L Station 1377+63	237	Noise Wall
South edge of 7th Street Ramp D	7th Street Ramp D Station 8+20 to 7th Street Ramp D Station 12+04	384	Noise Wall on Barrier
South edge of SR101L, East of 16th Street	SR101L Station 1468+94 to Station 1469+51	57	Combination Wall (Remove Noise Wall Portion)
	SR101L Station 1469+51 to Station 1481+35	1,245	Noise Wall
South edge of SR101L, East of Cave Creek Road	SR101L Station 1524+83 to Station 1530+19	532	Combination Wall (Remove Noise Wall Portion)
South edge of SR101L, West of 32nd Street	SR101L Station 1561+70 to Station 1574+32	1,262	Noise Wall on Barrier
South edge of SR101L, East of 32nd Street	SR101L Station 1577+45 to Station 1584+85	740	Noise Wall on Barrier
North edge of Westbound Frontage Road	Westbound Frontage Road Station 1324+80 to Station 1326+72	192	Noise Wall
North edge of 19th Avenue Ramp C	19th Avenue Ramp C Station 8+03 to Station 13+87	585	Noise Wall on Drilled Shaft Foundations
North edge of SR101L, West of 15th Avenue	SR101L Station 1328+37 to Station 1330+78	243	Soil Nail Wall
	SR101L Station 1335+10 to Station 1336+20	112	Soil Nail Wall
North edge of SR101L, East of 15th Avenue	SR101L Station 1336+83 to Station 1337+69	87	Soil Nail Wall
	SR101L Station 1348+63 to Station 1351+71	308	Soil Nail Wall
Between SR101L Mainline and South edge of 7th Avenue Ramp A, West of 7th Avenue	7th Avenue Ramp A Station 11+81 to Station 15+73	476	Retaining Wall
North Edge of 7th Avenue Ramp C, East of 7th Avenue	7th Avenue Ramp C Station 10+59 to Station 14+73	414	Noise Wall
North edge of SR101L, West of 16th Street	SR101L Station 1460+71 to Station 1466+61	591	Noise Wall
	SR101L Station 1466+61 to Station 1467+27	66	Combination Wall (Remove Noise Wall Portion)
North edge of SR101L, on 16th Street Overpass	SR101L Station 1467+27 to Station 1468+34	107	Panel Noise Wall
North edge of SR101L, East of 16th Street	SR101L Station 1468+34 to Station 1468+90	56	Combination Wall (Remove Noise Wall Portion)

(1) As-built Stationing was utilized

Table 34 – Existing Wall Removal Summary for General-Purpose Lane Widening (Cont.)

Description	Approximate Station Limits[1]	Approximate Wall Removal Length (Ft.)	Existing Wall Type
North edge of SR101L, East of 16th Street	SR101L Station 1468+90 to Station 1476+29	739	Noise Wall
North edge of SR101L, East of Cave Creek Road	SR101L Station 1525+10 to Station 1529+48	443	Combination Wall (Remove Noise Wall Portion)
North edge of Cave Creek Road Ramp C, East of Cave Creek Road	Cave Creek Road Ramp C Station 5+68 to Station 15+09	942	Noise Wall on Barrier
North edge of SR101L, West of 32nd Street	SR101L Station 1555+12 to Station 1574+32	1,921	Noise Wall on Barrier

(1) As-built Stationing was utilized

4.6.8 Noise Walls

A noise mitigation study is being prepared for this project. The initial findings of the noise analysis is summarized in Table 35 for the Preferred Alternative.

Table 35 – New Noise Wall Summary for General-Purpose Lane Widening

Wall No. [1]	Description	Approximate Station Limits	Approximate Wall Length [2] (Ft.)	Average Wall Height (Ft.)	Maximum Wall Height (Ft.)	Wall Type
Barrier 02C & 02D[3]	South edge of Eastbound Frontage Road	SR101L Station 1337+45 to Station 1353+56	1,582	17	20	Standard Sound Wall
SW2	South edge of 7th Avenue Ramp D	7th Avenue Ramp D Station 9+94 to Station 1377+63	237	12	12	Standard Sound Wall
SW3	South edge of 7th Street Ramp D	7th Street Ramp D Station 8+20 to Station 12+04	384	9.5	10	Standard Sound Wall
SW4	South edge of SR 101L	SR101L Station 1468+94 to Station 1481+35	1,245	20	24	Combination Wall
SW5	South edge of SR 101L	SR101L Station 1524+83 to Station 1530+19	532	12.5	12.5	Combination Wall
Barrier 06	South edge of SR101L, including bridges over 32nd Street, the CAP Canal, and the Low Flow Channel Bridge	SR101L Station 1559+15 to Station 1597+43	3,833	16	16	Combination Wall (Except Cast-in-place Wall On Bridge Deck At Overpasses)
SW7	North edge of Westbound Frontage Road	Westbound Frontage Road Station 1324+80 to Station 1326+72	192	17	17	Sound Wall on Drilled Shaft Foundations
SW8	Between 19th Avenue Ramp C and Westbound Frontage Road	19th Avenue Ramp C Station 16+96 to 19th Avenue Ramp C Station 22+80	585	17	17	Combination Wall
SW9	Between 7th Avenue Ramp C and Westbound Frontage Road	7th Avenue Ramp C Station 10+59 to Station 14+73	414	12	14	Standard Sound Wall

(1) Walls designated as "SW" are matching existing noise wall height and lengths. "Barrier" walls are new noise mitigation walls recommended by the noise analysis which improve existing noise wall mitigation.
(2) As-built stationing was utilized except for barrer 02C, 02D, and 06.
(3) Wall is split at 13th Aveune.

Table 35 – New Noise Wall Summary for General-Purpose Lane Widening (Cont.)

Wall No. [1]	Description	Approximate Station Limits	Approximate Wall Length [2] (Ft.)	Average Wall Height (Ft.)	Maximum Wall Height (Ft.)	Wall Type
SW10	North edge of SR 101L including 16th Street Overpass	SR101L Station 1460+71 to Station 1476+29	1,559	14	15	Combination Wall (Except Cast-in-place Wall On Bridge Deck At Overpasses)
SW11	North edge of SR 101L	SR101L Station 1525+10 to Station 1529+48	443	8	8	Combination Wall
SW12	North edge of Cave Creek Road Ramp C	Cave Creek Road Ramp C Station 5+68 to Cave Creek Road Ramp C Station 15+09	942	9.5	10	Combination Wall
SW13	North edge of SR 101L	SR101L Station 1555+12 to Station 1559+00	388	9.5	10	Standard Sound Wall
		SR101L Station 1559+00 to Station 1574+32	1,532	9.5	10	Combination Wall

(1) Walls designated as "SW" are matching existing noise wall height and lengths. "Barrier" walls are new noise mitigation walls recommended by the noise analysis which improve existing noise wall mitigation.
(2) As-built stationing was utilized except for barrer 02C, 02D, and 06.
(3) Wall is split at 13th Aveune.

4.6.9 Box Culverts

The general-purpose lane widening would impact several existing reinforced concrete box culverts (RCBC) within the study area where the edge of the widened roadway would be in close proximity to (or extends beyond) the ends of the existing culverts. A few locations would also exist where the finished pavement elevation would be near the top of the existing RCBC (less than 18 inches of cover).

The proposed fill heights would exceed the allowable fill design heights at three locations, so lightweight concrete foam would be recommended at these locations.

Table 36 provides the locations of the culverts where these unique design conditions would occur, and recommended design solution at each location.

Table 36 – Box Culvert Recommendations for General-Purpose Lane Widening

Culvert Location (SR 101L Station)	Existing Culvert Description	Situation	Preliminary Recommendation
1409+77.42	2 cell; 7.87' x 5.91'	The proposed fill height for the SR 101L westbound roadway widening would exceed the maximum design fill height of 25'.	Provide lightweight concrete foam to reduce the weight of the embankment.
1532+76.57	2 cell; 7.87' x 5.91'	The proposed fill height along the realigned Cave Creek Road ramp would exceed the maximum design fill height of 10'.	Provide lightweight concrete foam to reduce the weight of the embankment.

Table 36 – Box Culvert Recommendations for General-Purpose Lane Widening (Continued)

Culvert Location (SR 101L Station)	Existing Culvert Description	Situation	Preliminary Recommendation
1532+91.17	1 cell; 7.87' x 5.91'	The proposed fill height along the realigned Cave Creek Road ramp would exceed the maximum design fill height of 10'	Provide lightweight concrete foam to reduce the weight of the embankment.
1706+39.76	2 cell; 7.87' x 5.91'	The top of the eastbound roadway pavement would provide approximately 10½" of cover above the top of the box culvert.	Provide a reinforced PCCP section over the box culvert, with doweled joints on either side of the box culvert to minimize differential settlement.
1766+10.89	1 cell; 6' x 6'	The new edge of the westbound roadway pavement would extend beyond north end of the existing box culvert.	Extend the box culvert and realign the drainage channel and wingwalls (see Drainage Section).
1770+17.72	2 cell; 6' x 6'	The new edge of the westbound roadway pavement would be in close proximity of the north end of the existing box culvert.	Provide a special retaining wall design that would include a wall stem and footing doweled into the roof of the box culvert.
1783+13.65	3 cell; 6' x 6'	The new edge of the westbound roadway pavement would extend beyond north end of the existing box culvert.	Extend the box culvert and realign the drainage channel and wingwalls (see Drainage Section).
1785+56.82	5 cell; 6' x 6'	The new edge of the westbound roadway pavement would be in close proximity of the north end of the existing box culvert.	Provide a special retaining wall design that would include a wall stem and footing doweled into the roof of the box culvert.
1812+00.44	6 cell; 8' x 6'	The proposed fill height in the eastbound direction requires a retaining wall with a footing in close proximity to the roof of the existing box culvert. A similar condition exists in the westbound direction where a minimal height modified concrete retained half barrier is proposed.	Provide a special retaining wall design that would include a wall stem and footing connected to the roof of the box culvert. Doweling may also be required for the modified concrete half barrier.
1825+45.93	8 cell; 10' x 6'	The new edge of the eastbound and westbound roadway pavement would extend beyond south and north ends of the existing box culvert. The top of the westbound roadway pavement would provide approximately 11½" of cover above the top of the box culvert.	Extend the box culvert and realign the drainage channel and wingwalls (see Drainage Section). Provide a special retaining wall design that would include a wall stem and footing doweled into the roof of the box culvert.
1827+42.78	6 cell; 10' x 6'	The new edge of the eastbound and westbound roadway pavement would extend beyond south and north ends of the existing box culvert.	Provide a special retaining wall design that would include a wall stem and footing doweled into the roof of the box culvert.
1863+77.00	2 cell; 8' x 6'	The proposed fill height (using 4:1 foreslopes) would exceed the maximum design fill height of 10'.	Utilize a retaining half-barrier detail along SR 101L with 3:1 maximum foreslopes to reduce the embankment heights to 8.65' over the box culvert.

(1) See Section 1.3.7.4 for a more detailed description of box culverts at the stations noted.
(2) Preliminary recommendations shall be further evaluated during Stage II design.

4.7 DRAINAGE

4.7.1 Offsite Systems

The hydraulic performance of existing offsite drainage features is not expected to be impacted by the roadway widening. Small increases in onsite peak flows will not affect the capacity of the offsite drainage systems due to significant differences in design frequency and times of concentration between the onsite and offsite hydrographs.

Between Station 1647+50 and 1657+50, the westbound roadway would extend into an existing concrete-lined channel. Within this area, approximately 0'-19' of the existing channel lining would be removed to build a retaining wall adjacent to the roadway. The proposed channel modifications would result in an increased channel cross-sectional area. Therefore, the hydraulic capacity of the channel would be negatively impacted by the proposed improvements.

At Stations 1766+00, 1783+00, and 1825+00, the widened roadway would encroach into the existing soil cement inlet channel on the north side of the SR 101L mainline. In these cases, the box culverts would be extended along with the realignment of a short segment of the soil cement inlet channel. At Station 1825+00, the existing box culvert would also be extended at the south end of the culvert.

At Stations 1770+00, 1785+50, and 1827+00, the proposed roadway would encroach slightly into the existing channel. However, no culvert extension or channel modifications are proposed and the roadway would be designed to cantilever slightly beyond the culvert inlet.

An analysis of Cave Creek Wash will be required to verify the new ramp bridges will not impact the hydraulic conditions of the wash.

4.7.2 Onsite Systems

Analysis Criteria

The drainage evaluation was based on the requirements of Chapter 600 of ADOT's *Roadway Design Guidelines*. The minimum catch basin spacing was based on the allowable spread requirements for each roadway classification.

Onsite System Overview

The onsite drainage analysis evaluated the pavement drainage system modifications that would be needed to support the widened freeway mainline and interchange ramp realignment areas. The proposed drainage system concept is illustrated in Appendix H.

The proposed SR 101L mainline widening and the reconstruction of the ramps would require the relocation of the catch basins currently located along the outside edges of the roadways. Some of the area inlets located within the infield areas would also need to be relocated at traffic

interchanges. All of the current onsite drainage system outfalls will be retained with connections to the existing offsite drainage system.

The relocation of the catch basins would require the extension of the existing storm drain system to connect existing laterals to the new catch basins. Additional catch basins and manholes would be proposed at some locations to conform to the new roadway widths and design criteria.

Special detail catch basins or manholes would be proposed to retain or improve maintenance access to all existing lateral and trunk lines. These drainage structures would include modifications to the existing catch basins when the proposed catch basin is located close to an existing inlet. Other cases include modification of existing manholes into catch basins, or capping existing manholes and catch basins. The intent is to eliminate the presence of manhole rims located in the roadway pavement while meeting the maximum spacing criteria required for the trunk line's diameter. The design of special detail maintenance access structures will be coordinated with ADOT Drainage Design Section and Phoenix Maintenance District representatives during final design.

Gutter and Inlet Hydrology and Hydraulics

The delineation of the onsite drainage basins was conducted based on the location of inlets and roadway geometry for the Preferred Alternative. Rational method calculations were conducted using a minimum 10-minute time of concentration for the calculation of design peak flows.

Preliminary gutter and inlet hydrologic and hydraulic calculations follow guidelines and procedures in the *ADOT Hydraulic Manual* and HEC-22 publications. The method of calculation accounts for a roadway section with a 1" rubberized asphalt overlay above the lip of gutter and n-values of 0.013 for the gutter and 0.016 for the pavement segment.

A 4" curb height was used for at-grade and elevated freeway segments, and a 6" curb height was used for depressed freeway areas. The 4" curb is a variation of ADOT C-Standard C-05.10, Type C. The 4" height is obtained by extending the back slope of the gutter section from 1.5' to 2.0', increasing the hydraulic capacity of the gutter section to offset the cross-sectional loss resulting from the 1" rubberized asphalt overlay.

4.8 EARTHWORK

The earthwork required for the project would include approximately 173,285 cubic yards of excavation and 252,092 cubic yards of embankment.

4.9 TRAFFIC DESIGN

4.9.1 Signing and Pavement Marking

A guide sign concept was prepared to ensure an effective signing plan could be developed for the Preferred Alternative. The goal of the signing concept is to provide clear advance guide signing for the route, while maintaining the integrity of the signing schemes on the SR 101L freeway corridor. A preliminary guide signing plan is provided on the plan sheets in Appendix H. Curve warning signs with advisory speeds would also be placed on the SR 101L mainline at the locations with available stopping sight distances that are less than recommended by the AASHTO.

The existing signs and sign structures would be relocated or replaced to support the proposed freeway widening. The final sign locations will be determined during the development of the final design plans and must consider the existing and new locations of utilities, bridge structures, retaining and noise walls, drainage features, lighting standards, and other appurtenances. Sign lighting will conform to *ADOT Traffic Engineering Guidelines and Processes #790*. The retroreflective sheeting on the existing signs will be upgraded and the sign lighting would be removed for the service interchange guide signs.

The pavement marking concept was developed to incorporate the existing and new lane configurations for the mainline, auxiliary lanes, service interchange ramps and system interchange ramps. The final designer will need to coordinate with ADOT's Traffic Design Section to optimize the length of auxiliary lanes on the segment of SR 101L between I-17 and Cave Creek Road.

The preliminary pavement marking concept has been developed in accordance with the ADOT *Signing and Marking Standard Drawings* 2014 (and recent updates) that reference the requirements for lane lines, edge lines, and gore striping.

4.9.2 Traffic Signals

The widening of the existing overpass bridge structures would necessitate modifications to the existing traffic signal at the Tatum Boulevard TI. Existing signal heads mounted on the bridge fascia (for the northbound and southbound traffic movements) would be relocated to the outside of the widened bridge structure.

Traffic signals at the intersections of 15th Avenue and the frontage roads would also be modified due to the new intersection configurations. At the other service interchanges the impact of widened bridge structures is not currently anticipated to impact the signalized intersections but will need to be evaluated during final design.

4.9.3 Lighting

Continuous freeway lighting is currently provided on SR 101L between I-17 and Princess Drive. This lighting consists of a mixture of high mast poles (100' to 120' height) with 400-Watt high pressure sodium (HPS) high mast fixtures at the SR51/SR101L TI, high mast poles (100' height) with 400-Watt HPS high mast fixtures at the service interchanges, and high mast median mounted high mast poles (69' mounting height) with two 400-Watt HPS high mast fixtures along the freeway mainline. A preliminary evaluation of the existing lighting was conducted to determine if the existing lighting system could accommodate the additional travel lanes associated with the freeway widening.

Based on the preliminary lighting evaluation, the existing lighting would be able to accommodate the added general-purpose and auxiliary lanes. The lighting evaluation was prepared in conformance with the criteria established in the *American National Standard Practice for Roadway*

Lighting, ANSI/IES RP-8-00, published in 2000. This document identifies nationally recognized design criteria for roadway lighting that has been accepted by ADOT. In addition, the following criteria listed in ADOT's *Design Procedures Manual* were used in the lighting analysis:

- freeway lighting provides an average maintained horizontal illuminance in the range of 0.6 to 0.8 footcandles (Fc) on the traveled roadway;
- a minimum illuminance value of 0.2 footcandles;
- an average to minimum uniformity ratio of 3:1 to 4:1;
- a light loss factor (LLF) of 0.81; and
- light levels were calculated every 6' on the traveled roadway.

Based on the evaluation conducted with this study, the existing lighting would be sufficient for the widened SR 101L roadways. The existing light poles located at the interchange ramps would be relocated in accordance with the new ramp alignments.

Currently, ADOT uses the illuminance method for calculating the requirements for lighting along State freeways and highways. This method calculates the amount of light that falls onto the pavement from light fixtures along the roadway (measured in footcandles). The new IES RP-8-2014 Roadway Lighting Report is switching from this method to Luminance Method, which measures the amount of light that is reflected off the pavement and is measured in candelas per square meter.

ADOT is considering LED light fixtures and adopting the new IES RP-8-2014 and changing to the luminance method. As of this writing, a final decision has not been made for which criteria should be used for this project. Once this decision is finalized, the final designer shall coordinate with ADOT and conduct a lighting analysis based on the final criteria.

The lighting analyses shall include a "spillover" evaluation where the freeway is located adjacent to residential neighborhoods. The lighting analysis for the crossroads shall include an evaluation of the shadow effects of the freeway overpasses and underpasses, along with the use of underdeck lighting to enhance the lighting beneath the bridge structures.

4.9.4 Freeway Management System

The existing Freeway Management System (FMS) includes an integrated system of Dynamic Message Signs (DMS), pull boxes, system detectors, closed-circuit television (CCTV) cameras and ramp meters placed throughout this segment of the SR 101L corridor. These FMS features are connected to the ADOT Traffic Operations Center by fiber optic cable in three 3" conduits that are located along the eastbound and westbound roadways. These existing FMS features will be required to be relocated within the limits of the freeway widening.

ADOT's *ITS Design Guide* (May 2015) allows the FMS communication system to be provided with three 3" conduits placed along one side of the freeway. However, ADOT would still like to maintain a conduit system on both sides of the freeway. It is anticipated that conduits at the existing bridges will remain and be reused. The FMS elements along the freeway would be relocated away from the roadway as far as possible within the existing right-of-way. New fiber optic cable will be installed in the relocated conduit.

The existing system detectors would also be abandoned and replaced with new detectors placed approximately every mile in each direction of travel in advance of each entrance ramp. New DMS sign structures will also be required in conformance with the new sign support requirements.

The FMS system must remain operational at all times during the construction of this project. All FMS equipment should be evaluated during final design to determine potential construction conflicts. ADOT Transportation Technology Group (TTG) shall be involved in reviews and provide guidance for FMS design of the SR 101L improvements.

The final designer must coordinate with the City of Phoenix and the City of Scottsdale with regards to fiber connections between their system and ADOT's FMS system.

A storage length calculation was conducted for eastbound and westbound entrance ramps per ADOT's *Ramp Metering Design Guide* (November 2013). The result of the analysis indicates no modifications would be required for the ramp meters.

Vehicle "wrong way" detection and signing shall be placed on all service interchange exit ramps in accordance with the current details provided by ADOT TTG.

4.10 CONSTRUCTION PHASING AND TRAFFIC CONTROL

Traffic will be managed by detailed traffic control plans and by procedures and guidelines specified in Part VI of the current version of the *Manual of Uniform Traffic Control Devices* (MUTCD), and by the Arizona Supplement to Part VI of the MUTCD. Full freeway closures and freeway lane restrictions will be limited to nights and weekends.

Weekend and night closures are preferred over obliteration and restriping where practical. Existing mainline freeway traffic will be maintained with the existing striping during construction. Temporary concrete barrier would be placed adjacent to the existing SR 101L outside shoulders.

The final construction phasing and traffic control plans will be developed during the final design. Coordination will be required with the local agencies to identify project phasing restrictions that will impact construction. Restrictions due to arterial street capacity constraints, freeway access, and emergency vehicle access could limit the number of crossroads and ramp connections that would be under construction concurrently.

Successive entrance and exit ramps should not be closed to traffic concurrently. If necessary, the ramp closures should coincide with the widening of the bridge on the same interchange crossroad.

The eastbound frontage road between 15th Avenue and 7th Avenue must remain open at all times. Temporary pavement installation may be required in order to accomplish this during reconstruction of the 15th Avenue Underpass and approaches.

4.11 UTILITY COORDINATION

During final design, each city and utility agency will receive and review the preliminary design plans for this project. Utility conflicts will be resolved with the assistance and cooperation from the affected agencies. Construction plans for the relocations or adjustments of the utilities will be developed by the responsible parties.

All ADOT utilities that are in conflict will be included in the freeway design and utility relocation efforts, including the conversion of any existing unmetered freeway lighting, traffic signals or any other electrical facilities into metered services.

The cities of Phoenix and Scottsdale have numerous water, sewer, raw (untreated) and reclaimed water pipelines across the freeway mainline and cross streets. None of these utilities are expected to be in direct conflict with the freeway improvements and would be protected in-place. Some pipeline sleeve or encasement extensions may be required under new lanes.

The existing freeway crosses over the CAP Canal and its maintenance roads just east of 32nd Street. The CAP Canal includes a relatively shallow (24" ground cover typically) communication cable duct bank consisting of three 1.25" fiber optic cables along the west canal maintenance road. This duct bank was recently built to replace an older metallic line, and is located approximately 4' closer to the bridge piers (according to discussions with CAWCD staff).

The proposed reconstruction of the 15th Avenue bridge would require the relocation of existing APS electric conduits currently located inside the structure, as well as the CenturyLink underground telephone lines adjacent to and east of the bridge.

Construction of a proposed soil nail retaining wall along the south side of the freeway may impact underground utilities along the eastbound frontage road near 15th Avenue. These utilities include a 10" water line and a utility joint trench that includes APS underground power conduits and telecommunication fiber optic lines. In addition, the realignment and reconstruction of the eastbound and westbound frontage roads between 19th Avenue and 7th Avenue (including a new storm drain) would likely conflict with numerous subsurface utility lines and joint trench duct banks along the existing frontage roads.

The City of Phoenix has two water lines that cross the freeway along the west side of 7th Avenue that includes a 24" DIP water line within a 42" RCP sleeve, and a 12" DIP water line within a 24" RCP sleeve. The freeway widening may require the ends of the RCP sleeves to be extended to the new edge of the PCCP.

The City of Scottsdale has a 66" raw water transmission main across the freeway along the Union Hills Road alignment that must be protected in place.

APS has a 230kV overhead power line with 69kV underbuild that crosses SR 101L along the 12th Street alignment. This high voltage power line is not in conflict with this project and should be protected in-place.

APS also has a single-circuit 69kV overhead transmission power line that crosses SR 101L along the east side of 56th Street. No direct conflicts with the power line poles and conductors are anticipated. During final design, supplemental survey and power line sag determination will be needed to determine if remedial measures are necessary to ensure worker and public safety during bridge widening and retaining wall construction activities at the freeway overpass. Coordination with APS is also required to allow continued maintenance access to the power poles.

4.12 GEOTECHNICAL AND PAVEMENT DESIGN

4.12.1 Bridge Structures

The site soils are generally considered to be well suited for the use of either shallow spread foundations or drilled shaft foundations. Spread footings should provide adequate support for low to moderately loaded structure elements which are currently supported on shallow foundations. Drilled shaft foundations would provide greater support for heavier loaded structures.

Table 37 provides a summary of the existing structures that would be modified with this project, along with the existing foundation types, preliminary recommended foundation type, and general soil conditions.

Table 37 – Summary of Existing and Preliminary Recommended Foundation Types for SR 101L Bridges

Structure	Existing Foundation Type	Preliminary Recommended Foundation Type	General Soil Conditions
19TH Avenue Overpass	Abutments on Drilled Shaft Foundations	Drilled shaft foundations extending into the very dense gravelly sands	Moderately firm to very firm, clayey sand and sandy clay over dense to very dense, sands, gravels, and SGC with layers of firm to very firm, sandy clay
15th Avenue Underpass	Abutments and Piers on Spread Footings	Spread footings bearing in the firm to hard clayey sand or very dense gravelly sand	Firm to hard clayey sand over very dense gravelly sand.
15th Avenue Underpass	Abutments and Piers on Spread Footings	Spread footings bearing in the firm to hard clayey sand or very dense gravelly sand	Firm to hard clayey sand over very dense gravelly sand.
7th Avenue Underpass	Abutments and Piers on Spread Footings	Spread footings bearing in the hard silty sand and clayey gravel	Hard silty sand over hard clayey gravel over very dense sandy gravel over hard clayey gravel and silty sand
7th Street Ramp 7SA Bridge over Cave Creek Wash	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the silty and gravelly sands	Very dense sandy and silty gravels over very dense gravelly and silty sands
7th Street Ramp 7SB Bridge over Cave Creek Wash	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the silty and gravelly sands	Dense to very dense, silty gravels and sandy gravels over firm to hard silty sands
Cave Creek Wash Overpass	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the firm to hard silty sands.	Dense to very dense, sands and gravels over firm to hard silty sands
EB and WB Frontage Road over Cave Creek Wash	Abutments and Piers On Drilled Shaft Foundations	Drilled shaft foundations extending into the firm to hard, silty and clayey sands	Very dense SGC over firm to hard, silty sand and clayey sand
7TH Street Overpass	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the very dense sandy gravel present below 15'	Loose to medium dense sand over very dense sandy gravel
16th Street Overpass	Abutments on Spread Footings	Spread footings bearing in the very dense sandy gravel or gravelly sand	Very dense sandy gravel or gravelly sand over rock (Granodiorite or Greenstone)

Table 37 – Summary of Existing and Preliminary Recommended Foundation Types for SR 101L Bridges (Continued)

Structure	Existing Foundation Type	Preliminary Recommended Foundation Type	General Soil Conditions
Cave Creek Road Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the firm to hard, silty and or clayey, sand; Abutments supported by drilled shaft foundations bearing within the firm to hard, silty and or clayey, sand	Firm to hard, silty and or clayey, sand
32nd Street Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the moderately firm to hard, silty and or clayey sand; Abutments supported by drilled shaft foundations bearing within the moderately firm to hard, silty and or clayey sand	Moderately firm silty to clayey sand to 10' over hard silty to clayey sand
CAP Canal Bridges	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the hard clayey and silty sand	Firm to hard, clayey and silty, sand occasional layers of hard, sandy silt and clay and clayey sand; Silty to clayey gravel was encountered in some borings below 45'
Low Flow Channel Bridge (EB)	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the hard sandy clay and clayey sand layers	Moderately firm to hard, sandy clay and clayey sand
Low Flow Channel Bridge (WB)	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the hard silty to clayey sand layers	Moderately firm to hard, silty sand to clayey sand, over very dense or hard, silty to clayey gravel
Tatum Boulevard Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the firm to hard, clayey sand and sandy clay layers; Abutments supported by drilled shafts bearing within the firm to hard, clayey sand and sandy clay layers	Firm to hard, clayey sand with layers of firm to hard, sandy clay
56th Street Overpass	Abutments and Piers on Drilled Shaft Foundations	Drilled shaft foundations extending into the firm to hard, clayey sand and sandy clay layers	Soft sandy silt, sandy clay, and clayey sand in the upper 5' over firm to hard clayey sand with layers of sandy clay and sandy silt.
64th Street TI Underpass	Abutments and Piers on Drilled Shaft Foundations	Drilled shafts extending into the firm to hard, silty and clayey sand and sandy clay layers	Layers of moderately firm to hard, silty sand, clayey sand, and sandy clay increasing in firmness with depth.
Hayden Road TI Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the firm to hard, silty to clayey sand; Abutments supported by drilled shaft foundations bearing within the firm to hard, silty to clayey sand	Moderately firm to hard, silty to clayey sand

Table 37 – Summary of Existing and Preliminary Recommended Foundation Types for SR 101L Bridges (Continued)

Structure	Existing Foundation Type	Preliminary Recommended Foundation Type	General Soil Conditions
Scottsdale Road TI Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the firm to hard, silty to clayey sand; Abutments supported by drilled shaft foundations bearing within the firm to hard, silty to clayey sand	Soft to hard, silty to clayey sand increasing in firmness with depth
Princess Drive TI Overpass	Piers on Spread Footings, Abutments on Drilled Shaft Foundations	Piers on spread footings bearing within the firm to hard, silty to clayey sand; Abutments supported by drilled shaft foundations bearing within the firm to hard, silty to clayey sand	Soft to hard, silty to clayey sand increasing in firmness with depth

4.12.2 Retaining and Noise Walls

The majority of existing retaining walls and noise walls are founded on spread footings. Retaining wall R2 is founded on drilled shaft foundations at the SR51/SR101L TI. Also, a considerable amount of overexcavation of unsuitable soil was conducted for the construction of retaining walls in the vicinity of the 64th Street TI.

The majority of the new walls would likely be constructed as standard walls with spread footings at relatively low to moderate allowable soil bearing pressures. Variations of the actual wall types selected will likely be based upon constructability around existing and new structures versus soil conditions. Standard wall footings should be constructible provided the new walls are located a sufficient distance from existing walls (laterally and vertically). The use of drilled shaft foundations may be preferred in some locations, depending on proximity to existing structures, and in isolated areas as dictated by poor subgrade conditions. Other special design walls such as L-shaped footing walls may be needed due to the proximity of new walls to existing structures.

4.12.3 Unsuitable Soil Removal

The majority of the project alignment is underlain by relatively fair quality subgrade soils. However, overexcavation and removal of unsuitable soil took place during the construction of the SR 101L as indicated in the following table.

Table 38 – Limits of Overexcavation Performed for the Original Construction of SR 101L

Original Project	Depth of Overexcavation (Ft.)	SR 101L Station Range
Pima Freeway (101L), Jct. I-17 (23rd Ave.)-56th Street ACSTP-600-1(6)P 101L MA 022 H3565 01C	2' to 3.3' thickness of Topsoil Removal**	EBFR Sta. 43+190 to 43+565*, WBFR Sta. 43+275 to 43+555*, 43+220 to 43+475*, 48+540 to 49+185*, 49+200 to 49+900*, 49+940 to 50+745*, 53+619 to 53+780*
	Landfill Removal	42+575 to 42+660*
Pima Freeway (101L), Cave Creek Road - Scottsdale Road (Phase B) ACSTP-600-1(16)B 101L MA 029	2' to 3.3' Topsoil/Collapsible Soil Excavation**	53+780 to 54+530* 54+700 to 56+400*
Pima Freeway SR 101, Loop 101/64th Street TI NH-101-B(003)B 101 MA 032 H6240 01C	1' to 5' Overexcavation under outside shoulders for retaining walls and ramp embankments	1760+00 to 1837+00
Pima Freeway (101L), Scottsdale Road – Pima Road Ram 600-1-564 101 MA 034 H3230 02C	3' Overexcavation beneath entire footprint of embankment extending 2' past collector channel, between Scottsdale Road and Princess Drive	1856+50 to 1964+00

* Original metric stationing
** Converted from Metric units

4.12.4 Recommended Pavement Structural Sections

From a preliminary basis, it is recommended that the SR 101L mainline pavements generally match the adjacent existing structural pavement section. The following table provides recommended pavement structural sections:

Table 39 – Preliminary Recommended Pavement Sections

Project Segment	Item	AR-ACFC (inches)	PCCP (inches)	AB (Class 2) (inches)	ACB Mix (inches)	Total Thickness (inches)
SR 101L, I-17 to Princess Drive	General-Purpose Lanes and Outside Shoulders, except between 32nd Street and Low Flow Channel (Elevated or At-Grade Freeway)	1.0	12.0	4.0	--	17.0
SR 101L, I-17 to Princess Drive	General Purpose Lanes and Outside Shoulders (Depressed Freeway)	1.0	12.0	-	4.0	17.0

(1) AR-ACFC is not typically present in gore areas and some of the ramps.

Table 39 – Preliminary Recommended Pavement Sections (Continued)

Project Segment	Item	AR-ACFC (inches)	PCCP (inches)	AB (Class 2) (inches)	ACB Mix (inches)	Total Thickness (inches)
	General Purpose Lanes and Outside Shoulders between 32nd Street and CAP Bridge	1.0	14.0	-	4.0	19.0
	General Purpose Lanes and Outside Shoulders between CAP Bridge and Low Flow Channel Bridge	1.0	10.0 (CRCP)	-	4.0	15.0
	Ramps, Auxiliary Lanes, and Gores	1.0(1)	10.0	4.0	-	15.0

(1) AR-ACFC is not typically present in gore areas and some of the ramps.

4.13 SCOTTSDALE AIRPORT COORDINATION

This project is located beneath the Federal Aviation Regulation (FAR) Part 77 Navigable Airspace of Scottsdale Airport. Proposed freeway improvements on the northern portion of the project may occur within the current Part 77 Surface.

Federal Aviation Administration (FAA) Form 7460-1 must be submitted to the FAA for their evaluation of any permanent or temporary penetrations of the Part 77 surface. All potential permanent and temporary encroachments into the Part 77 navigable airspace shall be evaluated during the final design and construction phases of this project. The Scottsdale Aviation Department should be consulted during final design and construction to coordinate project issues and potential airport operation concerns.

4.14 REACH 11 DAM AND FLOOD RESERVOIR

The Reach 11 Dam extends along the north side of the CAP Canal from Cave Creek Road to Scottsdale Road. Reach 11 serves primarily as a flood detention basin to protect the CAP Canal and adjacent communities from flood flows originating from the watershed to the north.

A portion of the freeway widening will interface with the Reach 11 dam and flood storage reservoir. Design and construction of the portion of this project within the Reach 11 limits will require approval from the BOR/CAWCD.

The freeway widening will require additional retaining walls and fill within the limits of Reach 11 Basin 'A'. To offset the reduction in the flood pool storage in Basin 'A' due to this infill, a location was identified in Basin 'B' to remove material. Details regarding the impacts and mitigation were presented to CAP and BOR during a meeting on June 6, 2012 and subsequent correspondence, see Appendix C.

The BOR will require the completion of the necessary technical studies to ensure the project improvements will not impact the hydraulic performance of the reservoir, and to provide documentation that the volume of flood storage is not decreased as a result of the project.

4.15 AMERICANS WITH DIABILITIES ACT (ADA)

The final designer shall inventory the existing pedestrian features located within the ADOT right-of-way for the existing crossroads and frontage roads. The existing features shall be evaluated for compliance with the 2010 ADA Standards for Accessible Design (2010 Standards).

Based upon the information obtained from the ADOT Features Inventory System (FIS) and final designer field reviews, an ADA Compliance and Feasibility Report shall be prepared that includes all ADA features located within the ADOT jurisdictional limits. The report shall include a summary of all ADA features that are compliant and non-compliant. All non-compliant features shall be upgraded during the final design and construction of the SR 101L improvements.

The following shall be used for the design of the pedestrian facilities:

- 2010 Americans With Disabilities Act Standards for Accessible Design
- Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way, July 26, 2011

ADA/PROWAG compliant pedestrian access shall be maintained on at least one side of each crossroad at all times during construction.

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5.0 ITEMIZED ESTIMATE OF PROBABLE COSTS

5.1 PROJECT COST ESTIMATES

The order of magnitude estimate of probable project costs for the Preferred Alternative for the segment of SR 101L between I-17 and SR 51 is $103,821,200 which includes $6,584,600 for final design, $2,274,300 for right-of-way, and $94,962,300 for construction as shown on Table 40. The RTPFP Life-Cycle Program (certified in January 2016) includes $73,500,000 for this project that includes $4,800,000 for final design in Fiscal Year (FY) 2023 and $68,700,000 for construction in FY 2024.

The order of magnitude estimate of probable project costs for the Preferred Alternative for the segment of SR 101L between SR 51 and Princess Drive is $51,404,100, which includes $3,309,000 for final design and $48,095,100 for construction as shown on Table 41. The RTPFP Life-Cycle Program (certified in January 2016) includes $66,200,000 for this project that includes $5,100,000 for final design in Fiscal Year (FY) 2020 and $61,100,000 for construction in FY 2021.

The total order-of-magnitude estimate of probable project costs for the Preferred Alternative (I-17 - Princess Drive) is $155,225,300 which includes $9,893,600 for final design, $2,274,300 for right-of-way, and $143,057,400 for construction. The RTPFP Life-Cycle Program (certified in January 2016) includes a total project budget of $139,700,000.

The estimated unit costs are based on unit prices obtained from recent ADOT bid results. Pavement structural sections used for this estimate are provided in Section 4.12.4 of this report.

The following is a list of assumptions that are reflected in the cost estimates for the SR 101L Build Alternative:

- The right-of-way acquisition amount was provided by ADOT's Right-of-Way Group.
- The cost of temporary construction easements or maintenance agreements is not included in the cost estimates.
- Costs for landscaping are only for the restoration of disturbed areas.
- Drainage modifications would be limited to adjusting or replacing the existing drainage elements to match the pavement widening and ramp realignments.
- FMS improvements are included in the cost estimates.
- The earthwork factor applied to the project excavation is estimated to be 10% shrink. No additional earthwork quantities were included in anticipation of hazardous materials or unsuitable material sites.
- Environmental mitigation costs are not included in this cost estimate.
- The project costs for Final Design, Right-of-Way and Construction have been adjusted to include Indirect Cost Allocation (ICAP) at 10.35%
- The existing AR-ACFC pavement would be removed and replaced with each project.
- The "Unidentified Items" contingency was reduced from 20% to 5% based upon the recommendations of a cost risk assessment conducted in January 2015.
- The project cost estimates excludes the improvements needed to meet current ADA requirements. See Section 4.15.

Table 40 – Order of Magnitude Itemized Estimate (I-17 to SR 51)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
2020021	REMOVAL OF CONCRETE CURB AND GUTTER	L.FT.	48,782	5.00	244,000
2020027	REMOVAL OF CONCRETE BARRIER	L.FT.	36,567	15.00	548,600
2020029	REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.	8,321	3.00	25,000
2020031	REMOVAL OF PORTLAND CEMENT CONCRETE PAVEMENT	SQ.YD.	46,096	10.00	461,000
2020034	REMOVAL OF SIGNS	L.SUM	1	67,200.00	67,200
2020041	REMOVAL OF PIPE	L.FT.	1,598	15.00	24,000
2020052	REMOVE (GUARDRAIL)	L.FT.	533	4.00	2,200
2020081	REMOVE BITUMINOUS PAVEMENT (MILL 1" AC)	SQ.YD.	487,638	1	487,700
2020155	REMOVE (CATCH BASIN)	EACH	64	500.00	32,000
2020158	REMOVE ATTENUATORS	EACH	4	200.00	800
2020168	REMOVE (RETAINING WALL)	SQ.FT.	476	30.00	14,300
2020168	REMOVE (SOUND WALL)	SQ.FT.	11,045	30.00	331,400
2020201	SAW CUTTING	L.FT.	60,204	2.00	120,500
2030301	ROADWAY EXCAVATION	CU.YD.	122,704	7.00	859,000
4010010	PORTLAND CEMENT CONCRETE PAVEMENT (10" PCCP OVER 4" AB)(RAMPS)	SQ.YD.	31,654	30.00	949,700
4010010	PORTLAND CEMENT CONCRETE PAVEMENT (10" PCCP OVER 4" AC)(REINFORCED)	SQ.YD.	605	50.00	30,300
4010012	PORTLAND CEMENT CONCRETE PAVEMENT (12" PCCP OVER 4" AB)	SQ.YD.	79,262	35.00	2,774,200
4010013	PORTLAND CEMENT CONCRETE PAVEMENT (12" PCCP OVER 4" AC)	SQ.YD.	36,063	40.00	1,442,600
4010014	PORTLAND CEMENT CONCRETE PAVEMENT (14" PCCP OVER 4" AC)	SQ.YD.	3,768	40.00	150,800
4060023	ASPHALTIC CONCRETE (7" AC)(FRONTAGE ROADS)	SQ.YD.	18,971	35.00	664,000
407X001	ASPHALTIC CONCRETE (AR-ACFC 1" OVERLAY) (NEW PAVEMENT)	SQ.YD.	138,666	5.00	693,400
407X001	ASPHALTIC CONCRETE (AR-ACFC1" OVERLAY) (EXISTING PAVEMENT)	SQ.YD.	487,638	5.00	2,438,200
5010107	PIPE, CORRUGATED METAL, SLOTTED, 18"	L.FT.	1,690	85.00	143,700
5011050	PIPE, REINFORCED CONCRETE, CLASS V, 42"	L.FT.	1,127	200.00	225,400
5011071	PIPE, REINFORCED CONCRETE, CLASS I, 72"	L.FT.	150	250.00	37,500
5012518	STORM DRAIN PIPE, 18"	L.FT.	132	45.00	6,000
5012524	STORM DRAIN PIPE, 24"	L.FT.	3,939	50.00	197,000
5012530	STORM DRAIN PIPE, 30"	L.FT.	542	70.00	38,000
5014023	FLARED END SECTION, 24" (C-13.20)	EACH	2	400.00	800
5030023	CONCRETE CATCH BASIN (C-15.20) ONE 7.5' WING, H=8' OR LESS	EACH	7	3,500.00	24,500
5030142	CONCRETE CATCH BASIN (C=15.80) H=8' OR LESS	EACH	11	3,000.00	33,000
5030604	CONCRETE CATCH BASIN (C-15.91) H=8' OR LESS	EACH	14	3,200.00	44,800
5030606	CONCRETE CATCH BASIN (C-15.92) H=8' OR LESS	EACH	131	3,500.00	458,500
5050021	MANHOLE (C-18.10)(NO. 2)(FOR PIPES 6" TO 36")	EACH	9	3,500.00	31,500
5050022	MANHOLE (C-18.10)(NO. 2)(FOR PIPES OVER 36")	EACH	8	4,000.00	32,000
6060036	BRIDGE SIGN STRUCTURE (DMS SIGN)	EACH	3	130,000.00	390,000
6060048	BRIDGE SIGN STRUCTURE (SD9.20, TYPE 4F)	EACH	8	110,000.00	880,000
6060079	FOUNDATION FOR BRIDGE SIGN STRUCTURE (TAPERED TUBE)	EACH	16	8,000.00	128,000
6060080	FOUNDATION FOR BRIDGE SIGN STRUCTURE (DMS SIGN)	EACH	3	10,000.00	30,000
6060150	CANTILEVER SIGN STRUCTURE	EACH	21	40,000.00	840,000
6060240	FOUNDATION FOR CANTILEVER SIGN STRUCTURE	EACH	21	70,000.00	147,000
6061001	SIGN MOUNT ASSEMBLY (FOR BRIDGE FASCIA)	EACH	13	8,000.00	104,000
6070002	BREAKAWAY SIGN POST S4X7.7	L.FT.	728	25.00	18,200
6070022	FOUNDATION FOR BREAKAWAY SIGN POST S4X7.7	EACH	56	300.00	16,800
6070038	SLIP BASE (2 1/2S)	EACH	84	150.00	12,600
6070055	SIGN POST (PERFORATED)(2 1/2S)	L.FT.	1,008	8.00	8,100
6070060	FOUNDATION FOR SIGN POST (CONCRETE)	EACH	98	175.00	17,200
6080004	REGULATORY, WARN, OR MARKER SIGN PANEL	SQ.FT.	1,715	20.00	34,300
6080064	EXTRUDED ALUM SIGN PANEL WITH TYPE VIII/IX/X SHEET	SQ.FT.	8,356	25.00	208,900
7030095	MILEPOST MARKER (S-10)	EACH	14	300.00	4,200
7040070	PAVEMENT MARKING (WHITE THERMOPLASTIC)(0.090)	L.FT.	131,922	0.30	39,600
7040071	PAVEMENT MARKING (YELLOW THERMOPLASTIC)(0.090)	L.FT.	128,273	0.30	38,500
7040072	PAVEMENT MARKING (TRANSVERSE)(THERMOPLASTIC)(ALKYD)(0.090")	L.FT.	205,053	.50	102,600
7040074	PAVEMENT SYMBOL (EXTRUDED THERMOPLASTIC)(ALKYD)(0.090")	EACH	66	100.00	6,600
7050047	PAVEMENT MARKING, PREFORMED, PATTERNED, WHITE STRIPE	L.FT.	128,782	3.50	450,800
7060013	PAVEMENT MARKER, RAISED, TYPE C	EACH	10,236	3.00	30,800
7060017	PAVEMENT MARKER, RAISED, TYPE E	EACH	3,286	3.00	9,900
7080001	PERMANENT PAVEMENT MARKING (PAINTED)(WHITE)	L.FT.	224,650	0.10	22,500
7080011	PERMANENT PAVEMENT MARKING (PAINTED)(YELLOW)	L.FT.	85,515	0.10	8,600
7080101	PERMANENT PAVEMENT MARKING (PAINTED SYMBOL)	EACH	66	50.00	3,300
7310190	POLE (RELOCATE HIGH MAST POLE AND ASSEMBLY)	EACH	8	1,000.00	8,000
7310360	POLE FOUNDATION (FOR 100' HIGH MAST)	EACH	8	7,500.00	60,000
7320050	ELECTRICAL CONDUIT (2")(PVC)	L.FT.	160	7.00	1,200
7320071	ELECTRICAL CONDUIT (3")(PVC)	L.FT.	190	10.00	1,900
7320072	ELECTRICAL CONDUIT (3-3")(PVC)	L.FT.	47,670	12.00	572,100
7320073	ELECTRICAL CONDUIT (2-3")(PVC)	L.FT.	310	11.00	3,500
7320421	PULL BOX (NO. 7)(WITH EXTENSION)	EACH	72	600.00	43,200
7320455	PULL BOX (NO. 9)	EACH	40	2,500.00	100,000
7320456	PULL BOX (RELOCATE EXISTING)	EACH	1	200.00	200

Table 40 – Order of Magnitude Itemized Estimate (I-17 to SR 51)(Continued)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
7320520	CONDUCTOR (NO. 8)	L.FT.	320	0.50	200
7320585	CONDUCTOR (INSULATED BOND)(NO. 8)	L.FT.	160	0.50	100
7320787	SINGLE MODE FIBER OPTIC CABLE (144 STRAND)	L.FT.	55,390	2.50	138,500
7330620	RELOCATE TRAFFIC SIGNALS	L.SUM	1	120,000.00	120,000
7340105	CONTROL CABINET FOUNDATION	EACH	3	500.00	1,500
7340210	RELOCATE CONTROL CABINET	EACH	3	500.00	1,500
7350030	LOOP DETECTOR FOR TRAFFIC SURVEILLANCE (6'X6')	EACH	92	500.00	46,000
7360420	REMOVE AND SALVAGE EXISTING SIGN LIGHTING	L.SUM	1	2,000.00	2,000
7379111	VARIOUS MESSAGE SIGN ASSEMBLY AND INSTALLATION	EACH	3	2,000.00	6,000
800X002	LANDSCAPING (6 MILES @ $50,000/MI)	EACH	6	50,000.00	300,000
8081431	PIPE, DUCTILE IRON (10")(CLASS 52)	L.FT.	400	150.00	60,000
8090705	CASING (24" RCP SLEEVE FOR 12" DIP)	L.FT.	30	300.00	9,000
8090706	CASING (42" RCP SLEEVE FOR 24" DIP)	L.FT.	30	500.00	15,000
9050026	GUARD RAIL TERMINAL (TANGENT TYPE)	EACH	17	2,500.00	42,500
9050401	GUARD RAIL TRANSITION, W-BEAM TO CONCRETE BARRIER	EACH	17	3,000.00	51,000
9080084	CONCRETE CURB AND GUTTER	L.FT.	18,012	15.00	270,200
9080201	CONCRETE SIDEWALK (C-05.20)	SQ.FT.	2,760	4.00	11,100
9100000	CONCRETE BARRIER (SINGLE FACE WITH GUTTER)(2.5' PAN)	L.FT.	21,242	50.00	1,062,100
9100008	CONCRETE BARRIER (ADJACENT TO RETAINING WALL)(2.5' PAN)	L.FT.	21,386	50.00	1,069,300
9100009	CONCRETE BARRIER (SINGLE FACE WITH GUTTER)(4.5' PAN)	L.FT.	19,974	50.00	998,700
9100012	CONCRETE BARRIER (ADJACENT TO RETAINING WALL)(4.5' PAN)	L.FT.	3,596	85.00	305,700
9100014	CONCRETE BARRIER (RETAINING HALF BARRIER)	L.FT.	5,843	100.00	584,300
9140133	NOISE BARRIER WALL	SQ.FT.	44,991	30.00	1,349,800
9140134	NOISE BARRIER WALL (SPECIALTY)	SQ.FT.	3,264	50.00	163,200
9140138	WALL (COMBINATION WALL)(NOISE WALL PORTION ONLY)	SQ.FT.	152,785	25.00	3,819,700
9140153	RETAINING WALL (SD 7.01)	SQ.FT.	81,561	50.00	4,078,100
9140155	RETAINING WALL (COMBINATION)(RETAINING WALL PORTION ONLY)	SQ.FT.	91,057	50.00	4,552,900
9140156	RETAINING WALL (SPECIALTY WALL 1)	SQ.FT.	11,521	75.00	864,100
9140157	RETAINING WALL (SPECIALTY WALL 2)	SQ.FT.	28,812	75.00	2,160,900
9140158	RETAINING WALL (SPECIALTY WALL 3)	SQ.FT.	41,428	100.00	4,142,800
9140181	RETAINING WALL (SPECIALTY WALL 6)	SQ.FT.	4,486	50.00	224,300
9240050	MISCELLANEOUS WORK (BACKFILL EXISTING CHANNEL)	L.SUM	1	3,500.00	3,500
9240111	MISCELLANEOUS WORK (15TH AVENUE 4-5" ELECTRIC CONDUIT RELOCATION)	L.FT.	350	200.00	70,000
9240112	MISCELLANEOUS WORK (15TH AVENUE FRONTAGE ROAD UTILITY RELOCATION)	L.FT.	400	200.00	80,000
9240119	MISCELLANEOUS WORK (RELOCATE RAMP METER)	EACH	6	12,400.00	75,800
9240120	MISCELLANEOUS WORK (RELOCATE ADVANCED FLASHER)	EACH	6	12,400.00	74,400
9240121	MISCELLANEOUS WORK (CAP EXISTING CB)	EACH	101	750.00	75,800
9240122	MISCELLANEOUS WORK (CAP EXISTING MH)	EACH	14	750.00	10,500
9240127	MISCELLANEOUS WORK (C-15.91 Catch Basin Access to Ex MH)	EACH	11	4,000.00	44,000
9240131	MISCELLANEOUS WORK (C-15.92 Catch Basin Access to Ex MH)	EACH	10	4,000.00	40,000
9240134	MISCELLANEOUS WORK (C-15.92 Catch Basin Access to Ex CB)	EACH	5	3,500.00	17,500
9240135	MISCELLANEOUS WORK (C-15.20 Catch Basin Access to Ex CB)	EACH	3	3,500.00	10,500
9240136	MISCELLANEOUS WORK (MODIFY EXISTING MANHOLE RIM)	EACH	3	2,000.00	6,000
9300601	SHORING AND BRACING	L.SUM	1	10,000.00	10,000
9999910	LUMP SUM (19TH AVENUE OVERPASS WB)	L.SUM	1	411,300.00	411,300
9999910	LUMP SUM (15TH AVENUE UNDERPASS)	L.SUM	1	2,730,700.00	2,730,700
9999910	LUMP SUM (CAVE CREEK WASH OVERPASS EB)	L.SUM	1	236,200.00	236,200
9999910	LUMP SUM (CAVE CREEK WASH OVERPASS WB)	L.SUM	1	236,200.00	236,200
9999910	LUMP SUM (7TH STREET OVERPASS EB)	L.SUM	1	464,300.00	464,300
9999910	LUMP SUM (7TH STREET OVERPASS WB)	L.SUM	1	464,300.00	464,300
9999910	LUMP SUM (CAVE CREEK RAMP A-7TH STREET)	L.SUM	1	845,800.00	845,800
9999910	LUMP SUM (CAVE CREEK RAMP B-7TH STREET)	L.SUM	1	734,900.00	734,900
9999910	LUMP SUM (16TH STREET OVERPASS EB)	L.SUM	1	426,800.00	426,800
9999910	LUMP SUM (16TH STREET OVERPASS WB)	L.SUM	1	426,500.00	426,500
9999910	LUMP SUM (CAVE CREEK ROAD OVERPASS EB)	L.SUM	1	806,300.00	806,300
9999910	LUMP SUM (CAVE CREEK ROAD OVERPASS WB)	L.SUM	1	805,100.00	805,100
9999910	LUMP SUM (32ND STREET OVERPASS EB)	L.SUM	1	713,000.00	713,000
9999910	LUMP SUM (32ND STREET OVERPASS WB)	L.SUM	1	680,400.00	680,400
9999910	LUMP SUM (CAP CANAL BRIDGE EB)	L.SUM	1	1,427,200.00	1,427,200
9999910	LUMP SUM (CAP CANAL BRIDGE WB)	L.SUM	1	932,600.00	932,600
9999910	LUMP SUM (CAP BASIN NO. 1 BRIDGE EB)	L.SUM	1	735,200.00	735,200
9999910	LUMP SUM (LOW FLOW CHANNEL BRIDGE WB)	L.SUM	1	416,500.00	416,500
9999910	LUMP SUM (RCP HEADWALL STA 1540+46)	L.SUM	1	16,200.00	16,200
		ITEM TOTAL			**58,452,600**

Table 40 – Order of Magnitude Itemized Estimate (I-17 to SR 51)(Continued)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
PROJECT WIDE					
	Maintenance and Protection of Traffic (8%)	COST		4,677,000.00	4,677,000
	Dust and Water Palliative (0.75%)	COST		439,000.00	439,000
	Quality Control (0.75%)	COST		439,000.00	439,000
	Construction Surveying (1.5%)	COST		877,000.00	877,000
	Erosion Control (0.3%)	COST		176,000.00	176,000
	Mobilization (8% of all construction items)	COST		5,965,000.00	5,965,000
		PROJECT WIDE SUBTOTAL			**12,573,000**
	Unidentified Items (5% of Item Total and Project Wide Subtotal)	COST		3,552,000.00	3,552,000
		PROJECT WIDE TOTAL			**16,125,000**
OTHER COST					
	Construction Engineering (9%)	COST		6,712,000.00	6,712,000
	Construction Contingencies (5%)	COST		3,729,000.00	3,729,000
	Environmental Mitigation (Unknown at this time)	COST		50,000.00	50,000
	PCCP Quality Incentive	SQ.YD.	151,352	1.50	227,100
	AR-ACFC Smoothness Incentive	L.MILE	69	11,000.00	759,000
	Engineering Design (Includes Surveying and Geotechnical) (8% of all items)	COST		5,967,000.00	5,967,000
	Right-of-Way	COST		2,061,000.00	2,061,000
		OTHER COST TOTAL			**19,505,600**

SUMMARY

ITEM TOTAL	**58,452,600**
PROJECT WIDE	**16,125,000**
OTHER COST TOTAL	**19,505,600**
SUBTOTAL PROJECT COST	**94,083,200**
INDIRECT COST ALLOCATION (ICAP)(10.35%)	**9,738,000**
TOTAL PROJECT COST	**103,821,200**

Table 41 – Order of Magnitude Itemized Estimate (SR 51 to Princess Drive)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
2020021	REMOVAL OF CONCRETE CURB AND GUTTER	L.FT.	38,477	5.00	192,400
2020027	REMOVAL OF CONCRETE BARRIER	L.FT.	26,467	15.00	397,100
2020031	REMOVAL OF PORTLAND CEMENT CONCRETE PAVEMENT	SQ.YD.	67,405	10.00	674,100
2020034	REMOVAL OF SIGNS	L.SUM	1	87,200.00	87,200
2020041	REMOVAL OF PIPE	L.FT.	280	15.00	4,200
2020052	REMOVE (GUARDRAIL)	L.FT.	924	4.00	3,700
2020053	REMOVE (END SECTION)	EACH	1	200.00	200
2020081	REMOVE BITUMINOUS PAVEMENT (MILL 1” AC)	SQ.YD.	533,670	1.00	533,700
2020155	REMOVE (CATCH BASIN)	EACH	31	500.00	15,500
2020162	REMOVE (CONCRETE CHANNEL LINING)	SQ.YD.	1,771	5.00	8,900
2020201	SAW CUTTING	L.FT.	62,139	2.00	124,300
2030301	ROADWAY EXCAVATION	CU.YD.	50,581	7.00	354,100
2030901	BORROW	CU.YD.	61,926	8.00	495,500
4010010	PORTLAND CEMENT CONCRETE PAVEMENT (10" PCCP OVER 4" AB)(RAMPS)	SQ.YD.	46,365	30.00	1,390,000
4010012	PORTLAND CEMENT CONCRETE PAVEMENT (12" PCCP OVER 4" AB)	SQ.YD.	94,559	35.00	3,309,600
407X001	ASPHALTIC CONCRETE (AR-ACFC 1" OVERLAY) (NEW PAVEMENT)	SQ.YD.	125,968	5.00	629,900
407X001	ASPHALTIC CONCRETE (AR-ACFC 1” OVERLAY) (EXISTING PAVEMENT)	SQ.YD.	533,670	5.00	2,668,400
5010107	PIPE, CORRUGATED METAL, SLOTTED, 18"	L.FT.	2,045	85.00	173,900
5012524	STORM DRAIN PIPE, 24"	L.FT.	3,122	50.00	156,100
5012536	STORM DRAIN PIPE, 36"	L.FT.	31	105.00	3,300
5014024	FLARED END SECTION, 24" (C-13.25)	EACH	9	400.00	3,600
5014036	FLARED END SECTION, 36" (C-13.25)	EACH	2	550.00	1,100
5030023	CONCRETE CATCH BASIN (C-15.20) ONE 7.5' WING, H=8' OR LESS	EACH	1	3,500.00	3,500
5030142	CONCRETE CATCH BASIN (C=15.80) H=8' OR LESS	EACH	6	3,000.00	18,000
5030604	CONCRETE CATCH BASIN (C-15.91) H=8' OR LESS	EACH	28	3,200.00	89,600
5030606	CONCRETE CATCH BASIN (C-15.92) H=8' OR LESS	EACH	145	3,500.00	507,500
5050021	MANHOLE (C-18.10)(NO. 2)(FOR PIPES 6" TO 36")	EACH	5	3,500.00	17,500
6060036	BRIDGE SIGN STRUCTURE (DMS SIGN)	EACH	2	130,000	260,000
6060048	BRIDGE SIGN STRUCTURE (SD9.20, TYPE 4F)	EACH	4	110,000.00	440,000
6060079	FOUNDATION FOR BRIDGE SIGN STRUCTURE (SD9.20, TYPE 4F))	EACH	8	8,000	64,000
6060090	FOUNDATION FRO BRIDGE SIGN STRUCTURE (DMS SIGN)	EACH	1	1,000	1,000
6060150	CANTILEVER SIGN STRUCTURE	EACH	31	40,000.00	1,240,000
6060240	FOUNDATION FOR CANTILEVER SIGN STRUCTURE	EACH	31	7,000.00	217,000
6061001	SIGN MOUNT ASSEMBLY (FOR BRIDGE FASCIA)	EACH	2	8,000.00	16,000
6070002	BREAKAWAY SIGN POST S4X7.7	L.FT.	728	25.00	18,200
6070022	FOUNDATION FOR BREAKAWAY SIGN POST S4X7.7	EACH	56	300.00	16,800
6070038	SLIP BASE (2 1/2S)	EACH	84	150.00	12,600
6070055	SIGN POST (PERFORATED) (2 1/2 S)	L.FT.	1,008	8.00	8,100
6070060	FOUNDATION FOR SIGN POST (CONCRETE)	EACH	98	175.00	17,200
6080004	REGULATORY, WARN, OR MARKER SIGN PANEL	SQ.FT.	1,710	20.00	34,200
6080064	EXTRUDED ALUM SIGN PANEL WITH TYPE VIII/IX/X SHEET	SQ.FT.	6,063	25.00	151,600
7030095	MILEPOST MARKER (S-10)	EACH	14	300.00	4,200
7040070	PAVEMENT MARKING (WHITE THERMOPLASTIC)(0.090)	L.FT.	135,932	0.30	40,800
7040071	PAVEMENT MARKING (YELLOW THERMOPLASTIC)(0.090)	L.FT.	27,713	0.30	8,400
7040072	PAVEMENT MARKING (TRANSVERSE) (THERMOPLASTIC) (ALKYD)(0.090")	L.FT.	217,173	.50	108,600
7040074	PAVEMENT SYMBOL (EXTRUDED THERMOPLASTIC) (ALKYD)(0.090")	EACH	68	100	6,800
7050047	PAVEMENT MARKING, PREFORMED, PATTERNED, WHITE STRIPE	L.FT.	141,127	3.50	494,000
7060013	PAVEMENT MARKER, RAISED, TYPE C	EACH	10,895	2.50	27,300
7060017	PAVEMENT MARKER, RAISED, TYPE E	EACH	3,390	2.50	8,500
7080001	PERMANENT PAVEMENT MARKING (PAINTED)(WHITE)	L.FT.	235,403	0.10	23,600
7080011	PERMANENT PAVEMENT MARKING (PAINTED)(YELLOW)	L.FT.	18,475	0.10	1,900
7080101	PERMANENT PAVEMENT MARKING (PAINTED SYMBOL)	EACH	68	50.00	3,400
7310190	POLE (RELOCATE HIGH MAST POLE AND ASSEMBLY)	EACH	1	1,000.00	1,000
7310360	POLE FOUNDATION (FOR 100' HIGH MAST)	EACH	1	7,500.00	7,500
7320071	ELECTRICAL CONDUIT (3")(PVC)	L.FT.	60	10.00	600
7320072	ELECTRICAL CONDUIT (3-3")(PVC)	L.FT.	29,590	12.00	355,100
7320421	PULL BOX (NO. 7)(WITH EXTENSION)	EACH	40	600.00	24,000
7320455	PULL BOX (NO. 9)	EACH	25	2,500.00	62,500
7320787	SINGLE MODE FIBER OPTIC CABLE (144 STRAND)	L.FT.	43,400	2.50	108,500
7330620	RELOCATE TRAFFIC SIGNALS	L.SUM	1	120,000.00	120,000
7340105	CONTROL CABINET FOUNDATION	EACH	3	500.00	1,500
7340210	RELOCATE CONTROL CABINET	EACH	3	500.00	1,500
7350030	LOOP DETECTOR FOR TRAFFIC SURVEILLANCE (6'X6')	EACH	16	500.00	8,000
7360420	REMOVE AND SALVAGE EXISTING SIGN LIGHTING	L.SUM	1	2,000.00	2,000
7370452	MISCELLANEOUS ELECTRICAL (RELOCATE CCTV)	EACH	3	4,800.00	14,400
7379111	VARIABLE MESSAGE SIGN ASSEMBLY INSTALLATION	EACH	1	2,000.00	2,000

Table 41 – Order of Magnitude Itemized Estimate (SR 51 to Princess Drive)(Continued)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
800X002	LANDSCAPING (6 MILES @ $50,000/MI)	EACH	6	50,000.00	300,000
9050026	GUARD RAIL TERMINAL (TANGENT TYPE)	EACH	15	2,500.00	37,500
9050401	GUARD RAIL TRANSITION, W-BEAM TO CONCRETE BARRIER	EACH	15	3,000.00	45,000
9080084	CONCRETE CURB AND GUTTER	L.FT.	26,337	15.00	395,100
9080201	CONCRETE SIDEWALK (C-05.20)	SQ.FT.	1,140	4.00	4,600
9100000	CONCRETE BARRIER (SINGLE FACE WITH GUTTER)(2.5' PAN)	L.FT.	21,583	50.00	1,079,200
9100008	CONCRETE BARRIER (ADJACENT TO RETAINING WALL)(2.5' PAN)	L.FT.	3,384	50.00	169,200
9100009	CONCRETE BARRIER (SINGLE FACE WITH GUTTER)(4.5' PAN)	L.FT.	23,374	60.00	1,402,500
9100012	CONCRETE BARRIER (ADJACENT TO RETAINING WALL)(4.5' PAN)	L.FT.	1,316	85.00	111,900
9100014	CONCRETE BARRIER (RETAINING HALF BARRIER)	L.FT.	15,703	100.00	1,570,300
9130001	RIPRAP (DUMPED)	CU.YD.	6	90.00	600
9140153	RETAINING WALL (SD 7.01)	SQ.FT.	24,101	50.00	1,205,100
9140170	RETAINING WALL (SPECIALTY WALL 4)	SQ.FT.	27,899	65.00	1,813,500
9140180	RETAINING WALL (SPECIALTY WALL 5)	SQ.FT.	3,408	85.00	289,700
9201006	CONCRETE CHANNEL LINING (6")	SQ.YD.	811	40.00	32,500
9240109	MISCELLANEOUS WORK (SOIL CEMENT CHANNEL RECONSTRUCTION)	L.SUM	1	61,700.00	61,700
9240119	MISCELLANEOUS WORK (RELOCATE RAMP METER)	EACH	9	12,400.00	111,600
9240120	MISCELLANEOUS WORK (RELOCATE ADVANCED FLASHER)	EACH	9	12,400.00	111,600
9240121	MISCELLANEOUS WORK (CAP EXISTING CB)	EACH	130	750.00	97,500
9240122	MISCELLANEOUS WORK (CAP EXISTING MH)	EACH	4	750.00	3,000
9240127	MISCELLANEOUS WORK (C-15.91 Catch Basin Access to Ex MH)	EACH	1	4,000.00	4,000
9240131	MISCELLANEOUS WORK (C-15.92 Catch Basin Access to Ex MH)	EACH	13	4,000.00	52,000
9240133	MISCELLANEOUS WORK (C-15.91 Catch Basin Access to Ex CB)	EACH	1	3,500.00	3,500
9240134	MISCELLANEOUS WORK (C-15.92 Catch Basin Access to Ex CB)	EACH	2	3,500.00	7,000
9240135	MISCELLANEOUS WORK (C-15.20 Catch Basin Access to ex CB)	EACH	3	3,500.00	10,500
9240171	MISCELLANEOUS WORK (EXTEND EXISTING JUNCTION BOX/MH)	EACH	2	4,000.00	8,000
9240172	MISCELLANEOUS WORK (ADJUST EXISTING C-15.92 CB)	EACH	2	2,000.00	4,000
9240173	MISCELLANEOUS WORK (ADJUST EXISTING C-15.91 CB)	EACH	3	2,000.00	6,000
9999910	LUMP SUM (TATUM BOULEVARD OVERPASS WB)	L.SUM	1	807,100.00	807,100
9999910	LUMP SUM (56TH STREET OVERPASS EB)	L.SUM	1	686,200.00	686,200
9999910	LUMP SUM (56TH STREET OVERPASS WB)	L.SUM	1	686,200.00	686,200
9999910	LUMP SUM (SCOTTSDALE ROAD OVERPASS EB)	L.SUM	1	578,100.00	578,100
9999910	LUMP SUM (SCOTTSDALE ROAD OVERPASS WB)	L.SUM	1	578,100.00	578,100
9999910	LUMP SUM (HAYDEN ROAD OVERPASS EB)	L.SUM	1	553,500.00	553,500
9999910	LUMP SUM (HAYDEN ROAD OVERPASS WB)	L.SUM	1	553,500.00	553,500
9999910	LUMP SUM (RCB CULVERT STA 1766+00)(INLET END)(1-6'X6')(8.6' EXTENSION)	L.SUM	1	12,000.00	12,000
9999910	LUMP SUM (RCB CULVERT STA 1783+00)(INLET END)(3-6'X6')(8.5' EXTENSION)	L.SUM	1	16,600.00	16,600
9999910	LUMP SUM (RCB CULVERT STA 1825+00)(INLET END)(8-10'X6')(9.5' EXTENSION)	L.SUM	1	46,400.00	46,400
9999910	LUMP SUM (RCB CULVERT STA 1825+00)(OUTLET END)(8-10'X6')(8.1' EXTENSION)	L.SUM	1	45,600.00	45,600
				ITEM TOTAL	**29,297,100**
PROJECT WIDE					
	Maintenance and Protection of Traffic (8%)	COST		2,344,000.00	2,344,000
	Dust and Water Palliative (0.75%)	COST		220,000.00	220,000
	Quality Control (0.75%)	COST		220,000.00	220,000
	Construction Surveying (1.5%)	COST		440,000.00	440,000
	Erosion Control (0.3%)	COST		88,000.00	88,000
	Mobilization (8% of all construction items)	COST		2,990,000.00	2,990,000
				PROJECT WIDE SUBTOTAL	**6,302,000**
	Unidentified Items (5% of Item Total and Project Wide Subtotal)	COST		1,780,000.00	1,780,000
				PROJECT WIDE TOTAL	**8,082,000**

(Estimate continued on page 187)

Table 41 – Order of Magnitude Itemized Estimate (SR 51 to Princess Drive)(Continued)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
OTHER COST					
	Construction Engineering (9%)	COST		3,364,000.00	3,364,000
	Construction Contingencies (5%)	COST		1,869,000.00	1,869,000
	Environmental Mitigation (Unknown at this time)	COST		-	-
	PCCP Quality Incentive	SQ.YD.	140,924	1.50	211,400
	AR-ACFC Smoothness Incentive	L.MILE	70	11,000.00	770,000
	Engineering Design (Includes Surveying and Geotechnical) (8% of all items)	COST		2,999,000.00	2,999,000
	Right-of-Way	COST		-	-
			OTHER COST TOTAL		9,204,000

SUMMARY	
ITEM TOTAL	29,297,100
PROJECT WIDE	8,082,000
OTHER COST TOTAL	9,204,000
TOTAL PROJECT COST	46,583,100
INDIRECT COST ALLOCATION (ICAP)(10.35%)	4,821,000
TOTAL PROJECT COST	51,404,100

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5.2 ESTIMATE OF FUTURE MAINTENANCE COSTS

An estimate of the additional future maintenance costs that would be the result of the additional roadway lane miles added to the freeway system was evaluated for the Preferred Alternative. The additional future maintenance costs are provided in Tables 42 and 43.

Table 42 – Estimate of Future Maintenance Costs (I-17 to SR 51)

Annual Maintenance Cost Per Lane Mile Using PeCoS Latest FY Data[1]	
Category	**Metropolitan Phoenix**
1. Paved Surfaces & Shoulders	600
2. Roadside	3,070
3. Drainage & Environmental	300
4. Rest Areas	
5. Traffic Operations - Signal & Lighting; Signing & Striping - ITS	1,030
6. Landscaping	6,720
7. Winter Storms	
8. Emergency Response	130
9. Miscellaneous Maintenance[2]	2,400
10. Support and Other Operating Expenses	3,150
11. Other Specialty Items[3]	
MCL = Maintenance Cost per Lane Mile	**$17,400**
Annual Maintenance Cost of Project at PA/DCR Phase	**Metropolitan Phoenix[6]**
PW = Total Pavement Width[4]	12
NL = Number of Lane Miles	1
LP = Length of Project in Miles	17
PMC = Current Project Maintenance Cost	**$294,060**
Annual Maintenance Cost of Project at Beginning of Maintenance Phase	**Metropolitan Phoenix[6]**
IF = Inflation Factor[5]	1.058
N = Number of Years to Maintenance Phase	5
PMCI = Project Maintenance Cost including Inflation	**$516,764**

Notes:
1- Lane mile width is 12 ft, Total maintenance lane miles = 27,722 miles
Metropolitan Phoenix maintenance lane miles = 2,016 miles, Other Locations = 25,706 miles
2- Miscellaneous maintenance include building and yard maintenance, work for other divisions, training, material handling, vegetation control and contract administration for categories not considered in the maintenance cost breakdown
3- For Other Specialty Items, contact Central Maintenance.
4- Total pavement width includes the main line, ramps and shoulders.
5- Based on increase in maintenance costs of 76% over the last 10 years
6- Numbers for maintenance cost at PA/DCR Phase and Beginning of Maintenance Phase represent an Example Project, 24 feet wide, 2 miles long, going into the maintenance phase 3 years later.

Gray areas require manual entry
NL = PW / 12
PMC = MCL x NL x LP
PMCI = PMC x (IF^N)

Table 43 – Estimate of Future Maintenance Costs (SR 51 to Princess Drive)

Annual Maintenance Cost Per Lane Mile Using PeCoS Latest FY Data[1]	
Category	**Metropolitan Phoenix**
1. Paved Surfaces & Shoulders	600
2. Roadside	3,070
3. Drainage & Environmental	300
4. Rest Areas	
5. Traffic Operations - Signal & Lighting; Signing & Striping - ITS	1,030
6. Landscaping	6,720
7. Winter Storms	
8. Emergency Response	130
9. Miscellaneous Maintenance[2]	2,400
10. Support and Other Operating Expenses	3,150
11. Other Specialty Items[3]	
MCL = Maintenance Cost per Lane Mile	**$17,400**
Annual Maintenance Cost of Project at PA/DCR Phase	**Metropolitan Phoenix[6]**
PW = Total Pavement Width[4]	12
NL = Number of Lane Miles	1
LP = Length of Project in Miles	12
PMC = Current Project Maintenance Cost	**$203,580**
Annual Maintenance Cost of Project at Beginning of Maintenance Phase	**Metropolitan Phoenix[6]**
IF = Inflation Factor[5]	1.058
N = Number of Years to Maintenance Phase	8
PMCI = Project Maintenance Cost including Inflation	**$319,610**

Notes:
1- Lane mile width is 12 ft, Total maintenance lane miles = 27,722 miles
Metropolitan Phoenix maintenance lane miles = 2,016 miles, Other Locations = 25,706 miles
2- Miscellaneous maintenance include building and yard maintenance, work for other divisions, training, material handling, vegetation control and contract administration for categories not considered in the maintenance cost breakdown
3- For Other Specialty Items, contact Central Maintenance.
4- Total pavement width includes the main line, ramps and shoulders.
5- Based on increase in maintenance costs of 76% over the last 10 years
6- Numbers for maintenance cost at PA/DCR Phase and Beginning of Maintenance Phase represent an Example Project, 24 feet wide, 2 miles long, going into the maintenance phase 3 years later.

Gray areas require manual entry
NL = PW / 12
PMC = MCL x NL x LP
PMCI = PMC x (IF^N)

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6.0 IMPLEMENTATION PLAN

The RTPFP Life-Cycle Program (certified in January 2106) includes a total budget of $139,700,000 for the I-17 to Princess Drive general-purpose lane widening projects. The total order-of-magnitude estimate of project costs for the total Preferred Alternative is $155,225,300 which includes $143,057,400 for construction, $9,893,600 for final design and $2,274,300 for right-of-way.

The I-17 to SR 51 segment is included in the RTPFP in Phase 4. The order-of-magnitude estimate of project costs for this project is $103,821,200 which includes $6,584,600 for final design, $2,274,300 for right-of-way, and $94,962,300 for construction.

The SR 51 to Princess Drive segment also is included in the RTPFP in Phase 4. The order-of-magnitude estimate of project costs for this project is $51,404,100 which includes $3,309,000 for final design and $48,095,100 for construction.

Table 44 – Program Schedule

Route	Freeway Segment	Type of Work	RTPFP Budget ($000)	Order of Magnitude Estimate ($000)	RTPFP Phase	RTPFP Fiscal Year
SR 101L	SR 51 to Princess Drive	General-Purpose Lanes (Design)	5,100	3,309	4	2020
SR 101L	SR 51 to Princess Drive	General-Purpose Lanes (Construction)	61,000	48,095	4	2021
SR 101L	I-17 to SR 51	General-Purpose Lanes (Design)	4,800	6,585	4	2023
SR 101L	I-17 to SR 51	General-Purpose Lanes (Right-of-Way)	N/A	2,274	N/A	N/A
SR 101L	I-17 to SR 51	General-Purpose Lanes (Construction)	68,700	94,962	4	2024
		Total:	139,700	155,225		

Note 1: All amounts include ICAP (10.35%)

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7.0 AASHTO CONTROLLING DESIGN CRITERIA

American Association of State Highway and Transportation Officials (AASHTO) Controlling Design Criteria have been reviewed for the existing roadways that will remain as a part of the proposed improvements. The proposed features for the Preferred Alternative that would not meet the current AASHTO (2011 Green Book) recommended guidelines are indicated below.

The ADOT Design Criteria has also been reviewed for the existing roadways which will remain as a part of the proposed improvements. A complete listing of the existing SR 101L features and evaluation results are presented within the *AASHTO Controlling Criteria Report*, dated November 2013. This report is included in the Appendix E.

7.1 REQUEST FOR AASHTO DESIGN EXCPTIONS

No AASHTO design exceptions are anticipated.

7.2 REQUEST FOR ADOT DESIGN DEVIATIONS

No ADOT design deviations are anticipated**.**

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8.0 SOCIAL, ECONOMIC AND ENVIRONMENTAL CONCERNS

8.1 ENVIRONMENTAL DOCUMENTATION

A Categorical Exclusion (CE) has been prepared as part of this project. The CE was approved on June 22, 2015.

8.2 MITIGATION MEASURES

The following mitigation measures are not subject to change without prior written approval from the Federal Highway Administration.

Design Responsibilities

- The Arizona Department of Transportation project manager will contact the Arizona Department of Transportation Environmental Planning Group (602.712.7767 or 602.712.8633) 30 (thirty) days prior to bid advertisement to verify that the environmental clearance is still valid.
- Arizona Department of Transportation project manager will contact the Environmental Planning Group Biologist (602.712.7134 or 602.712.7767) at least 60 (sixty) days prior to bid advertisement to arrange for a qualified biologist to survey all bridge structures that will be impacted by the project to determine if the structures are being used by bats for roosting. If it is determined that the bridges are being used for roosting the Arizona Department of Transportation project manager will coordinate with the Environmental Planning Group biologist to determine the required mitigation.
- Maricopa County Flood Control District floodplain manager (602.506.1501), the City of Phoenix Floodplain Management manager (602.262.4960) and the City of Scottsdale Floodplain Management manager (480.312.4317) will be provided an opportunity to review and comment on the design plans.
- During final design the Arizona Department of Transportation Project Manager will coordinate with representatives of the Scottsdale Airport to identify any new concerns and to avoid impacts to airport operations during construction.
- The Arizona Department of Transportation project manager will contact the Arizona Department of Transportation Environmental Planning Group hazardous materials coordination (602.920.3882 or 602.712.7767) 30 (thirty) days prior to bid advertisement to determine the need for additional site assessment.
- During final design, the project manager will contact the Department Noise Coordinator (602.712.6161 or 602.712.7767) to arrange for qualified personnel to review and update the noise analysis.
- The existing noise barriers that will be impacted on 101L north of 17th Drive, north of 3rd Avenue, north of 9th Street, north of 16th Street and at Cave Creek Road will be relocated and replaced in-kind.
- New noise barriers will be installed: two located on the south side of SR 01L beginning at approximately 15th Avenue (MP 24.7) and extending approximately 1,600 feet and ranging in height from 16-20 feet, and on the south side of SR 101L beginning at approximate MP 28.9 and extending approximately 3,800 feet and approximately 16 feet in height.
- During final design the Arizona Department of Transportation Project Manager shall coordinate the development of a Jurisdictional Determination and a Section 404 Nationwide Permit Number 14 at locations where the proposed improvements encroach into existing waterways. This work shall be coordinated with and approved by the US Army Corps of Engineers.

Roadside Development Responsibilities

- Protected native plants within the project limits will be impacted by this project; therefore, the Arizona Department of Transportation Roadside Development Section will determine if Arizona Department of Agriculture notification is needed. If notification is needed, the Arizona Department of Transportation Roadside Development Section will send the notification at least 60 (sixty) calendar days prior to the start of construction.
- The Arizona Department of Transportation Roadside Development Section will provide special provisions for the control of noxious and invasive plant species during construction that may requirement treatment and control within the project limits. The Arizona Department of Transportation Roadside Development Section will review and approve or reject the Noxious and Invasive Plant Species Treatment and control Plan prepared by the contractor and submitted to the Engineer as required in the specifications within 10 (ten) working days of receipt. Once approved the Arizona Department of Transportation Roadside Development Section will return the plan to the Engineer.

Direct Responsibilities

- If burrowing owls or active burrows are identified during construction, the Engineer will contact the Arizona Department of Transportation Environmental Planning Group Biologist (602.712.7134 or 602.712.7767) to arrange for a qualified biologist to evaluate the situation. The Engineer and qualified biologist will determine whether the owls can be avoided during construction or if a biologist holding a permit from the US Fish & Wildlife Service is needed to relocate burrowing owls from the project area.
- The contractor shall not conduct vegetation trimming or removal activities such as grubbing or clearing between February 1 and August 31 unless biologist approved by the Arizona Department of Transportation Environmental Planning Group has conducted a bird nest search and has determined that no active bird nests are present. Vegetation may be trimmed removed if it has been surveyed with 5 days prior to removal as long as only inactive bird nests, if any, are present. Between September 1 and January 31, vegetation trimming and removal activities are not subject to restriction.
- If previously unidentified cultural resources are encountered during activity related to the construction of the project, the contractor shall stop work immediately ate the location notify the Engineer and shall take all reasonable steps to secure the preservation of those resources. The Engineer will contact the Arizona Department of Transportation Environmental Planning Group, Historic Preservation Team, (602.712.8636 or 602.712.7767) immediately, and make arrangements for proper treatment of those resources.
- Access to adjacent businesses and residences will be maintained throughout construction.
- The Engineer, in association with the contractor, will complete the National Emission Standard for Hazardous Air Pollutants documentation and submit it to the Arizona Department of Transportation Environmental Planning Group hazardous materials coordination (602.920.3882 or 602.712.7767) for review 5 (five) working days prior to being submitted to the regulatory agency.

- The contractor cannot start work associated with the widening of overpass bridges at 19th Ave, Cave Creek Wash, 7th St, 16th St, Cave Creek Rd, 32nd St, Central Arizona Project (CAP) Canal, Reach 11 Dam Low Flow Channel, Tatum Blvd, 56th St, Scottsdale Rd, and Hayden Rd; modifying the underpass structures at 7th Ave and 64th St; removing the 15th Ave bridge; or removing any existing noise walls until 10 (ten) working days have passed since the submittal of the notification of the regulatory agency.
- The Engineer will review and approve the contractor's Stormwater Pollution Prevention Plan, Notice of Intent and Notice of Termination prior to submission to the Arizona Department of Environmental Quality.

Contractor Responsibilities

- To prevent invasive special seeds from leaving the site, the contractor shall inspect all construction equipment and remove all attached plant/vegetation and soil/mud debris prior to leaving the construction site.
- To prevent the introduction of invasive species seeds, the contractor shall inspect all earthmoving and hauling equipment at the equipment storage facility and the equipment shall be washed prior to entering the construction site.
- The contractor shall develop a Noxious and Invasive Plant Species Treatment and Control Plan in accordance with the requirements in the contract documents. Plants to be controlled shall include those listed in the State and Federal Noxious Weed and the State Invasive Species list in accordance with the State and Federal Laws and Executive Orders. The plan and associated treatments shall include all areas within the project right-of-way and easements as shown on the project plans. The treatment and control plan shall be submitted to the Arizona Department of Transportation Roadside Development Section for review and approval prior to implementation by the contractor.
- Prior to the start of ground-disturbing activities, the contractor shall arrange for and perform the control of noxious and invasive species in the project areas.
- The contractor shall not conduct vegetation trimming or removal activities such as grubbing or clearing between February 1 and August 31 unless biologist approved by the Arizona Department of Transportation Environmental Planning Group has conducted a bird nest search and has determined that no active bird nests are present. Vegetation may be trimmed removed if it has been surveyed with 5 days prior to removal as long as only inactive bird nests, if any, are present. Between September 1 and January 31, vegetation trimming and removal activities are not subject to restriction.
- The contractor shall not cause injury or death to swallows, including eggs and nestlings, and shall avoid work within 100 feet of nesting swallows from February 1 to August 31 of any calendar year. If work will occur within 100 feet of nesting swallows between February 1 and August 31, the contractor shall adhere to the following:
    - The contractor shall completely remove all existing swallow nests within 100 feet of work areas after August 31 but prior to February 1 to prevent swallows from reusing those nests.
    - The contractor shall implement exclusionary measures to prevent swallows from building new nests within 100 feet of work areas. Exclusionary measures shall be implemented in all areas where swallows are likely to nest, and may include (a) continually nesting materials during early nest construction when eggs or nestlings are not present, (b) installing exclusionary netting (wire or plastic mesh 0.75 inch or less in diameter), (c) installing deterrent spike strips, and/or (d) applying an appropriate bird exclusion liquid or gel (per manufacturer's instructions).
    - The contractor shall not disturb any active swallow nests (completed or partially completed nests that contain eggs or nestlings). If any active nest is discovered within 100 feet of construction activities, work shall stop and the Arizona Department of Transportation Environmental Planning Group biologist shall be contacted (602.712.7134 or 602.712.7767). to evaluate the potential for disturbance of nests.
    - The contractor shall monitor and maintain the effectiveness of exclusionary measures used. Netting shall be maintained such that it remains in place without any loose areas or opening that could trap and/or entangle birds. Spike strips shall be maintained such that they remain in place. Exclusion liquid or gel shall be reapplied s often as necessary to remain effective (per manufacturer's instructions).
    - The contractor shall remove all exclusionary measures after project completion to the satisfaction of the Engineer.
- Prior to construction, all personnel who will be on-site, including, but not limited to, contractors, contractor's employees, supervisors, inspectors, and subcontractors shall review the attached Arizona Department of Transportation Environmental Planning Group "Western Burrowing Owl Awareness" flyer.
- If any burrowing owls are located during construction, the contractor shall stop work at the location and notify the Engineer immediately. The Engineer will contact the Arizona Department of Transportation Environmental Planning Group biologist at (602.712.7134 or 602.712.7767) to determine whether the owls can be avoided or must be relocated. If owls must be relocated, the Contractor shall employ a biologist holding a permit from the United States Fish and Wildlife Service to relocate burrowing owls from the project area, as appropriate.
- The contractor shall comply with all terms, general conditions, and special conditions of the attached Section 404 Nationwide Permit Number 14, as established by the US Army Corps of Engineers.
- The contractor shall comply with all terms and conditions of the Section 401 Conditional Water Quality Certification, certified by the Arizona Department of Environmental Quality.
- If previously unidentified cultural resources are encountered during activity related to the construction of the project, the contractor shall stop work immediately at that location notify the Engineer and shall take all reasonable steps to secure the preservation of those resources. The Engineer will contact the Arizona Department of Transportation Environmental Planning Group, Historic Preservation Team, (602.712.8636 or 602.712.7767) immediately, and make arrangements for proper treatment of those resources.
- Access to adjacent business and residences will be maintained throughout construction.
- The contractor shall complete a National Emissions Standards for Hazardous Air Pollutants notification for work associated with the widening of overpass bridges at 19th Ave, Cave Creek Wash, 7th St, 16th St, Cave Creek Rd, 32nd St, Central Arizona Project (CAP) Canal, Reach 11 Dam Low Flow Channel, Tatum Blvd, 56th St, Scottsdale Rd, and Hayden Rd; modifying the underpass structure at 7th Ave and 64th St; removing the 15th Ave bridge; and removing any existing noise walls and submit it to the Engineer for review.
- After Engineer approval, the notification shall be submitted to the Arizona Department of Transportation Environmental Planning Group hazardous materials coordinator (602.920.3882 or 602.712.7767) for a 5 (five) working-day review and approval. Upon approval by the

Arizona Department of Transportation Environmental Planning Group hazardous materials coordinator, the contractor shall file the notification with the Arizona Department of Environmental Quality and the Maricopa County Air Quality Department at least 10 (ten) working days prior to demolition/renovation associated with the widening of overpass bridges at 19th Ave, Cave Creek Wash, 7th St, 16th St, Cave Creek Rd, 32nd St, Central Arizona Project (CAP) Canal, Reach 11 Dam Low Flow Channel, Tatum Blvd, 56th St, Scottsdale Rd, and Hayden Rd; modifying the underpass structures at 7th Ave and 64th St; removing the 15th Ave bridge; or removing any existing noise walls.

- For milling activities, the roadway surface preceding the milling machine shall be kept sufficiently wet so as to prevent the generation of any visible fugitive dust particles, but not so wet as to cause excess runoff from the roadway surface onto the roadway shoulder.
- If suspected hazardous materials are encountered during construction, work shall cease at that location and the Engineer will be notified. The Engineer will contact the Arizona Department of Transportation Environmental Planning Group hazardous materials coordinator (602.920.3882 or 602.712.7767) immediately, and make arrangements for assessment, treatment and disposal of those materials.
- The contractor shall develop a Stormwater Pollution Prevention Plan, Notice of Intent, and Notice of Termination, and submit it to the Engineer for approval.
- The contractor, upon approval from the engineer shall submit the Stormwater Pollution Prevention Plan's Notice of Intent and Notice of Termination to the Arizona Department of Environmental Quality.
- This project is located within a designated municipal separate storm sewer system. Therefore the contractor will submit the Notice of Intent and the Notice of Termination to the City of Phoenix, City of Scottsdale, and Maricopa County.
- The existing noise barriers that will be impacted on 101L north of 17th Drive, north of 3rd Avenue, north of 9th Street, north of 16th Street and at Cave Creek Road will be relocated and replaced in-kind.
- New noise barriers will be installed: two located on the south side of SR 101L beginning at approximately 15th Avenue (MP 24.7) and extending approximately 1,600 feet and ranging in height from 16-20 feet, and on the south side of SR 101L beginning at approximate MP 82.9 and extending approximately 3,800 feet and approximately 16 feet in height.
- The contractor shall comply with all local air quality and dust control rules, regulations and ordinances which apply to any work performed pursuant to the contract.

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