LOOP 202
South Mountain
Freeway Study

Final Location/Design Concept Report

State Route 202L (South Mountain Freeway)
Interstate 10 (Maricopa Freeway) to Interstate 10 (Papago Freeway)
TRACS No. 202L MA 054 H5764 01L
Federal Project No. NH-202-D(ADY)
Maricopa County, Arizona
Phoenix Construction District

Prepared for

ADOT

Arizona Department of Transportation
Urban Project Management

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

101L	Loop 101
202L	Loop 202
303L	Loop 303
AASHTO	American Association of State Highway and Transportation Officials
ADEQ	Arizona Department of Environmental Quality
ADMP	Area Drainage Master Plan
ADOT	Arizona Department of Transportation
ADT	average daily traffic
ADWR	Arizona Department of Water Resources
AGFD	Arizona Game and Fish Department
AM	morning
AR-ACFC	asphalt rubber-asphaltic concrete friction course
ARS	Avenida Rio Salado
ASLD	Arizona State Land Department
AZ	Arizona
BIA	Bureau of Indian Affairs
BNSF	Burlington Northern – Santa Fe Railway Company
CDI	compact diamond interchange
CIP	cast-in-place
Community	Gila River Indian Community
CWA	Clean Water Act
DCR	Design Concept Report
DEIS	Draft Environmental Impact Statement
DHOV	direct HOV connection
DRCC	Durango Regional Conveyance Channel
E1	E1 Alternative
EA	environmental assessment
EB	eastbound
EIS	environmental impact statement
FCDMC	Flood Control District of Maricopa County
FEIS	final environmental impact statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FMS	Freeway Management System
FO	fiber optic
Ft	foot
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HEC	Hydraulic Engineering Circular
HOV	high-occupancy vehicle
I	Interstate
I-8	Interstate 8
I-10	Interstate 10
I-17	Interstate 17
IGA	Intergovernmental Agreement
kV	kilovolt
L	Loop
LACC	Laveen Area Conveyance Channel
L/DCR	Location/Design Concept Report
LOS	level of service
LRTP	Long-range Transportation Plan
MAG	Maricopa Association of Governments
MCDOT	Maricopa County Department of Transportation
METRO	Valley Metro Rail Inc.
MP	milepost
mph	miles per hour
MSE	mechanically stabilized earth
MUTCD	*Manual on Uniform Traffic Control Devices*
NA	not applicable
NB	northbound
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
OH	overhead
PCCP	Portland cement concrete pavement
PGP	Policies, Guides, and Procedures
PHF	peak hour factor
PHV	peak hour volume
PM	evening
PT	post-tensioned
RAS	River Analysis System
RCBC	reinforced concrete box culvert
RDG	*ADOT Roadway Design Guide*
RFS	Regional Freeway System
RID	Roosevelt Irrigation District
ROD	Record of Decision
RSDG	*Roadside Design Guidelines*
RTP	*Regional Transportation Plan*
SB	southbound
sec	second
SMCAT	South Mountain Citizens Advisory Team
SMPP	Phoenix South Mountain Park/Preserve
SMTC	South Mountain Transportation Corridor
SPUI	single point urban interchange
SR	State Route
SRP	Salt River Project
STB	State Transportation Board
TCP	traditional cultural property
TDM	transportation demand management
TSM	transportation system management
U.S.	United States
UG	underground
USPAP	Uniform Standards of Professional Appraisal Practice
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
veh	vehicle
VMT	vehicle miles traveled
vpd	vehicles per day
vph	vehicles per hour
W101	W101 Alternative
W55	W55 Alternative
W59	W59 Alternative
W71	W71 Alternative
WB	westbound
Western	Western Area Power Administration

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Executive Summary

This Final Location/Design Concept Report (L/DCR) describes the development and evaluation process for the proposed State Route (SR) 202L (Loop 202, South Mountain Freeway) between Interstate 10 (I-10, Maricopa Freeway) on the east and I-10 (Papago Freeway) on the west in Maricopa County, Arizona. This document describes the development, evaluation, and recommendations for the alternatives studied. It is consistent with the environmental impact statement process being completed by the Arizona Department of Transportation (ADOT) and the Federal Highway Administration (FHWA). The Draft Environmental Impact Statement (DEIS) was finalized and available for public comment on April 26, 2013. Following the public comment period for the DEIS, the Final Environmental Impact Statement (FEIS) was developed in coordination with the Final L/DCR. The FEIS was available for public and agency review on September 26, 2014. Following the public review period for the FEIS, the Record of Decision (ROD) for the entire project was prepared and signed by FHWA on March 5, 2015.

The ADOT project number for this study is 202L MA 054 H5764 01L and the Federal-aid project number is NH-202-D(ADY). The project is located in ADOT's Phoenix Construction and Maintenance Districts.

Historical Context of the Project

The South Mountain Freeway was originally included in the proposed 232-mile Maricopa Association of Governments (MAG) Regional Freeway System (RFS). As planned in 1985, it represented a major element of the region's freeway loop, or beltway system, traversing the Study Area (see Figure ES.1). It was originally called the Southwest Loop and was an integral piece of the RFS approved by Maricopa County voters in the 1985 ½ cent sales tax referendum. Subsequent location/design and state-level environmental studies were conducted by ADOT for RFS segments including the Southwest Loop. These studies examined different modes, alignments, and design options for a major transportation facility in the Study Area (ADOT 1988a and 1988b).

The RFS was constructed sequentially to meet the most pressing transportation needs in the MAG region as funds were available. Consequently, freeway construction followed geographic patterns of development and population growth. High-growth areas historically were in the northeastern, northwestern, southeastern, and central areas of the MAG region. Due in part to funding shortfalls, ADOT evaluated changes to the RFS in the mid-1990s. Some of the changes included removing corridors (Paradise Parkway), adjusting the scope of corridors (Grand Avenue), and deferring corridors (SR 202L [South Mountain Freeway] and SR 303L). The deferred corridors remained part of the planned RFS and priorities in the region's transportation planning.

In November 2003, MAG developed the comprehensive, performance based, multi-modal and coordinated Regional Transportation Plan (RTP), covering the period through 2026. In November 2004, the voters of Maricopa County approved Proposition 400 allowing for a 20-year extension of the ½ cent sales tax to fund the proposed improvements in the RTP including the South Mountain Freeway.

In 2009 and 2011, MAG and ADOT completed substantial updates to the freeway program of the RTP (the transit and arterial programs were subjected to similar reviews). The updates became necessary as declining sales tax revenues from the economic downturn that began in 2007 were combined with rising project cost opinions for the freeway program. In developing the recommended scenario, MAG considered numerous options including removing projects, reprioritizing projects, scaling projects back, and deferring projects outside of the funding horizon. The projects that remained funded by the RTP, including the South Mountain Freeway, were repackaged including new budgets and cost savings recommendations.

The *2035 Regional Transportation Plan (RTP)* (MAG 2014a) includes a program amount of $1.8 billion for the South Mountain Freeway between fiscal year 2014 and 2026. The latest ADOT 5-year facilities construction program which covers fiscal year 2015 to 2019 includes $1.62 billion ($538 million for right-of-way, $76 million for design, and $1 billion for construction) for the South Mountain Freeway (ADOT 2014a).

Concurrent and Future Projects

The project team regularly communicates with representatives of adjacent projects that could directly affect or be directly affected by the proposed freeway. Table ES.1 presents a list and general description of these projects.

Table ES.1 – Concurrent and Future Projects

Project	Owner	Purpose	Status	Programmed Construction
Avenida Rio Salado (ARS), SR 202L (South Mountain Freeway) to 7th Street	City of Phoenix	Additional travel lanes, improvements to Broadway Road	Completed	2013
Buckeye Road, 67th Avenue to 35th Avenue	City of Phoenix	New 36 inch waterline	Construction	2015
Baseline Road, 59th Avenue to 51st Avenue	City of Phoenix	Road widening from 4 to 6 lanes	Final Design	2015
Buckeye Road, 67th Avenue to 59th Avenue	City of Phoenix	Reconstruction of roadway to 74-foot section	Final Design	2015
Interstate 10/Interstate 17 Corridor Master Plan	MAG	Identify multimodal transportation improvements in the Central Phoenix area	Design concept development	Study Only
Capitol/I-10 West Light Rail Extension	Valley Metro	Light rail transit in Interstate 10 (Papago Freeway) corridor	Design concept development and environmental study	2016-2020
State Route 30, SR 303L to SR 202L (South Mountain Freeway)	ADOT	New freeway	Design concept development and environmental study	2026-2031

Need and Purpose for the Project

This project is needed based on regional transportation demand, socioeconomic factors including population, housing, and employment growth, and existing and projected transportation system capacity deficiencies. Even with the recent economic downturn, it is projected that Maricopa County's population, employment, and housing would increase by approximately 50 percent between 2010 and 2035. The area served by the proposed freeway would experience almost half of that total growth (MAG 2013a). Additionally, the total vehicle miles traveled is projected to increase faster than the socioeconomic factors (MAG 2013b). The existing regional transportation system operates at poor levels of service during the peak morning and evening commute periods. Even with the planned multimodal improvements from the RTP (not including the South Mountain Freeway), the system's operations would further degrade over the next 25 years. Without a major transportation facility in the Study Area, the region would suffer even greater congestion, travel delays, and limited options for moving people and goods safely through the Phoenix metropolitan region.

The purpose of the proposed freeway is to address these transportation deficiencies by providing additional regional mobility and capacity by linking regional freeways in the eastern and western portions of the Phoenix metropolitan area. The connection would further optimize system continuity and the effectiveness of individual network components, which are important to overall transportation operation. The proposed freeway would reduce the duration of congested conditions on most adjacent freeways, improve travel times throughout the region, and attract trips from the arterial street network.

The proposed freeway has been identified as a needed element in regional transportation planning efforts for the past 25 years. The need today is greater than it has ever been.

Alternatives Studied in Detail

The process undertaken to develop a range of alternatives, screen those alternatives using a multidisciplinary set of criteria, and identify alternatives to be studied is documented in detail in the FEIS. At each step in the process, alternatives were screened against multiple criteria, including the ability to meet purpose and need criteria, cost effectiveness, minimization of environmental impacts, operational and design characteristics, constructibility, and public and agency acceptability. Alternatives were either eliminated from further study or carried forward to the next level of evaluations. During the screening process it was determined that it would be beneficial to break the Study Area into two sections, the Eastern and Western sections. The sections differ in characteristics and issues and by separating them, it allowed for more specific comparative impact analyses among the alternatives. Upon completion of the screening process, one action alternative in the Eastern Section of the Study Area, three action alternatives in the Western Section of the Study Area, and the No-Action Alternative were determined to adequately represent a range of reasonable alternatives for detailed study. The action alternatives are the E1 Alternative in the Eastern Section and the W59 Alternative, W71 Alternative, and W101 Alternative (with three alignment options) in the Western Section. Figure ES.1 illustrates the locations of the four action alternatives (and options) studied in detail.

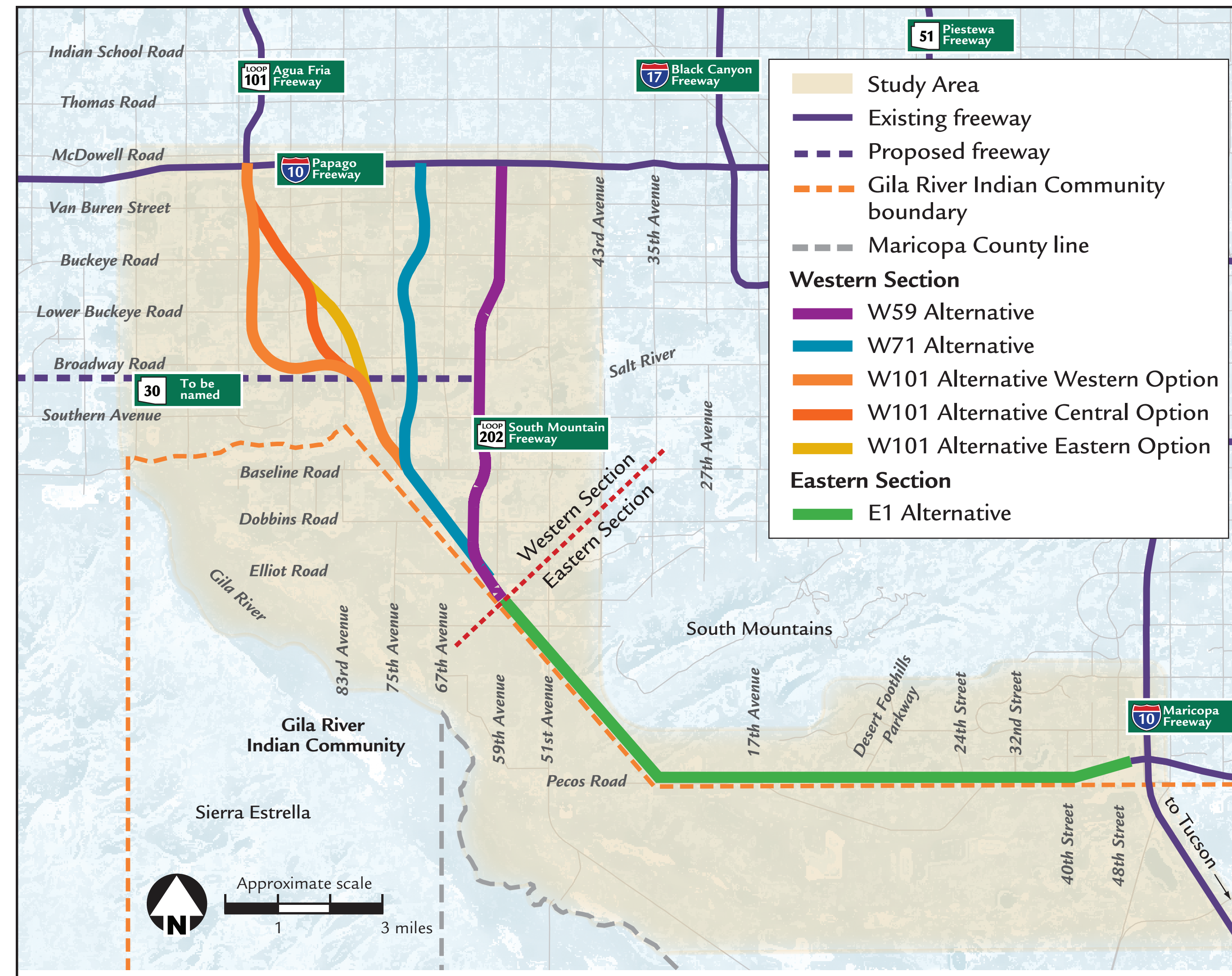
The E1 Alternative would begin at the existing system traffic interchange with I-10 (Maricopa Freeway) and SR 202L (Santan Freeway) and proceed west along the border between the City of Phoenix (COP) and the Gila River Indian Community (Community) replacing the existing Pecos Road. At approximately 35th Avenue, the alignment would curve to the northwest and continue along the Community boundary until ending at the common point between the Eastern and Western sections. The entire alignment would be outside of Community land and would pass through the western edge of the South Mountains. Each of the action alternatives in the Western Section would begin at the end of the E1 Alternative and proceed north and northwest through Phoenix until connecting with I-10 (Papago Freeway). The W59 Alternative would connect to I-10 at approximately 59th Avenue, while the W71 Alternative would connect at approximately 71st Avenue. The W101 Alternative and options would connect at the existing system traffic interchange with SR 101L (Agua Fria Freeway) and I-10.

The design of each action alternative was developed to a common level of detail sufficient enough to determine that the construction was feasible, to allow analysts to meaningfully assess and compare impacts that would occur from any of the action alternatives, and to allow for decisions to be made about the preference of each alternative.

The No-Action Alternative is included for detailed study in accordance with the National Environmental Policy Act requirements to compare beneficial and adverse impacts of the action alternatives with those benefits and adverse impacts of not proceeding with one of the action alternatives.

Identification of a Selected Alternative

In 2006, ADOT, with concurrence from FHWA, identified the W55 Alternative as the preliminary preferred alternative in the Western Section. In 2009, based on recommendations from MAG, the portion of the W55 Alternative between Lower Buckeye Road and I-10 (Papago Freeway) was modified to connect to I-10 at 59th Avenue. The new alignment was called the W59 Alternative and was preferred to the W55 Alternative based on improved traffic operations along I-10 and crossroad interchanges, reduced right-of-way needed and business relocations, increased separation from the Van Buren Street petroleum tank farm, and local support from the COP and MAG Regional Council.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

**Figure ES.1
Study Area and Action Alternatives**

The W59 Alternative is the Selected Alternative in the Western Section because:

- The W59 Alternative is supported by local municipalities. The other action alternatives (W71 and W101 Alternative) are opposed by local municipalities.
- The W59 Alternative is more consistent with the region's current and historical planning efforts.
- The W59 Alternative would cost the least when compared to the W71 and W101 Alternatives.

The E1 Alternative is the Selected Alternative in the Eastern Section because:

- Alternatives north of the E1 Alternative through the Ahwatukee Foothills Village would result in impacts of extraordinary magnitude.
- Alternatives north of the South Mountains would not satisfy the project purpose and need and would also result in significant impacts.
- Alternatives south of the E1 Alternative would be located on Community land and as a sovereign nation, they have not provided ADOT and FHWA permission to study in detail or locate alternatives on their land. Alternatives even farther south (Riggs Road to Beltline Road or I-8 to SR 85) would not satisfy the project purpose and need.

Design Elements of the South Mountain Freeway

SR 202L (South Mountain Freeway) would complete the Loop 202 from I-10 (Maricopa Freeway) (milepost [MP] 54.31) to I-10 (Papago Freeway) (MP 75.91), a distance of approximately 22 miles, in the southwestern quadrant of the Phoenix metropolitan area. SR 202L (South Mountain Freeway) would begin at its eastern terminus with the existing system traffic interchange between I-10 (Maricopa Freeway) and SR 202L (Santan Freeway). From this point, SR 202L (South Mountain Freeway) would travel westward on the Pecos Road alignment for approximately 8 miles before heading northwest for approximately 5 miles to a point near the existing Elliot Road and 59th Avenue intersection. The freeway would head northward for approximately 9 miles, crossing the Salt River, and reach its western terminus at a new system traffic interchange with I-10 (Papago Freeway) near 59th Avenue. The new system traffic interchange would include a direct high-occupancy vehicle (DHOV) ramp connection to and from the east on I-10 that would provide direct HOV access to Downtown Phoenix and the Capitol for buses, carpools, and vanpools. The design of the system traffic interchange at I-10 is being coordinated with the high-capacity transit corridor planned for I-10.

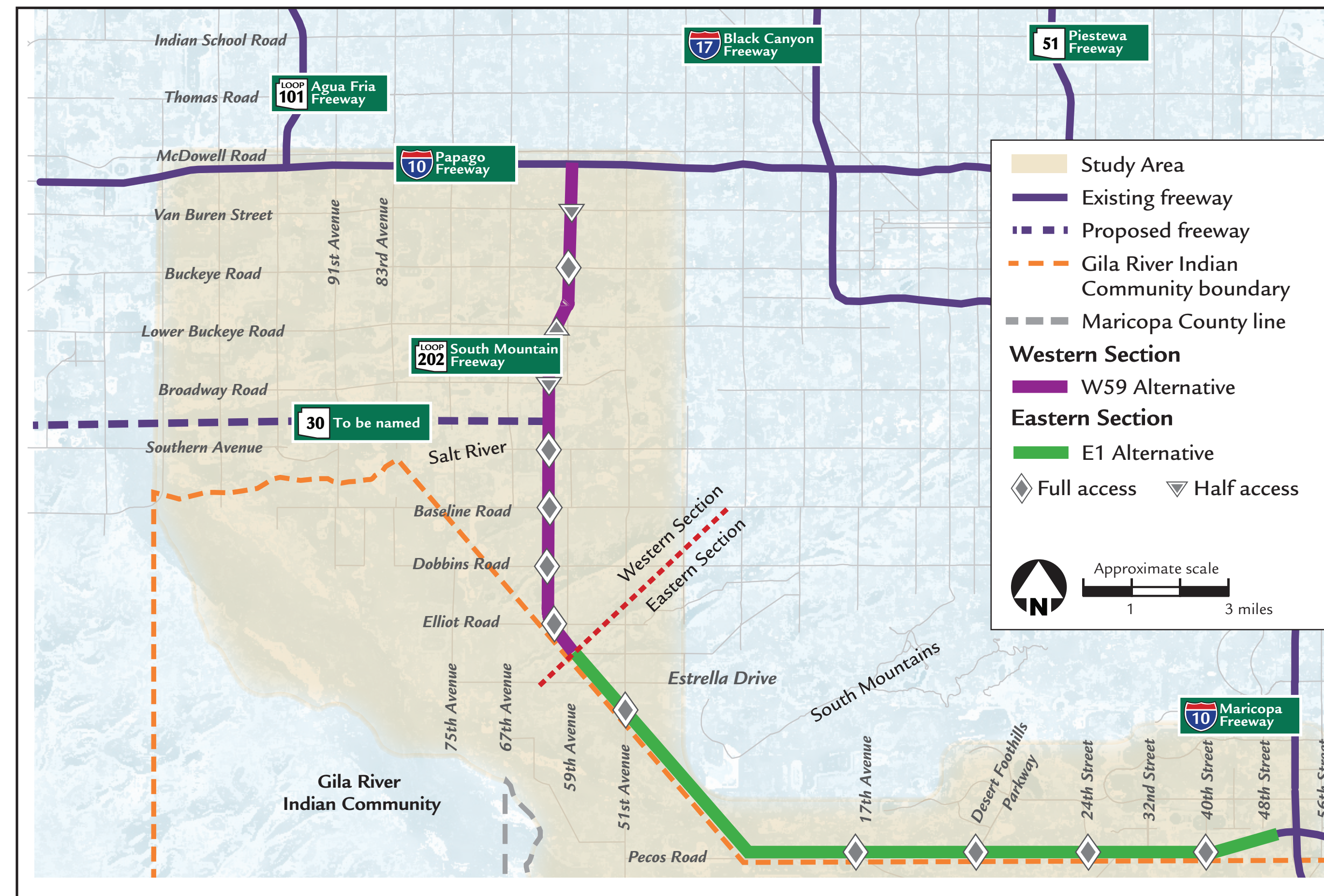
The proposed roadway typical section consists of eight-lanes with three general purpose lanes and one high-occupancy vehicle (HOV) lane in each direction. There would be full inside and outside shoulders The median would be typically closed with a concrete median barrier dividing the directions of travel. Entrance and exit ramps have been designed using a parallel-type configuration coupled with auxiliary lanes between service traffic interchanges, as warranted. The freeway main line design primarily features a rolling profile with the freeway rising above grade to cross over the crossroads. The typical sections, geometry and plans for the proposed freeway are provided in Appendix A.

Each arterial crossroad was evaluated on a case-by-case basis to determine the need for an interchange. Figure ES.2 shows the locations of the proposed full access and half access interchanges along the freeway. Diamond-type interchanges were assumed at all locations because they are common in the area, cost effective, and provide adequate level of service (LOS) for the projected traffic conditions.

The Eastern Section of the freeway alignment has off-site drainage that would be passed under the freeway. The existing culverts that pass under Pecos Road would be extended or replaced to maintain existing flow characteristics. Small retention basins would be located north and south of the freeway to retain flows and treat freeway runoff. The Western Section of the freeway alignment has off-site drainage that would be collected and conveyed by a channel located on the east side of the freeway and includes detention basins with outfalls to the Salt River or the Laveen Area Conveyance Channel.

The proposed freeway would potentially impact several extra high-voltage overhead transmission power lines operated by Salt River Project (SRP), Arizona Public Service (APS), and Western Area Power Administration (Western), Kinder Morgan and El Paso Natural Gas petroleum pipelines, SRP irrigation pipes and channels, and COP water, storm, and sewer lines. The proposed freeway and 59th Avenue frontage roads would also pass over Union Pacific Railroad (UPRR) facilities on grade-separated structures while the proposed drainage channel would be installed as a siphon under the UPRR facilities.

There are approximately 77 bridges along the freeway corridor. All of them are overpass structures. Notable bridges include the Salt River bridge, which is over 3,000 feet long, multiple bridges over the UPRR, and the north-to-west, east-to-south, west-to-south, and DHOV flyover ramps at I-10 (Papago Freeway). There are also five multiuse crossings proposed in the area of the South Mountains.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure ES.2
Selected Alternative

In summer 2013, ADOT received an unsolicited public-private partnership (P3) proposal to construct the South Mountain Freeway from a group of private companies. Constructing the freeway as a toll road was not considered in the proposal. On July 31, 2014, ADOT announced that if the Selected Alternative in the ROD is an action alternative, the South Mountain Freeway would be procured as a single project using a public-private-partnership (P3) approach, Design-Build-Maintain (DBM). The DBM delivery mechanism would include a long-term maintenance component but would not include a private finance option.

Historically, the freeway corridor has been divided into nine segments to establish a construction implementation plan. The segments, numbered from east to west were determined by considering issues such as traffic operations and continuity, drainage, and contract management. For continuity, some information presented in this L/DCR includes reference to the segment even though the construction is now planned to be implemented as a single project

According to Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) guidelines, any project with a budget over $500 million is considered a major project and must conduct a Cost Estimate Review in coordination with FHWA as well as prepare a Project Management Plan and Financial Plan for FHWA approval prior to receiving authorization for construction. In October 2014, the Cost Estimate Review was performed by the FHWA and project team. The risk-based cost estimate in the year of expenditure is $1.902 billion. A detailed cost estimate for the proposed freeway is provided in Appendix B.

1. Introduction

The Arizona Department of Transportation (ADOT) is the sponsor of a proposed action, the construction and operation of the South Mountain Freeway in the southwestern portion of the Phoenix metropolitan area. The proposed freeway would constitute a section of the Regional Freeway and Highway System, the Loop 202, referred to as State Route (SR) 202L in this document.

ADOT is working in close consultation with the Federal Highway Administration (FHWA), the lead federal agency, and in cooperation with the U.S. Army Corps of Engineers (USACE), Western Area Power Administration (Western), and the U.S. Bureau of Indian Affairs (BIA) to complete the environmental impact statement (EIS) process for the proposed action. The EIS process 1) satisfies FHWA and ADOT's environmental analysis requirements; 2) provides a comparison of the social, economic, and environmental impacts that may occur from implementation of the proposed action—operation and construction of a major transportation facility; and 3) identifies measures to avoid, reduce, or otherwise mitigate adverse impacts.

This Final Location and Design Concept Report (L/DCR) has been developed in support of the EIS process. It describes the development, evaluation, and recommendations for the alternatives studied.

The Study Area for the project is located in ADOT's Phoenix Construction and Maintenance Districts. As shown in Figure 1.1, the Study Area is located in Maricopa County, Arizona, south and southwest of the downtown Phoenix area. The Study Area encompasses portions of the planning areas of the cities of Avondale, Chandler, Phoenix, and Tolleson and part of the Gila River Indian Community (Community).

The logical termini for the proposed freeway are:

- In the east, SR 202L (Santan Freeway) and Interstate 10 (I-10, Maricopa Freeway) are major traffic generators serving regional and interstate travel. The project would terminate near the existing system traffic interchange connecting those freeways at I-10 (milepost [MP] 161.3).
- In the west, I-10 (Papago Freeway) is a major east–west Interstate highway and a major traffic generator serving regional and interstate travel. The project would terminate at I-10 between 115th Avenue/Avondale Boulevard (MP 131.7) and 43rd Avenue (MP 140.7).

1.1 Historical Context of the Project

The South Mountain Freeway was originally included in the proposed 232-mile Maricopa Association of Governments (MAG) Regional Freeway System (RFS). As planned in 1985, it represented a major element of the region's freeway loop, or beltway system, traversing the Study Area. It was originally called the Southwest Loop and was an integral piece of the RFS approved by Maricopa County voters in the 1985 ½ cent sales tax referendum. Subsequent location/design and state-level environmental studies were conducted by ADOT for RFS segments including the Southwest Loop. These studies examined modal, alignment, and design options for a major transportation facility in the Study Area (ADOT 1988a and 1988b).The proposed facility was designed as a high-speed, access-controlled freeway. The route was approved by the State Transportation Board (STB) in 1988. All these studies provided sufficient design detail to establish an adopted and publicized location for the freeway that became an element of long-range planning efforts of local jurisdictions throughout the Study Area.

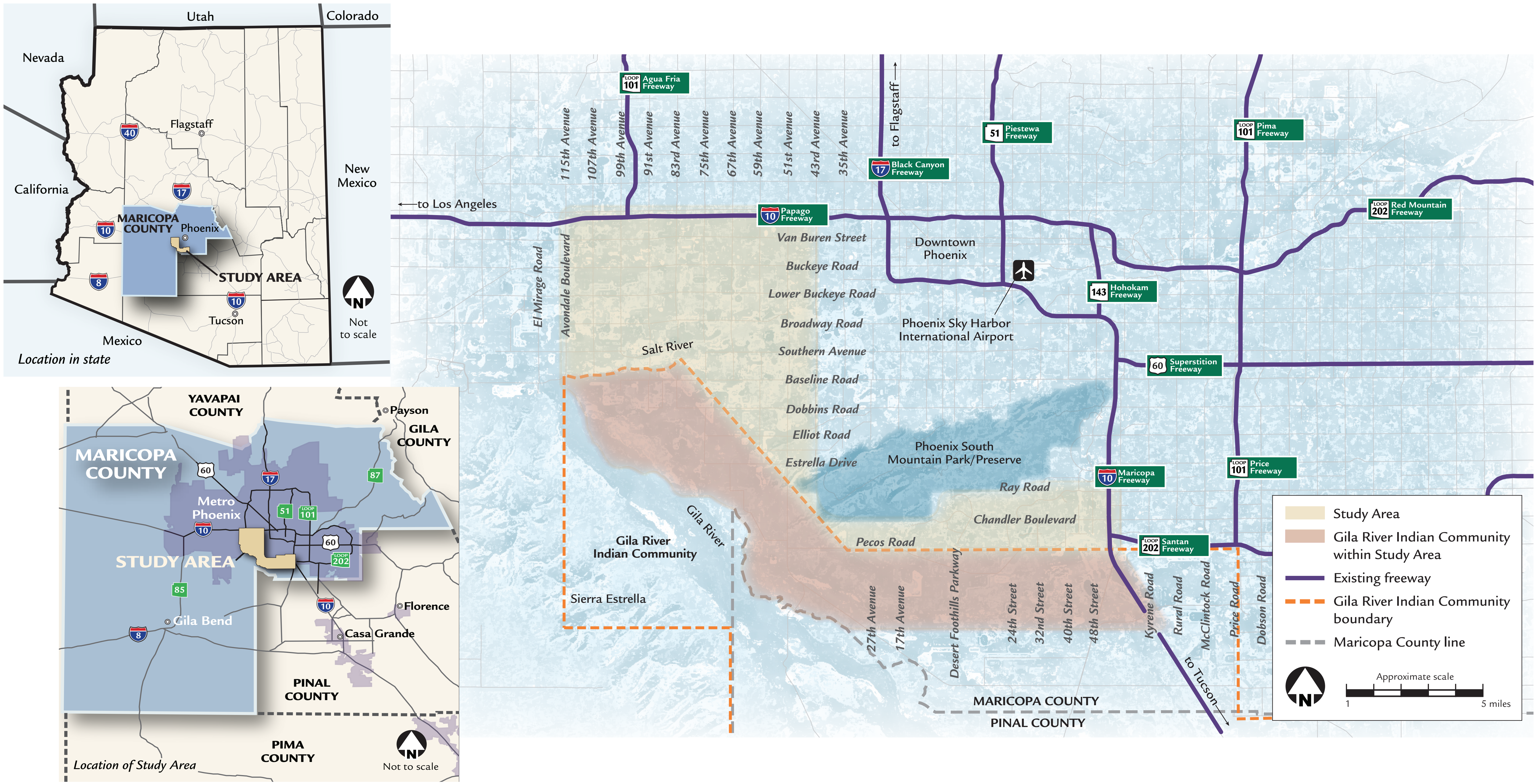
Since 1985, ADOT has sequenced construction of the RFS to meet the most pressing regional transportation needs as funds became available. Due in part to the funding shortfall experienced in the mid 1990s, ADOT was forced to evaluate the RFS for cost savings measures. Some of the changes included removing corridors (Paradise Parkway), adjusting the scope of corridors (Grand Avenue), and deferring corridors (SR 202L [South Mountain Freeway] and SR 303L) outside of the funding horizon. The deferred corridors remained part of the planned RFS and have continued to be priorities for the region. In 1997, an independent group studied the feasibility of constructing the South Mountain Freeway as a toll road (Arizona Transportation Group in association with South Mountain Community Highway Association 1997). In addition, the South Mountain Freeway remained in MAG transportation planning documents, including the current adopted MAG Regional Transportation Plan (RTP) (MAG 2003). The 2003 RTP is a comprehensive regional, multimodal plan addressing needs for all transportation modes and for planned transportation improvements in the MAG region through fiscal year 2026.

In 2009, MAG and ADOT began the process of making a substantial update to the freeway program of the RTP (the transit and arterial programs were subjected to similar reviews). The update became necessary as declining sales tax revenues from the economic downturn that began in 2007 were combined with rising project cost opinions for the freeway program. The *RTP 2010 Update* (MAG 2010a) presents the updated financial situation. The original, 2003, RTP budget (projected revenue) and project cost opinions were balanced at approximately $9.4 billion. Since that time, the cost opinions increased to approximately $16.0 billion with $2.7 billion obligated or spent through 2009. With declining revenues and softer revenue projections, it was anticipated that only $6.6 billion in additional revenue would be collected through the end of the RTP (2026) to fund the remaining $13.3 billion in projects. That left a program deficit of approximately $6.7 billion.

MAG held meetings throughout 2009 to discuss the options for balancing the freeway program. In developing the recommended scenario, MAG considered numerous options including removing projects, reprioritizing projects, scaling projects back, and deferring projects outside of the funding horizon. The recommended changes were presented at a public hearing on October 13, 2009 and adopted by the MAG Regional Council later that month. The recommended scenario maintains the core elements and priorities of the RTP and balances the budget by deferring a number of projects to an "unfunded" status outside of the plan's funding horizon. The projects that remain funded by the RTP, including the proposed action, were repackaged including new budgets and cost savings recommendations. Acknowledging community concerns regarding residential and business impacts and addressing declining revenues, three major changes were recommended for the South Mountain Freeway in the revised RTP adopted by the Regional Council, including:

- reduce the proposed freeway to eight lanes (from the previously planned 10-lane concept) thereby reducing the right-of-way needed
- construct all of the lanes at one time (instead of deferring construction of the high-occupancy vehicle (HOV) lanes until additional funding was available) thereby reducing future traffic disruption
- shift the Western Section alignment between Lower Buckeye Road and I-10 to connect to I-10 at 59th Avenue (rather than 55th Avenue) thereby reducing the right-of-way needed and improving traffic operations

The *2035 Regional Transportation Plan (RTP)* (MAG 2014a) includes a program amount of $1.8 billion for the South Mountain Freeway between fiscal year 2014 and 2026. The latest ADOT 5-year facilities construction program which covers fiscal year 2015 to 2019 includes $1.62 billion ($538 million for right-of-way, $76 million for design, and $1 billion for construction) for the South Mountain Freeway (ADOT 2014a).



South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 1.1
Study Area

Because the proposed freeway requires a Federal action for the approval of the change of access to I-10 (Papago Freeway) and approval to use federal funds, FHWA is required to ensure that the study complies with the provisions of the National Environmental Policy Act (NEPA) and other environmental laws.

1.2 Need and Purpose for the Project

Over the past 40 years, Phoenix-area population, housing, and employment experienced some of the fastest growth in the nation. From the early 1950s to the mid-1990s, population in the MAG region grew by over 500 percent (see Figure 1.2). Several factors—desirable climate and desert setting, advantageous location as a distribution hub, popularity as a travel destination, year-round agricultural benefit, enhanced water supply (e.g., from the Central Arizona Project)—have substantially contributed to the greater Phoenix metropolitan area being a popular destination for people and industry.

MAG projections indicate Maricopa County's population would increase from 3.8 million in 2010 to 5.8 million in 2035 (MAG 2013a). This equates to almost 80,000 additional people per year. The housing unit numbers are projected to maintain a similar growth rate to meet population growth demand. The number of housing units is projected to increase from 1.6 million in 2010 to 2.3 million in 2035. The region's employment is projected to increase from 1.7 million jobs in 2010 to 2.9 million jobs in 2035. To summarize, rates of population, housing, and employment growth experienced since the 1950s are projected to continue through 2035. As has been the case in the past, vehicle miles traveled (VMT) are projected to meet or exceed the three socioeconomic trends (see Figure 1.2).

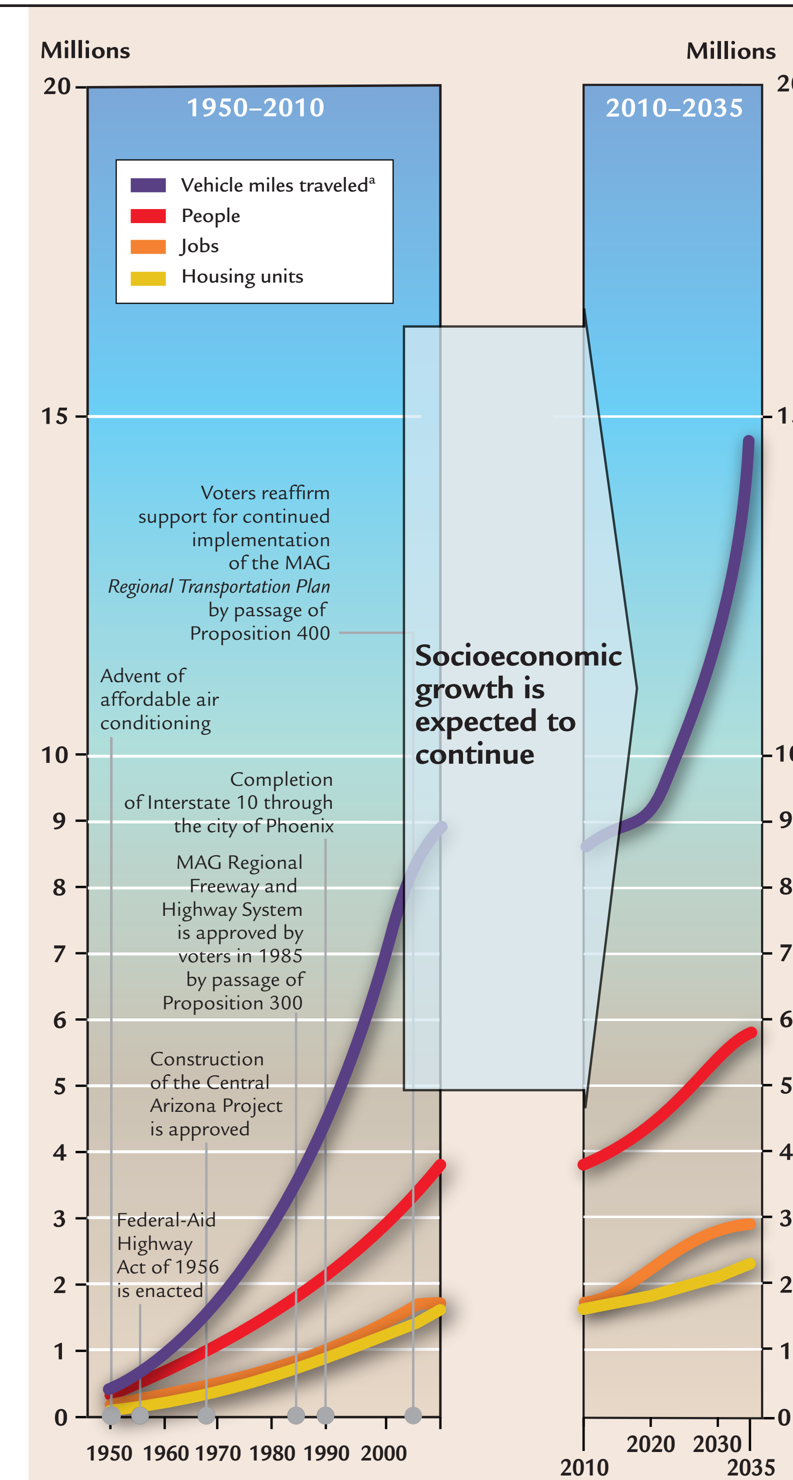
This growth continues to drive the need for public infrastructure (e.g., transportation systems). MAG's 1985 *Long-Range Transportation Plan* (LRTP), which included the planned 232-mile RFS, was a direct response to the growth occurring in the region (MAG 1985). The multimodal 2003 RTP serves as the "next generation" of the LRTP.

As previously noted, RTP-planned projects generally are sequenced based on funding availability, immediacy of transportation infrastructure need, and projected growth areas. Most historical growth has occurred in the northeastern, southeastern, northwestern, and central portions of the region. This trend, however, is projected to change. Almost 50 percent of the projected increases in population, housing, and employment from 2010 to 2035 are expected primarily in the southern and southwestern portions of the MAG region—the areas that would be directly served by a major transportation facility in the Study Area.

A major transportation facility (the South Mountain Freeway) has been included in the region's adopted transportation planning documents since 1985 and remains in the current RTP. At the beginning of the study process, the need for a major transportation facility in the Study Area was reexamined and documented in the Final Environmental Impact Statement (FEIS) (ADOT 2014b) and the *Traffic Overview* (ADOT 2014c). The evaluation revealed that a major transportation facility is needed even more now than it was in the past. The need is based on:

Socioeconomic factors

- Population, housing, and employment are projected to increase by approximately 50 percent between 2010 and 2035, increasing travel demand.
- Growth in VMT is projected to meet or exceed the growth of these socioeconomic factors and to further burden the already-overtaxed regional transportation system.
- Almost 50 percent of projected increases in population, housing, and employment from 2010 to 2035 for the MAG region are expected to occur in the southwestern and southeastern portions of the Phoenix metropolitan area, which a major transportation facility in the Study Area would serve (Figure 1.3).



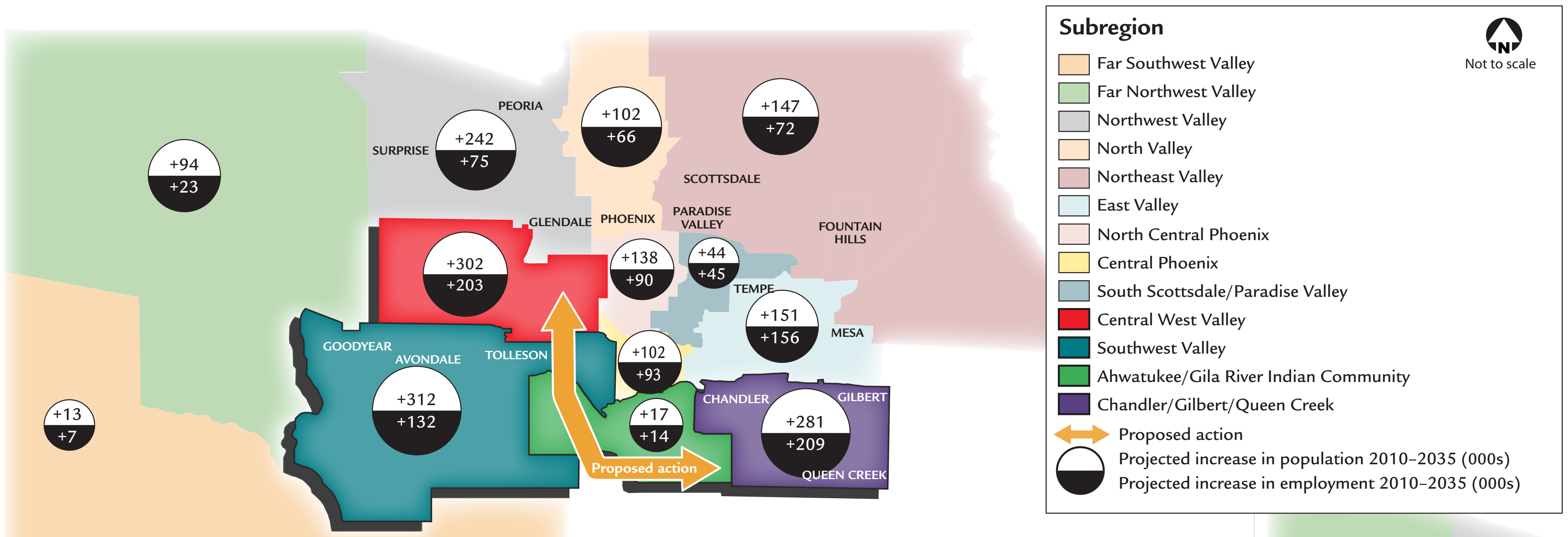
[a] vehicle miles traveled reduced to one-tenth of their actual values to facilitate comparison of growth rates on the same axis

Sources: US Census 1950-2010, MAG 2013a and 2013b, extrapolated analysis

South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

**Figure 1.2
Historical and Projected Growth**

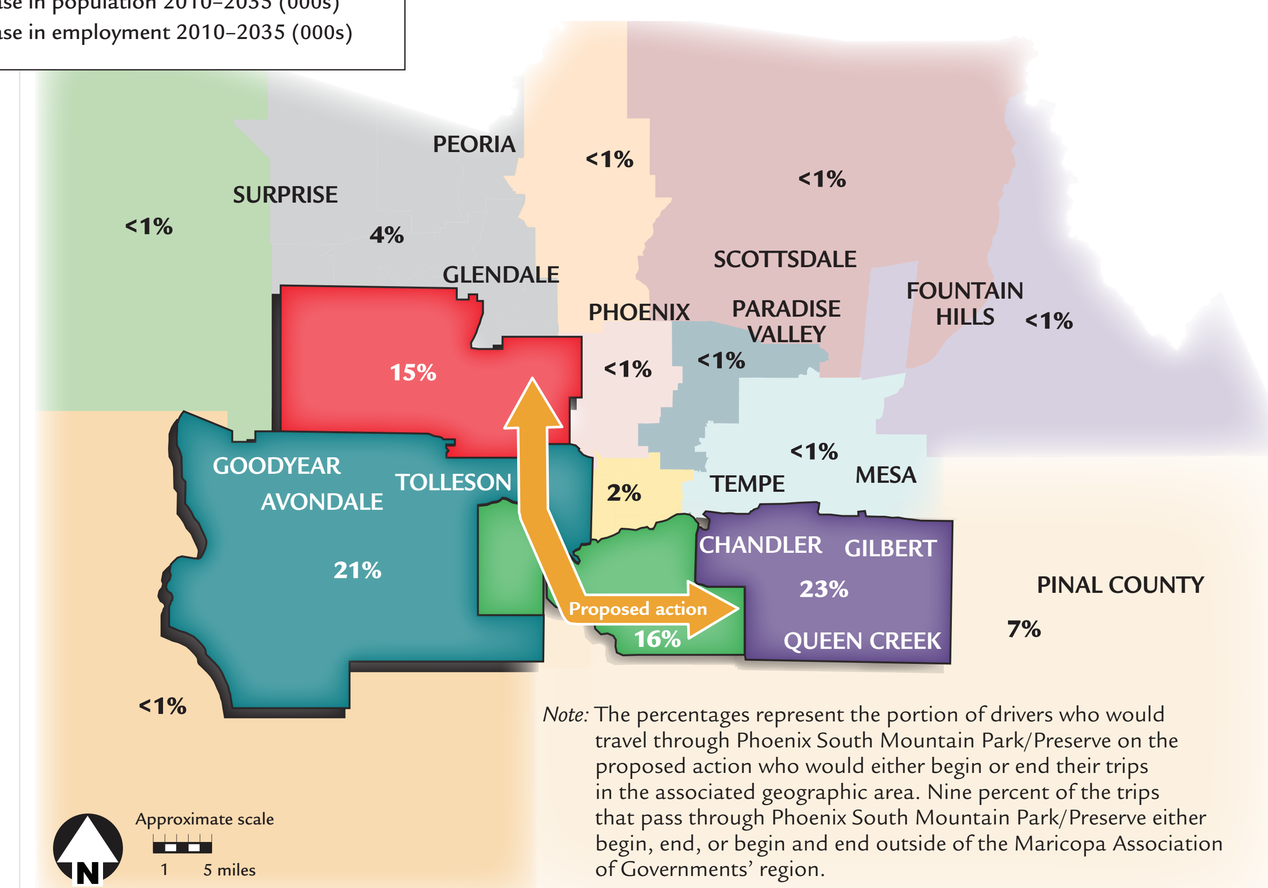


Growth Distribution in Maricopa County

Activity Area	Population (000s)			Employment (000s)		
	2010	2035	Projected Increase	2010	2035	Projected Increase
Central West Valley	578	880	302	136	339	203
Southwest Valley	203	521	318	58	190	132
Ahwatukee/Gila River Indian Community	80	97	17	27	41	14
Chandler/Gilbert/Queen Creek	645	926	281	288	497	209
Total for the proposed action activity area	1,506	2,424	918	509	1,067	558
Total Maricopa County	3,824	5,776	1,952	1,707	2,892	1,185
Percentage contribution – proposed action corridor activity area	**39%**	**42%**	**47%**	**30%**	**37%**	**47%**

Source: MAG 2013a and 2013b, extrapolated analysis

Projected Freeway Users



Note: The percentages represent the portion of drivers who would travel through Phoenix South Mountain Park/Preserve on the proposed action who would either begin or end their trips in the associated geographic area. Nine percent of the trips that pass through Phoenix South Mountain Park/Preserve either begin, end, or begin and end outside of the Maricopa Association of Governments' region.

Source: MAG 2013b, extrapolated analysis

South Mountain corridor team

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 1.3
Growth Distribution and Projected Freeway Users

Transportation capacity

- The 2012 road network can serve 84 percent of the total demand while operating at LOS D.
- Even with planned RTP improvements (except for the proposed action), the 2035 road network would be able to serve only 69 percent of the total demand while operating at LOS D.

Transportation demand

- Between 2012 and 2035, total daily VMT in the entire MAG region are projected to increase from 91 million to 147 million. Daily VMT in the Study Area are projected to grow at a similar rate as the MAG region.
- Average daily traffic (ADT) volumes on freeways and arterial streets are projected to increase substantially in and adjacent to the Study Area between 2012 and 2035.
- Without any new major transportation facility in the Study Area, the volume of traffic on local arterial streets would increase at a greater rate than would the volume on freeways. Therefore, a desired outcome of the RTP—to redistribute traffic appropriately based on travel needs—would not be achieved in the Study Area and its immediate surroundings.

Quality of traffic operations

- During the morning and evening commutes in 2012, the region's freeways were noticeably congested and operated poorly.
- Even with RTP-planned improvements (except for the proposed action), congestion conditions in 2035 would be substantially worse than in 2012.
- The increased travel demand on the arterial streets would result in major congestion, with almost all major signalized intersections operating at level of service (LOS) E or F.

Travel time

- Travel time comparisons between 2012 and 2035 conditions for representative trips from Laveen to downtown Phoenix and from Ahwatukee to downtown Phoenix in the morning and in the evening revealed an increase of 10 minutes for the Laveen trips and 6 minutes for the Ahwatukee trips.
- When considered in the context of hundreds of thousands of drivers each day, over the course of more than 20 years, the total lost time because of increased congestion would be substantial.

When considering the historical planning for a major transportation facility; socioeconomic factors; and the analyses of existing and projected transportation capacity and demand, quality of traffic operational performance, and travel time; the proposed action is a needed element of the transportation network in the MAG region. The purpose of the proposed action is to fulfill the multiple dimensions of this need. The screening process described in the following section determined that a freeway located in the Study Area would be the most appropriate response to the need described above. Table 1.1 presents a comparison between 2035 conditions with and without the proposed freeway and shows there is a need for a freeway within the Study Area.

1.3 Alternatives Development and Screening Process

A key issue from the start of the alternatives development and screening process has been whether ADOT and FHWA would be able to study in detail an alternative on Community land. Despite the efforts to formally develop an alignment on Community land, the Community has not granted permission. In addition, the Community has neither rescinded nor amended resolution GR-126-00, which strongly opposed any future alignment on Community land. While outreach efforts to the Community have been ongoing for many years, efforts to resolve this issue were unsuccessful. Therefore, FHWA and ADOT have determined that an alternative alignment on Community land is not feasible.

Another key issue is the treatment of the South Mountains as resources afforded protection under Section 4(f) of the U.S. Department of Transportation Act, as amended. The South Mountains are eligible for protection as a public park (Phoenix South Mountain Park/Preserve [SMPP]), historic property, and traditional cultural property (TCP). Figure 1.1 illustrates the location of the mountains and park relative to the Community boundary. Because alignments could not be developed on Community land, any alignment alternative located south of the mountains and north of the Community would pass through the mountains to connect I-10 in the east to I-10 in the west. An alignment passing through the mountains is consistent with what has been planned since the mid-1980s.

The process undertaken to develop a range of alternatives, screen those alternatives using a multidisciplinary set of criteria, and identify alternatives to be studied is documented in detail in the FEIS. In brief, ADOT, FHWA, and other stakeholders participated in an integrated, methodical approach that led to outcomes in the consideration of the proposed action including:

- a comprehensive set of alternatives to be considered at the start of the study process
- a comprehensive set of diverse viewpoints and expertise relevant to pertinent decision-making factors associated with environmental concerns, design requirements, optimization of traffic conditions, ability to meet purpose and need criteria, minimization of project cost, and concerns of localized importance
- assurance that the comparative importance of criteria maintained an appropriate balance when considering the performance of alternatives under analysis
- assurance that the screening process was an open process; results of each step were shared in a timely manner with project team members, local jurisdictions, and the public

The screening process used in the FEIS is schematically illustrated in Figure 1.4. At each step in the process, alternatives were comparatively measured against multiple criteria, including ability to meet purpose and need criteria, cost effectiveness, minimization of environmental impacts, operational and design characteristics, constructibility, and public and agency acceptability. As shown in Figure 1.4, alternatives were either eliminated from further study or carried forward to the next level of evaluations. Additional information regarding each step of the alternatives development and screening process is presented in the FEIS (ADOT 2014b).

1.3.1 Alternatives Studied in Detail

Upon completion of the screening process, one action alternative in the Eastern Section of the Study Area, three action alternatives in the Western Section of the Study Area, and the No-Action Alternative were determined to adequately represent a range of reasonable alternatives for detailed study. During the screening process it was determined that it would be beneficial to break the Study Area into two sections, the Eastern and Western sections. The sections differ in characteristics and issues and by separating them, it allowed for more specific comparative impact analyses among the alternatives.

The action alternatives are the E1 Alternative in the Eastern Section and the W59 Alternative, W71 Alternative, and W101 Alternative (with alignment options) in the Western Section. Figure 1.5 illustrates the locations of the four action alternatives (and options) studied in detail.

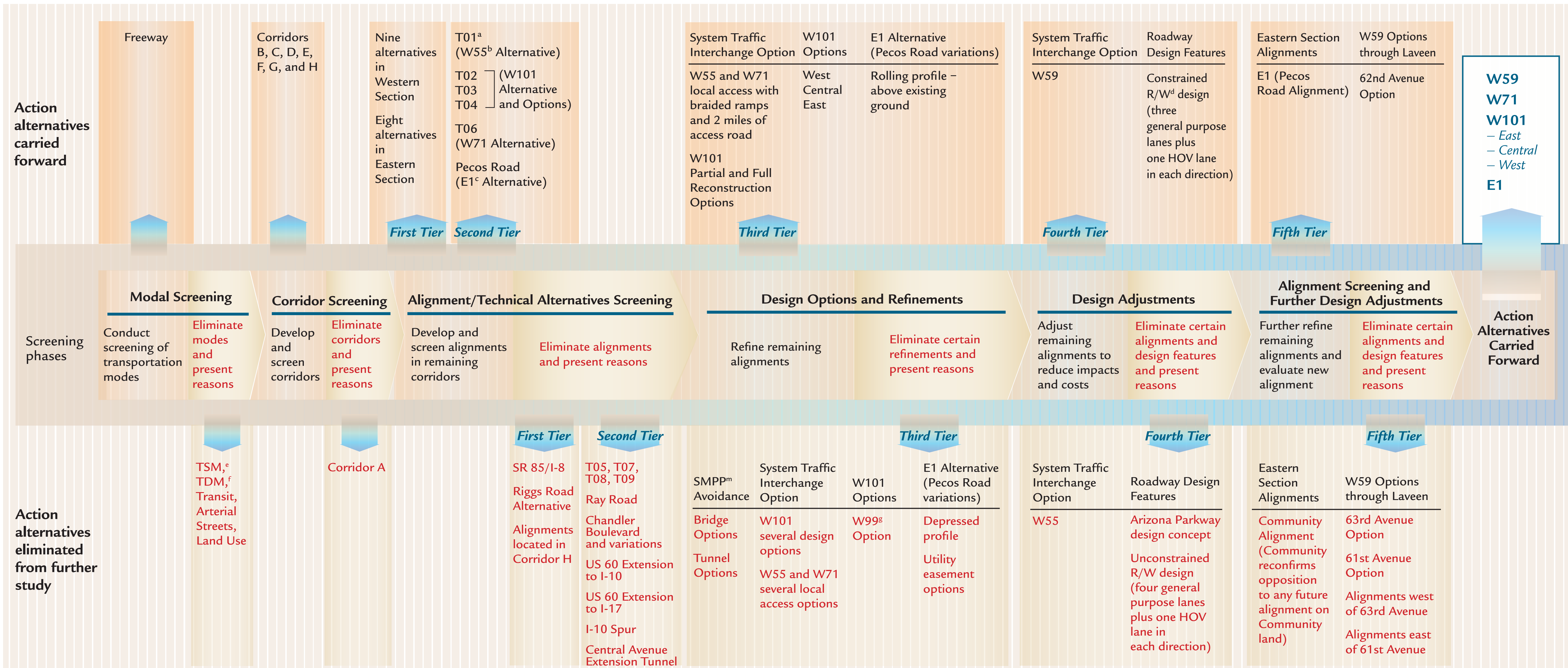
The E1 Alternative would be common to any of the action alternatives in the Western Section. It would begin at the existing system traffic interchange with I-10 (Maricopa Freeway) and SR 202L (Santan Freeway) and proceed west along the border between Phoenix and the Community (replacing the existing Pecos Road). At approximately 35th Avenue, the alignment would curve to the northwest and continue along the Community boundary until ending at the common point between the Eastern and Western sections. The entire alignment would be outside of Community land and would pass through the western edge of the South Mountains.

Table 1.1 – Conditions With and Without the Proposed Freeway, 2035

Decisional Criteria	With the Proposed Freeway	Without the Proposed Freeway
Who would use the proposed freeway?	• 75 percent of drivers using the proposed freeway would be coming from or traveling to the area surrounding the proposed freeway; this area is projected to experience almost 50 percent of the growth in Maricopa County by 2035	• Travelers would continue to use existing routes such as I-10 and Baseline Road, which would become more and more congested • Increased congestion and travel time would occur because no other high-capacity facilities (e.g., freeways) are planned in the area
How would the proposed freeway affect the average traveler?	• By reducing congestion, travel times would improve within the region, resulting in an estimated $200 million annual savings in travel time	• Trip times and traffic congestion would worsen without the proposed freeway
What effects would the proposed freeway have on the regional freeway system?	• Would improve the regional transportation network as planned for during the past 25 years, increasing the efficiency of other existing and planned freeways • Would remove traffic from congested freeways and arterial streets • Would optimize use of adjacent freeways such as SR 202L (Santan Freeway) and the proposed SR 30	• Freeways would not experience congestion relief provided by proposed freeway • If the connections were not provided, the need for other planned freeways would have to be reassessed and reanalyzed in terms of traffic performance • Segments of the regional freeway system, such as SR 202L (Santan Freeway) and SR 30, would be underused
What effects would the proposed freeway have on the area's arterial street network?	• Proposed freeway would reduce traffic on arterial streets by 274,000 vpd[a], which equates to 33 arterial street-lanes of traffic being removed from the system	• Street widening and intersection improvements would be needed to address increased congestion, but these improvements are not planned or funded and obtaining the right-of-way for these improvements would be difficult
What effects would the proposed freeway have on areawide continuity and connectivity?	• Would complete the freeway loop system (as part of SR 202L) • Would increase mobility and access by connecting freeways such as SR 202L (Santan Freeway) in the east to SR 30, SR 101L, and SR 303L in the west	• Freeway loop system would be incomplete; SR 202L would be incomplete and underused • An alternative connection between the eastern and western portions of the Phoenix metropolitan area would not be provided • Motorists on the local arterial street network would have to drive longer distances on these congested streets before being able to gain access to Interstate and regional freeways
What effects would the proposed freeway have on the area's overall transportation capacity deficiency?	• 20 percent of the travel demand in 2035 would remain unmet; 11 percent less than without the proposed freeway, which would make a substantial difference for the areas's overall transportation network	• 31 percent of the travel demand in 2035 would remain unmet
Would the proposed freeway affect traffic in the Broadway Curve[b] area of I-10?	• Proposed freeway would reduce daily traffic volumes by 32,000 vpd on this portion of I-10 and to the south on I-10 between Baseline and Elliot roads, more than any other segments of the region's freeways • During the morning commute, the Broadway Curve would experience shorter duration of LOS E or F conditions	• Would carry approximately 11 percent more traffic without the proposed freeway and would experience a greater degradation of traffic performance • During the morning commute, the Broadway Curve would experience longer duration of LOS E and F conditions
What effects would the proposed freeway have on SR 202L (Santan Freeway)?	• Would increase use on the segment near the proposed freeway by 42,000 vpd • Would optimize operation of the remainder of the SR 202L system	• SR 202L near the proposed freeway would remain underused
Would the proposed freeway affect traffic using 51st Avenue through Community land?	• Would reduce traffic from 9,200 vpd in 2012 to 8,100 vpd in 2035, preventing an increase in unwanted traffic cutting through the Community	• Traffic volumes would increase to 11,800 vpd in 2035 • 51st Avenue would continue to be used by unwanted traffic cutting through the Community
What other general transportation effects would the proposed freeway have?	• Would reduce projected traffic volumes on the remaining regional freeway system, Interstate freeways, and local road network • Would provide opportunities for freeway-dependent transit services • Would provide additional opportunities for transportation system management and transportation demand management	• No improvement in performance of the region's freeways, Interstate freeways, and arterial streets would occur • Additional opportunities for regional freeway-dependent transit services, transportation system management, and transportation demand management would not occur
What effects would the proposed freeway have on the area's transportation planning efforts?	• Would fulfill the planning efforts of numerous governmental entities • Would be an integral element and enhance operation of other planned improvements in the *Regional Transportation Plan* • Would fulfill a need first formally acknowledged in 1985	• Lack of the proposed freeway would be inconsistent with the planning efforts of numerous governmental entities • Would not complete the planned improvements in the *Regional Transportation Plan*

[a] vehicles per day [b] The Broadway Curve is the local name for the segment of the Interstate 10/Maricopa Freeway between the SR-143/Hohokam Expressway and the US-60/Superstition Freeway at the Broadway Rd traffic interchange; in 2013 this segment experiences some of the highest levels of peak period travel delays in the Phoenix metropolitan area.

Source: ADOT 2014b



[a] refers to names for technical alternatives in the Western Section [b] refers to Western Section alternative [c] refers to Eastern Section alternative [d] right-of-way [e] transportation system management [f] transportation demand management
[g] an early alternative roughly aligned with 99th Avenue

Source: ADOT 2014b

South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 1.4
Screening Process and Results

Each of the alternatives in the Western Section would begin at the end of the E1 Alternative and proceed north and northwest through Phoenix until connecting with I-10 (Papago Freeway). The W59 Alternative would connect to I-10 at approximately 59th Avenue, while the W71 Alternative would connect at approximately 71st Avenue. The W101 Alternative and options would connect at the existing system traffic interchange with SR 101L (Agua Fria Freeway) and I-10. This alternative would either require a full or partial reconstruction of the existing system traffic interchange to make the connection.

The design of each action alternative was developed to a common level of detail sufficient enough to determine that the construction was feasible, to allow analysts to meaningfully assess and compare impacts that would occur from any of the action alternatives, and to allow for decisions to be made about the preference of each alternative.

The No-Action Alternative is included for detailed study in accordance with NEPA requirements to compare beneficial and adverse impacts of the action alternatives with those benefits and consequences (adverse impacts) of not proceeding with one of the action alternatives. The No-Action Alternative would not extend SR 202L (Santan Freeway) west of I-10 (Maricopa Freeway); however, it would include all other projects included in the RTP. Traffic on the existing segment of SR 202L (Santan Freeway) as well as along I-10 would be required to use existing Interstate and regional freeway system or the local street network. As described in previous sections, regional traffic volumes are projected to increase substantially (VMT are projected to increase by 50 percent between 2012 and 2035), and the No-Action Alternative would not alleviate projected increases in traffic volumes and congestion on the Interstate and regional freeway systems nor on the local street network by the design year 2035. Implementation of the No-Action Alternative would result in:

- further difficulty in gaining access to adjacent land uses
- increased difficulty in gaining access to the Interstate and regional freeway systems from the local arterial street network
- increased levels of congestion-related impacts on freeways and arterials
- continued degradation in performance of regional freeway-dependent transit services
- increased trip times and higher user costs

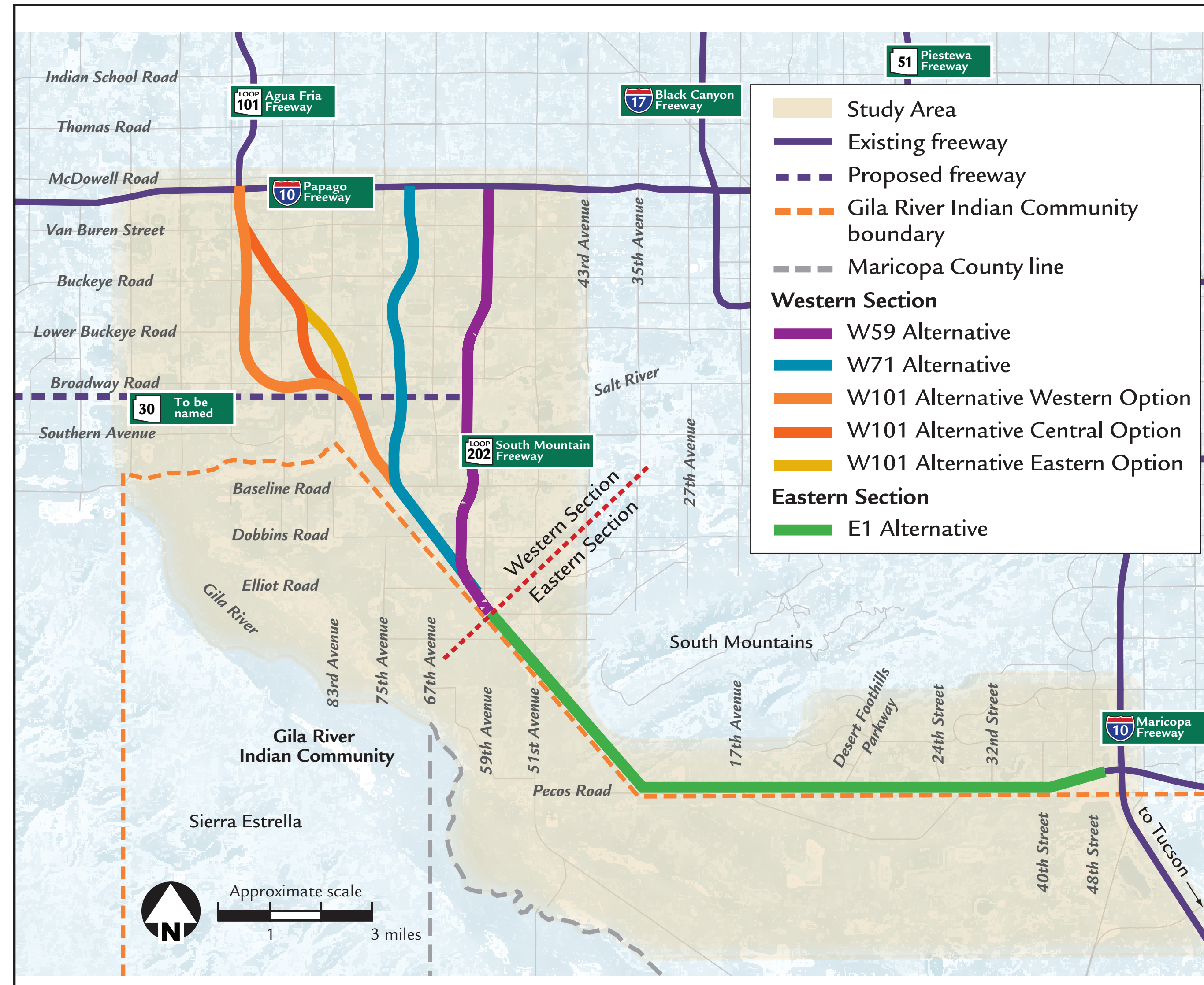
Further, an important link in the freeway system would not be constructed, thereby resulting in increased congestion on completed freeway segments. The No-Action Alternative would be inconsistent with MAG and local jurisdictions' long-range planning and policies for access to development areas in the Study Area. Both SR 30 and Avenida Rio Salado (ARS) would need to be reassessed in terms of purpose and need and logical termini and be reanalyzed in terms of traffic performance. The No-Action Alternative would not adequately serve transit opportunities because it would preclude future development of HOV lanes, express bus service, and park-and-ride lots adjacent to the proposed freeway.

The No-Action Alternative would not satisfy the need for the project as described in Section 1.2.

1.3.2 Identification of a Selected Alternative

In summer 2006, ADOT, with concurrence from FHWA, identified the W55 Alternative as the preliminary preferred alternative in the Western Section. The public announcement of the W55 Alternative as the preliminary preferred alternative prior to issuance of the DEIS or L/DCR was in response to increasing requests by officials of affected municipalities and the land development community to allow better land planning in the rapidly developing Western Section around the preliminary preferred alignment.

In 2009, MAG suggested that a portion of the W55 Alternative could be shifted west onto 59th Avenue to take advantage of right-of-way owned by the City of Phoenix (COP). This shifted alignment (called the



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 1.5
Action Alternatives

W59 Alternative) would connect to I-10 (Papago Freeway) at an existing service traffic interchange. The analysis supporting the shift was documented in the *W59 Alternative Environmental and Engineering Overview Memorandum* (ADOT 2009a). Some of the advantages of the W59 Alternative included:

- I-10 traffic operations would perform better than with the W55 Alternative.
- would improve operations along Van Buren Street and Buckeye Road by eliminating the condition with a major arterial intersection closely spaced to the service interchange ramp intersections
- would be preferred from a security perspective because it would be farther removed from the petroleum facility at 51st Avenue and Van Buren Street
- would require less right-of-way and impact fewer businesses
- would not need to reconstruct 51st Avenue Bridge at the system traffic interchange

Some of the disadvantages of the W59 Alternative included:

- would impact more residences including two apartment complexes with approximately 680 units and approximately 22 homes west of 59th Avenue along the south side of I-10
- would require the relocation of major utilities located within the 59th Avenue corridor
- would affect local circulation by converting 59th Avenue into one-way frontage roads

At the conclusion of the analysis, the W59 Alternative was identified as the preliminary preferred alternative in the Western Section.

In preparing the Record of Decision (ADOT 2015) for the proposed action, ADOT and FHWA reconfirmed the following:

- Previous identification of the W59 Alternative as the preliminary preferred alternative in the Western Section of the corridor does not preclude the No-Action Alternative from being the Selected Alternative later in the EIS process.
- The issues and factors leading ADOT and FHWA to previously identify the W59 Alternative as the preliminary preferred alternative remain applicable and well-founded.

The following text describes the process and factors considered in the decision making leading to identification of the W59 Alternative as the Selected Alternative in the Western Section. Additional detail and background is provided in the ROD.

When comparing action alternatives in the Western Section, the W71 Alternative was considered the least desirable of the three action alternatives because:

- Traffic conditions with I-10 would be the least desirable of the alternatives considered.
- Residential impacts and relocations would be high (up to 839 properties affected).
- Regional and public support is lacking.
- The presence of an alignment is not consistent with local land use plans dating back to the mid-1980s.

ADOT continued the evaluation of the Western Section action alternatives by conducting a comparative analysis of the W59 and W101 Alternatives and a summary follows:

Overall Transportation Needs

- The W59 Alternative would better link the southern areas of the region with the central metropolitan area and would provide an alternative route to I-10 for regional connectivity.
- The W59 Alternative would be more consistent with local and regional transportation plans including the RTP.
- Northbound and southbound motorists using the W101 Alternative would have a direct connection to SR 101L (Agua Fria Freeway) and would not have to travel on I-10 (Papago Freeway). This would complete a true loop around the Phoenix metropolitan area.
- The W101 Alternative would require additional widening improvements to SR 101L (Agua Fria Freeway) and I-10 (Papago Freeway).
- The W59 Alternative would require additional widening improvements to I-10 (Papago Freeway).

Consistency with Regional and Long-range Planning Goals

- The W59 Alternative would result in the least amount of land being converted to freeway use, thereby optimizing opportunities for planned development.
- Since the mid-1980s, COP land use planning has progressed in recognition of the planned location of the proposed freeway near the W59 Alternative. Related land use planning for the Phoenix villages of Estrella and Laveen has been consistent with the COP's long-range land use planning.
- The location of the Salt River crossing of the W59 Alternative would be consistent with the Rio Salado Oeste joint use project planned by the COP, USACE, and Flood Control District of Maricopa County (FCDMC).
- The W59 Alternative would avoid impacts on the planned expansion of the city of Tolleson wastewater treatment facility.

Environmental and Societal Impacts

- The W59 Alternative would result in the least residential displacements.
- The W59 Alternative would have a nominal effect on the local tax base in Phoenix. It would result in the least impact on the local tax bases in the cities of Tolleson and Avondale.
- The W101 Alternative would have a severe impact on the city of Tolleson's tax base and would lead to a reduction in city-provided services.
- Right-of-way for the W101 Alternative would eliminate a substantial portion of the remaining developable land in Tolleson. Tolleson is landlocked by the cities of Phoenix and Avondale, with no opportunity for future expansion of its city limits.
- None of the action alternatives would compromise the security and operation of the fuel tank farm.

Operational Differences

- The W101 Alternative would have the best traffic conditions along I-10 (Papago Freeway) near downtown Phoenix.
- The W59 Alternative would have the best traffic conditions along I-10 (Papago Freeway) west of 59th Avenue, with less congestion expected on I-10 during both the morning and evening commutes compared with the other action alternatives.
- The W101 Alternative would provide a direct connection to SR 101L (Agua Fria Freeway), thus completing the loop system without any overlap on I-10.
- The W59 Alternative would provide the most direct access to downtown Phoenix.
- The W101 Alternative would provide better access to destinations west and north of downtown Phoenix.
- The W59 Alternative would better optimize the long-term system of freeways planned in the southwestern portion of metropolitan Phoenix. However, these benefits would not be realized until SR 30 and SR 303L, south of I-10, are completed.
- The W59 Alternative would avoid the skewed arterial street interchange configurations that would be required for the W101 Alternative to connect with the planned SR 30, ARS, and several arterial streets.

Estimated Costs

- The W59 Alternative would cost an estimated $490 million to $640 million less than the W101 Alternative.

Regional Support and Public Input

- Resolutions passed by the City/Town Councils of Avondale, Buckeye, Gila Bend, Goodyear, Litchfield Park, Phoenix, and Tolleson supported an alternative near 55th Avenue (now closely represented by the W59 Alternative) and opposed the W101 Alternative.
- Public input was split in support of either the W55 (now closely represented by the W59 Alternative) or W101 Alternative. The South Mountain Citizens Advisory Team (SMCAT) supported the W101 Alternative, but expressed concern about its impacts on the communities surrounding the proposed freeway.

After considering the above points, FHWA, with concurrence from ADOT, identified the W59 Alternative as its Selected Alternative in the Western Section.

The E1 Alternative is the only action alternative developed for the Eastern Section. ADOT and FHWA sought permission to study alternatives in detail on Community land, but the Community decided such alternatives would not be in the Community's best interest. Therefore, FHWA, with concurrence from ADOT, identified the E1 Alternative as the Selected Alternative in the Eastern Section. In reaching its decision, FHWA and ADOT sought to balance the need to address regional mobility deficiencies while being fiscally responsible and sensitive to local communities.

2. Traffic Data

The following sections include a discussion of the traffic analysis conducted for the study, the development of traffic volumes, and the analysis of traffic performance on the freeway main line, system traffic interchanges, and service traffic interchanges.

2.1 Traffic Analysis

Traffic analysis has been a key component in the development of the South Mountain Freeway study. As presented in Section 1.2, *Need for the Project*, regional traffic performance has been the driving force behind the purpose and need for the freeway. As presented in Section 1.3.2, *Identification of a Selected Alternative*, traffic performance along I-10 (Papago Freeway) and cohesion with other regional freeways were a major consideration for selection of a Selected Alternative in the Western Section of the Study Area. The traffic information related to those two considerations are documented in the *Traffic Overview* (ADOT 2014b) and *Draft Change of Access Report* (ADOT 2011e).

- Traffic Overview – This report provides documentation of traffic analysis for the FEIS. It includes traffic analysis for the purpose and need for the freeway, a review of the existing conditions of the Study Area, a review of the design year projections for traffic on the alternatives studied in detail, and presents microsimulation analysis of the I-10 system traffic interchange scenarios considered for each alternative.
- Change of Access Report – The new system traffic interchange at I-10 (Papago Freeway) requires FHWA approval of a “change of access”. The report presents traffic analysis associated with the proposed W59 Alternative system traffic interchange at I-10 (Papago Freeway) using the Highway Capacity Manual (HCM) methodology and microsimulation software.

The traffic analysis presented in this L/DCR evaluates the major components of the Selected Alternative (freeway main line and service traffic interchanges) to ensure that they would perform at an acceptable LOS in the design year. The desirable design LOS for a new freeway in an urban area is LOS C or D according to Table 103.2A in the ADOT *Roadway Design Guidelines* (RDG) (ADOT 2012). For those locations with LOS E or F, additional design modifications were evaluated to improve operations.

2.2 Development of Traffic Volumes

This section documents the process and approach undertaken to develop the design year traffic volumes used to analyze the traffic performance of the South Mountain Freeway. The goal is to provide a clear discussion of the assumptions that were made for each type of facility (freeway main line, system traffic interchange and service traffic interchange ramps, and arterial streets), from the general review of daily traffic volumes to the more detailed analysis of peak hour traffic volumes and turning movements.

The traffic projections used during the analysis are from the 2035 MAG regional travel demand model (MAG 2013b). The types of information provided by the model include:

- daily traffic projections for each road segment
- morning (AM) and evening (PM) peak 3-hour period traffic projections for each road segment
- AM and PM peak period turning movement projections at service traffic interchange ramp intersections
- projected duration LOS E or F on regional freeway segments

Three scenarios were modeled to develop design year traffic projections:

- No-Action Alternative - which included the 2035 road network with all planned improvements except for the South Mountain Freeway.
- W59/E1 Alternative, with SR 30 - which includes all planned improvements in the RTP.
- W59/E1 Alternative, without SR 30 - which includes all planned improvements except the SR 30 freeway.

Notable features common to the action alternative model network include:

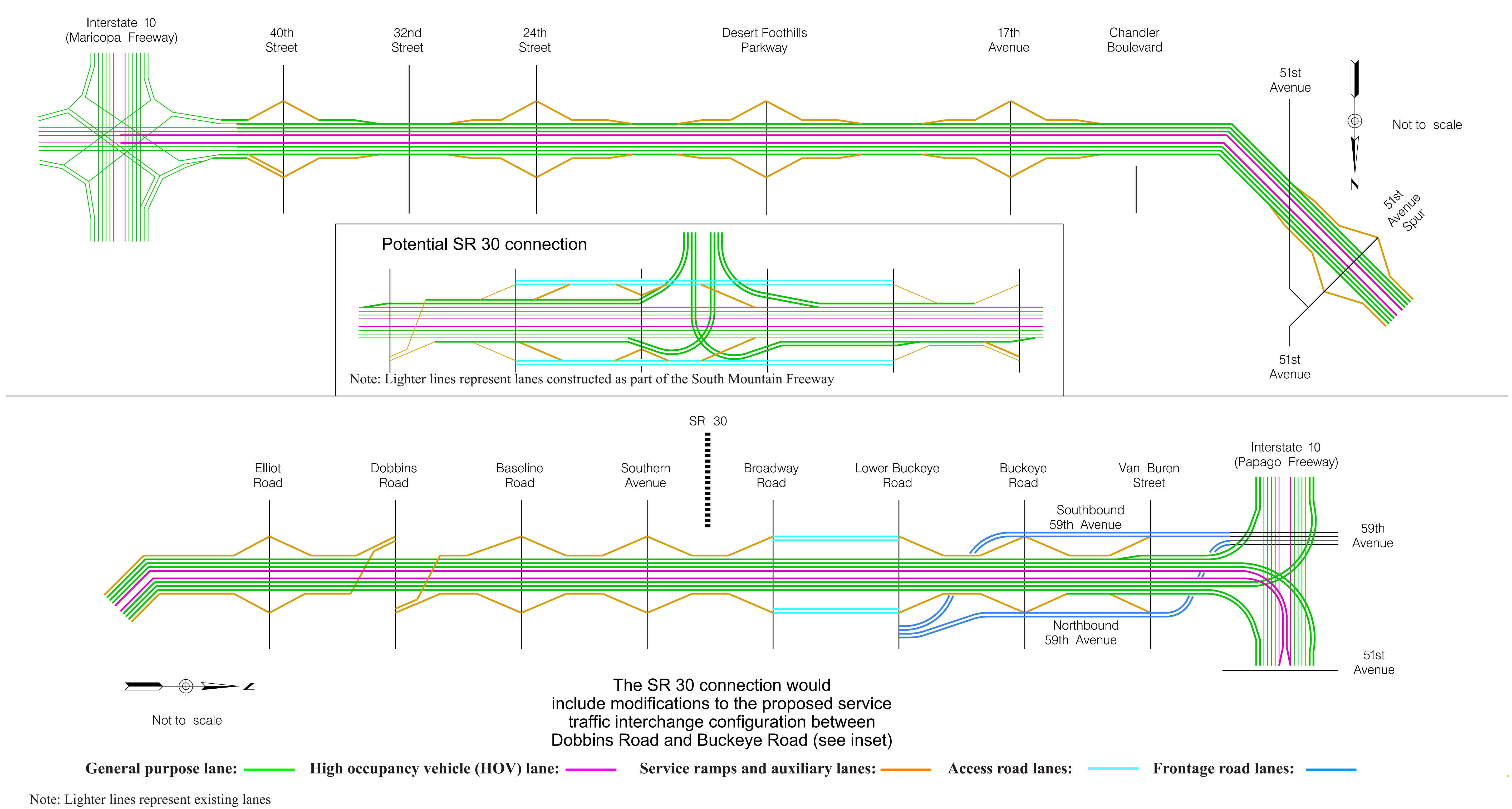
- There is no service traffic interchange provided at 32nd Street. The freeway still crosses over 32nd Street so that the street may continue south of the freeway. This interchange was removed from the plan at the request of COP to reduce impacts on the surrounding community.
- There is no service traffic interchange provided at Chandler Boulevard (27th Avenue alignment). Chandler Boulevard would end just north of the freeway. This interchange was removed from the plan at the request of COP to reduce impacts on the surrounding community.
- The 51st Avenue service traffic interchange and adjacent local street network have been modified to eliminate the skewed intersection that would have been required.

The only difference between the two action alternative model networks was that one included the SR 30 freeway and the other did not. The lane configuration of the South Mountain Freeway without the SR 30 freeway and the potential lane configuration of the SR 30 connection are presented in Figure 2.1. Notable observations regarding travel patterns with and without the SR 30 freeway include:

- The main line and ramp traffic volumes between 40th Street and 51st Avenue would be nearly the same with and without the SR 30 freeway.
- The main line and ramp traffic volumes between 51st Avenue and SR 30 would be higher with SR 30 than without SR 30.
- The main line and ramp traffic volumes between SR 30 and I-10 would be higher without SR 30 than with SR 30.
- The traffic split at I-10 (Papago Freeway) would be different with respect to total volume (as noted in bullet above) and directional split. With SR 30, approximately 50 percent of traffic uses the system ramps to and from the east (downtown Phoenix) and 50 percent uses the ramps to and from the west. Without SR 30, only 45 percent uses the ramps to and from the east, while 55 percent uses the ramps to and from the west. This shift is consistent with the purpose of the SR 30 freeway, to reduce traffic on I-10 between SR 303L and SR 202L.

The SR 30 project has been deferred beyond the RTP funding horizon and would likely not be completed until around 2030. Therefore, the South Mountain Freeway could be in operation for over 10 years before the SR 30 freeway is completed. Extensive coordination has occurred between the South Mountain Freeway and SR 30 projects. A number of provisions have been incorporated into the South Mountain Freeway design concept to reduce the impacts of the future construction of the SR 30 connection and are described in Section 3.1.7, *Design Considerations for the SR 30 System Traffic Interchange*. The SR 30 project would include detailed traffic analysis supporting the system traffic interchange including operations along the South Mountain Freeway main line and operations of modifications to the service traffic interchanges.

Based on all of this information, the traffic analysis presented in this report has considered the traffic projections with and without the SR 30 freeway and developed a conservative volume scenario to analyze



South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.1
Proposed South Mountain Freeway Lane Configuration

the operations of the South Mountain Freeway as a stand-alone project. The subsequent analysis of the combined South Mountain Freeway and SR 30 system should be documented during the SR 30 project development.

2.2.1 Review of 2035 Traffic Projections

This section provides a review of the 2035 traffic projections for the South Mountain Freeway main line, system traffic interchange ramps, service traffic interchange ramps, and adjacent arterial streets. Because the South Mountain Freeway would be a new corridor, there is little or no existing data that can be used to compare with the future year traffic projections. This is especially true for the freeway main line and system and service traffic interchange ramps. For these facilities, the data were reviewed to verify that the directional split of traffic (D factor) and average percentage of traffic occurring in the peak hour (K factor) were in appropriate ranges. When existing traffic data (counts or traffic impact studies) were available, the model projections were compared to verify that the growth of traffic was appropriate and that the travel patterns matched projected development. The projected average daily traffic and peak hour traffic volumes are presented in Figures 2.2 and 2.3, respectively. Additional peak hour turning movement projections are provided in Section 2.5, *Service Traffic interchange Analysis*.

Freeway Main Line
The 2035 projections for daily traffic on the South Mountain Freeway were reviewed and found to be appropriate based on the number of lanes provided and comparisons with similar facilities in the region. The 2035 travel demand model projections for AM and PM peak hour traffic on the South Mountain Freeway were reviewed and found to be appropriate based on the expected range of the D and K factors. Notable observations from the review include:

- Approximately 128,000 vehicles are projected to travel around the South Mountains each day.
- The sections of freeway expected to have the highest daily traffic are located between Southern Avenue and Broadway Road and between Buckeye Road and Van Buren Street with approximately 188,000 vehicles per day (vpd) and 197,000 vpd, respectively.
- During the AM peak hour, the directional split is projected to be approximately 46 percent traveling north and west and 54 percent traveling south and east. Conversely, during the PM peak hour, the directional split is projected to be approximately 55 percent traveling north and west and 45 percent traveling south and east. During both peak hours, the peak direction is projected to include between 7 and 9 percent of the daily traffic volume (K factor).

System Traffic Interchange Ramps
The 2035 projections for daily traffic connecting the South Mountain Freeway to other freeways on system traffic interchange ramps were reviewed and found to be appropriate based on the number of lanes provided and comparisons with similar facilities in the region. The highest traffic movements are at I-10 (Papago Freeway) (north to west and east to south). The K factors for the ramps were in a similar range, 7 percent to 9 percent, as the freeway main line. The vehicle split favoring the movements to and from the west at the I-10 (Papago Freeway) would also occur during the AM and PM peak hour. Notable observations from the review include:

- The directional split at the I-10 (Maricopa Freeway) system traffic interchange is approximately 53 percent going through to SR 202L (Santan Freeway), 25 percent going to and from the south, and 22 percent going to and from the north. The directional split reinforces the need for the project as a link in the regional loop system that adds additional east-to-west mobility.
- The directional split at the I-10 (Papago Freeway) system traffic interchange is approximately 44 percent going to and from the east, and 56 percent going to and from the west. Without the SR 30 connection to the west, traffic would have to use I-10 as their route to reach destinations west of downtown Phoenix.

Service Traffic Interchange Ramps
The 2035 projections for daily traffic connecting the South Mountain Freeway to arterial streets on service traffic interchange ramps were reviewed and found to be appropriate based on the adjacent development, arterial volumes, and comparisons with similar facilities. The highest projected ramp volumes are located at Broadway Road, Buckeye Road, Baseline Road, and Van Buren Street. The lowest projected ramp volumes are located at Desert Foothills Parkway, Elliot Road, and Dobbins Road.

Arterial Streets
Because arterial streets have different factors affecting traffic growth, they were reviewed individually. Table 2.1 presents a comparison between 2012 and 2035 projected daily traffic on each arterial street.

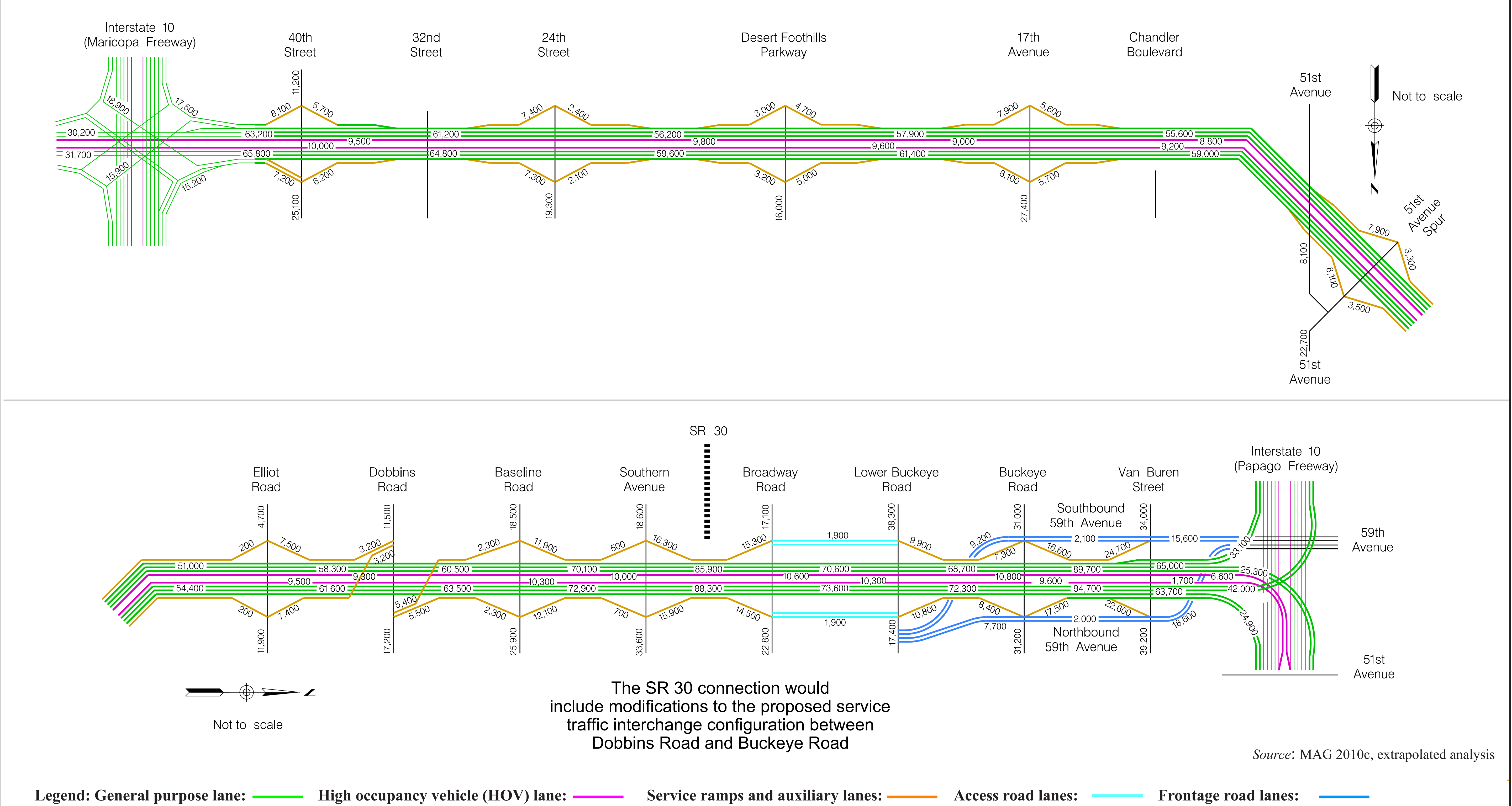
Notable observations regarding each arterial street include:

- 40th Street would have approximately 50 percent additional vehicles each day between today and 2035. This increase is reasonable because the adjacent development is nearly built out and the freeway would provide similar access to I-10 and SR 202L (Santan Freeway) as Pecos Road does

Table 2.1 – 2007 and 2035 Projected Daily Traffic Volumes on Arterial Streets

Road	Location	Existing Count[a]	2035 Projection[b]	
			North of Service TI	South of Service TI
40th Street	Pecos Road to Chandler Boulevard	16,400	25,100	11,200
24th Street	Pecos Road to Chandler Boulevard	6,500	19,300	c
Desert Foothills Parkway	Pecos Road to Chandler Boulevard	10,500	16,000	c
17th Avenue	Pecos Road to Chandler Boulevard	4,700	27,400	c
51st Avenue	Komatke Drive to Estrella Drive	13,500	22,700	8,100
			East of Service TI	West of Service TI
Elliot Road	67th Avenue to 59th Avenue	200	11,900	4,700
Dobbins Road	67th Avenue to 59th Avenue	800	17,100	11,500
Baseline Road	67th Avenue to 59th Avenue	17,000	11,500	17,200
Southern Avenue	67th Avenue to 59th Avenue	7,900	17,200	16,500
Broadway Road	67th Avenue to 59th Avenue	6,900	22,800	17,100
Lower Buckeye Road	67th Avenue to 59th Avenue	11,900	17,400	38,300
Buckeye Road	59th Avenue to 51st Avenue	25,900	31,200	31,000
Van Buren Street	59th Avenue to 51st Avenue	16,800	39,200	34,000

Notes: [a] *Source:* City of Phoenix 2014; [b] *Source:* MAG 2013b, extrapolated analysis
[c] No road exists south of the traffic interchange in either the existing or future condition.
TI = traffic interchange

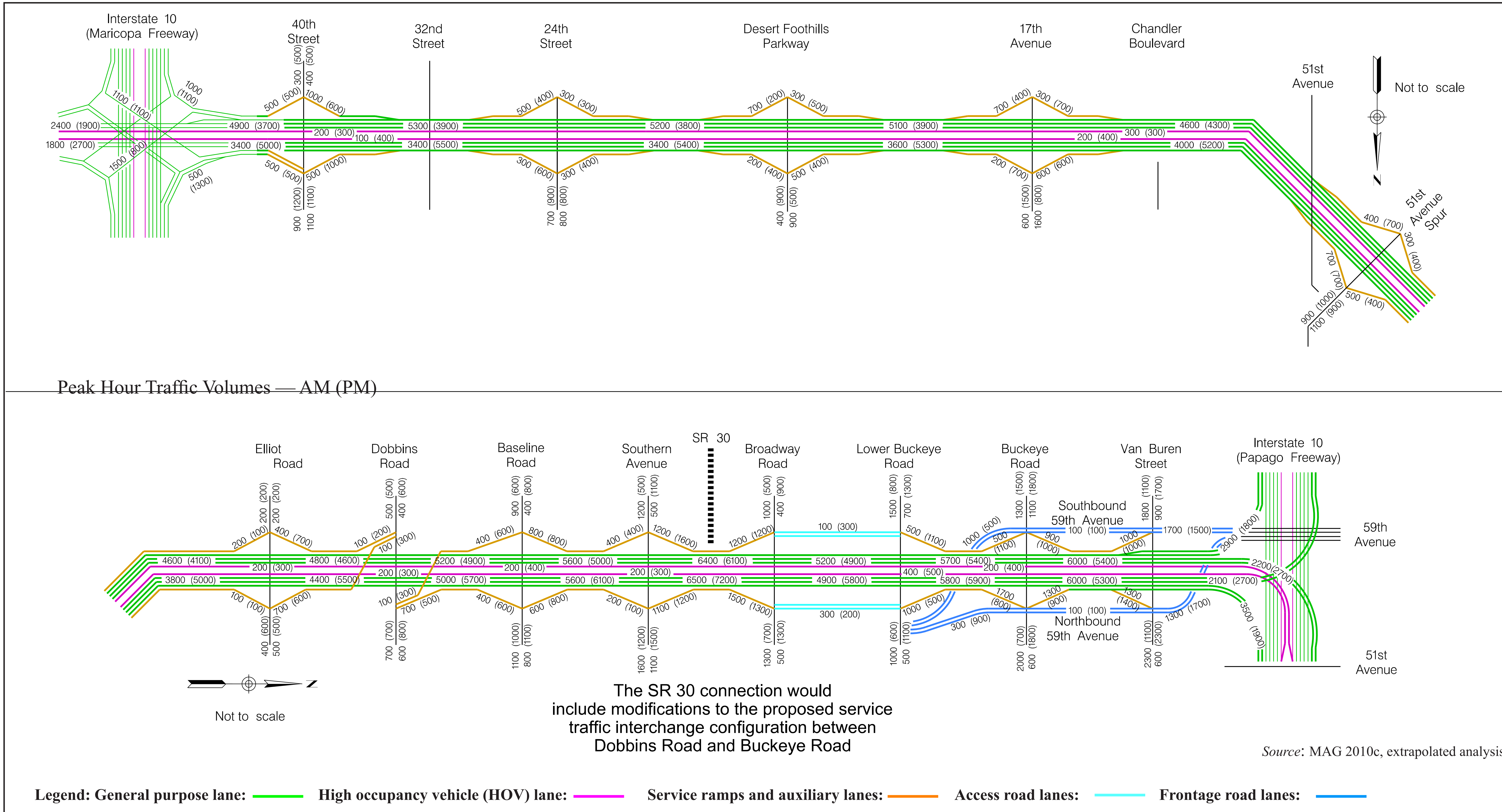


South Mountain corridor team

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.2
Projected Average Daily Traffic Volumes, 2035



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South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.3
Projected Peak Hour Traffic Volumes, 2035

today. Some increased traffic could be attributed to the removal of access at 32nd Street, which carries approximately 7,000 vpd.
- 24th Street is projected to experience almost triple the amount of daily traffic between today and 2035. It is expected that 24th Street traffic interchange would attract a portion of the traffic that currently use 32nd Street.
- Desert Foothills Parkway – Desert Foothills Parkway would have approximately 50 percent additional vehicles each day between today and 2035. This increase is reasonable because the adjacent development is nearly built out and the freeway would provide similar access to I-10 and SR 202L (Santan Freeway) as Pecos Road does today. It is not anticipated that 17th Avenue would be extended to the south on Community land.
- 17th Avenue – 17th Avenue is projected to experience an increase of over 20,000 vpd between today and 2035. The 17th Avenue traffic interchange would accommodate developments to the west that currently access Pecos Road from Chandler Boulevard as well as any new developments in the vacant land to the west. It is not anticipated that 17th Avenue would be extended to the south on Community land.
- 51st Avenue – The projected 2035 traffic north of the freeway is 65 percent greater than the existing traffic counts. The decrease in traffic south of the interchange is expected because the freeway would provide a quicker route than the one that previously traveled through the Community.
- Elliot Road, Dobbins Road, and Baseline Road – The increase in traffic on these roads is expected and in line with planned residential and commercial developments in the Laveen area. In conjunction with new development, the roads are expected to be widened, which would add additional capacity.
- Southern Avenue – The increase in traffic east of the freeway is expected and in line with planned residential and commercial developments in the Laveen area. In conjunction with new development, the roads are expected to be widened, which would add additional capacity.
- Broadway Road, Lower Buckeye Road, Buckeye Road, and Van Buren Street – Although the freeway goes through predominantly industrial and commercial areas at these cross streets, the traffic is still anticipated to increase in line with the 2035 projected volumes. The smallest increase would occur on Buckeye Road, which is designated as MC 85, a major east-west arterial in the area, and would experience the fewest changes to adjacent land uses.

Turning Movement Volumes

The traffic analysis of the arterial street and service traffic interchange ramp intersections required morning and evening peak hour turning movement volumes. The MAG regional travel demand model provides 2035 projected turning movement volumes. The volumes were closely reviewed and their use or modification determined by reviewing existing and projected travel patterns as well as by using engineering judgment. Reasons for modifications included populating movements that are expected to have greater than zero movements, more evenly distributing left and right turns based on expected travel patterns, and balancing turning movement volumes to sum to the approach hourly volumes.

2.3 Main Line Analysis

The freeway main line analysis evaluated the performance of the freeway and ramp junctions based on the proposed lane configuration. The main line analysis was conducted using Highway Capacity Software (HCS 2010). The software provides an interface to more easily implement the methodology and procedures from the HCM, which provides a collection of state-of-the-art techniques for estimating the capacity and determining the LOS for transportation facilities (Transportation Research Board [TRB] 2010). The HCS provides an LOS grade for basic freeway segments, ramp weaving segments, and ramp junction segments. LOS is reported by grade ranging from A (free-flow) to F (congested) that describes the conditions within a traffic stream and the perception of traffic conditions by motorists and passengers.

The LOS grade is based on the density of vehicles per lane. Visual representations of the freeway LOS grades are presented in Figure 2.4.

HCS uses the morning and evening peak-hour volumes and a number of road and driver characteristics to determine LOS. Some of the inputs that are constant for each analysis include:

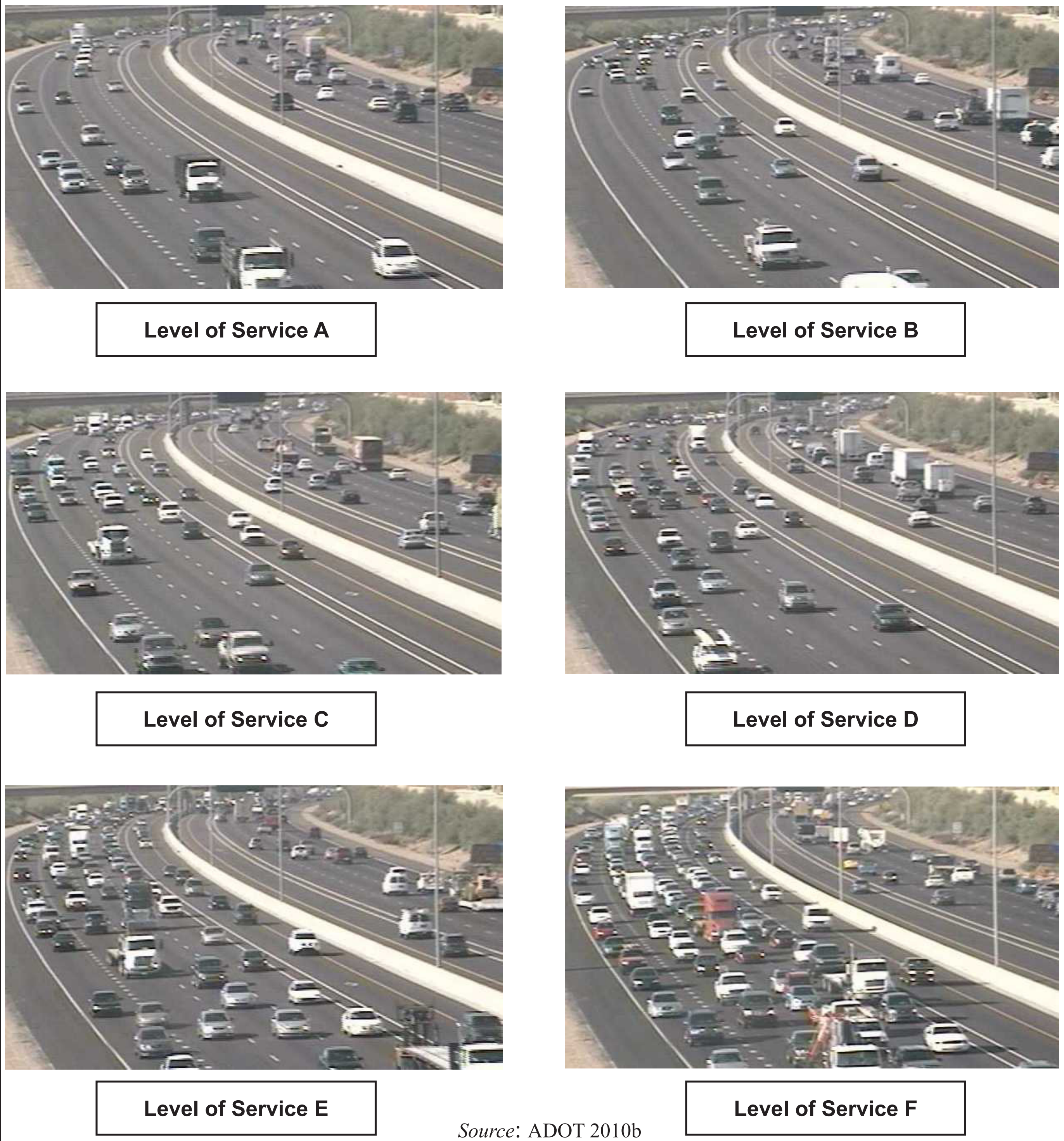
- A peak hour factor of 0.95
- A truck factor of 10 percent
- A driver population factor of 1.0
- A free-flow speed based on the type of road:
  - freeway main line – 65 miles per hour (mph)
  - system traffic interchange ramp – 55 mph
  - service traffic interchange on ramp – 50 mph
  - service traffic interchange off ramp – 55 mph
  - arterial street – 45 mph

The HCM methodology for freeways suggests that the freeway be broken into segments based on its characteristics. The three types of segments are:

- Weaving segments – The weaving analysis is used for segments of freeway in which a lane change must be made to either leave or join the freeway main line. When auxiliary lanes are used between successive service interchanges, the weaving was assumed to be Type A (weaving vehicles in both directions must make one lane change to successfully complete a weaving maneuver).
- Ramp junctions – The ramp junction analysis is used in locations where a ramp entrance or exit is not coupled with a weaving area. This generally occurs at the system traffic interchange ramp junctions and when an auxiliary lane was not provided between successive service traffic interchanges because the distance between them would be greater than 1.5 miles.
- Basic freeway segments – The basic freeway analysis is used for segments of freeway that are outside of the weaving or ramp junction influence areas. This generally occurs between successive off ramps and on ramps as well as when the distance between successive interchanges is greater than 1.5 miles. The basic freeway segments analysis is also used to analyze the system traffic interchange ramps.

The LOS results of the freeway HCS analysis are presented in Figures 2.5 and 2.6 and Tables 2.2 and 2.3. Detailed HCS reports are provided in Appendix C. Notable observations from the freeway main line analysis include:

- In general, the main line operations would not completely meet the desirable design LOS of D with the 2035 projected traffic volumes because the HCS analysis resulted in a number of locations with LOS E or F. HCS provides localized analysis, and as such, it should be noted that the poor operations of one segment would, over time, create a wave of congestion upstream of the segment.
- The overall projected operations during the morning peak hour are good, however, LOS E or F conditions would occur in the northbound direction at Southern Avenue, between Southern Avenue and Broadway Road, and between Lower Buckeye Road and Buckeye Road. Although adjacent sections of the main line may operate at LOS D or better, it could be assumed that congestion would occur in the northbound direction from around Baseline Road to I-10 (Papago Freeway) during the morning commute. Further discussion of the morning conditions follow:
  - The morning peak hour through traffic volume is highest at the basic segment at Southern Avenue with 5,900 vehicles per hour. This level of demand is just over the threshold between LOS D and LOS E conditions. From this point north to I-10 (Papago Freeway) the LOS remains near this threshold.



Source: ADOT 2010b

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South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.4
Level of Service

 - ○ The LOS F conditions between Southern Avenue and Broadway Road in the northbound direction are caused by the high through traffic volume discussed in the previous bullet coupled with high ramp traffic entering from Southern Avenue and exiting to Broadway Road. Because of the split diamond configuration, the Broadway Road northbound exit also provides access to Lower Buckeye Road. These two roads are the first two east-west arterials north of the Salt River and provide access to destinations west of the freeway as well as into downtown Phoenix. Another reason for the high ramp traffic between Southern Avenue and Broadway Road is that the freeway provides for a crossing of the Salt River between these two streets. Therefore, the projected traffic volume may include some portion of vehicles that are merely crossing the river to complete a short local trip and not continuing on the freeway. Another consideration is that the poor operations in this segment would be improved with the construction of SR 30 because traffic would use SR 30 to continue west of South Mountain Freeway instead of the arterial streets.
 - ○ The weaving segment between Lower Buckeye and Buckeye roads operates at LOS E during the morning peak hour. The conditions are similar, a high through traffic volume coupled with high on- and off-ramp traffic volumes. Another consideration at this location is that the weaving length is relatively short due to the frontage road system. The operations at this location could be improved by extending the auxiliary lane beyond the exit ramp gore to allow a longer weaving length for entering traffic.
- The projected operations during the PM peak hour are noticeably worse than the operations during the AM peak hour. The majority of the freeway sections in the southbound (peak) direction would operate at LOS D or worse with ten locations at LOS E and one at LOS F. Also, one location in the northbound (off-peak) direction would operate at LOS E. Further discussion of the evening conditions follow:
  - ○ There are four eastbound locations between 51st Avenue and I-10 (Maricopa Freeway) that would operate at LOS E in the PM. These are all “basic” segments so the only way to improve operations would be to add additional through lanes. The parallel acceleration and deceleration lanes allow vehicles to enter and exit the freeway more freely even in congested conditions.
  - ○ The heaviest congestion in the PM peak hour is in the southbound direction between I-10 (Papago Freeway) and Dobbins Road.
  - ○ The weaving sections between Van Buren Street and Buckeye Road and between Buckeye Road and Lower Buckeye Road are LOS E. Both locations have relatively short weaving lengths due to the frontage road system. To alleviate some of the issues, the auxiliary lanes could be extended beyond the exit gore to provide additional weaving length for traffic entering the freeway.
  - ○ Between Broadway Road and Dobbins Road, a number of “basic” segments operate at LOS E. This shows that the overall demand for the freeway is greater than its capacity. The high ramp traffic volumes between Broadway Road and Southern Avenue further degrade the operations to LOS F in that segment, however, the overriding issue is capacity, which can only be improved by adding through lanes.
  - ○ The final LOS E segment in the PM peak hour is in the off-peak, northbound direction, between Southern Avenue and Broadway Road. As discussed in a previous bullet, this weaving segment also performed poorly during the AM peak hour. Because Broadway Road and Southern Avenue are the first major arterials north and south of the Salt River, respectively, this segment experiences a high volume of on- and off-ramp traffic.

In summary, the following recommendations have been incorporated into the main line design to help improve the areas that do not meet the design LOS.

- Parallel add- and drop-lanes are used along the Pecos Road section to improve the merge and diverge conditions for the on- and off-ramps.
- A two-lane exit ramp has been included for the westbound 40th Street off-ramp. This design is consistent with Figure 504.7 in the ADOT RDG (ADOT 2012).

South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.5
Highway Capacity Software Analysis, AM Level of Service, 2035

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.6
Highway Capacity Software Analysis, PM Level of Service, 2035

Table 2.2 – Highway Capacity Software Analysis, Main Line, Eastbound and Southbound Direction

Section ID	Section	Type	Direction	Time Period	Level of Service	Data Input										
						Number of Lanes	Main Line Peak Hour Volume	Weaving Lanes	Volume	On-Ramp Volume	Off-Ramp Volume	Volume AC	Volume BD	Volume AD	Volume BC	Weave Length
1	Eastbound to northbound directional ramp	Basic	Eastbound	AM	A	2	1,500	*Not applicable*								
				PM	A		800									
2	Eastbound to southbound directional ramp	Basic	Eastbound	AM	A	2	1,000	*Not applicable*								
				PM	B		1,100									
3	Main line at I-10 (Maricopa Freeway)	Basic	Eastbound	AM	C	3	2,400	*Not applicable*								
				PM	E		1,900									
4	40th Street on ramp	Merge	Eastbound	AM	C	3	4,400			500						
				PM	D		3,200			500						
5	Main line at 40th Street	Basic	Eastbound	AM	B	3	4,400	*Not applicable*								
				PM	D		3,200									
6	Off ramp to 40th Street	Diverge	Eastbound	AM	C	3	5,400				1,000					
				PM	D		3,800				600					
7	Main line at 32nd Street	Basic	Eastbound	AM	C	3	5,300	*Not applicable*								
				PM	E		3,900									
8	24th Street on ramp	Merge	Eastbound	AM	C	3	4,900			500						
				PM	D		3,500			400						
9	Main line at 24th Street	Basic	Eastbound	AM	C	3	4,900	*Not applicable*								
				PM	D		3,500									
10	Off ramp to 24th Street	Diverge	Eastbound	AM	C	3	5,200				300					
				PM	D		3,800				300					
11	Between 24th Street and Desert Foothills Parkway	Basic	Eastbound	AM	C	3	5,200	Not applicable								
				PM	D		3,800									
12	Desert Foothills Parkway on ramp	Merge	Eastbound	AM	B	3	4,800			400						
				PM	D		3,400			200						
13	Main line at Desert Foothills Parkway	Basic	Eastbound	AM	B	3	4,800	*Not applicable*								
				PM	D		3,400									
14	Off ramp to Desert Foothills Parkway	Diverge	Eastbound	AM	C	3	5,100				300					
				PM	D		3,900				500					
15	Between Desert Foothills Parkway and 17th Avenue	Basic	Eastbound	AM	C	3	5,100	*Not applicable*								
				PM	E		3,900									
16	17th Avenue on ramp	Merge	Eastbound	AM	B	3	4,300			700						
				PM	D		3,600			400						
17	Main line at 17th Avenue	Basic	Eastbound	AM	B	3	4,300	Not applicable								
				PM	D		3,600									
18	Off ramp to 17th Avenue	Diverge	Eastbound	AM	B	3	4,600				300					
				PM	D		4,300				700					
19	Between 17th Avenue and 51st Avenue	Basic	Eastbound	AM	B	3	4,600	*Not applicable*								
				PM	E		4,300									
20	51st Avenue on ramp	Merge	Eastbound	AM	B	3	4,300			400						
				PM	D		3,600			700						
21	Main line at 51st Avenue	Basic	Eastbound	AM	B	3	4,300	*Not applicable*								
				PM	D		3,600									

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Table 2.2 – Highway Capacity Software Analysis, Main Line, Eastbound and Southbound Direction (continued)

Section ID	Section	Type	Direction	Time Period	Level of Service	Data Input										
						Number of Lanes	Main Line Peak Hour Volume	Weaving Lanes	Volume	On-Ramp Volume	Off-Ramp Volume	Volume AC	Volume BD	Volume AD	Volume BC	Weave Length
22	Between 51st Avenue and Elliott Road	Weave	Eastbound	AM	B	4	2,800	4	4,600	200	300	4,300	0	300	200	2,500
				PM	C		5,500		4,100	100	400	3,700	0	400	100	
23	Main line at Elliott Road	Basic	Southbound	AM	B	3	2,700	*Not Applicable*								
				PM	D		5,400									
24	Between Elliott Road and Dobbins Road	Weave	Southbound	AM	B	4	3,200	4	4,800	100	400	4,400	0	400	100	2,100
				PM	D		6,200		4,600	200	700	3,900	0	700	200	
25	Main line at Dobbins Road	Basic	Southbound	AM	B	3	2,800	*Not Applicable*								
				PM	E		5,800									
26	Between Dobbins Road and Baseline Road	Weave	Southbound	AM	B	4	3,100	4	5,200	400	500	4,700	0	500	400	2,300
				PM	E		6,400		4,900	600	500	4,400	0	500	600	
27	Main line at Baseline Road	Basic	Southbound	AM	B	3	2,700	*Not Applicable*								
				PM	E		5,800									
28	Between Baseline Road and Southern Avenue	Weave	Southbound	AM	B	4	3,100	4	5,600	400	800	4,800	0	800	400	1,900
				PM	D		6,300		5,000	400	800	4,200	0	800	400	
29	Main line at Southern Avenue	Basic	Southbound	AM	B	3	3,100	*Not Applicable*								
				PM	E		5,900									
30	Between Southern Avenue and Broadway Road	Weave	Southbound	AM	C	4	3,800	4	6,400	1,200	1,200	5,200	0	1,200	1,200	2,300
				PM	F		7,100		6,100	1,200	1,600	4,500	0	1,600	1,200	
31	Main line at Broadway Road	Basic	Southbound	AM	B	3	2,900	*Not Applicable*								
				PM	D		5,500									
32	Between Broadway Road and Lower Buckeye Road	Weave	Southbound	AM	B	3	2,900	*Not Applicable*								
				PM	D		5,500									
33	Main line at Lower Buckeye Road	Basic	Southbound	AM	B	3	2,900	*Not Applicable*								
				PM	D		5,500									
34	Between Lower Buckeye Road and Buckeye Road	Weave	Southbound	AM	B	4	3,200	4	5,700	500	500	5,200	0	500	500	1,800
				PM	E		6,200		5,400	1,100	1,100	4,300	0	1,100	1,100	
35	Main line at Buckeye Road	Basic	Southbound	AM	B	4	3,000	*Not Applicable*								
				PM	C		5,600									
36	Between Buckeye Road and Van Buren Street	Weave	Southbound	AM	C	5	4,000	5	6,000	1,000	900	5,100	0	900	1,000	1,600
				PM	E		6,500		5,400	1,000	1,000	4,400	0	1,000	1,000	
37	Between Van Buren Street and I-10 (Papago Freeway)	Basic	Southbound	AM	B	4	3,300	*Not Applicable*								
				PM	C		5,300									
38	I-10 (Papago Freeway) on ramp (from the west)	Basic	Southbound	AM	C	2	2,200	*Not Applicable*								
				PM	C		3,000									
39	I-10 (Papago Freeway) on ramp (from the east)	Basic	Southbound	AM	A	2	1,100	*Not Applicable*								
				PM	C		2,300									

Table 2.3 – Highway Capacity Software Analysis, Main Line, Westbound and Northbound Direction

Section ID	Section	Type	Direction	Time Period	Level of Service	Data Input: Number of Lanes	Main Line Peak Hour Volume	Weaving Lanes	Volume	On-Ramp Volume	Off-Ramp Volume	Volume AC	Volume BD	Volume AD	Volume BC	Weave Length
1	I-10 (Maricopa Freeway) on ramp (from the north)	Basic	Westbound	AM	C	2	1,100	*Not applicable*								
				PM	A		1,100									
2	I-10 (Maricopa Freeway) on ramp (from the south)	Basic	Westbound	AM	A	2	500	*Not applicable*								
				PM	A		1,300									
3	Main line at I-10 (Maricopa Freeway)	Basic	Westbound	AM	D	3	1,800	*Not applicable*								
				PM	D		2,700									
4	Off ramp to 40th Street	Diverge	Westbound	AM	D	3	3,400				500					
				PM	D		5,000				500					
5	Main line at 40th Street	Basic	Westbound	AM	D	3	2,900	*Not applicable*								
				PM	C		4,500									
6	40th Street on ramp	Merge	Westbound	AM	C	3	2,900			500						
				PM	C		4,500			1,000						
7	Main line at 32nd Street	Basic	Westbound	AM	D	3	3,400	*Not applicable*								
				PM	C		5,500									
8	Off ramp to 24th Street	Diverge	Westbound	AM	D	3	3,400				300					
				PM	C		5,500				600					
9	Main line at 24th Street	Basic	Westbound	AM	C	3	3,100	*Not applicable*								
				PM	C		5,000									
10	24th Street on ramp	Merge	Westbound	AM	C	3	3,100			300						
				PM	C		5,000			400						
11	Between 24th Street and Desert Foothills Parkway	Basic	Westbound	AM	D	3	3,400	*Not applicable*								
				PM	C		5,300									
12	Off ramp to Desert Foothills Parkway	Diverge	Westbound	AM	D	3	3,200				500					
				PM	C		5,000				400					
13	Main line at Desert Foothills Parkway	Basic	Westbound	AM	C	3	3,200	*Not applicable*								
				PM	C		5,000									
14	Desert Foothills Parkway on ramp	Merge	Westbound	AM	C	3	3,200			500						
				PM	C		5,000			400						
15	Between Desert Foothills Parkway and 17th Avenue	Basic	Westbound	AM	D	3	3,600	*Not applicable*								
				PM	C		5,300									
16	Off ramp to 17th Avenue	Diverge	Westbound	AM	D	3	3,600				200					
				PM	C		5,300				700					
17	Main line at 17th Avenue	Basic	Westbound	AM	D	3	3,400	*Not applicable*								
				PM	C		4,600									
18	17th Avenue on ramp	Merge	Westbound	AM	D	3	3,400			600						
				PM	C		4,600			600						
19	Between 17th Avenue and 51st Avenue	Basic	Westbound	AM	D	3	4,000	*Not applicable*								
				PM	C		5,200									
20	Off ramp to 51st Avenue	Diverge	Westbound	AM	D	3	4,000				700					
				PM	C		5,200				700					
21	Main line at 51st Avenue	Basic	Westbound	AM	C	3	3,300	*Not applicable*								
				PM	C		4,500									

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Table 2.3 – Highway Capacity Software Analysis, Main Line, Westbound and Northbound Direction (continued)

Section ID	Section	Type	Direction	Time Period	Level of Service	Data Input										
						Number of Lanes	Main Line Peak Hour Volume	Weaving Lanes	Volume	On-Ramp Volume	Off-Ramp Volume	Volume AC	Volume BD	Volume AD	Volume BC	Weave Length
22	Between 51st Avenue and Elliott Road	Weave	Northbound	AM	C	4	3,800	3,800	500	100	3,700	0	100	500	600	2,500
				PM	B		5,000		5,000	400	100	4,900	0	100	400	
23	Main line at Elliott Road	Basic	Northbound	AM	D	3	3,700	*Not applicable*								
				PM	C		4,900									
24	Between Elliott Road and Dobbins Road	Weave	Northbound	AM	D	4	4,400	4	4,400	700	100	4,300	0	100	700	2,000
				PM	C		5,500		5,500	600	300	5,200	0	300	600	
25	Main line at Dobbins Road	Basic	Northbound	AM	D	3	4,300	*Not Applicable*								
				PM	C		5,200									
26	Between Dobbins Road and Baseline Road	Weave	Northbound	AM	D	4	5,000	4	5,000	700	400	4,600	0	400	700	2,300
				PM	B		5,700		5,700	500	600	5,100	0	600	500	
27	Main line at Baseline Road	Basic	Northbound	AM	D	3	4,600	*Not Applicable*								
				PM	C		5,100									
28	Between Baseline Road and Southern Avenue	Weave	Northbound	AM	D	4	5,600	4	5,600	1,000	200	5,400	0	200	1,000	2,100
				PM	C		6,100		6,100	1,000	100	6,000	0	100	1,000	
29	Main line at Southern Avenue	Basic	Northbound	AM	E	3	5,400	*Not Applicable*								
				PM	C		6,000									
30	Between Southern Avenue and Broadway Road	Weave	Northbound	AM	F	4	6,500	4	6,500	1,100	1,500	5,000	0	1,500	1,100	2,300
				PM	E		7,100		7,100	1,200	1,300	5,800	0	1,300	1,200	
31	Main line at Broadway Road	Basic	Northbound	AM	D	3	5,000	*Not Applicable*								
				PM	C		5,800									
32	Between Broadway Road and Lower Buckeye Road	Basic	Northbound	AM	D	3	4,900	*Not Applicable*								
				PM	C		5,800									
33	Main line at Lower Buckeye Road	Basic	Northbound	AM	D	3	4,900	*Not Applicable*								
				PM	C		5,500									
34	Between Lower Buckeye Road and Buckeye Road	Weave	Northbound	AM	E	4	5,800	4	5,800	1,000	1,700	4,100	0	1,700	1,000	2,100
				PM	C		5,900		5,900	500	800	5,100	0	800	500	
35	Main line at Buckeye Road	Basic	Northbound	AM	C	4	4,100	*Not Applicable*								
				PM	B		5,100									
36	Between Buckeye Road and Van Buren Street	Weave	Northbound	AM	D	5	5,300	5	5,300	1,300	1,300	4,000	0	1,300	1,300	1,300
				PM	D		6,000		6,000	900	1,400	4,600	0	1,400	900	
37	Main line at Van Buren Street	Basic	Northbound	AM	C	4	5,400	*Not Applicable*								
				PM	B		4,600									
38	I-10 (Papago Freeway off ramp (to the east)	Basic	Northbound	AM	B	2	3,500	*Not Applicable*								
				PM	B		1,900									
39	I-10 (Papago Freeway off ramp (to the west)	Basic	Northbound	AM	C	2	2,100	*Not Applicable*								
				PM	C		2,700									

A number of weave sections were identified that could experience improved operations by extending the auxiliary lanes a minimum 500 feet beyond the exit ramp nose before dropping them at a 50:1 taper. This application is based on the recommendation in Section 504.9 of the ADOT RDG (ADOT 2012). These improvements have not been included in the roadway plans due to the cost and uncertainty of the future demand and operations. The design does not preclude the improvements from occurring in the future when traffic operations begin to become congested.

Because much of the system would be operating at LOS E or F in 2035, and thus at or exceeding the limitation of the HCM, a sensitivity analysis was not conducted.

2.4 System Traffic Interchanges

The South Mountain Freeway corridor includes one existing and one new system traffic interchange. In the east, the South Mountain Freeway would connect to the existing system traffic interchange at I-10 (Maricopa Freeway) and SR 202L (Santan Freeway). In the west, a new connection would be constructed at approximately 59th Avenue and I-10 (Papago Freeway).

The original I-10 (Maricopa Freeway) and SR 202L (Santan Freeway) system traffic interchange was constructed in 2000 along with the construction of SR 202L (Santan Freeway). The design year for the traffic analysis was 2020. An updated traffic analysis for the system traffic interchange, including microsimulation, was completed in 2008 as part of the I-10 (SR 202L to I-8) Widening Study (ADOT 2008a). The main recommendation affecting the South Mountain Freeway was to widen the north-to-west and west-to-south ramps from one lane to two lanes. The design of the South Mountain Freeway would accommodate this widening. Although a construction date for the ramps has not been planned, it is anticipated that it would occur after construction of the South Mountain Freeway.

A design-build project recently constructed direct HOV (DHOV) connection ramps between SR 202L (Santan Freeway) and I-10 (Maricopa Freeway) as well as HOV lanes on SR 202L (Santan Freeway) from I-10 to Gilbert Road. The South Mountain Freeway would include constructing the HOV lanes to connect to those constructed by this current project.

In the west, the new system traffic interchange would be located at the existing I-10 (Papago Freeway) and 59th Avenue service traffic interchange. The design elements associated with this new system interchange are presented in Section 3.4, *System Traffic Interchanges*, of this report and the detailed traffic analysis is presented in the *Change of Access Report* (ADOT 2011e). Notable observations include:

- Each of the directional ramps includes two lanes. This was determined based on the design hourly vehicles in accordance with ADOT RDG Section 504.5.
- In December 2011 FHWA Headquarters approved the “Determination of Engineering and Operational Acceptability” for the COAR.

2.5 Service Traffic Interchange Analysis

The interchange analysis evaluated and recommended the service traffic interchange lane configuration, geometry, and type at each location based on traffic turning movement projections for 2035. The analysis assumed a compact diamond interchange (CDI) at each location. Additional discussion of the design elements of the proposed service traffic interchanges can be found in Section 3.5, *Service Traffic Interchanges*. The assumptions, approach, and results of the traffic analysis are discussed in the following sections.

2.5.1 Background

This section presents the methodology and background information used to evaluate the service traffic interchanges.

Interchange Analysis Methodology
The interchange signal traffic analysis was performed using Synchro/SimTraffic simulation analysis package (Version 7, Build Series 773, Revision 8) developed by Trafficware, Inc. Synchro is a widely-used traffic analysis tool that evaluates intersection delays and congestion based on procedures similar to those described in the 2010 HCM (Chapters 16 and 17). It is often used for localized intersection analyses, signal coordination, and traffic study work. SimTraffic is a microsimulation tool that provides network measures of effectiveness and allows the user to visually review the geometry and traffic progression. Combined, they were used to evaluate the ramp intersection performance. Major adjacent street intersections were included within the network to account for the effect of platooning on the ramp terminal intersections that were evaluated.

Basic inputs to Synchro include traffic volumes, lane configurations and signal design. Because almost all of the intersections evaluated do not exist today, Synchro was used to optimize the signal cycle length and phasing.

The HCM evaluates the LOS of the individual lane groups and of the entire signalized intersection based on the control delay. The HCM states that:

> *control delay—the delay brought about by the precense of a traffic control device—is the principal service measure in the HCM for evaluating LOS at signalized and unsignalized intersections. Control delay includes delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed.*

The HCM LOS grade and associated range of intersection control delay are presented in Table 2.4.

Lane Configurations
The lane configurations for roads approaching the interchanges were based on the *Street Classification Map* (COP 2010). Where no future designation was made, COP transportation staff were contacted to determine the future lane configuration of the road. A summary of the planned lane configurations is provided in Table 2.5.

The basic number of lanes on the road was assumed to pass through the interchange. The ADOT *Lessons Learned Document on Traffic Volume Projections and Operational Analysis* (ADOT 2005) states that “the minimum number of turning lanes necessary to achieve an intersection approach and overall interchange LOS of D” should be the basis for ADOT plans. Any additional turn lanes could be added at the request of a local agency, but would require the local agency to share the additional cost with ADOT. Other guidance used in developing the lane configurations was that a right turn lane should be provided if the right turn volume is greater than 300 vehicles per hour (vph) and a left turn lane should be provided at all appropriate locations and a second left turn lane should be provided when the volume is greater than 300 vph (ADOT 2000 and 2007).

An iterative process was undertaken to determine the final lane configurations at each interchange location. The analysis began with the basic lane configuration (without any additional turn lanes) and evolved through analysis and use of the guidelines above to develop a lane configuration that would provide desirable traffic operations based on projected traffic demand in 2035.

Table 2.4 – Highway Capacity Manual Level of Service for Signalized Intersections

Level of Service	Control Delay per Vehicle (seconds)
A	≤ 10
B	>10 to 20
C	> 20 to 35
D	> 35 to 55
E	> 55 to 80
F	> 80

Source: TRB 2010; Exhibit 18-4

Interchange Type

The service traffic interchange analysis includes an evaluation of a CDI at each service traffic interchange location. Alternate interchange types would be evaluated if the CDI does not operate at LOS D or better. The *Draft MAG Freeway System Interchange Enhancement Policy* (ADOT 2008b) has been established to guide the analysis process and resulting cost-sharing agreements. It states:

> *ADOT's design policy for a service interchange is to provide LOS D or better for the 20 year design year. This design process provides results for a tight diamond interchange configuration. ADOT performs a sensitivity analysis by increasing peak hour values 10-30 percent to assure the interchange won't degrade to less than LOS D, should the traffic modeling yield low volumes from unanticipated development.*
>
> *Should local governments choose to upgrade or enhance the geometrics of an interchange to provide an improved LOS with increased through levels, dual turn lanes, free right turn bays, or even a different type of interchange, they would be responsible for 50 percent of the cost increase for those upgrades.*
>
> *The Life Cycle Program would fund the remaining 50 percent as there is a system benefit for improved LOS for improved operational characteristics, reduced congestion, improved air quality, and less cost for future intersection upgrades.*

Signal Design

There are numerous signal timing and phasing designs that can be used to coordinate the two signals at a CDI. The Synchro analysis presented in this report assumed a single controller for both interchange signals. The signal designs at locations adjacent to the Community (40th Street, 24th Street, Desert Foothills Parkway, 17th Avenue, and 51st Avenue) were set to take advantage of the heavy movement to the north side of the freeway.

The signal designs at the other locations (Elliot Road, Dobbins Road, Baseline Road, Southern Avenue, Broadway Road, Lower Buckeye Road, Buckeye Road, and Van Buren Street) were set to the Lagging Simultaneous Phasing. This design includes three phases at each signal including: 1) all off-ramp movements, 2) crossroad through and permitted turning movements, and 3) crossroad protected turning movements. This design is common for diamond interchanges in the area.

Table 2.5 – Ultimate Lane Configurations for Roads Approaching Service Traffic Interchanges

Road	Local Jurisdiction	Street Classification[a]	Right-of-way width[a] (in feet)	Road width[a] (in feet)	Number of lanes in each direction[b]	City of Phoenix cross section[c]
40th Street	COP	Arterial	110	74	2	Match existing
24th Street	COP	Arterial	110	74	2	Match existing
Desert Foothills Parkway	COP	Arterial	110	74	2	Match existing
17th Avenue	COP	Arterial	110	74	2	Match existing
51st Avenue	COP	Arterial	110	74	2	CM
Elliot Road	COP	Collector	110	74	2	CM
Dobbins Road	COP	Arterial	110	74	2	C
Baseline Road	COP	Major arterial	140	104	3	B
Southern Avenue	COP	Arterial	110	74	2	CM
Broadway Road	COP	Arterial	110	74	2	CM
Lower Buckeye Road	COP	Arterial	110	74	2	CM
Buckeye Road	COP	Arterial	110	74	2	Match existing
Van Buren Street	COP	Arterial	110	74	2 EB, 3 WB	Match existing

Notes: [a] from COP *Street Classification Map*, COP transportation staff; [b] All roads would also include a median turn lane and a bicycle lane.
[c] references whether the design should match the existing road or a COP cross section as shown in COP Detail P-1010
EB = eastbound; WB = westbound

2.5.2 Synchro Analysis

The following sections discuss each service traffic interchange location. Each section includes a review of the crossroad characteristics, traffic volumes, the Synchro analysis results, and recommendations for lane configurations. Detailed Synchro reports for each interchange are provided in Appendix C.

40th Street

The 40th Street interchange is located at the eastern end of the freeway, closest to the existing system traffic interchange connecting I-10 (Maricopa Freeway), SR 202L (Santan Freeway), and the proposed South Mountain Freeway. The northwest corner of the interchange contains a park-and-ride lot. The northeastern corner is currently vacant. Although both southern corners are currently vacant, a commercial development in the southeastern corner has received environmental clearances from the Bureau of Indian Affairs and the Community. 40th Street is a four-lane arterial street north of Pecos Road. South of Pecos Road, 40th Street is a four-lane arterial street that connects to the recently completed casino and outlet mall. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.7. The recommended lane configuration is presented in Table 2.6. The Synchro analysis results are presented in Table 2.7.

Table 2.6 – 40th Street Service Traffic Interchange Lane Configuration

	Northbound 40th Street			Southbound 40th Street			Eastbound off-ramp			Westbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
North	1	2	–	2[a]	2	1	–	–	–	1	1[b]	1
South	1[a]	2	1	2	2	–	1	1[b]	1	–	–	–

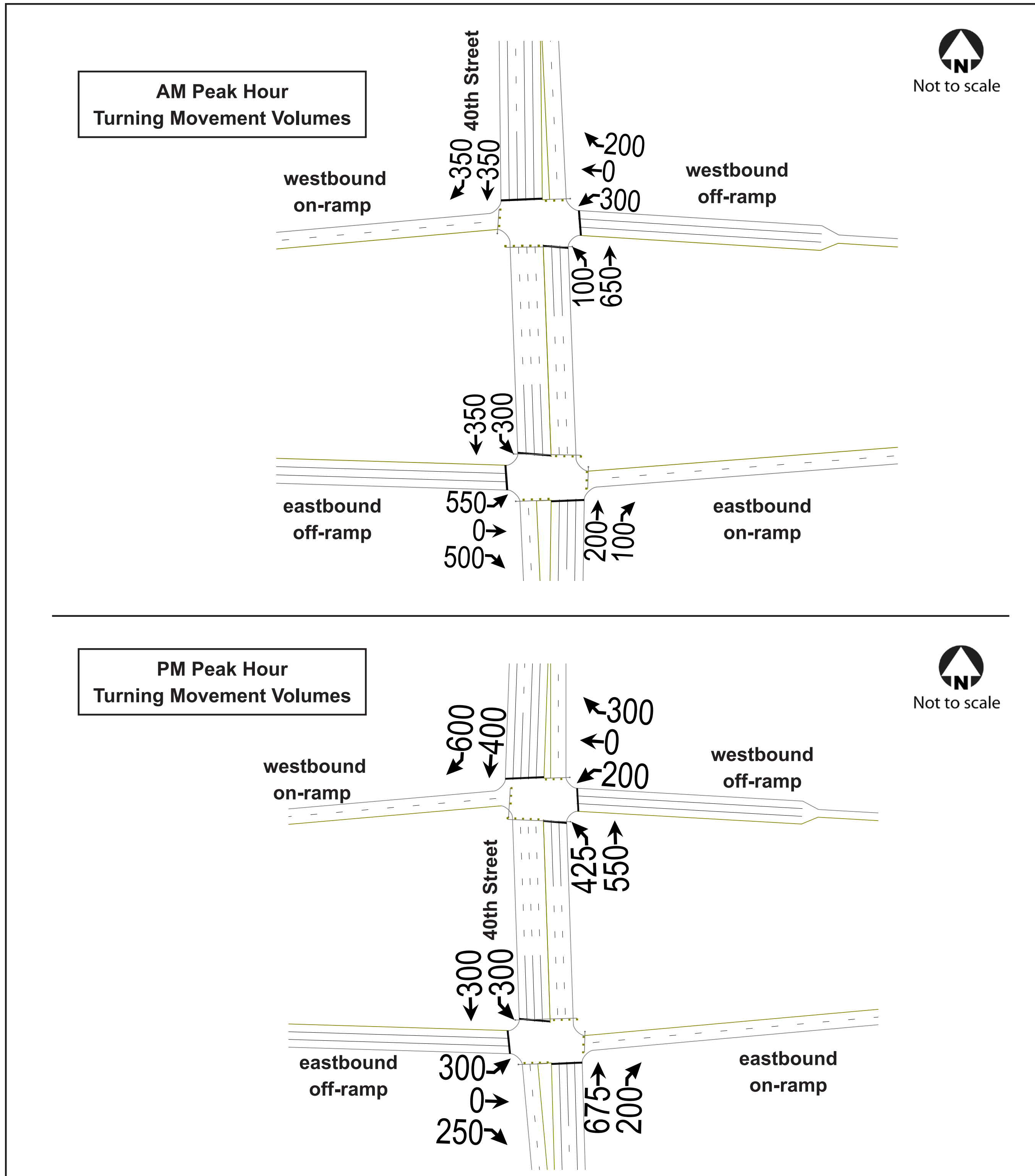
Notes: [a] advanced left-turn storage; [b] shared thru-, left-, and right-turn lane

Table 2.7 – 40th Street Service Traffic Interchange Analysis

	AM					PM				
	North Signal		South Signal		Cycle Length (sec)	North Signal		South Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
40th Street	20.7	C	20.1	C	70	26.1	C	19.7	B	70

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) include the lanes associated with the proposed CDI from Table 2.6. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.7
40th Street, Turning Movement Volumes, AM and PM Peak Hour, 2035

24th Street

24th Street is currently a two-lane road with a paved median striped for a two-way left-turn lane. The northwestern corner of the interchange contains an apartment complex, while the northeastern corner contains a residential area. Vacant Community land is located on both southern corners. Although 24th Street does not currently extend south of Pecos Road, it is anticipated the Community would construct a connecting arterial street with two lanes in each direction in the future. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.8. The recommended lane configuration is presented in Table 2.8. The Synchro analysis results are presented in Table 2.9.

Table 2.8 – 24th Street Service Traffic Interchange Lane Configuration

	Northbound 24th Street			Southbound 24th Street			Eastbound off-ramp			Westbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
North	1	2	–	2[a]	2	1	–	–	–	1	1[c]	1
South	1[a]	1.5[b]	0.5[b]	2	2	–	1	1[c]	1	–	–	–

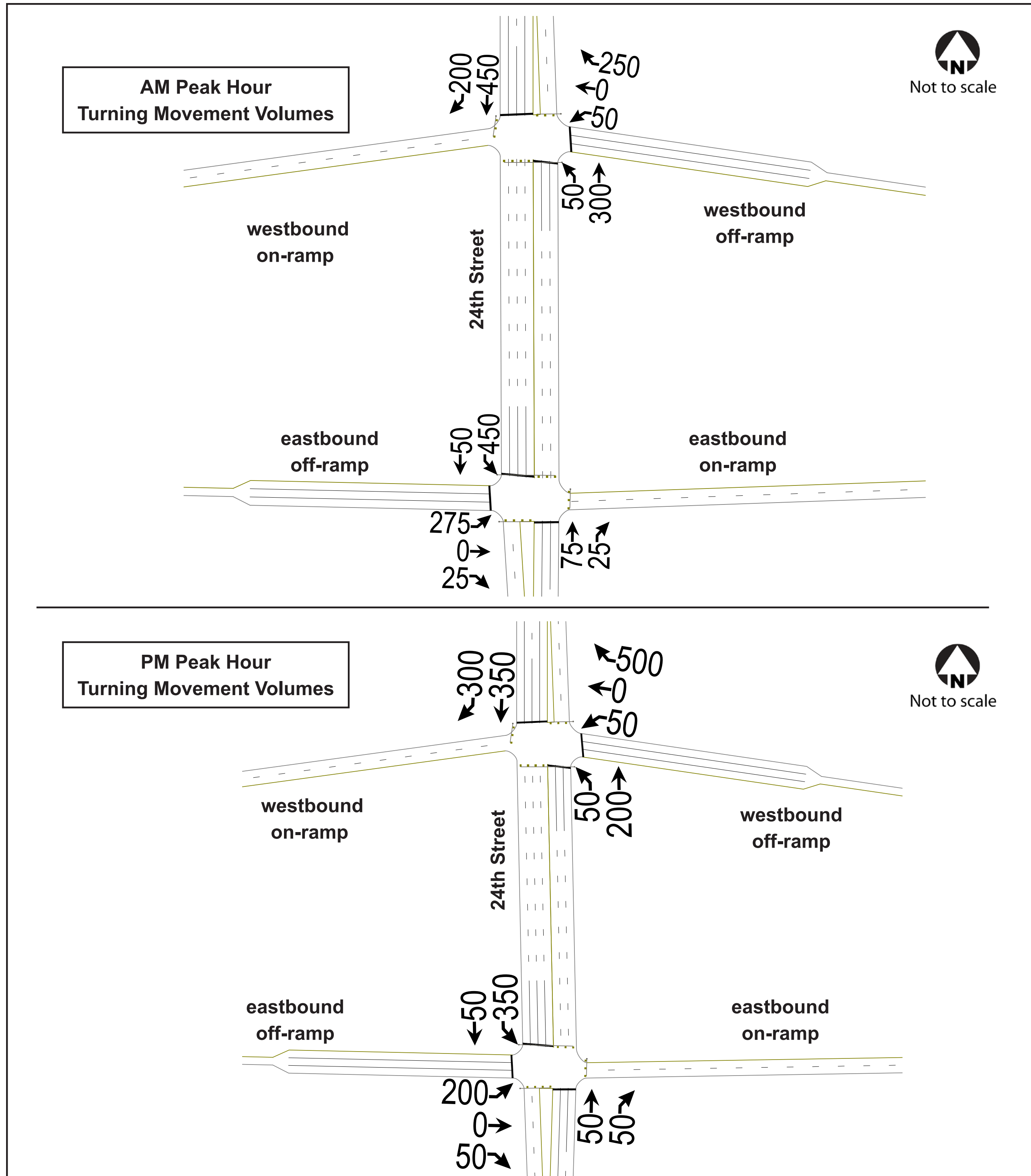
Notes: [a] advanced left-turn storage; [b] shared thru- and right-turn lane; [c] shared thru-, left-, and right-turn lane

Table 2.9 – 24th Street Service Traffic Interchange Analysis

	AM					PM				
	North Signal		South Signal		Cycle Length (sec)	North Signal		South Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
24th Street	17.2	B	16.4	B	70	20.1	C	18.4	B	70

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.8. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.8
24th Street, Turning Movement Volumes, AM and PM Peak Hour, 2035

Desert Foothills Parkway

Desert Foothills Parkway is currently a four-lane road with a raised median. The northwestern corner contains a residential area and a utility substation and the northeastern corner contains a post office. Vacant Community land is located on both southern corners. Desert Foothills Parkway does not currently extend south of Pecos Road and the MAG model did not include any road network south of the freeway. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.9. The recommended lane configuration is presented in Table 2.10. The Synchro analysis results are presented in Table 2.11.

Table 2.10– Desert Foothills Parkway Service Traffic Interchange Lane Configuration

Signal	Northbound Desert Foothills Parkway			Southbound Desert Foothills Parkway			Eastbound off-ramp			Westbound off-ramp		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
North	1	2	–	2[a]	–	1	–	–	–	1[b]	–	2
South	–	–	–	2	–	–	2	–	–	–	–	–

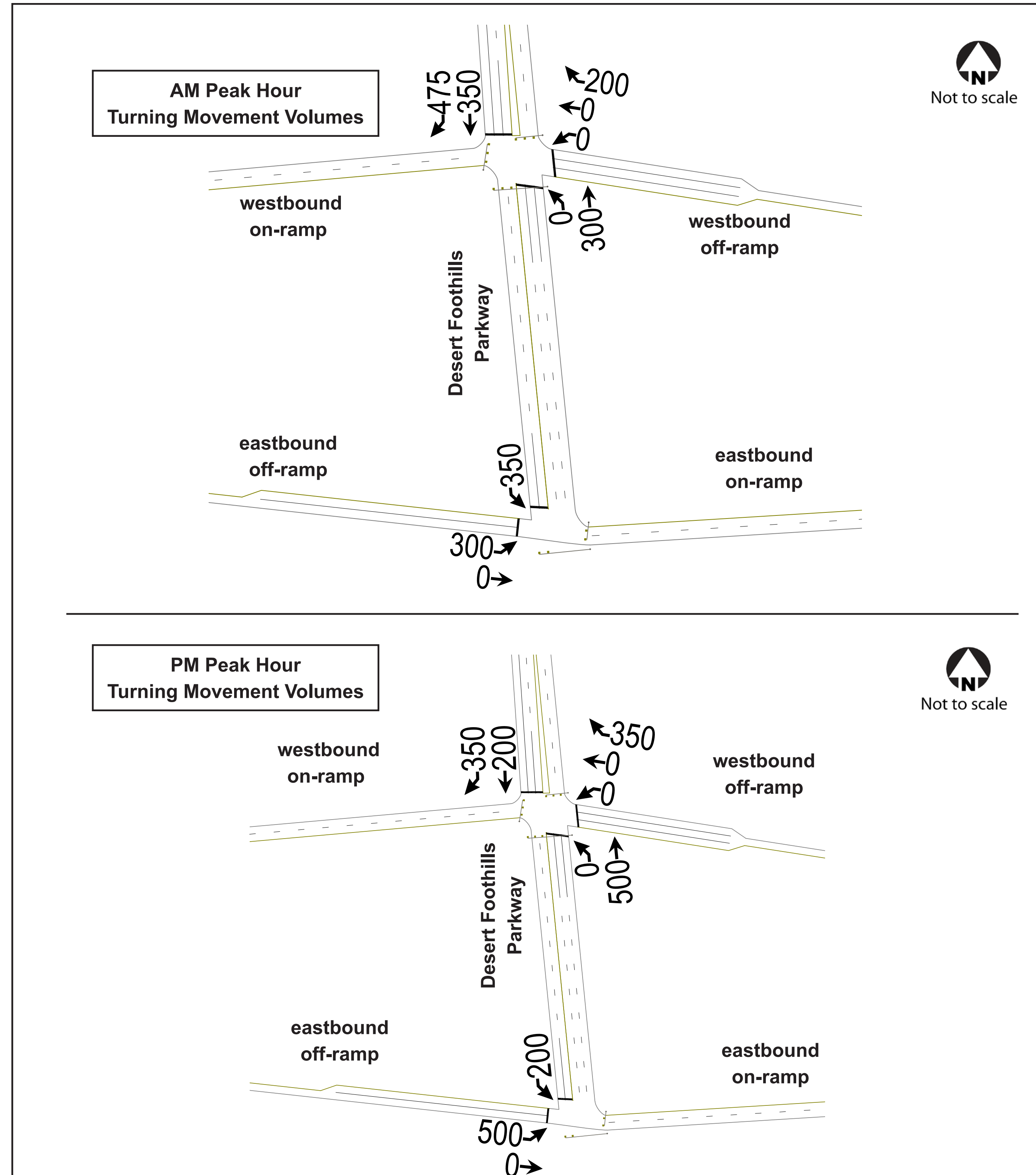
Notes: [a] advanced left-turn storage; [b] would be striped out

Table 2.11 – Desert Foothills Parkway Service Traffic Interchange Analysis

Location	AM					PM				
	North Signal		South Signal		Cycle Length (sec)	North Signal		South Signal		Cycle Length (sec)
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
Desert Foothills Parkway	14.6	B	14.3	B	70	17.4	B	21.0	C	60

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.10. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.9
Desert Foothills Parkway, Turning Movement Volumes, AM and PM Peak Hour, 2035

17th Avenue

17th Avenue is currently a four-lane road with a paved median striped for a two-way left-turn lane. The northwestern corner is vacant and the northeastern corner contains a residential area currently under development. Vacant Community land is located on both southern corners. 17th Avenue does not currently extend south of Pecos Road and the MAG model did not include any road network south of the freeway. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.10. The recommended lane configuration is presented in Table 2.12. The Synchro analysis results are presented in Table 2.13.

Table 2.12– 17th Avenue Service Traffic Interchange Lane Configuration

	Northbound 17th Avenue			Southbound 17th Avenue			Eastbound off-ramp			Westbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
North	1	2	–	1.5[a]	–	1.5[b]	–	–	–	1[c]		2
South	–	–	–	2	–	–	2		–	–	–	–

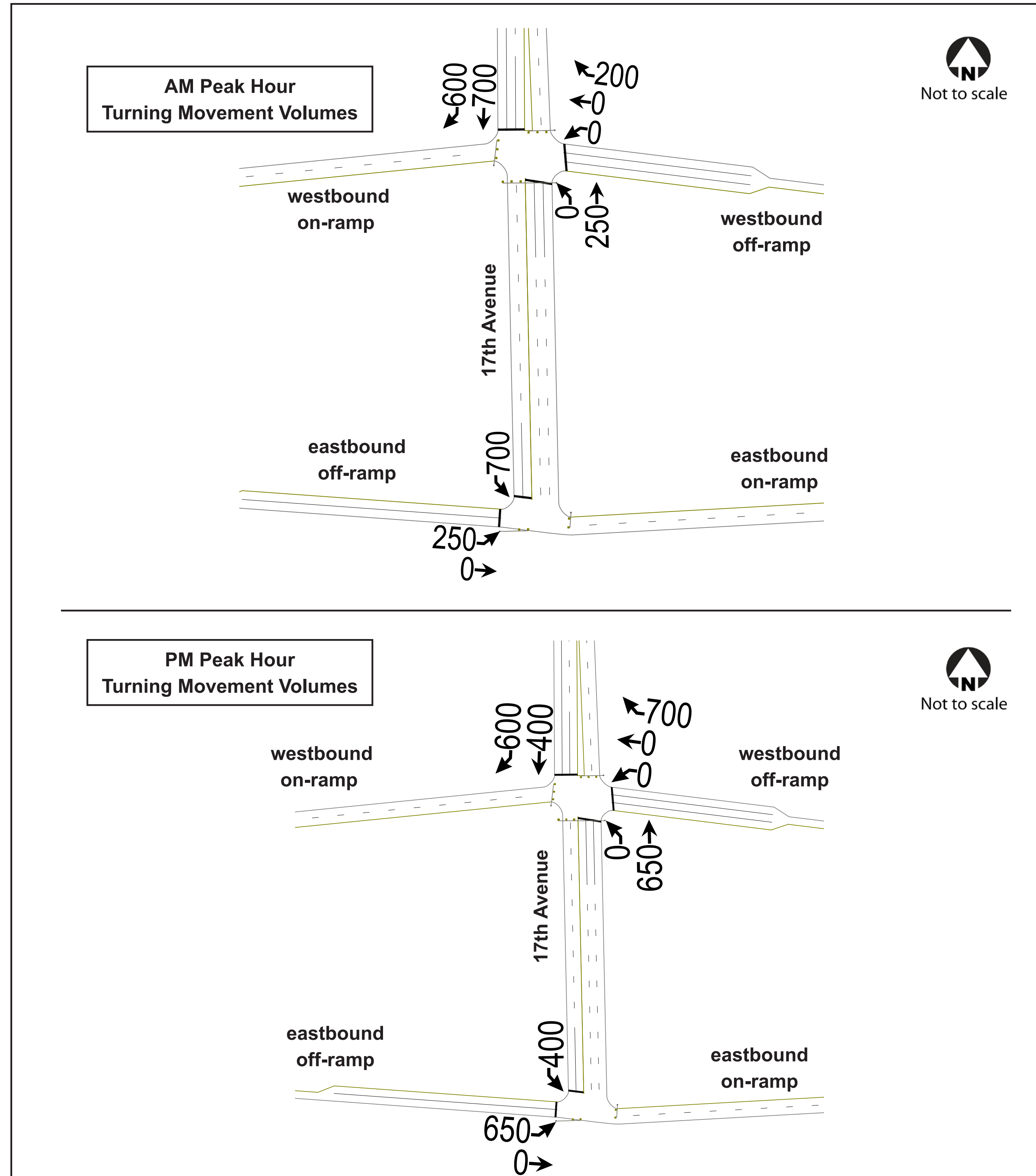
Notes: [a] advanced left-turn storage; [b] shared thru/left- and right-turn lane; [c] would be striped out

Table 2.13– 17th Avenue Service Traffic Interchange Analysis

	AM					PM				
	North Signal		South Signal		Cycle Length (sec)	North Signal		South Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
17th Avenue	14.5	B	8.3	A	60	18.5	B	20.5	C	60

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.12. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain corridor team

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.10
17th Avenue, Turning Movement Volumes, AM and PM Peak Hour, 2035

51st Avenue

The 51st Avenue interchange includes the realignment of 51st Avenue by constructing a new road (denoted with "spur" in plans) that curves to the southwest and intersects the freeway perpendicularly. From the south, 51st Avenue would be reconstructed to form a "T" intersection with the new road. It is anticipated that 51st Avenue would be widened to a four-lane arterial street, according to COP cross section presented in Table 2.5. Both eastern corners are currently undeveloped agricultural fields. Vacant Community land is located on both western corners. The MAG model did not include any road network west of the freeway. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.11. The recommended lane configuration is presented in Table 2.14. The Synchro analysis results for the interchange and adjacent arterial intersections are presented in Tables 2.15, 2.16, and 2.17.

Table 2.14 – 51st Avenue Service Traffic Interchange Lane Configuration

Signal	Northbound 51st Avenue Spur			Southbound 51st Avenue Spur			Eastbound off-ramp			Westbound off-ramp		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
East	1	2	–	2[a]	–	1	–	–	–	1	0	2
West	–	–	–	2	–	–	2	–	–	–	–	–

Notes: [a] advanced left-turn storage

Table 2.15 – 51st Avenue Service Traffic Interchange Analysis

Location	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
51st Avenue	21.4	C	11.6	B	60	18.3	B	12.2	B	70

Notes: sec/veh = seconds per vehicle

Table 2.16 – 51st Avenue Spur and 51st Avenue Intersection Analysis

Location	AM			PM		
	Delay (sec/veh)	LOS	Cycle Length (sec)	Delay (sec/veh)	LOS	Cycle Length (sec)
51st Avenue Spur and 51st Avenue	11.2	B	60	15.4	B	70

Notes: sec/veh = seconds per vehicle

Table 2.17 – 51st Avenue and Estrella Drive Intersection Analysis

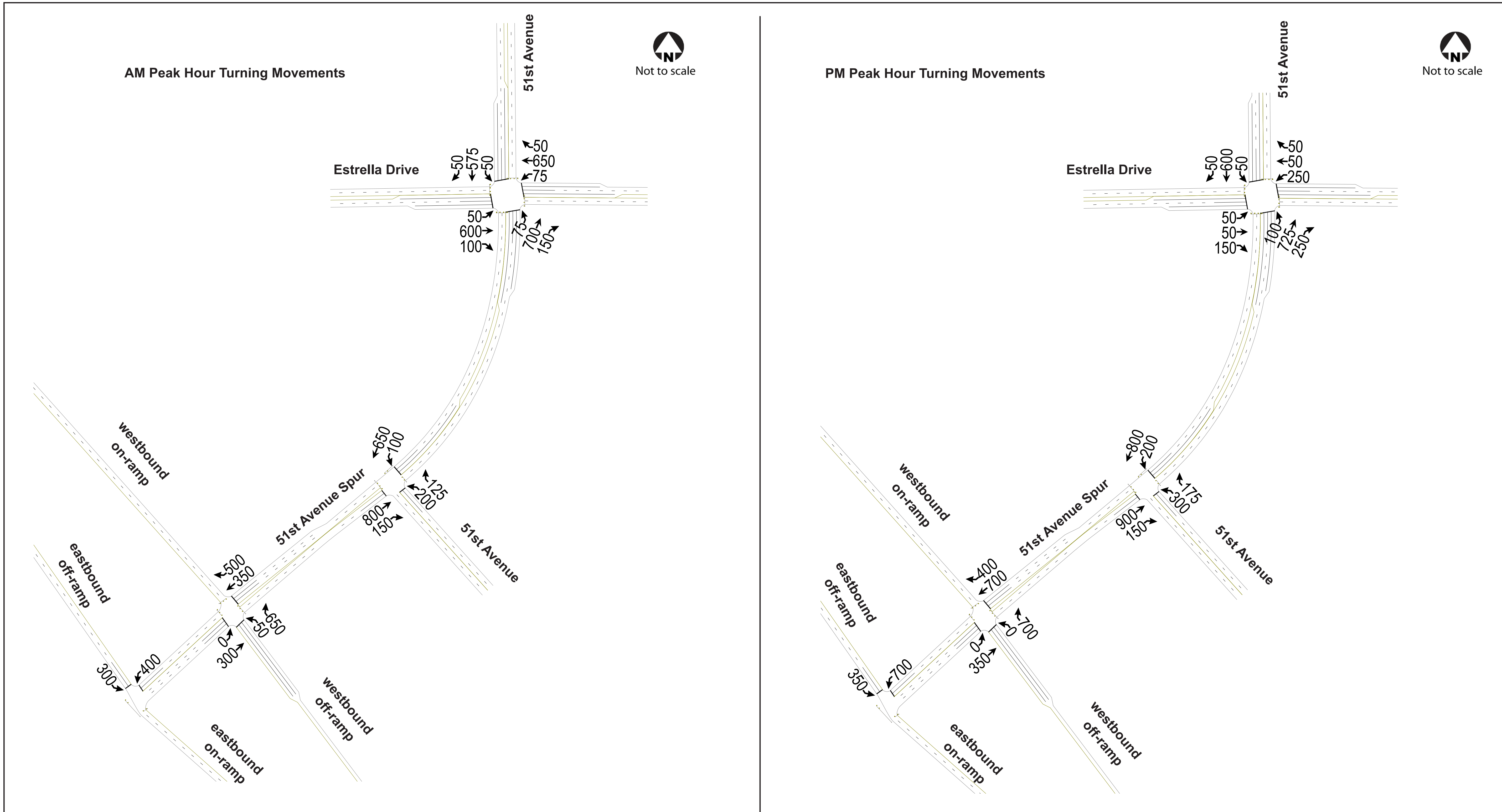
Location	AM			PM		
	Delay (sec/veh)	LOS	Cycle Length (sec)	Delay (sec/veh)	LOS	Cycle Length (sec)
51st Avenue and Estrella Drive	18.7	B	60	16.8	B	70

Notes: sec/veh = seconds per vehicle

Notable observations from the table and figure include:

- Signals were assumed at each of the four major intersections. Signal coordination is extremely important with this configuration as there are 4 signals within one mile of each other.
- The signal timing is planned to provide the majority of green time to the major movements which are to and from the east at the freeway and through movements along 51st Avenue.
- The realigned 51st Avenue design was preferred by the Community because it would provide better access to the freeway and reduce the traffic that enters the Community on 51st Avenue.
- The realigned 51st Avenue design would also reduce the total right-of-way and impacts to the mountains by eliminating the skewed interchange that would be required if connecting directly to existing 51st Avenue.

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.14. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain corridor team

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.11
51st Avenue, Turning Movement Volumes, AM and PM Peak Hour, 2035

Elliot Road

Elliot Road is currently a two-lane road. It is anticipated that Elliot Road would be widened to a four-lane road according to COP cross section presented in Table 2.5. Both eastern corners are currently undeveloped agricultural fields. Vacant Community land is located on both western corners. Elliot Road continues to the west onto Community land. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.12. The recommended lane configuration is presented in Table 2.18. The Synchro analysis results are presented in Table 2.19.

Table 2.18 – Elliot Road Service Traffic Interchange Lane Configuration

Signal	Eastbound Elliot Road			Westbound Elliot Road			Northbound off-ramp			Southbound off-ramp		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
East	1	2	–	1[a]	2	1	1	1[b]	1	–	–	–
West	1[a]	2	1	1	2	–	–	–	–	1	1[b]	1

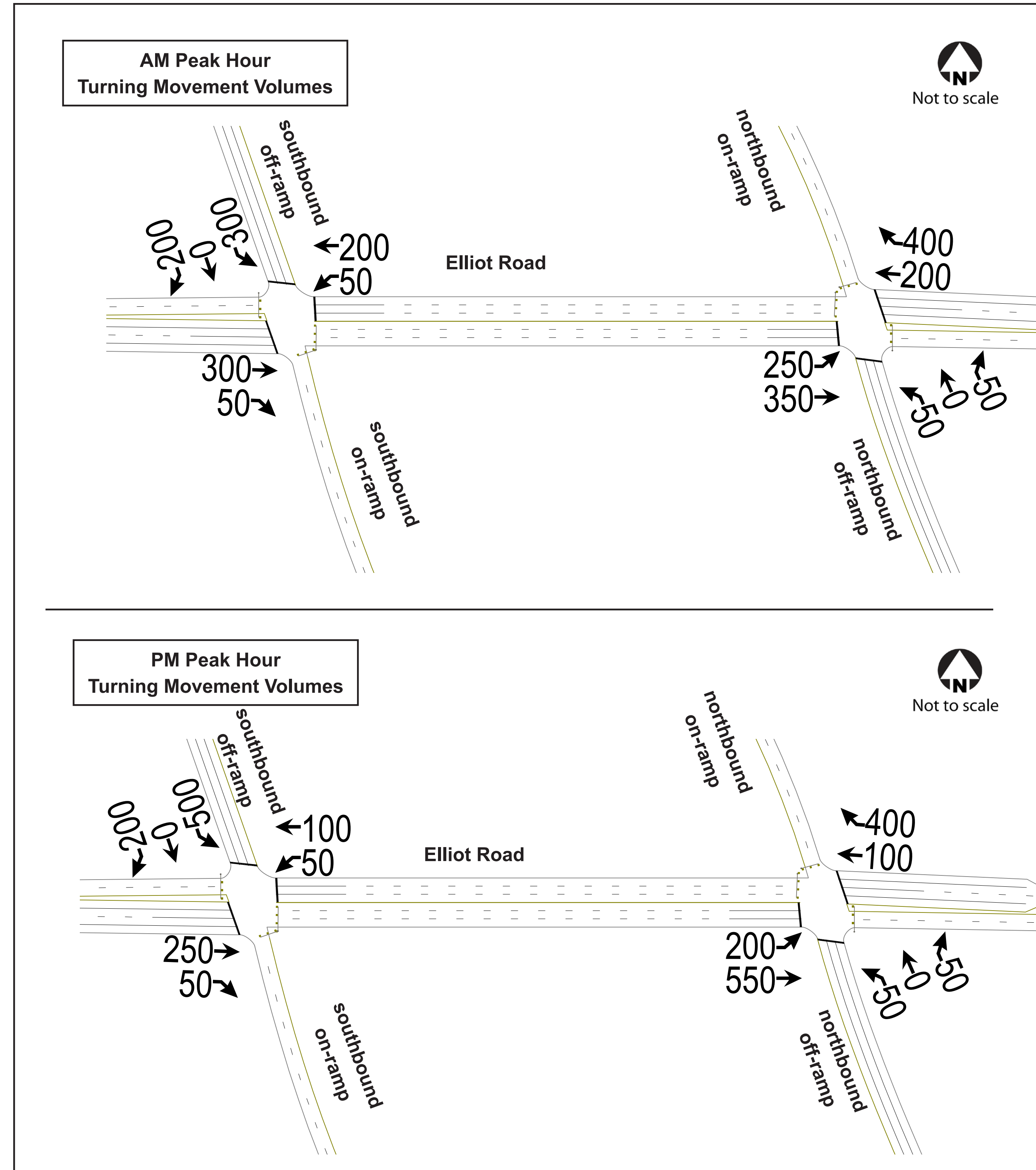
Notes: [a] advanced left-turn storage; [b] shared thru-, left-, and right-turn lane

Table 2.19 – Elliot Road Service Traffic Interchange Analysis

Location	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
Elliot Road	8.0	A	13.8	B	60	8.9	A	15.9	B	60

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.18. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.12
Elliot Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Dobbins Road

Dobbins Road is currently a two-lane road. It is anticipated that Dobbins Road would be widened to four lanes according to COP cross section presented in Table 2.5. As the South Mountain Freeway passes through the area near 59th Avenue and Dobbins Road, there are a number of sensitive features that constrain alignment choices. There are four potential historic resources afforded protection under Section 4(f) of the U.S. Department of Transportation Act of 1966. Also, the area surrounding Dobbins Road and 59th Avenue is identified in the City of Phoenix *General Plan* as the commercial core for the Laveen Village and there is a property zoned to allow for uses such as a hospital. The local municipality has deemed the hospital an essential element of the village core.

To avoid the Section 4(f) resources and minimize the impacts to the Laveen Village Core, an alternative interchange type to the CDI has been proposed. The freeway alignment crosses Dobbins Road near 62nd Avenue and the ramps have been shifted such that the off-ramps curve to the opposite side of the freeway so that near Dobbins Road, ramps are present in the southwest and northeast corners. An example of a similar interchange configuration, located at McClintock Drive and SR 202L (Red Mountain Freeway) is shown in Figure 2.13. The eastern interchange signal is located approximately 1,300 feet from 59th Avenue.

South Mountain Freeway Traffic Report
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.13 Example of Diamond Interchange with Shifted Ramp

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.14. The recommended lane configuration is presented in Table 2.20. The Synchro analysis results are presented in Table 2.21 and 2.22.

Table 2.20 – Dobbins Road Service Traffic Interchange Lane Configuration

	Eastbound Dobbins Road			Westbound Dobbins Road			Northbound off-ramp			Southbound off-ramp		
Signal	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
East	2	2	–	1[a]	2	1	–	–	–	2	–	1
West	2[a]	2	1	1	2	–	2	–	1	–	–	–

Notes: [a] advanced left-turn storage; [b] shared thru-, left-, and right-turn lane

Table 2.21 – Dobbins Road Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
Dobbins Road	13.4	B	10.8	B	60	10.8	B	16.7	B	60

Notes: sec/veh = seconds per vehicle

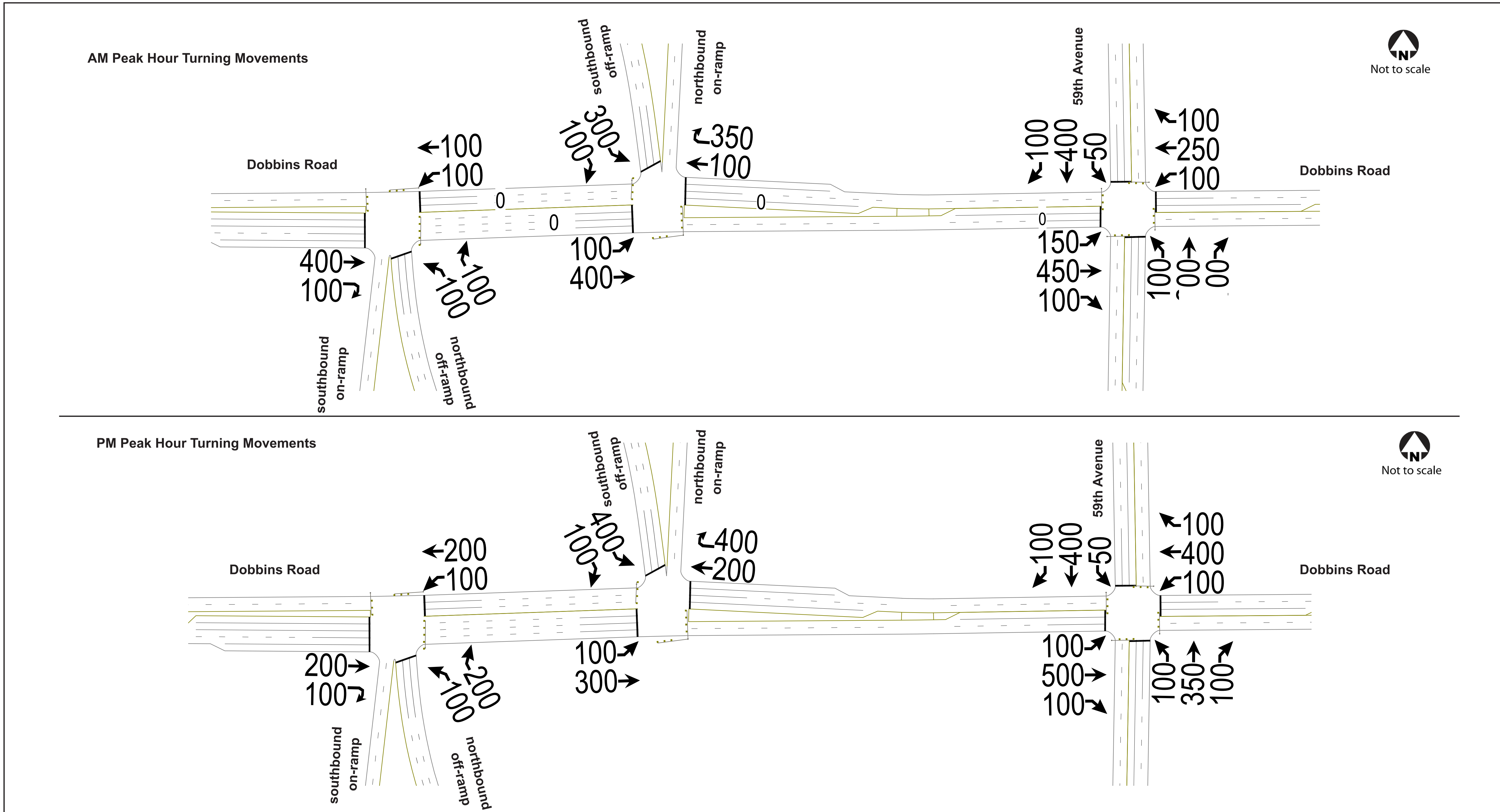
Table 2.22 – Dobbins Road and 59th Avenue Intersection Analysis

	AM			PM		
Location	Delay (sec/veh)	LOS	Cycle Length (sec)	Delay (sec/veh)	LOS	Cycle Length (sec)
Dobbins Road and 59th Avenue	11.7	B	60	12.1	B	60

Notes: sec/veh = seconds per vehicle

The roadway and striping plans present the lanes associated with the proposed collapsed diamond interchange from Table 2.20. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035. This recommendation is supported by the following:

- The modified diamond interchange provides full access to Dobbins Road and the commercial village core without adversely affecting the historic properties or commercial development planned in the area.



South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.14
Dobbins Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Baseline Road

The Baseline Road service traffic interchange is located within the Laveen Village of Phoenix. The area northwest of the interchange currently contains a low-density residential development. The other three corners currently contain agricultural fields that are zoned for commercial or residential developments. The intersection of 59th Avenue and Baseline Road would be located approximately 1,100 feet east of the freeway. Baseline Road is currently a two-lane road. It is anticipated that Baseline Road would be widened to six lanes according to COP cross section presented in Table 2.5. A CDI is proposed at this location.

Extensive coordination with the COP and the adjacent developers has occurred throughout the study process. Commercial developments are planned for the northwest and southwest corner of 59th Avenue and Baseline Road, adjacent to the freeway. Traffic studies related to these developments were used in the analysis (see Section 2.2.2, *Review of Traffic Impact Studies*) through the inclusion of proposed business access points and use of traffic volumes that combined the MAG 2035 traffic projections and the site traffic for the adjacent commercial developments.

The 2035 AM and PM peak hour traffic projections and turning-lane configurations used in the analysis are presented in Figures 2.15. The recommended lane configurations are presented in Tables 2.23. The Synchro analysis results are presented in Tables 2.24, 2.25, and 2.26.

Table 2.23 – Baseline Road Service Traffic Interchange Lane Configuration

	Eastbound Baseline Road			Westbound Baseline Road			Northbound off-ramp			Southbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
East	2	3	–	1[a]	3	1	1	1[b]	1	–	–	–
West	2[a]	3	1	1	3	–	–	–	–	2	–	2

Notes: [a] advanced left-turn storage; [b] shared thru-, left-, and right-turn lane

Table 2.24 – Baseline Road Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
Baseline Road	13.9	B	18.7	B	60	15.3	B	17.4	B	60

Notes: sec/veh = seconds per vehicle

Table 2.25 – Baseline Road and 59th Avenue Intersection Analysis

	AM			PM		
Location	**Delay (sec/veh)**	**LOS**	**Cycle Length (sec)**	**Delay (sec/veh)**	**LOS**	**Cycle Length (sec)**
Baseline Road and 59th Avenue	23.1	C	60	27.4	C	70

Notes: sec/veh = seconds per vehicle

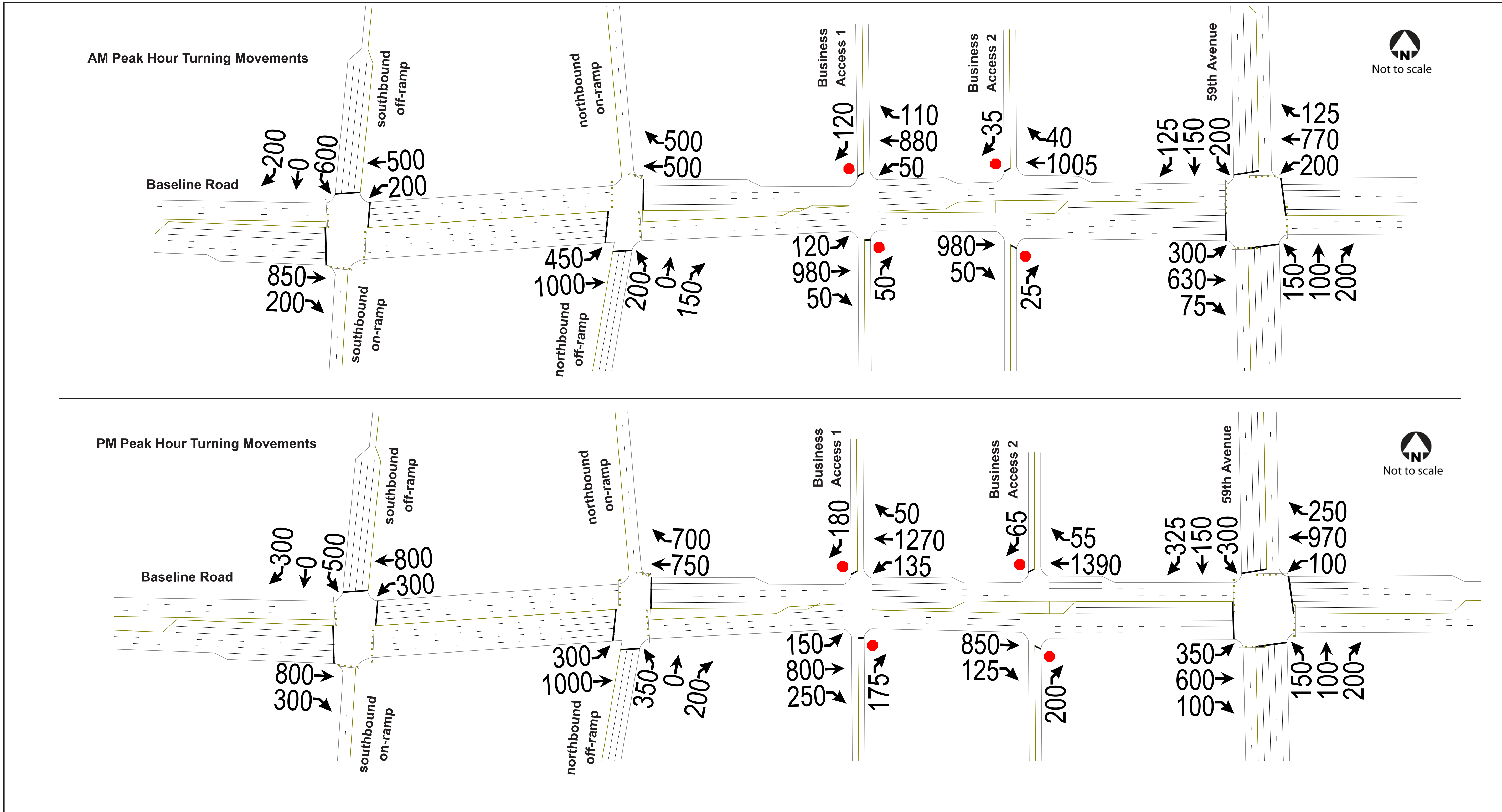
Table 2.26 – Baseline Road Business Access Analysis

	AM				PM			
	Business Access 1		Business Access 2		Business Access 1		Business Access 2	
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**
Baseline Road	9.7	A	10.1	B	10.9	B	13.9	B

Notes: intersections are controlled by stop signs at driveways; sec/veh = seconds per vehicle;

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.23. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.

The roadway and striping plan would continue to be evaluated and updated throughout the design process. The future connection of the SR 30 freeway may cause local access modifications along the South Mountain Freeway, including Baseline Road. Also, coordination with adjacent developers would continue and any changes to the adjacent site plans incorporated into the analysis. Although the intersections would operate at LOS C or better, the eastbound left-turn at business access 1 presents a concern due to its proximity to the interchange and the potential for vehicles to back up into the interchange.



South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.15
Baseline Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Southern Avenue

Southern Avenue is currently a two-lane road. It is anticipated that Southern Avenue would be widened to four lanes according to COP cross section presented in Table 2.5. The northern corners currently contain a mining operation and a construction equipment sales lot. The southwestern corner currently contains low-density residential properties, while the southeastern corner is currently agricultural land planned for a community college and other mixed-use developments. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.16. The recommended lane configuration is presented in Table 2.27. The Synchro analysis results are presented in Table 2.28.

Table 2.27 – Southern Avenue Service Traffic Interchange, Lane Configuration

	Eastbound Southern Avenue			Westbound Southern Avenue			Northbound off-ramp			Southbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
East	1	2	–	1[a]	2	1	1	1[c]	1	–	–	–
West	1[a]	1.5[b]	0.5[b]	1	2	–	–	–	–	1	1[c]	1

Notes: [a] advanced left-turn storage; [b] shared thru- and right-turn lane; [c] shared thru-, left-, and right-turn lane

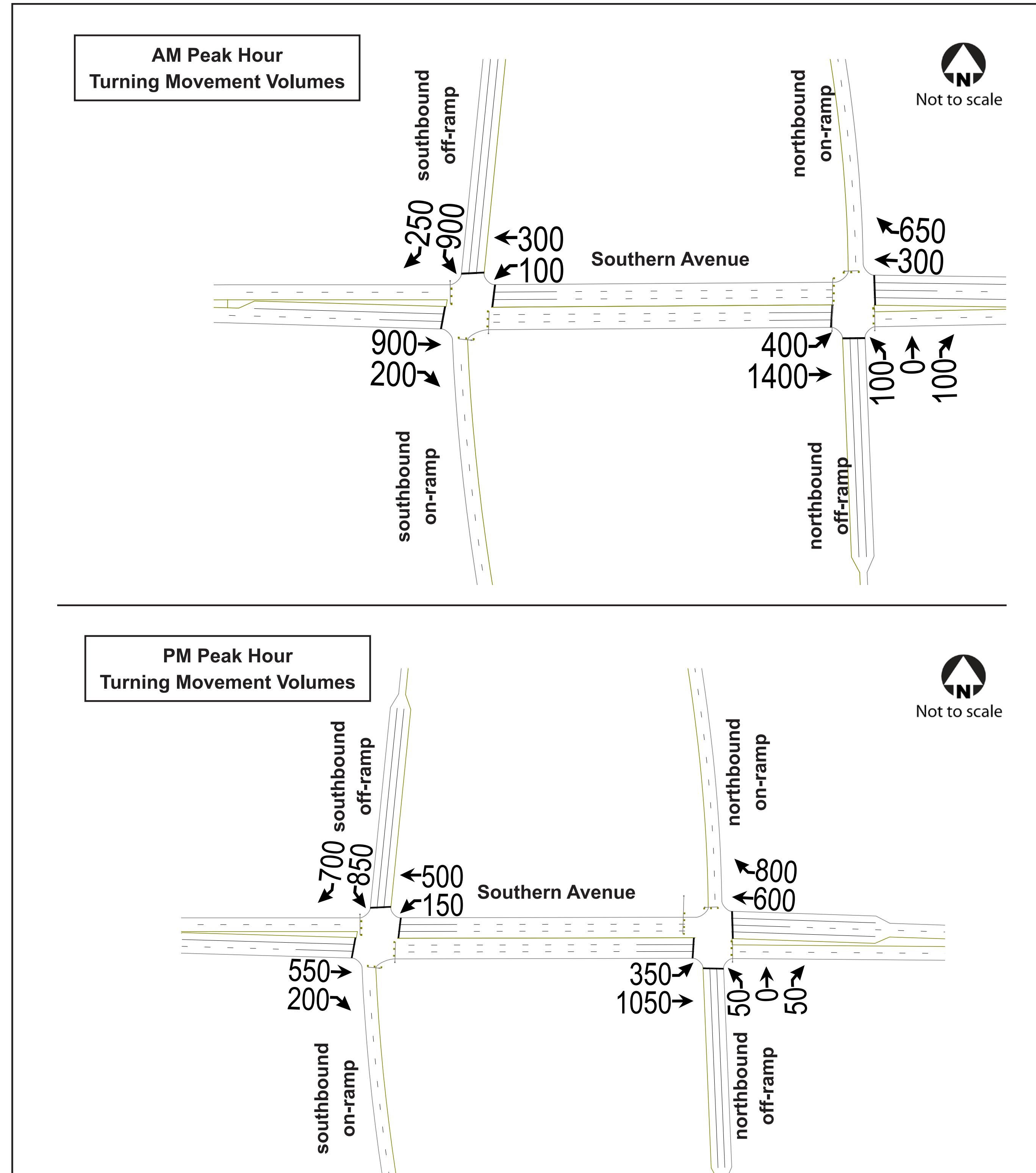
Table 2.28 – Southern Avenue Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
Southern Avenue	16.1	B	33.0	C	70	24.3	C	34.1	C	70

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.27. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.

The roadway and striping plan would continue to be evaluated and updated throughout the design process. The future connection of the SR 30 freeway may cause local access modifications along the South Mountain Freeway, including Southern Avenue.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.16
Southern Avenue, Turning Movement Volumes, AM and PM Peak Hour, 2035

Broadway Road

Broadway Road varies between two and four lanes in the area of the proposed interchange. It is anticipated that Broadway Road would be widened to four lanes according to COP cross section presented in Table 2.5. The northern corners currently contain residential developments. The southern corners currently contain agricultural fields planned to be used for drainage basins for the freeway. A split CDI is proposed at this location with access roads on the north side of the interchange connecting to Lower Buckeye Road in lieu of ramps.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.17. The recommended lane configuration is presented in Table 2.29. The Synchro analysis results are presented in Table 2.30.

Table 2.29 – Broadway Road Service Traffic Interchange, Lane Configuration

Signal	Eastbound Broadway Road			Westbound Broadway Road			Northbound off-ramp			Southbound access road		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
East	1	2	–	1[a]	2	1	1	2[b]	1	–	–	–
West	1[a]	2	1	1	2	–	–	–	–	1	2[b]	1

Notes: [a] advanced left-turn storage; [b] shared thru- left lane and shared thru-right lane

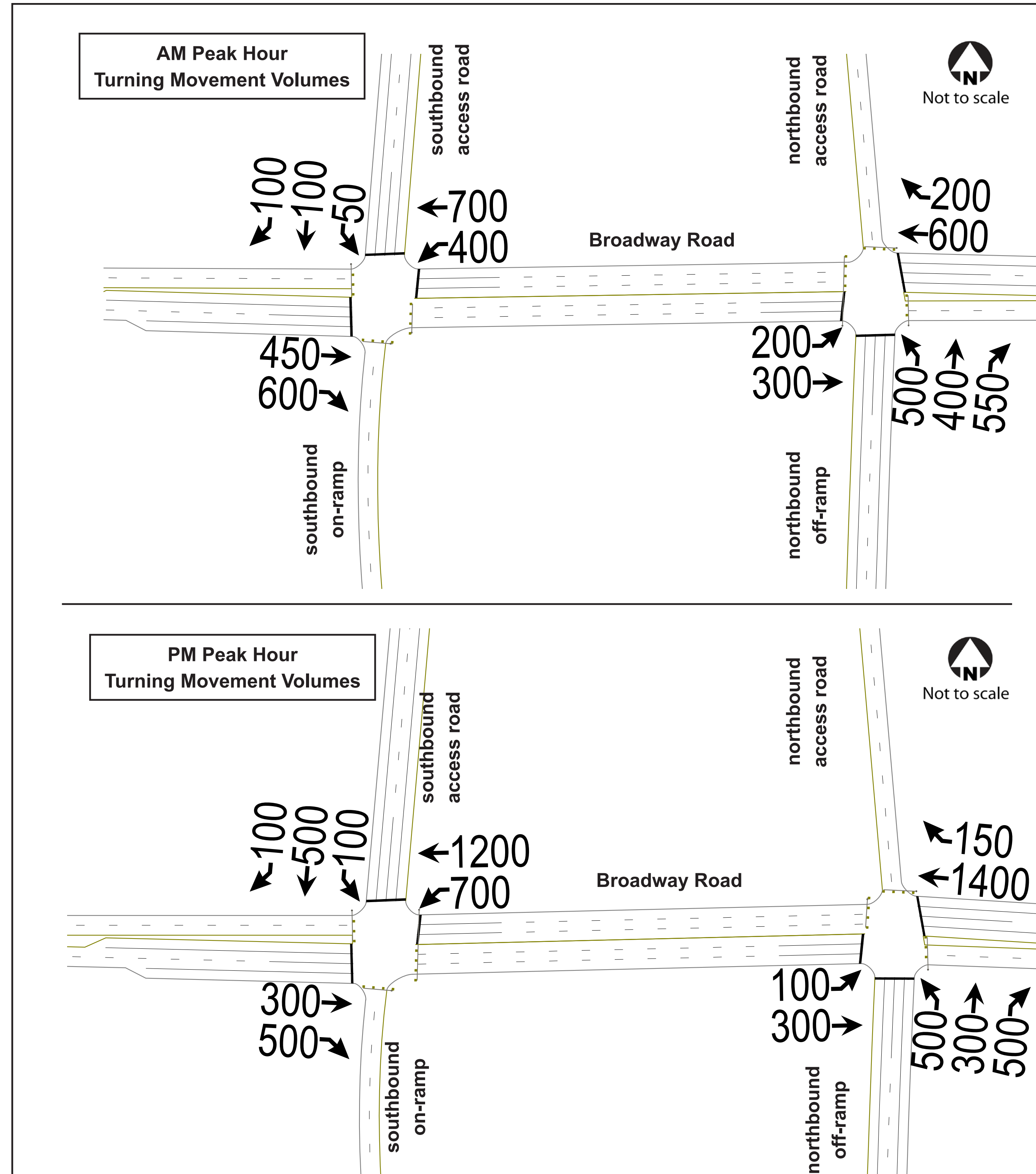
Table 2.30 – Broadway Road Service Traffic Interchange Analysis

Location	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
Broadway Road	17.6	B	16.2	B	60	31.9	C	33.6	C	90

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed split CDI from Table 2.29. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035. This recommendation is supported because the split CDI is the least costly alternative for this location and consistent with the future SR 30.

The roadway and striping plan would continue to be evaluated and updated throughout the design process. The future connection of the SR 30 freeway may cause local access modifications along the South Mountain Freeway, including Broadway Road.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.17
Broadway Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Lower Buckeye Road

Lower Buckeye Road is currently a two-lane road. It is anticipated that Lower Buckeye Road would be widened to four lanes according to COP cross section presented in Table 2.5. The northern corners currently contain agricultural land that is zoned for commercial development. The southeastern corner contains a utility substation and the southwestern corner contains agricultural land that is zoned for commercial development. This anticipated development is consistent with the local planning, which has designated the area around the Lower Buckeye Road interchange an urban core for the Estrella Village in Phoenix. The intersection of 59th Avenue and Lower Buckeye Road would be located approximately 1,000 feet east of the freeway. A split CDI is proposed at this location with access roads to the south of the interchange connecting to Broadway Road.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.18. The recommended lane configuration is presented in Table 2.31. The lane configuration at the 59th Avenue intersection includes dual left-turn lanes in the east-to-north direction and the north-to-west direction (towards and away from the interchange). The Synchro analysis results for the interchange and adjacent intersection of 59th Avenue are presented in Tables 2.32 and 2.33.

Table 2.31 – Lower Buckeye Road Service Traffic Interchange, Lane Configuration

	Eastbound Lower Buckeye Road			Westbound Lower Buckeye Road			Northbound access road			Southbound off-ramp		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
East	2	2	–	2[a]	2	1	1	2[b]	1	–	–	–
West	2[a]	2	1	2	2	–	–	–	–	1	2[b]	1

Notes: [a] advanced left-turn storage; [b] shared thru-left turn lane and shared thru-right turn lane

Table 2.32 – Lower Buckeye Road Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
Lower Buckeye Road	28.3	C	18.4	B	70	20.6	C	25.4	C	65

Notes: sec/veh = seconds per vehicle

Table 2.33 – Lower Buckeye Road and 59th Avenue Intersection Analysis

	AM			PM		
Location	**Delay (sec/veh)**	**LOS**	**Cycle Length (sec)**	**Delay (sec/veh)**	**LOS**	**Cycle Length (sec)**
Lower Buckeye Road and 59th Avenue	23.2	C	70	27.7	C	65

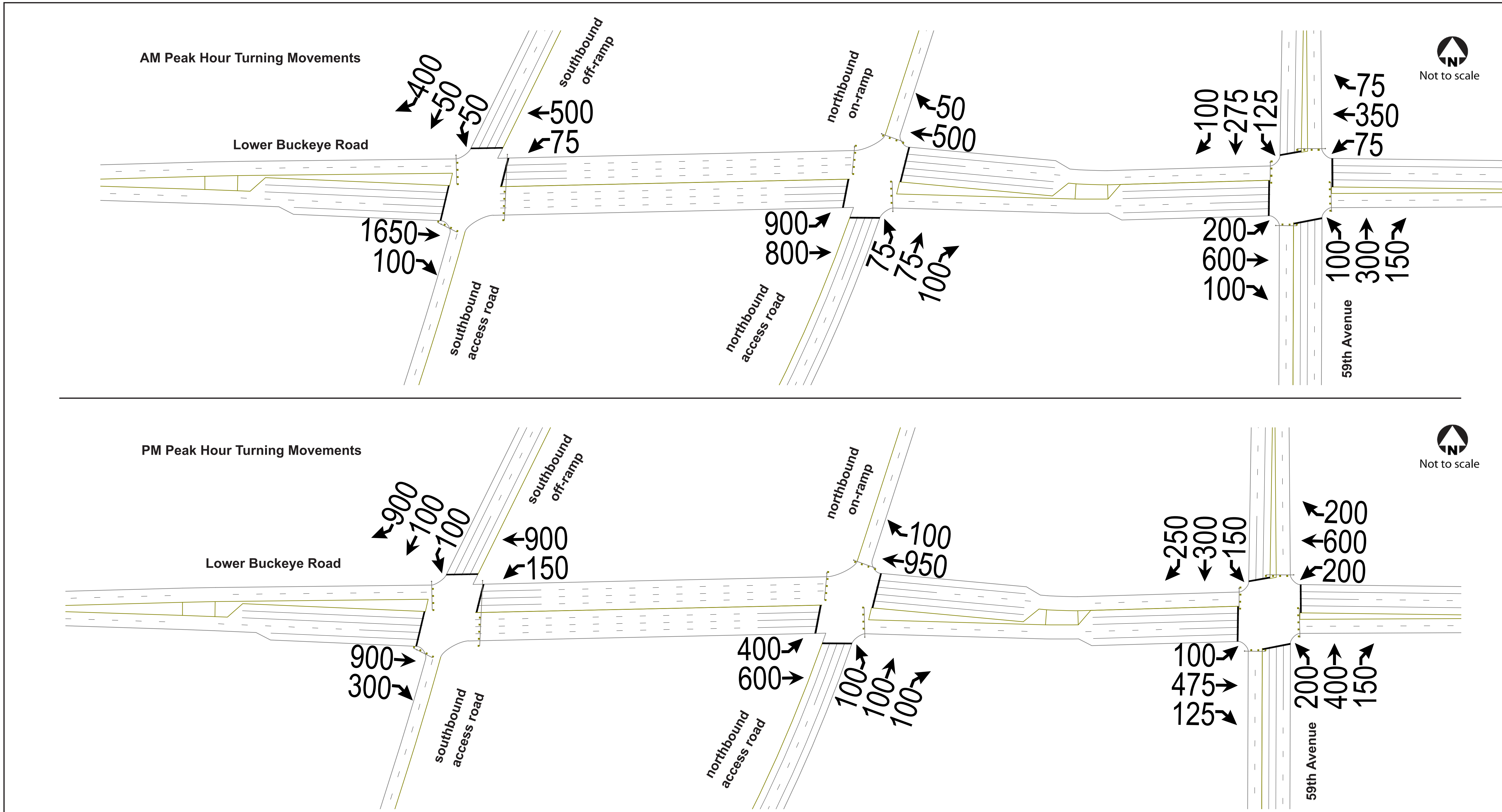
Notes: sec/veh = seconds per vehicle

Notable observations from the analysis include:

- Performance of the 59th Avenue and Lower Buckeye Road intersection could be improved by adding through lanes, dual left-turn lanes, and dedicated right turn lanes.
- Because of the tight spacing of the three signals, it is important that ADOT and COP coordinate the signal timings so that traffic at the 59th Avenue and Lower Buckeye Road intersection doesn’t back up into the interchange intersections.

The road and striping plans (see Appendix A) present the lanes associated with the proposed split CDI from Table 2.31. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035. This recommendation is supported because the split CDI is the least costly alternative for this location and is consistent with the future connection of SR 30.

The roadway and striping plan would continue to be evaluated and updated throughout the design process. The future connection of the SR 30 freeway may cause local access modifications along the South Mountain Freeway, including Lower Buckeye Road.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.18
Lower Buckeye Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Buckeye Road

Buckeye Road is currently a six-lane road with a paved median striped for a two-way left-turn lane. This matches the ultimate lane configuration as presented in Table 2.5. All four corners currently contain industrial uses. In this area, 59th Avenue has been incorporated into the freeway cross section as a series of one-way frontage roads. The freeway on-ramps diverge from the frontage roads immediately downstream from the signal and the off-ramps merge into the frontage roads immediately upstream from the signals. A CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.19. The recommended lane configuration is presented in Table 2.34. The Synchro analysis results are presented in Table 2.35.

Table 2.34 – Buckeye Road Service Traffic Interchange, Lane Configuration

	Eastbound Buckeye Road			Westbound Buckeye Road			Northbound frontage road			Southbound frontage road		
Signal	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
East	2	3	–	2[a]	3	1	1	2[b]	1	–	–	–
West	2[a]	3	1	2	3	–	–	–	–	1	2[b]	1

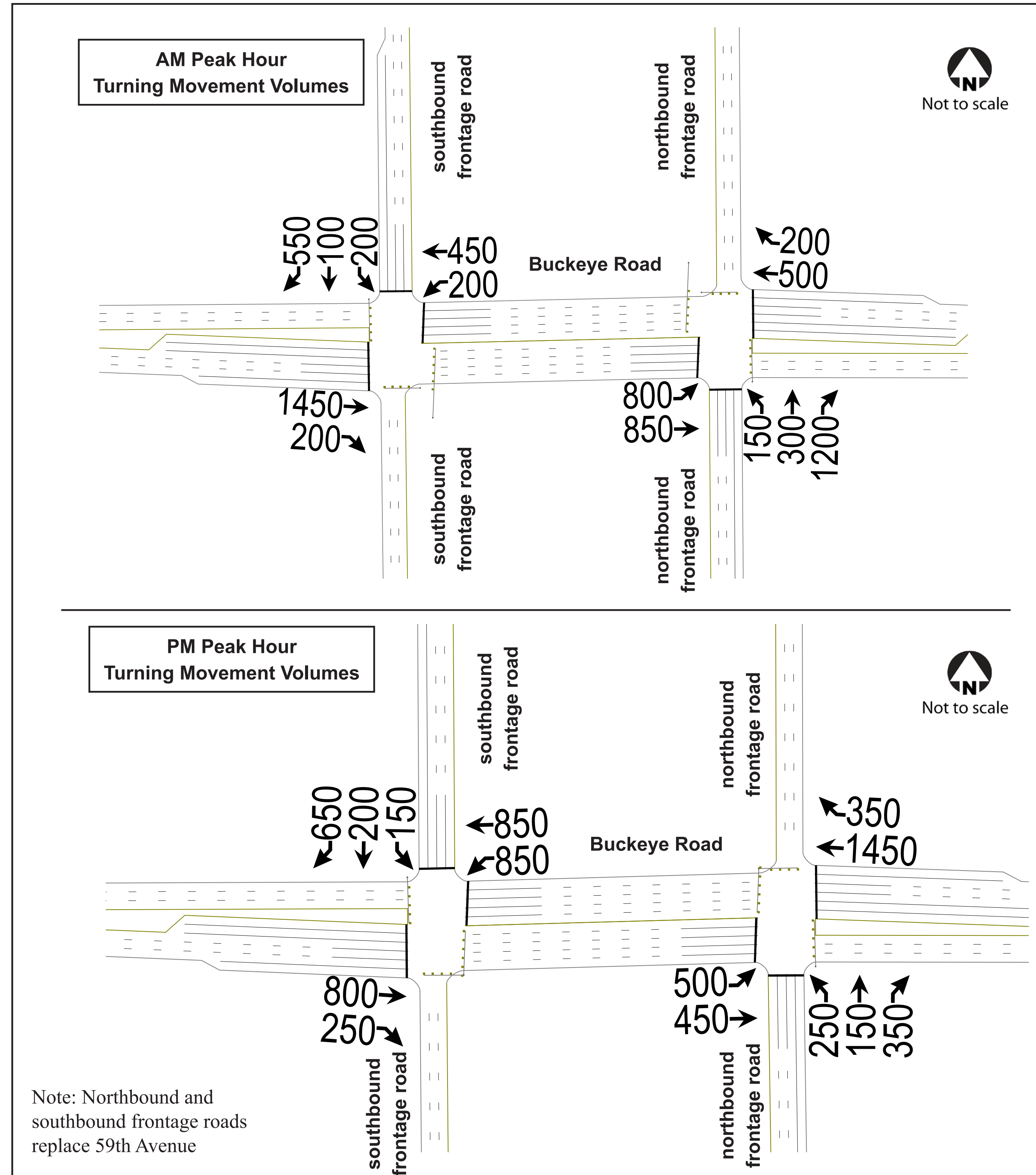
Notes: [a] advanced left-turn storage; [b] shared thru-left turn lane and shared thru-right turn lane

Table 2.35 – Buckeye Road Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**		**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	
Buckeye Road	23.5	C	26.1	C	90	21.4	C	29.9	C	60

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed CDI from Table 2.34. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.19 Buckeye Road, Turning Movement Volumes, AM and PM Peak Hour, 2035

Van Buren Street

Van Buren Street is currently a five-lane road (three westbound lanes and two eastbound lanes) with a paved median striped for a two-way left-turn lane. This matches the ultimate lane configuration as presented in Table 2.5. The southern corners contain industrial businesses, while the northern corners contain agricultural land. In this area, 59th Avenue has been incorporated into the freeway cross section as a pair of one-way frontage roads. On- and off-ramps are only provided to and from the south due to the proximity of the I-10 system traffic interchange. The signal design similar to a CDI is proposed at this location.

The 2035 AM and PM peak hour turning movement volumes used in the analysis are presented in Figure 2.20. The recommended lane configuration is presented in Table 2.36. The Synchro analysis results are presented in Table 2.37.

Table 2.36 – Van Buren Street Service Traffic Interchange, Lane Configuration

	Eastbound Van Buren Street			Westbound Van Buren Street			Northbound frontage road			Southbound frontage road		
Signal	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
East	2	2	–	2[a]	2	1	1	2[b]	1	–	–	–
West	2[a]	2	1	2	2	–	–	–	–	1	2[b]	1

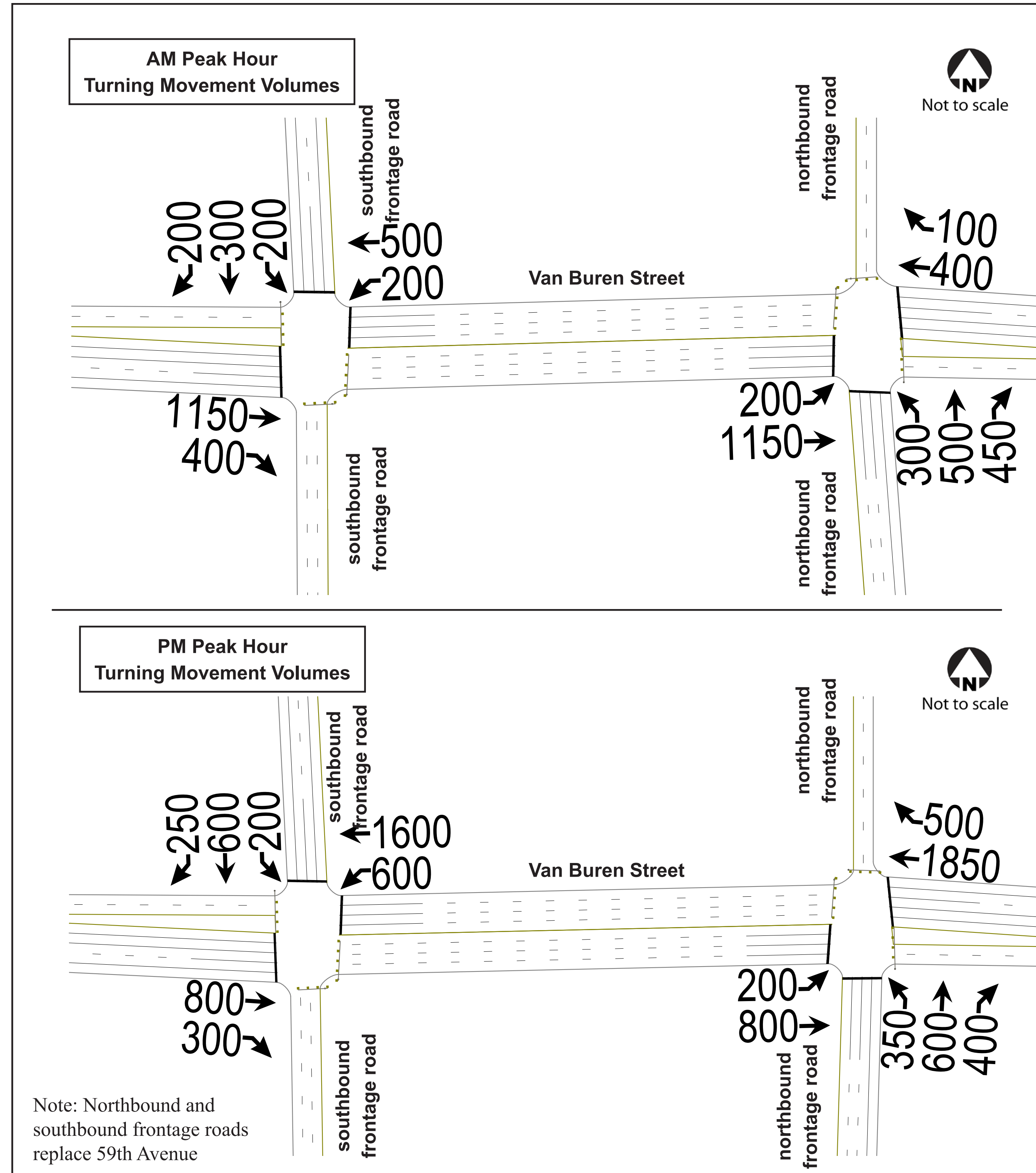
Notes: [a] advanced left-turn storage; [b] shared thru-left turn lane and shared thru-right turn lane

Table 2.37 – Van Buren Street Service Traffic Interchange Analysis

	AM					PM				
	West Signal		East Signal		Cycle Length (sec)	West Signal		East Signal		Cycle Length (sec)
Location	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
Van Buren Street	22.9	C	19.3	B	70	22.2	C	24.6	C	80

Notes: sec/veh = seconds per vehicle

The roadway and striping plans (see Appendix A) present the lanes associated with the proposed half diamond interchange as shown in Table 2.36. This represents the maximum right-of-way that would be required to meet the traffic demand needs projected for 2035.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 2.20
Van Buren Street, Turning Movement Volumes, AM and PM Peak Hour, 2035

2.5.3 Turning Movement Storage Length

The minimum storage lengths for turning movements were determined by using the methodology presented in the *ADOT Lessons Learned Document on Traffic Volume Projections and Operational Analysis* (ADOT 2005). The methodology compares the queue lengths from the sources listed below and uses engineering judgment based on this comparison to determine an appropriate storage length.

- Synchro 50 and 95 percentile queue length from intersection report
- ADOT Traffic Engineering Policies, Guides, and Procedures (PGP) section 430, Turn Lane Design (ADOT 2000)
- ADOT Phoenix Construction District memo (February 2000) stating "The default storage length for left turn lanes and right turn lanes shall be 300 and 250 feet, respectively" (ADOT 2005)
- any known outside factors that could affect storage (e.g., train tracks)

The minimum storage lengths proposed for the crossroad and ramp turning lanes are presented in Table 2.38. In almost all cases, the controlling criteria was the minimum 300 feet for left-turn lanes and 250 feet for right-turn lanes.

Table 2.38 – Minimum Storage Length, feet

Turn Lane	40th Street	24th Street	Desert Foothills Parkway	17th Avenue	51st Avenue
South signal					
Eastbound left	300	300	300	300	300
Eastbound right	250	250	—	—	—
Westbound left	—[a]	—	—	—	—
Westbound right	—	—	—	—	—
Northbound left	—	—	—	—	—
Northbound right	250	—	—	—	—
Southbound left	300	300	300	300	300
Southbound right	—	—	—	—	—
North signal					
Eastbound left	—	—	—	—	—
Eastbound right	—	—	—	—	—
Westbound left	300	300	300	300	300
Westbound right	250	250	250	250	250
Northbound left	300	300	300	300	300
Northbound right	—	—	—	—	—
Southbound left	—	—	—	—	—
Southbound right	250	250	250	250	250

Turn Lane	Elliot Road	Dobbins Road	Baseline Road	Southern Avenue	Broadway Road	Lower Buckeye Road	Buckeye Road	Van Buren Street
West signal								
Eastbound left	—	—	—	—	—	—	—	—
Eastbound right	250	250	250	—	250	250	250	250
Westbound left	300	300	300	300	300	300	300	300
Westbound right	—	—	—	—	—	—	—	—
Northbound left	300	—	—	—	—	—	—	—
Northbound right	250	—	—	—	—	—	—	—
Southbound left	—	300	300	350[b]	300	300	300	300
Southbound right	—	250	250	250	250	250	250	250
East signal								
Eastbound left	300	300	300	300	300	300	300	300
Eastbound right	—	—	—	—	—	—	—	—
Westbound left	—	—	—	—	—	—	—	—
Westbound right	250	250	250	250	250	250	250	250
Northbound left	—	300	300	300	350[b]	350[b]	300	300
Northbound right	—	250	250	250	250	250	250	250
Southbound left	300	—	—	—	—	—	—	—
Southbound right	250	—	—	—	—	—	—	—

Notes: [a] not applicable; either movement is not present, no storage lane is identified, or storage is not limited; [b] locations where minimum storage is greater than ADOT minimum

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3. Major Design Features of the Selected Alternative

The following sections describe major design features of the Selected Alternative.

3.1 Design Background

As presented in Section 1.1, *Historical Context of the Project*, the study and design of a freeway in the Study Area has been ongoing for over 25 years. In that time, numerous changes to the alignment, vertical profile, cross section, interchange locations, and other design concepts have been made. The changes and evaluation of concepts were documented in technical reports and memorandums and were used to determine the design elements to be carried forward into the Selected Alternative. The following sections present details related to notable design elements not covered in other sections of this report:

- Profile options along Pecos Road section
- Profile options through South Mountains' ridges
- Rock excavation slopes and rockfall containment ditches
- Multiuse crossings
- Avoidance of traditional cultural properties
- MAG recommended changes to the SR 202L corridor
- Alignment through Laveen Village core
- Community Alignments
- Design considerations for the SR 30 system traffic interchange
- Design considerations for the I-10 light-rail transit corridor

3.1.1 Profile Options along Pecos Road Section

The design team considered the use of either an aboveground rolling profile or a belowground (depressed) profile along the Pecos Road section. A frequent comment received from members of the public was that the belowground option would be preferable because it would reduce noise and visual impacts. The design team evaluated the impacts associated with both profile options.

Drainage was the primary design constraint for the evaluation. Runoff from the South Mountains follows mostly natural drainage patterns as it flows to the southwest through Ahwatukee Foothills Village, across Pecos Road, and onto Community land. The Community, through correspondence and comments received, has expressed concerns related to the quantity, quality, and location of drainage released onto its land. The existing system includes pipes and concrete box culverts to pass the runoff under Pecos Road. The development of the proposed drainage facilities assumed that the flows with the proposed freeway in place would be required to remain the same as the flows in the existing conditions (no increase in runoff to downstream properties over existing conditions).

A typical freeway drainage design including large detention basins, linear channels, and pump stations was initially used to evaluate the belowground profile option. Additional enhancements including the use of linear channels, underground storage, off-site detention basins, and channels and drainage flumes were incorporated to attempt to reduce the cost and right-of-way area needed.

To summarize the results presented in the technical memorandum, *E1 Alternative – Profile Variations Along Pecos Road* (ADOT 2008c), the belowground profile options would create:

- Drainage design complexities – The existing drainage facilities adjacent to and passing under Pecos Road are designed to accommodate a 10-year storm. According to ADOT guidelines for aboveground freeway sections, the drainage facilities for on-site flow must accommodate a 10-year storm, and facilities for off-site flow must accommodate, minimally, a 50-year storm. Using an aboveground rolling profile, maintenance of the existing flow rate would require extension of the existing drainage structures and construction of small drainage basins at regular intervals. To protect motorists on belowground freeway sections, drainage facilities for both the on- and off-site flows would, at a minimum, have to accommodate a 50-year storm. The belowground freeway section would sever the existing drainageways, resulting in the need to develop new facilities, including four to six pump stations. Because the design would combine multiple outflow locations into one crossing location, more water would need to be stored upstream, resulting in the need to develop large drainage basins and, therefore, acquire more right-of-way.
- Greater right-of-way requirements than the aboveground rolling profile – Approximately 150 additional acres would be needed when compared with the aboveground rolling profile under study.
- More residential displacements – As a result of the increased right-of-way needed, between 152 and 326 more residences would be displaced, depending on the drainage design enhancements considered.
- Increased costs – The total construction and right-of-way costs for the belowground profile options would increase by approximately $400 million.
- Increased maintenance costs – The addition of multiple pump stations and large drainage basins would add to the long-term life-cycle costs for the freeway.
- Impacts on Ahwatukee Foothills Village – The public generally believes that a belowground freeway reduces and/or eliminates impacts on visual resources and freeway-related noise. Visual and noise-level impacts from operation of the proposed freeway would, however, still occur and would require mitigation, as would be the case for the aboveground freeway.

For these reasons, the belowground freeway options were eliminated from further study. The profile for the proposed freeway along Pecos Road includes an aboveground, rolling profile (see Appendix A).

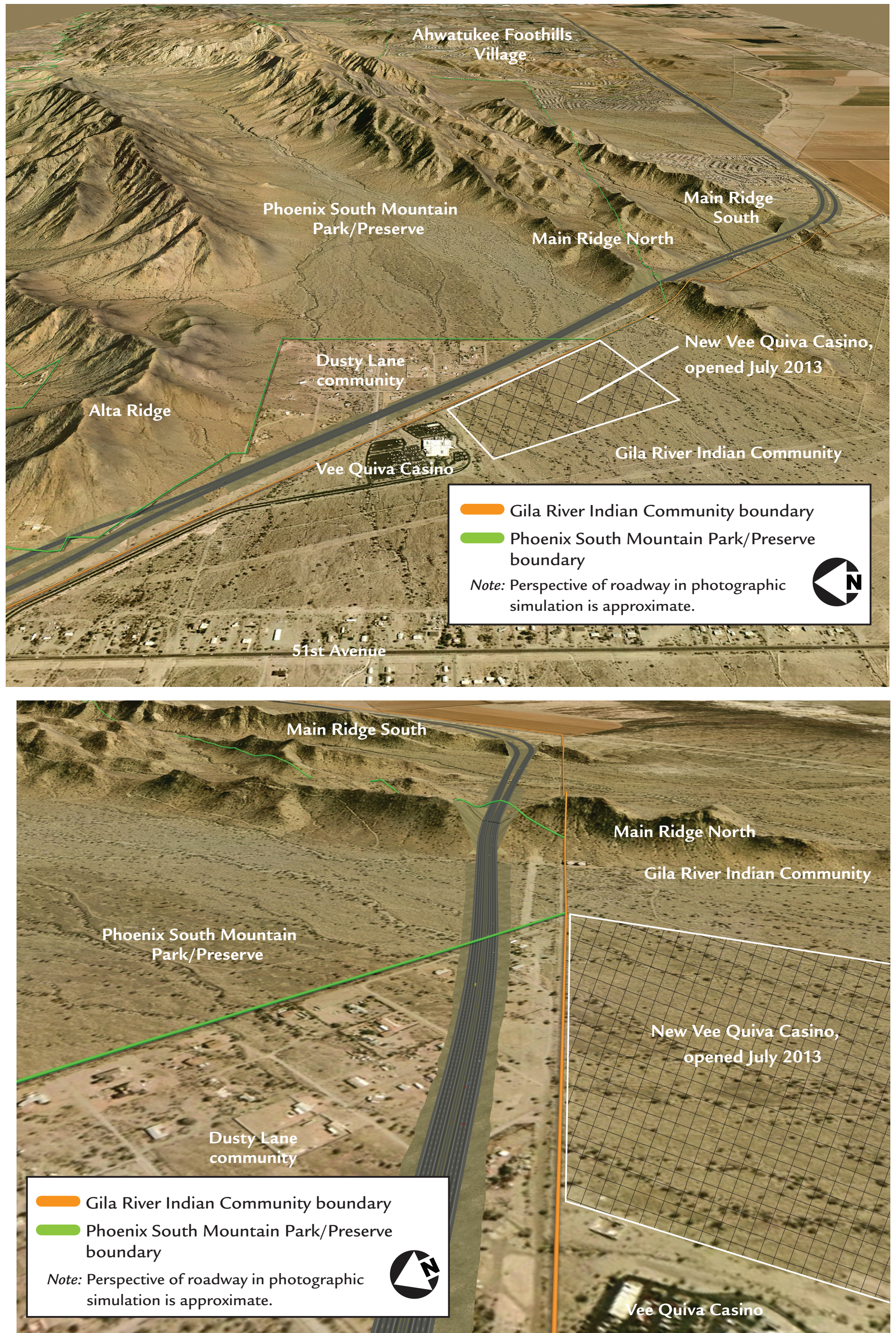
3.1.2 Profile Options through South Mountains' Ridges

The proposed freeway alignment would pass through the southwestern edge of the South Mountains. This alignment would follow existing terrain except where cuts would be needed to pass through the ridgelines. Photo simulations of the potential cuts are depicted in Figure 3.1, and cross sections are presented in Figure 3.2.

Local residents and representatives from COP, Ahwatukee Foothills Village, the Community, and the public expressed concerns that these cuts would substantially and adversely affect the South Mountains' valued resources. In response, design options were developed in an effort to avoid and/or reduce impacts on the mountains. Design options were considered for bridging over or tunneling under the South Mountains. The following sections present a summary of the analysis from the technical memorandum, *Phoenix South Mountain Park/Preserve and Traditional Cultural Property Avoidance (Ridge Bridge – Tunnel) Analysis* (ADOT 2006a).

Bridge Alternatives

In an effort to avoid impacts on the resources associated with the South Mountains, designs and profiles that included a bridge through and over the mountains were investigated (see Figures 3.3 and 3.4). The alternatives were determined to not be prudent and feasible because:



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.1
Photo Simulation of Cuts through Ridges of the South Mountains

- Complete avoidance of the resources would not be achieved.
- The desired effects from the bridge alternatives—avoidance of use-related impacts such as landscape alteration and visual intrusion—would not be achieved. Necessary bridge piers, bridge foundations, fill slopes for approaches, and cut slopes would cause impacts.
- Costs to construct the bridges—estimated to be between approximately $232 million and $323 million—were determined to not be prudent.
- The bridge alternatives would increase visual impacts (the main impact the alternatives would attempt to avoid) for views from the South Mountains to adjacent land and from adjacent land to the South Mountains.
- Incident management would be constrained on the bridge alternatives because of the height above existing ground, lack of a graded side-slope, and the distances between access points.
- Perceived driver safety may be impaired because the bridge heights and continuous maximum grades of length would be unique to an urban freeway in the Phoenix area.

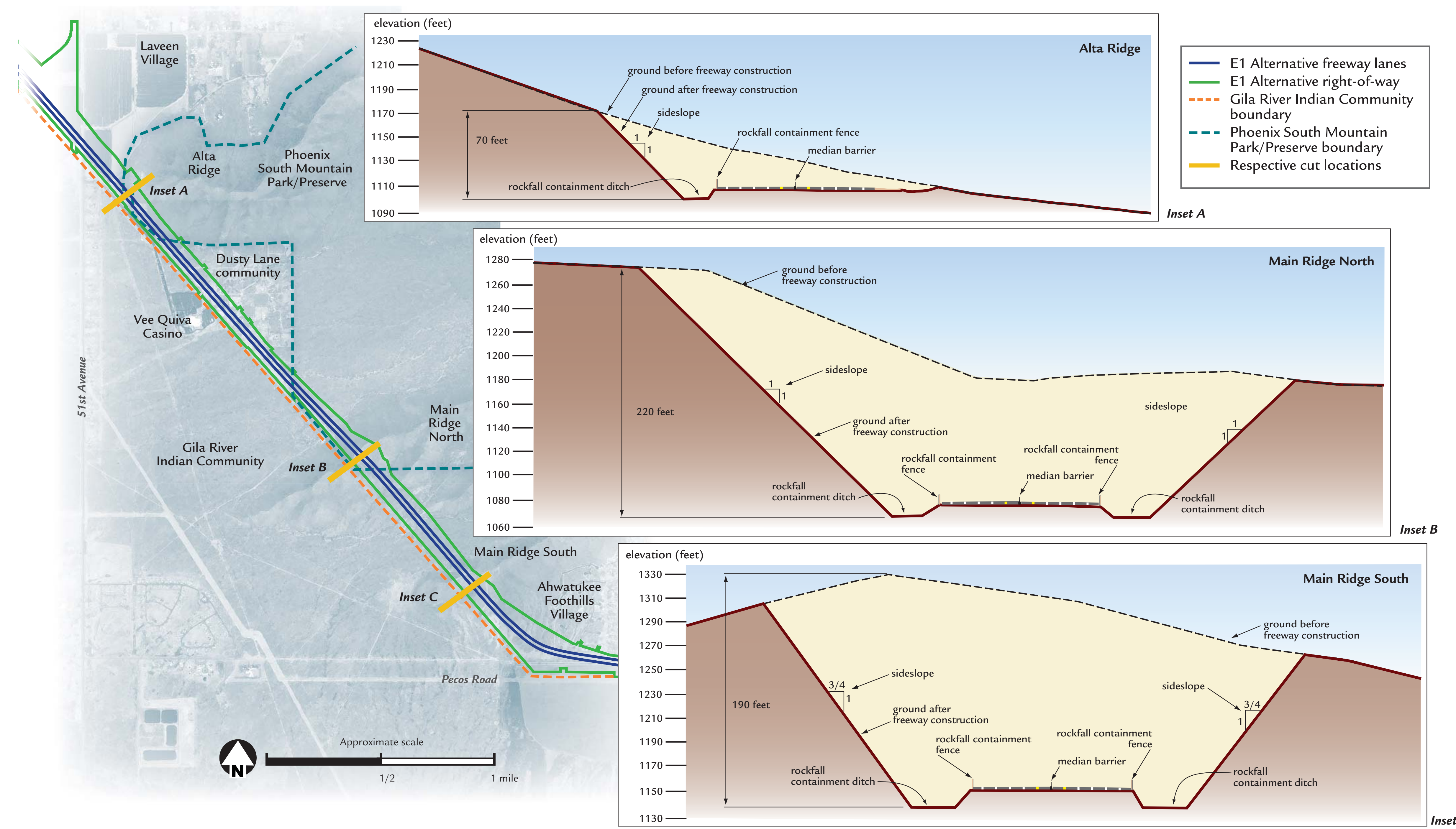
These factors alone were determined to be of extraordinary magnitude, and, therefore, no further analysis (e.g., assessment of long-term maintenance costs) was warranted. Based on costs of extraordinary magnitude and the inability to avoid direct use of the resources associated with the South Mountains, the bridge alternatives would not be prudent and feasible and were, therefore, eliminated from further consideration.

Tunnel Alternatives
In an effort to avoid impacts on resources associated with the South Mountains, various tunnel design and profile options were investigated (see Figure 3.5). A photo simulation of the low profile tunnel option through the ridges is presented in Figure 3.6. The design of a typical tunnel is generally controlled by the following:

- A tunnel's dimensions and its distance below ground are dictated by existing geological conditions and available construction technology. When coupled with appropriate safety considerations, these factors basically determine a single tunnel's size or conditions.
- Once geologic and construction capabilities are determined, operational needs are considered, including the number of lanes, safe sight distances and other safety features, maintenance features, and security issues. These considerations are used to determine whether the operational needs can be met with the tunnel conditions outlined or whether more than one tunnel (located adjacent to each other) would be needed.
- Finally, it is necessary to determine whether the tunnel(s) would be sufficiently deep and long to avoid or reduce impacts on the surrounding environment.

When considered together, these factors helped determine the minimum acceptable tunnel dimensions (height and width), distance below ground, number of adjacent tunnels to accommodate all of the freeway lanes, tunnel length and location, and possible construction techniques. In determining what type of tunnel could be built, ADOT and FHWA balanced traffic performance against existing technological capabilities. Tunneling options were also assessed to determine the feasibility of their construction and maintenance, to determine their effectiveness in avoiding or reducing impacts to the South Mountains, and to assess whether tunneling through the mountain range would generate other desirable or undesirable outcomes.

Three tunnel configurations, illustrated in Figure 3.7, were considered for the evaluation. All the configurations were located along the same alignment as the proposed freeway. Based on the assessment, summarized below, tunneling options were eliminated from further detailed study.

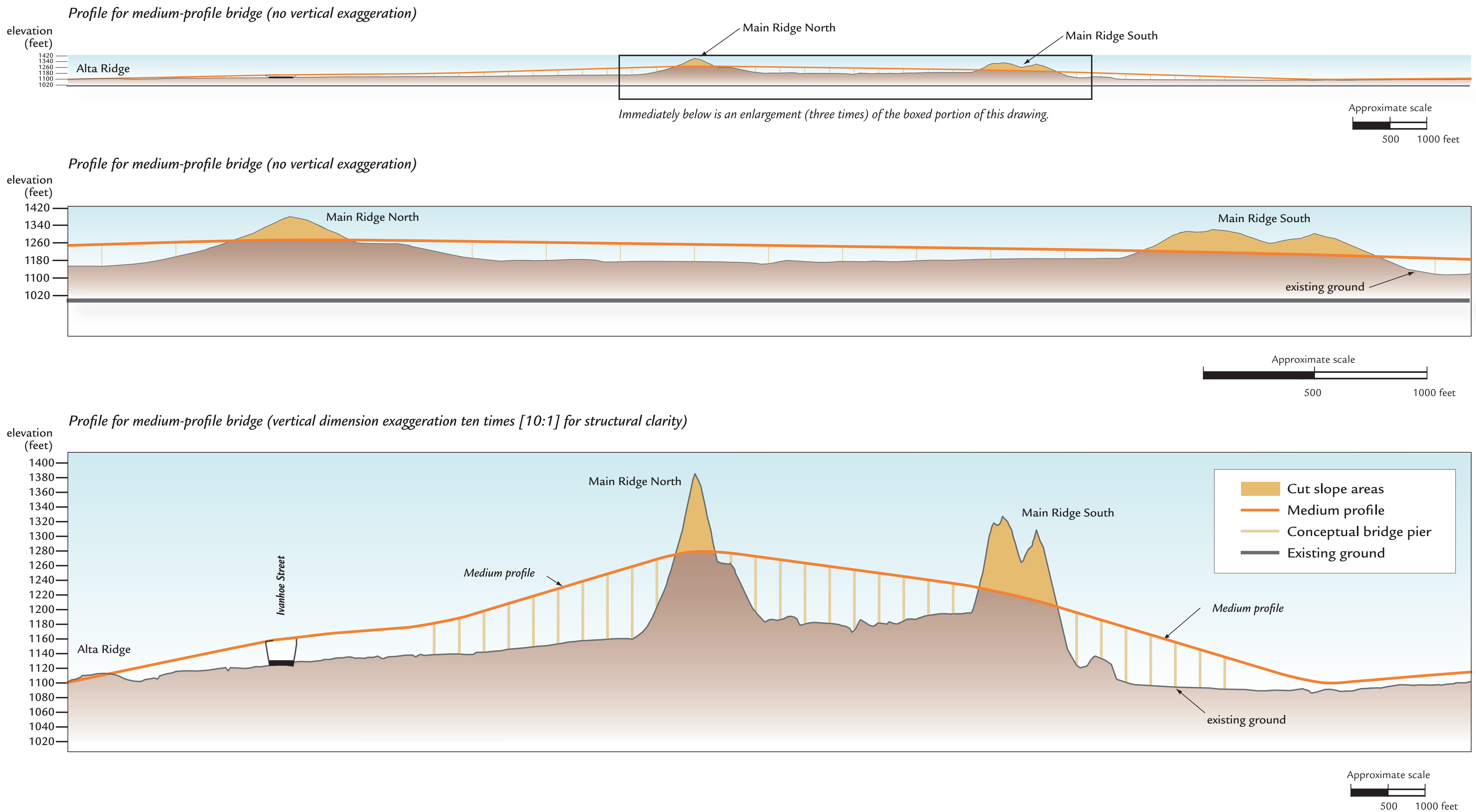


South Mountain corridor team

South Mountain Freeway L/DCR

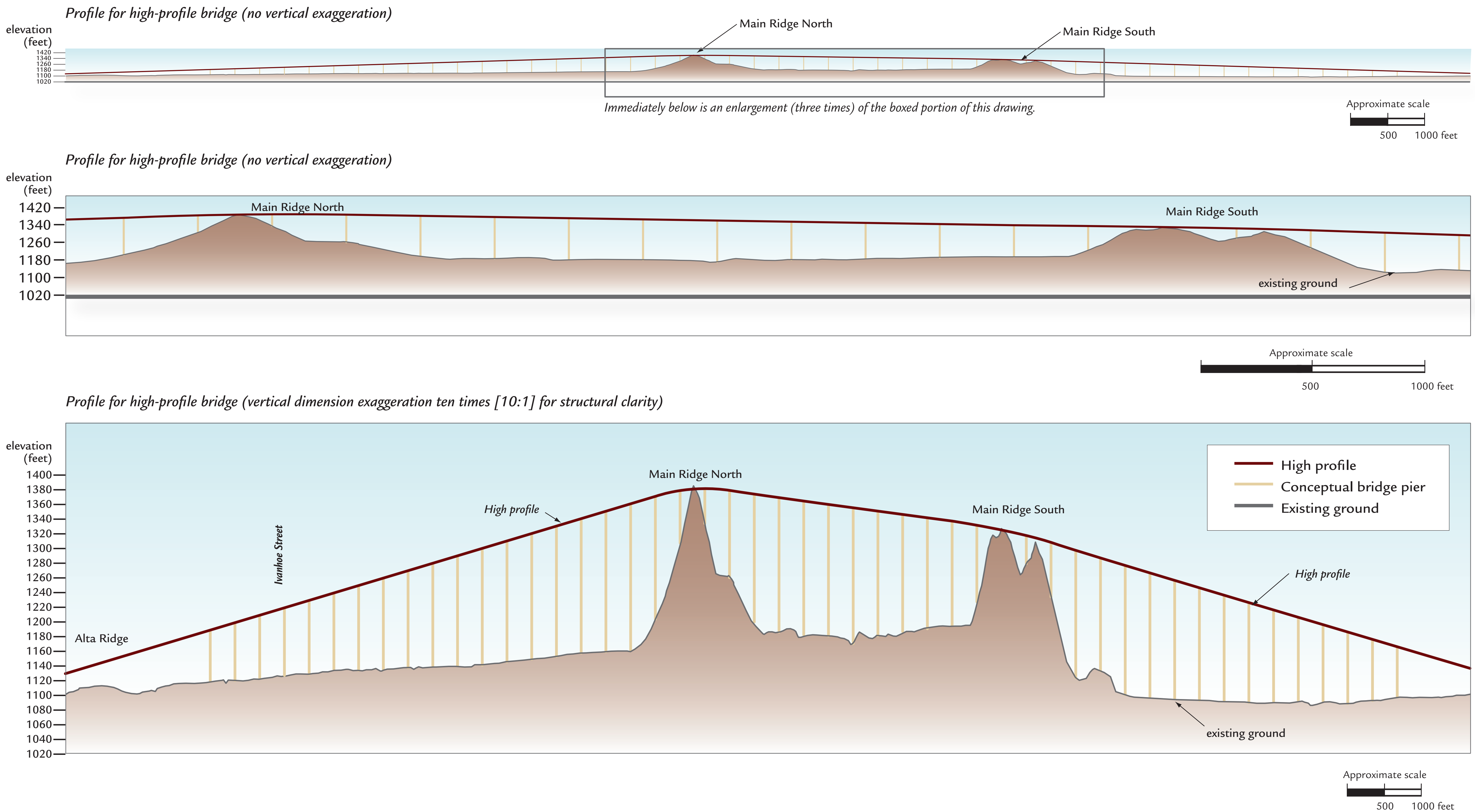
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.2
Proposed Cuts through the Ridges of the South Mountains



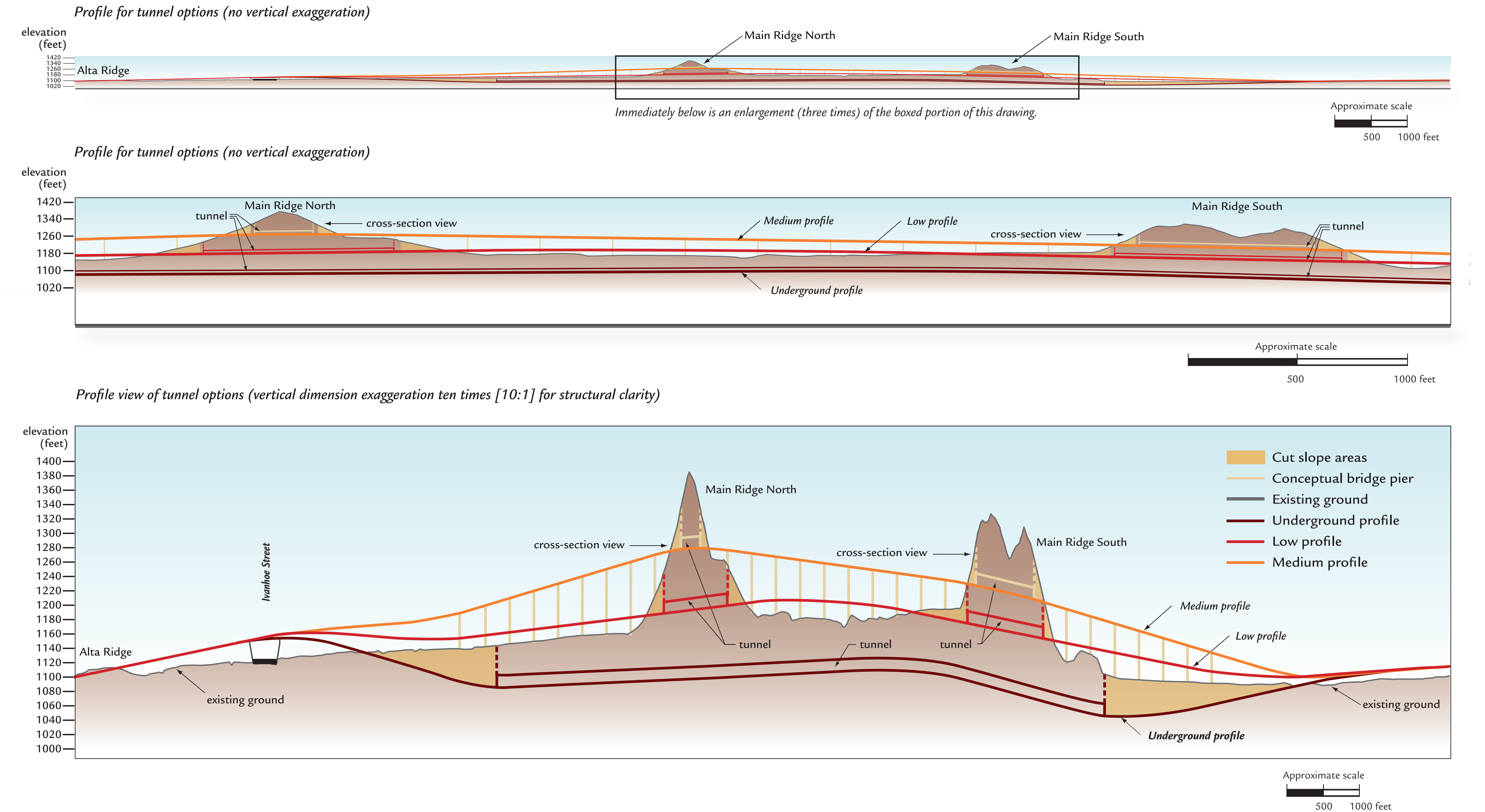
South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.3
Medium Bridge Alternative Profile



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

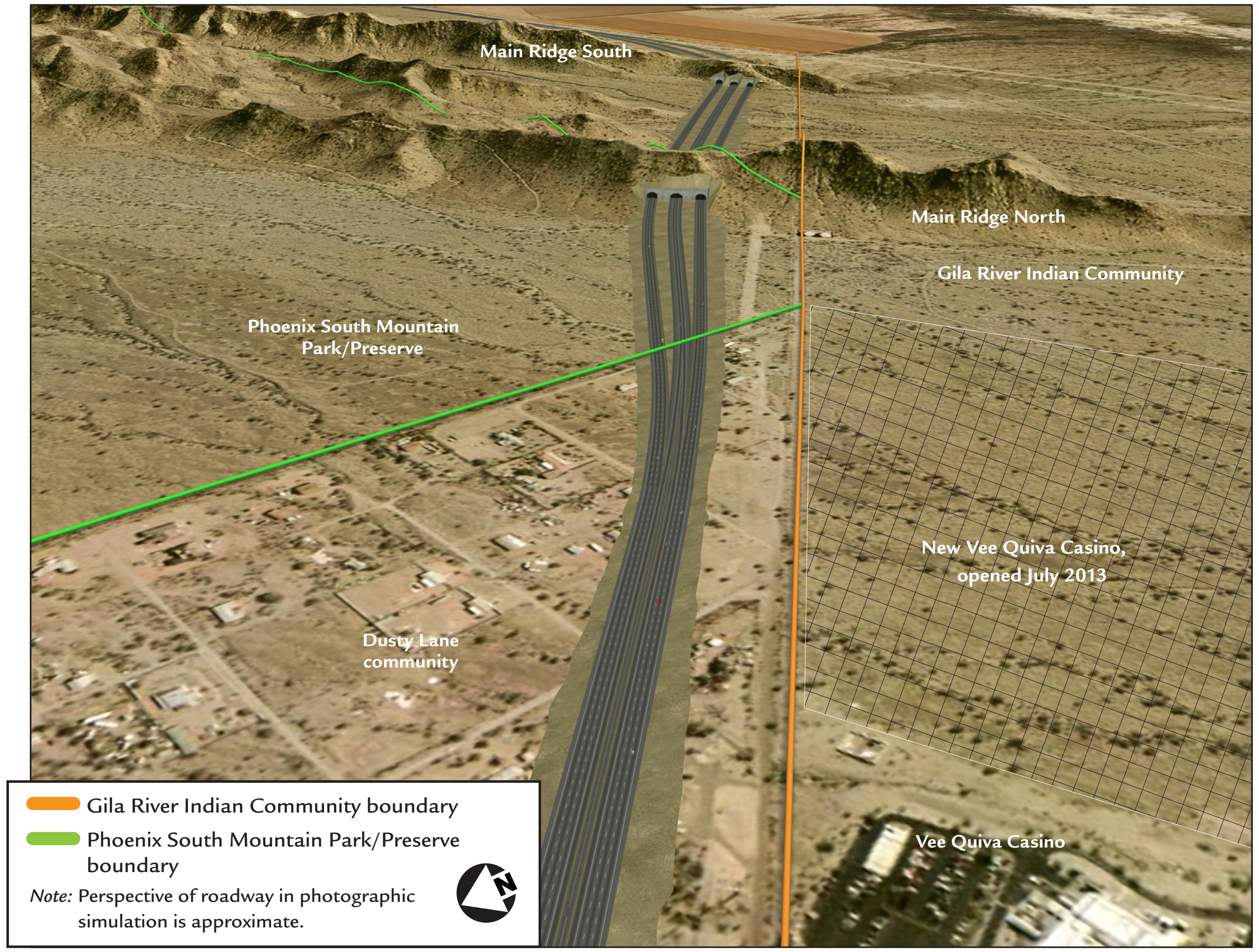
Figure 3.4
High Bridge Alternative Profile



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.5
Tunnel Alternative Profiles



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.6
Photo Simulation of Tunnel through Ridges of the South Mountains

Tunnel options would create undesirable safety issues. Emergencies would require complex response planning for traffic control, fire detection, ventilation and exhaust, and fire safety systems. There are security concerns with tunnels on urban freeways being considered potential terrorist targets (AASHTO 2003). With a tunnel, the entire length of the South Mountain Freeway would potentially have signs installed prohibiting the transportation of hazardous cargo.

The proposed freeway would include eight lanes of traffic. In an ideal situation, all lanes of traffic moving in one direction would be in one tunnel (see “ideal,” in the top graphic of Figure 3.7). For the proposed freeway’s eight lanes, this would result in two tunnels, each approximately 92 feet wide. The next most appropriate options—termed “constructible” option A and B—would have HOV traffic for both directions using a single 80-foot-wide tunnel or individual 56-foot-wide tunnels, respectively. A review of tunnels constructed in the United States and around the world indicates that 80 feet is the maximum practicable limit for tunnel excavation under ideal conditions, about 12 feet narrower than would be necessary for the ideal option.

The only options that appear constructible using current technology would use three or four tunnels, splitting HOV traffic from the general purpose lanes Two of the tunnels would require an 80-foot width, at the limit of constructibility for any known existing tunnels in the United States. Because of the variable nature of site-specific geology (including dangers that could arise from encountering fractured rock), it is not possible at this time to determine specific dimensions of a maximum feasible tunnel width.

Both ADOT and FHWA believe that an 80-foot tunnel option would result in unacceptable safety concerns, with diverging traffic and increased constructibility challenges.

The desired effect resulting from tunnel options—avoiding impacts to resources associated with the South Mountains—would not be fully achieved. The tunnel options would have less visual, noise level, and habitat acreage impacts than would the open cut design of the proposed action; total avoidance of such impacts would not be possible. Each tunnel option would require entrances, or portals, that would necessitate ridgeline excavation and subsequent scarring as high as 75 feet.

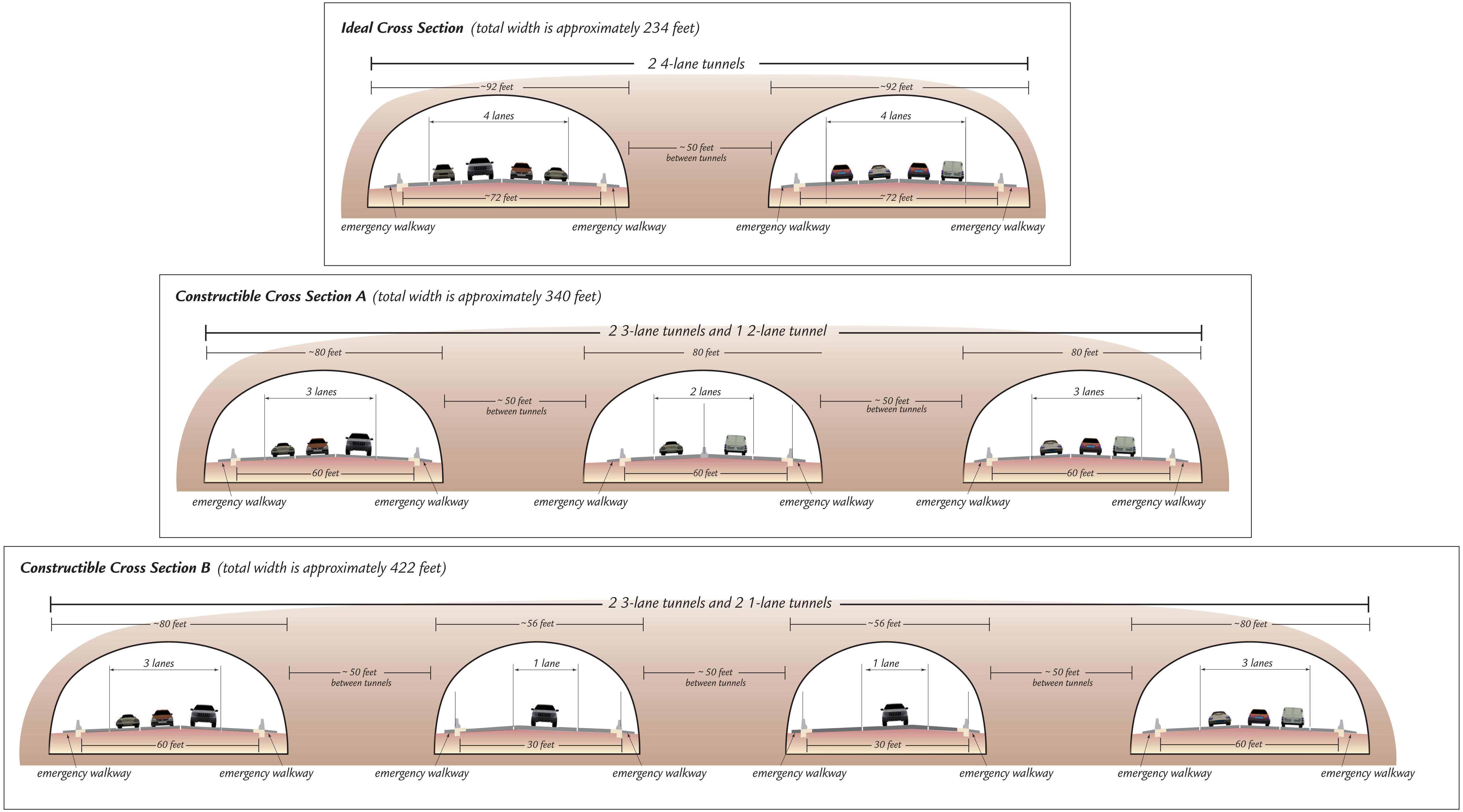
ADOT would evaluate treatment of any newly exposed rock faces for suitability for application of standard treatments. These might include recessing the face of the tunnel portals to minimize their apparent breadth; incorporating rock crags characteristic of the adjacent natural rock features; rounding and blending newly cut faces to minimize existing contours and highlight natural formations; adjusting or warping slopes to flow into each other or transition with the natural ground surface with minimally noticeable breaks; shaping, sloping, and fracturing exposed rock formations to the extent practicable and feasible, depending on geotechnical and constructibility reviews; using shotcrete that matches the colors and textures of adjacent rocks; or staining cut faces to match the surrounding rock colors.

Additionally, necessary bridge structures, embankments for approaches, rockfall protection systems above the portals, ventilation equipment locations, maintenance facilities, and access roads would further alter the natural setting in the SMPP. Therefore, avoidance of the impacts outlined would not be fully achieved using the tunnel options.

With regard to maintenance, tunnel options would result in higher long-term operational and maintenance costs than a typical freeway. Costs would include full-time personnel for operation and maintenance of ventilation equipment and drainage structures, rockfall protection maintenance at the portals, and tunnel rehabilitation. Annually, these costs are estimated to range from $1.5 million to $2 million. Furthermore, regular maintenance would require tunnel closures lasting a weekend and would require undesirable traffic detour planning and routing.

Preliminary construction costs for the tunnel options range from approximately $215 million to $1.9 billion depending on the tunnel length and excavation method. The estimate for the same segment of the proposed freeway (open cut) is approximately $41 million. Considering that current construction techniques do not allow for construction of tunnels that would meet the ideal characteristics and that tunnel options would not fully achieve the desired outcomes, ADOT and FHWA have determined the additional costs presented by tunnel options would not be warranted and are not justified.

For the reasons stated, the tunnel options were eliminated from further study. The study of tunnel options through the South Mountains is not new. In the late 1980s, similar concerns regarding impacts on the South Mountains were expressed by the public, and tunnel options were studied as part of the design process undertaken in 1988 (ADOT 1988b). Reasons to eliminate the tunnel options from further study at that time are consistent with the conclusions reached in this study and presented in this document.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.7
Tunnel Cross Sections

3.1.3 Rock Excavation Slopes and Rockfall Containment Ditches

The project team reviewed available information and research to develop preliminary recommendations for excavation slopes and rockfall containment ditch geometry for the areas through the South Mountains' ridges. The following sections include a summary of the information documented in the technical memorandum, *Preliminary Recommendations Rock Excavation Slopes & Rockfall Containment Ditche*s (ADOT 2004).

Rock Excavation Slopes

Geotechnical conditions within the proposed road cuts are described based on a review of available geologic and geotechnical information. Boring information was available from the original 1988 freeway study and COP water main project built in 2000. The original freeway DCR also included preliminary rock excavation slope recommendations. From this information, preliminary rock excavation slopes were determined and presented in Table 3.1. The differences in recommended slope are based on differences found during drilling with respect to anticipated orientation of joints and fractures in the bedrock. A visual representation of the preliminary recommended slopes is presented in Figure 3.2. Because a full geologic investigation has not been completed, the actual constructed slopes may vary from those presented in Table 3.1.

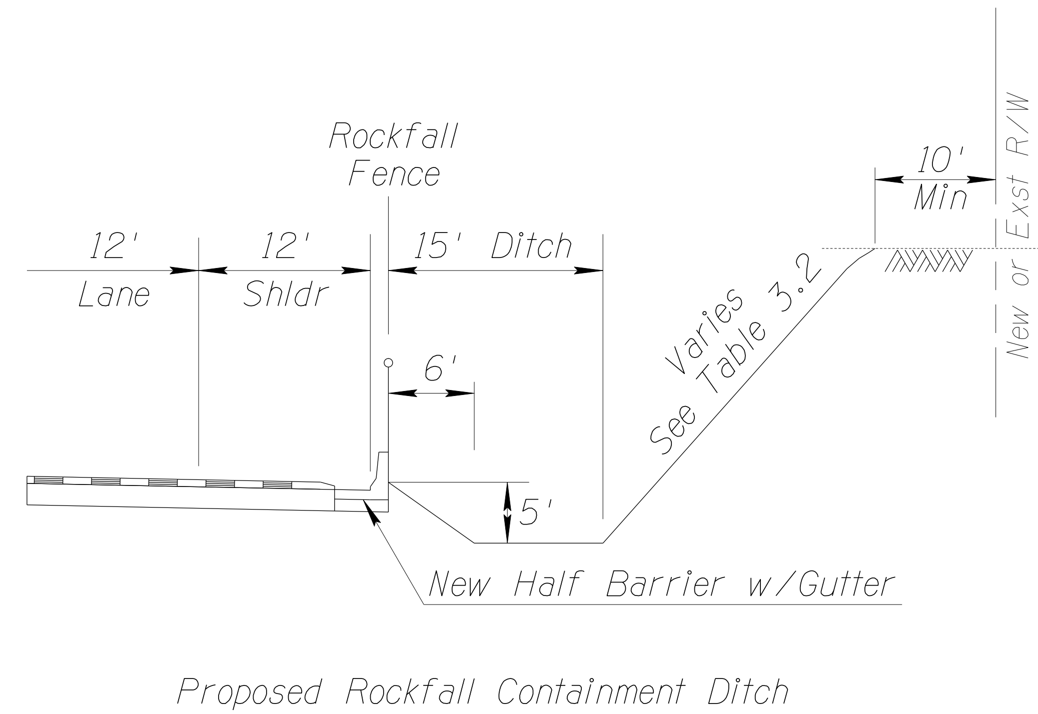
Table 3.1 – Proposed Rock Excavation Slopes

Cut Area	Preliminary Recommended Slope (horizontal:vertical)	Approximate Maximum Cut Depth
Main Ridge South	¾:1	Left cut – 190 feet Right cut – 170 feet
Main Ridge North	1:1	Left cut – 220 feet Right cut – 190 feet
Alta Ridge	1:1	Left cut – 70 feet

Rockfall Containment Ditches

The primary issue of concern is that the proposed excavation slopes would be more susceptible to generating rockfall—with a potential to reach the road—than either steeper or flatter slopes and create a need for more substantial rockfall containment measures. The project team reviewed a number of studies including recent research completed for the Hoover Dam Bypass project (FHWA 2003a) to develop a proposed rockfall containment ditch design. In general, the options included a deep flat-bottom ditch with a steep foreslope or a wide v-ditch with a flat foreslope.

The proposed freeway uses the flat-bottom ditch and steep foreslope configuration shown in Figure 3.8. It reduces the overall depth and width of the cut area and reduces the overall impacts on the resources associated with the South Mountains. A rockfall fence is also included as an additional safety precaution and to further reduce the required size of the ditch. For lower cut slope heights, the rockfall ditch widths and depths would be tapered from the maximum values presented. A minimum ten-foot buffer is provided between the top of the slope and right-of-way fence for maintenance access.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.8
Rockfall Containment Ditch Geometry

3.1.4 Multiuse Crossings

There is growing support among state and federal agencies, as well as the general public, for maintaining landscape connectivity to maintain wildlife movement. Many scientific studies have concluded that roads can fragment habitat, isolate wildlife populations, and ultimately diminish landscape connectivity. Although no major migration corridors were identified within the Study Area, many species of wildlife have the potential to travel through the Study Area for life requirement purposes. This is especially true in the areas around the South Mountains.

The project team, in consultation with the Arizona Game and Fish Department (AGFD), investigated potential locations along the South Mountains that would be appropriate for wildlife crossings. The investigation focused on the locations where existing washes would cross the freeway in a concrete box culvert or other drainage structure. Locations were evaluated to determine if it would be cost effective to enhance the drainage feature to make it more wildlife-friendly. In general, this was accomplished by providing a bridge structure. It was also determined that it would be beneficial to the surrounding communities to provide clearance for pedestrian, equestrian, bicycle, and/or motorized vehicles access at some of the locations. The proposed bridges are included in the ROD as mitigation measures to reduce impacts related to wildlife movements, wildlife-vehicle collisions, habitat connectivity, and access to the mountains.

The following five multiuse crossings, documented in the technical memorandum, *Cost Comparison of Wildlife Crossing Structures* (ADOT 2006b), are included in the proposed freeway design.

- south of Main Ridge South
- between Main Ridge South and Main Ridge North
- north of Main Ridge North
- south of Alta Ridge, connecting with the future Maricopa and Sun Circle Trails
- north of Alta Ridge

The final location and design of the multiuse crossings would be coordinated with AGFD and the Community.

3.1.5 Avoidance of Traditional Cultural Properties

The proposed freeway alignment includes measures to avoid and minimize impacts to traditional cultural properties (TCP) within the area of the South Mountains. Due to the sensitive nature of the sites, no specific information related to the location or content of the sites is provided in this document. The locations of the multiuse crossings have been coordinated with the measures to allow for potential access by Community members to the sites. Protection during construction, and access and protection of the sites after construction would be discussed during final design.

3.1.6 MAG Recommended Changes to the SR 202L Corridor

As discussed previously in this report, the number of lanes and connection to I-10 was modified based on recommendation from the MAG Regional Council in an effort to reduce environmental and social impacts and project cost by minimizing the amount of right-of-way needed for construction. The plans presented in Appendix A reflect the changes to the corridor. Notable observations from the changes include:

- The previous 10-lane freeway was planned to be constructed in two phases. The first phase would have included 6 general purpose lanes and the second phase would have included an additional general purpose lane and an HOV lane in the median. In the current plan, eight lanes, including the HOV lane, would be constructed at the same time.
- The right-of-way along the corridor was further minimized by using retaining walls. A cost analysis was performed to identify locations where the walls would cost less than the adjacent right-of-way. Along the Pecos Road section, the right-of-way reductions resulted in 91 fewer residential displacements.
- Based on a comparative analysis documented in the *W59 Alternative Engineering and Environmental Overview Memorandum* (ADOT 2009a) and input from COP, MAG, and ADOT, the W59 alignment option that remains mostly west of 59th Avenue between Lower Buckeye Road and Van Buren Street and has the drainage channel between the northbound frontage road and the freeway was selected as the preferred option.
- The W59 Alternative requires 59th Avenue to be split into two one-way frontage roads from just north of Lower Buckeye Road to just north of Van Buren Street.
- The frontage roads would both require new grade-separated crossings of the Union Pacific Railroad (UPRR) and Roosevelt Irrigation District (RID) canal.
- The W59 Alternative would impact two apartment complexes (approximately 680 total units) north of Van Buren Street and approximately 20 single family residences along I-10 west of 59th Avenue.
- The I-10 (Papago Freeway) system traffic interchange has been designed to provide improvements necessary to provide a safe and efficient connection between the two freeways. Based on recommendations from MAG and FHWA, the system traffic interchange includes DHOV connection ramps from SR 202L to and from the east along I-10.

3.1.7 Alignment through Laveen Village core

In 2010, the City of Phoenix requested that ADOT and FHWA reexamine the alignment of the W59 Alternative near Dobbins Road in Laveen Village. The alignment presented to the public in 2005 generally followed 63rd Avenue between Dobbins and Elliot roads. This alignment (termed the 63rd Avenue Option) would avoid two historic properties in the area, the Hudson Farm and the Barnes Dairy Barn. The 63rd Avenue Option would adversely affect the planned Laveen Village core and would conflict with City-approved zoning activities in Laveen Village that occurred in the latter part of the past decade.

The 63rd Avenue Option would not be consistent nor compatible with City of Phoenix long-range plans for the Laveen Village core. To support the creation of the Laveen Village core (as planned since the mid-1980s), the City of Phoenix plans to widen Dobbins Road from two lanes to four lanes (with a center turn lane) and has changed the area’s zoning to accommodate high-intensity commercial and residential land uses. The Laveen Village core is essentially “downtown” Laveen Village (City of Phoenix 2004b).

The City of Phoenix supported shifting the alignment east approximately ¼ mile to be more consistent with the Laveen Village core plans. This alignment (termed the 61st Avenue Option), however, would affect a historic property in the area, the Hudson Farm. A public meeting was held in Laveen in February 2011 to present the 61st Avenue Option and 63rd Avenue Option of the W59 Alternative and to gather input regarding local support for protecting the Hudson Farm.

After the meeting, ADOT submitted a formal request to FHWA to consider an alignment on 61st Avenue (through the Hudson Farm property). FHWA, after serious consideration, concluded the agency could not support the 61st Avenue Option because of its impacts to the historic property.

As a result, examination of other potential avoidance alternatives (besides just the 63rd Avenue Option) was undertaken for the W59 Alternative. At the same time, the study team reevaluated the historic properties in the area. This reevaluation confirmed the importance and eligibility for protection from Section 4(f) for the Hudson Farm and Barnes Dairy Barn, but also determined that the Dobbins Road Streetscape was no longer eligible. This finding allowed for greater flexibility in locating freeway alignments in the area. With this new information, the project team evaluated alignments that would be located east of, west of, and between the 63rd Avenue Option and the 61st Avenue Option.

After extensive discussions with the City of Phoenix and MAG, FHWA and ADOT decided to support the alignment that would be located between the 63rd Avenue Option and the 61st Avenue Option (termed the 62nd Avenue Option). The 62nd Avenue Option would avoid historic properties in the area and would not conflict with City-approved zoning activities in Laveen Village; therefore, the 62nd Avenue Option of the W59 Alternative was advanced for further study and the other options were eliminated from further consideration.

3.1.8 Community Alignment

In January 2010, the ADOT Director received a letter from the Community Governor, who indicated that the Community was willing to assist in conducting a study of the proposed South Mountain Freeway on Community land. The Governor requested that the following concerns be addressed in developing a proposed alignment on Community land:

- mitigation of negative impacts of the freeway (noise, trash, etc.)
- avoidance of cultural sites and culturally important properties
- preservation of traditional routes and wildlife corridors between the Sierra Estrella and the South Mountains
- reduction of truck and commuter traffic on 51st Avenue and Beltline Highway

In response, the project team conducted preliminary analyses of projected engineering issues, cultural resources impacts, natural resources, multiuse crossings, air quality impacts, noise level impacts, socioeconomic impacts, and Section 4(f) issues. The project team created preliminary designs for major features of the potential freeway alignment, including proposed freeway cross sections, horizontal and vertical alignments, service traffic interchanges, modifications to local streets and intersections, drainage facilities, bridge structures, major utilities, maintenance needs, landscaping, and aesthetic components. The project team also developed traffic projections for the Community Alignment. The project team compiled a description of current conditions along the Community Alignment and briefly assessed the types of impacts the Community could expect from construction and operation of a freeway along the Community Alignment.

ADOT discussed the results of the preliminary analyses with the Community's Transportation Technical Team (TTT) in the summer and fall of 2010 and delivered its report on these preliminary analyses in November 2010. Between December 2010 and March 2011, the Community conducted extensive outreach to its members regarding the proposed Community Alignment. After considering the project team's preliminary findings and the comments and concerns of its members, the Community Council approved Resolution GR-164-11 authorizing a referendum of Community members to choose between three freeway options: 1) Build On GRIC Land; 2) Build Off GRIC Land and; 3) Do Not Build. The referendum occurred in February 2012, and Community members voted in favor of the no build option. Therefore, the Community Alignment was not carried forward for further study.

3.1.9 Design Considerations for the SR 30 System Traffic Interchange

As discussed in Section 2.0, *Traffic Data*, and shown in Figure 2.1, SR 30 is planned to connect to SR 202L between Broadway Road and Southern Avenue with a system traffic interchange. The ultimate design of the system traffic interchange also includes a connection to the east side of SR 202L. To facilitate the connection, additional freeway lanes and local access modifications would be needed along SR 202L between Dobbins Road and Buckeye Road. Coordination between the engineering and environmental documents for these two future freeways is ongoing to ensure that conflicts are avoided or minimized. The modifications or enhancements that have been included in the proposed SR 202L design includes:

- The profile of SR 202L on the north side of the river was raised to provide space for SR 30 lanes to cross under SR 202L and the Salt River bridge was extended to allow SR 30 to ultimately pass under the freeway and continue to the east.
- The SR 202L median was split from Broadway Road to south of Southern Avenue to provide space for a potential DHOV connection.
- A split diamond interchange configuration was implemented between Broadway Road and Lower Buckeye Road to provide space for the east to north and south to west system ramp connections onto SR 202L. The access roads between Broadway Road and Lower Buckeye Road were designed so that they would not conflict with the system ramps.
- The SR 202L main line horizontal alignment was shifted slightly to the west to improve the geometry of the system interchange and to create more space between the freeway main line and the adjacent channel for future widening.
- The SR 202L bridge overpasses between Elliot Road and Buckeye Road were all designed so that future lane widening would not result in sight distance or clearance deficiencies.
- The SR 202L entrance and exit ramps in this area were all designed so that future lane widening would not require major reconstruction of the gore areas.

Other design considerations may be added to the SR 202L project during final design and as the SR 30 design progresses. The preliminary design and environmental clearance for SR 30 are expected to be completed in early 2016. Final design and construction is anticipated to begin around 2026. Although the SR 30 corridor funding was recommended to be deferred by the MAG Regional Council (MAG 2010a), it remains a priority to develop a cost effective and coordinated implementation plan for the SR 202L corridor and the future system traffic interchange with SR 30.

3.1.10 Design Considerations for the I-10 Light-Rail Transit Corridor

In 2007, Valley Metro initiated a study of high-capacity transit options within the I-10 (Papago Freeway) corridor. Light rail has been identified as the preferred transit mode and a preferred alignment has been determined. The preferred route would connect to the existing light rail service in downtown Phoenix. From downtown Phoenix, the route would head west to I-17 and then north to I-10 along the frontage road that is just west of I-17. At I-10, light rail would operate in the freeway median for approximately three miles between I-17 and 47th Avenue. The route would then transition via a bridge over the westbound freeway traffic lanes to the north side of I-10. At that point, the route would remain on the north side of the freeway until it reaches the existing 79th Avenue Park-and-Ride. Extensive coordination has occurred between ADOT and Valley Metro to minimize future disruption. It is anticipated that the freeway construction would occur before the light rail construction.

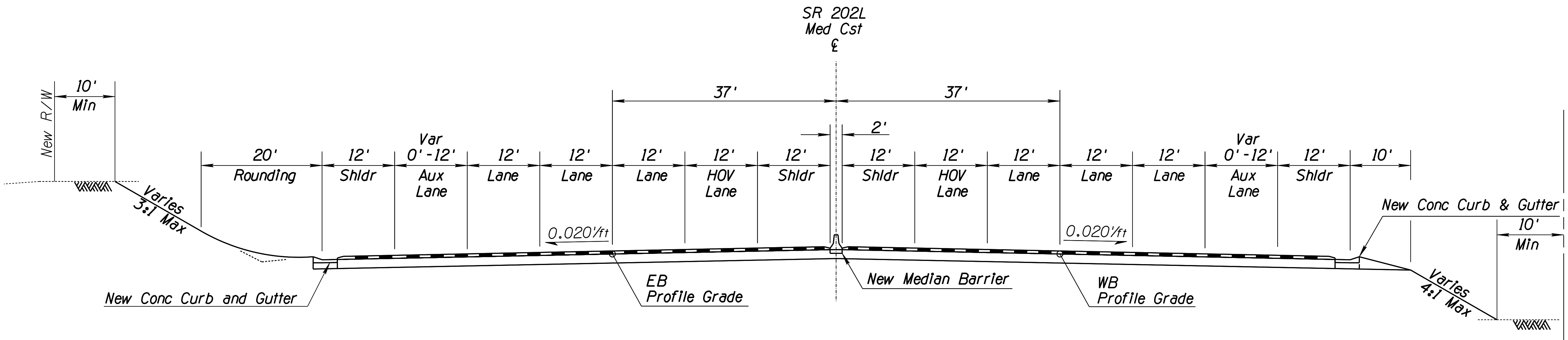
3.2 Design Overview

The proposed construction of SR 202L (South Mountain Freeway) includes three general purpose and one HOV lane in each direction (see Figure 3.9). The travel lanes would be 12 feet wide with full inside and outside shoulders. The pavement would be overlaid with asphalt-rubber/asphaltic-concrete friction course (AR-ACFC). With few exceptions, the median would be closed with a concrete median barrier separating the directions of travel. Entrance and exit ramps connect using a parallel-type configuration coupled with auxiliary lanes between service traffic interchanges, as warranted.

The following sections focus on the major design features of the proposed freeway, including design controls, system traffic interchanges, service traffic interchanges, streets and intersections, horizontal and vertical alignments, traffic design, drainage, bridge structures and walls, utilities, geotechnical, earthwork, right-of-way, constructibility and traffic control, and implementation. All of these items are incorporated into the probable cost estimate presented in Section 4.0.

3.3 Design Controls

The design criteria used to define the freeway elements presented in this L/DCR were developed in accordance with the ADOT RDG and Standard Drawings (all with current revisions and updates), as well the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (AASHTO 2004) (Green Book) and *Roadside Design Guide* (RSDG) (AASHTO 2006). Standard details from ADOT, MAG, and COP would be used for the project, as appropriate. The notable design criteria for the associated road types are presented in Tables 3.2 to 3.5. The source of the design criteria is the ADOT RDG unless otherwise noted in the table.



TYPICAL SR 202L SECTION

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.9
Proposed Freeway Typical Section

Table 3.2 – Design Controls for SR 202L Main Line

Item Description	Proposed Eight-lane Freeway
Typical section	see Figure 3.9
Design year	2035
Design vehicle	WB-67
Design speed	65 mph (minimum)
Superelevation	0.06 feet/feet (maximum)
Minimum vertical curve	800 feet
Maximum angle break	0º 45' 00"
Maximum gradient	3% (level terrain); 4% (rolling terrain); 5% (mountainous terrain)
Horizontal curve	1º 15' 00" maximum degree of curvature due to horizontal sight distance limitations Minimum length = 975 feet (15 times the design speed) (Spiral transitions are not used.)
Half road width (including shoulders, excluding auxiliary lanes)	73 feet
Lane width	12 feet
Median shoulder width	12 feet
Outside shoulder width	12 feet (no additional shy distance added)
Recovery area	ADOT RDG Section 303.2
Cross slope	0.02 feet/feet
Pavement design life	20 years
Barrier type	Outside: concrete (per ADOT C-Standards) Median: concrete (per ADOT C-Standards)
Curb and gutter type	ADOT Standard C-05.10 (Type B or C)
Access control	Full
Right-of-way	Minimum: 10 feet from outside toe of slope Desirable: 20 feet from outside toe of slope
Tapers	50 to 1 to drop main line lanes added by on-ramp lane (RDG Figure 504.8A) Design speed to 1 to drop main line lane or shoulder 25 to 1 to add lane or shoulder
Utilities	*Policy for Accommodating Utilities on Highway Rights-of-Way* (ADOT 2009b)
Lighting	Median mounted with supplementary lighting at interchanges

Table 3.3 – Design Controls for Directional Ramps

Item Description	Directional Ramp
Design year	2035
Design vehicle	WB-67
Design speed	55 mph (main body); 65 mph (at main line exit)
Superelevation	0.06 feet/feet (maximum)
Maximum gradient	4% upgrade; 5% downgrade
Horizontal curve	5º 15' (maximum degree of curvature)
Road width	36 feet (40 feet with barrier) (2-lane ramps)
Lane width	12 feet
Barrier type	ADOT Standard C-10.62
Curb and gutter type	ADOT Standard C-05.10, Type B or C

Table 3.4 – Design Controls for Entrance and Exit Ramps

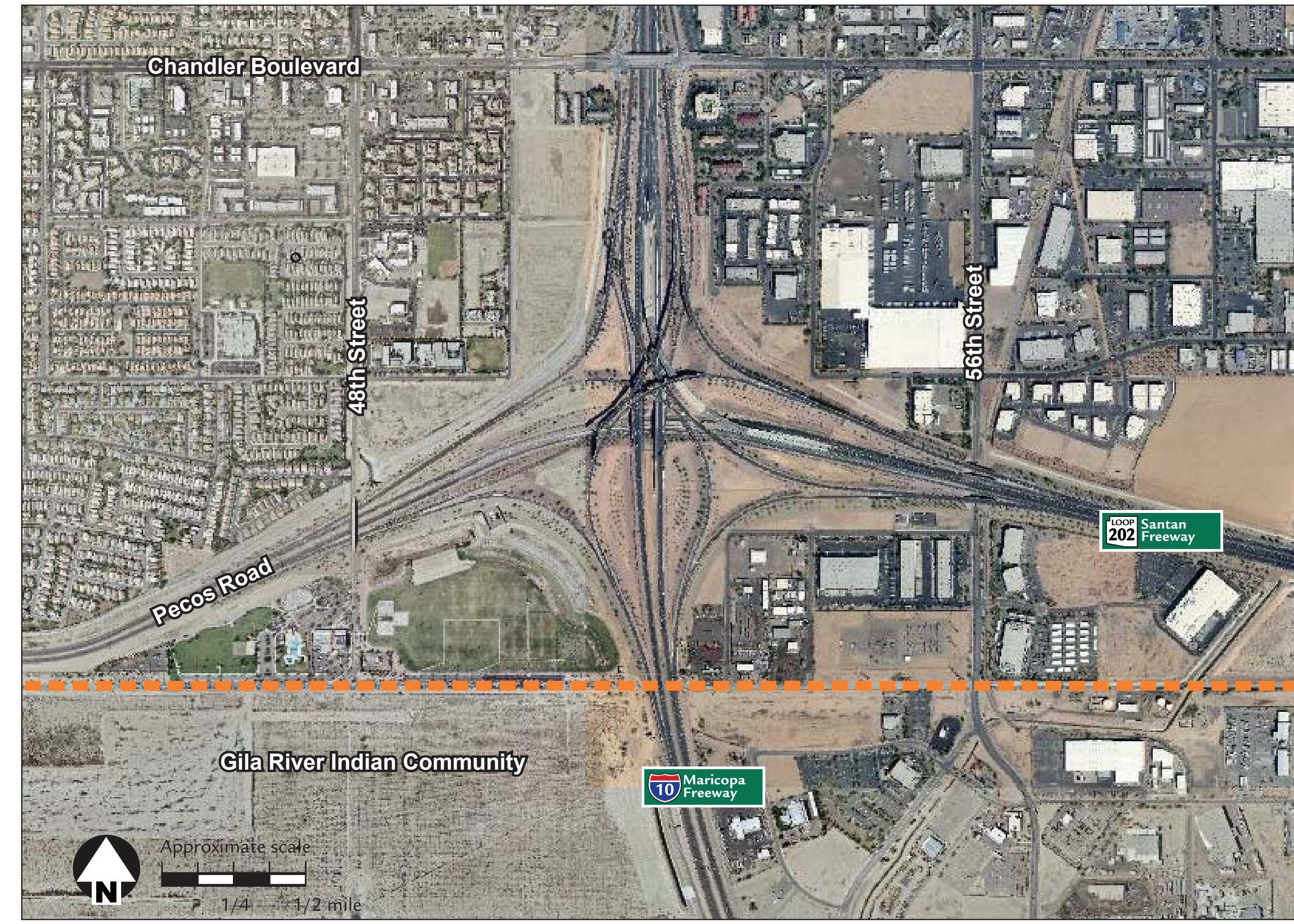
Item Description	Entrance Ramp	Exit Ramp
Design year	2035	
Design vehicle	WB-67	
Design speed	55 mph (gore area) 50 mph (ramp body) 35 mph (intersection)	60 mph (gore area) 50 mph (ramp body) 35 mph (intersection)
Superelevation	0.06 feet/feet (maximum)	
Maximum gradient	4% upgrade/5% downgrade	
Horizontal curve	Max D_c at gore area is controlled by minimum superelevation breakover criteria of 2 percent (ADOT RDG Section 504.3) Max D_c for 50 mph and 35 mph design speed is 6º 53' and 17º 30', respectively Length = 500 feet minimum for Δ = 5°; increase length by 100 feet for each 1° decrease in Δ	
Road width	28 feet (ramp body, excluding shy distance)	Varies at intersection 22 feet (gore and ramp body, excluding shy distance)
Lane width	12 feet	
Recovery area	ADOT RDG Section 303.2	
Barrier type	ADOT Standard C-10.62	
Curb and gutter type	ADOT Standard C-05.10, Type B or C	

Table 3.5 – Design Controls for Major Arterial Streets

Item Description	Major Arterial Street
Crossroad typical section	COP Detail Number P1010 (Section B or C)
Design year	2035
Design vehicle	WB-67
Design speed	50 mph (45 mph at interchanges)
Road width	Section B: 94 feet Section C or CM: 74 feet
Number of through lanes	Section B: 6 lanes Section C or CM: 4 lanes
Number of left-turn lanes at interchange	Based on traffic analysis
Number of right-turn lanes prior to interchange	Based on traffic analysis
Bike lane	6 feet (includes gutter)
Sidewalk	5 feet
Pavement design life	20 years
Drainage (pavement)	10 years
Right-of-way	Section B: 130 feet Section C: 110 feet
Lane width	11 or 12 feet
Clear zone width	1.5 feet from face of curb minimum, 6 feet desirable
Road foreslope	3:1
Median	14 feet (4 feet within interchange)
Curb and gutter type	MAG Standard Detail 220 (ADOT Standard C-05.10, Type D within access control)

3.4 System Traffic Interchanges

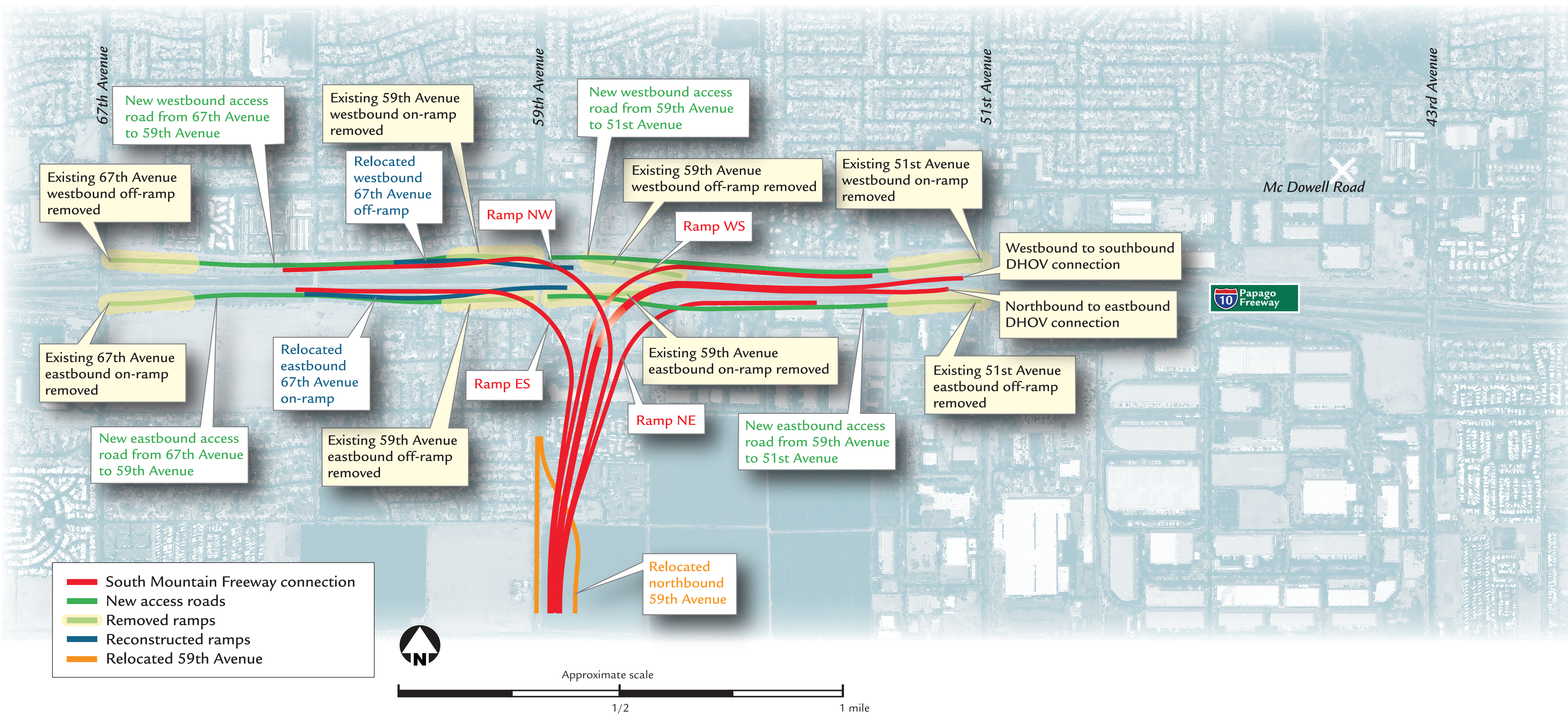
The eastern and western termini for the proposed freeway are shown in Figures 3.10 and 3.11, respectively. The eastern terminus for the proposed freeway would connect to the existing system traffic interchange that connects I-10 (Maricopa Freeway), SR 202L (Santan Freeway), and Pecos Road. The proposed freeway would replace the Pecos Road connection shown in Figure 3.10. The system traffic interchange was recently expanded to include a DHOV connection between I-10 (Maricopa Freeway) and SR 202L (Santan Freeway) for the south-to-east and west-to-north movements. Also, HOV lanes were added to SR 202L (Santan Freeway) from I-10 to Gilbert Road. The HOV lanes proposed as part of the South Mountain Freeway project would connect to the HOV lanes on the Santan Freeway. Additional improvements to the existing system traffic interchange ramps are not included as part of the SR 202L (South Mountain Freeway) construction. It is anticipated that ramp north-to-west and ramp east-to-south would be widened from one lane to two lanes with a future improvement project. The design of the proposed freeway would allow for the additional ramp lanes within the existing right-of-way. Provisions have not been made for a DHOV connection to connect SR 202L (South Mountain Freeway) to I-10 (Maricopa Freeway).



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.10
System Traffic Interchange at Eastern Terminus

The western terminus for the proposed freeway would connect to I-10 (Papago Freeway) with a new three-legged system traffic interchange at 59th Avenue alignment. The new system traffic interchange would have three levels with four directional ramps—ramp north-to-east (NE), ramp north-to-west (NW), ramp west-to-south (WS) and ramp east-to-south (ES)—connecting SR 202L (South Mountain Freeway) and I-10 (Papago Freeway). Two DHOV connection ramps (WS and NE) would be constructed with the system traffic interchange. The design controls for the directional ramps are presented in Table 3.3. The service traffic interchange ramps along I-10 between 67th and 51st avenues would be modified as shown in Figure 3.11 to allow the freeway-to-freeway connection. The system traffic interchange and I-10 modifications have been developed in coordination with a planned high-capacity transit corridor within I-10 right-of-way. ADOT and METRO have engaged in an on-going planning and project development process to coordinate the two projects.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

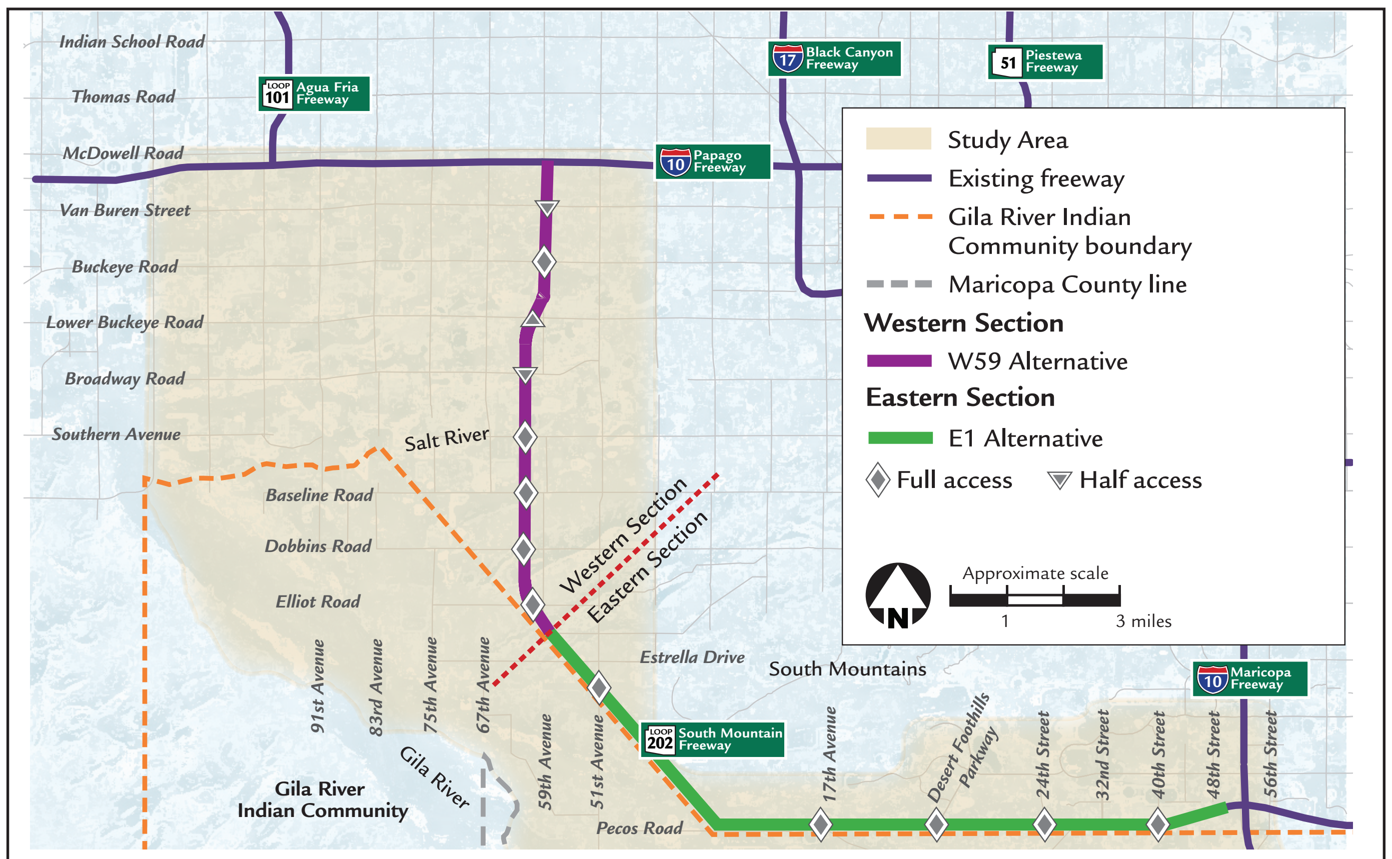
Figure 3.11
Proposed System Traffic Interchange at Western Terminus

3.5 Service Traffic Interchanges

Thirteen compact diamond service traffic interchanges are proposed along SR 202L (South Mountain Freeway). As presented in Figure 3.12, the majority of the service traffic interchanges would provide full access. Half access to the south would be provided at Van Buren Street because of its proximity to the proposed system traffic interchange at I-10 (Papago Freeway). Other notable information related to the service traffic interchanges include:

- At the 40th Street interchange, a bus-only slip ramp is provided from the westbound on-ramp to the 40th Street park-and-ride lot located just north of the interchange.
- A modified diamond interchange is proposed at Dobbins Road to avoid impacts to historic properties and reduce impacts on planned development. In each direction, the off-ramp crosses under the freeway and ties into Dobbins Road coincident with the entrance ramp.
- A split diamond interchange with connector roads would be provided between Broadway Road and Lower Buckeye Road because of its proximity to the planned interchange with SR 30 and because it minimizes impacts to the residential neighborhood north of Broadway Road.

The design controls for the entrance and exit ramps are presented in Table 3.4. In accordance with the ADOT RDG, entrance ramps would have two lanes that begin to taper to one lane after the back of the main line and ramp gore to provide for ramp metering, if necessary. The service traffic interchanges should be consistent with the most current COP Street Classification Map, lane assignments, and cross sections.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.12
Proposed Service Traffic Interchange Locations

3.5.1 Auxiliary Lanes

Auxiliary lanes would be designed in accordance with the *Interim Auxiliary Lane Design Guidelines* (ADOT 1996). Auxiliary lanes would be provided between successive service traffic interchanges located within 1.5 miles of each other. Parallel drop- and add-lanes would be provided between interchanges separated by more than 1.5 miles. Table 3.6 presents the application between each service traffic interchange along the proposed freeway.

Table 3.6 – Auxiliary Lane Application

Location	Spacing (miles)	Application
40th Street to 24th Street	2.0	Parallel add- and drop-lanes
24th Street to Desert Foothills Parkway	1.8	Parallel add- and drop-lanes
Desert Foothills Parkway to 17th Avenue	1.9	Parallel add- and drop-lanes
17th Avenue to 51st Avenue	5.5	Parallel add- and drop-lanes
51st Avenue to Elliot Road	1.5	Auxiliary lanes
Elliot Road to Dobbins Road	1.0	Auxiliary lanes
Dobbins Road to Baseline Road	1.0	Auxiliary lanes
Baseline Road to Southern Avenue	1.0	Auxiliary lanes
Southern Avenue to Broadway Road	1.0	Auxiliary lanes
Broadway Road to Lower Buckeye Road	1.0	not applicable
Lower Buckeye Road to Buckeye Road	1.0	Auxiliary lanes
Buckeye Road to Van Buren Street	1.0	Auxiliary lanes

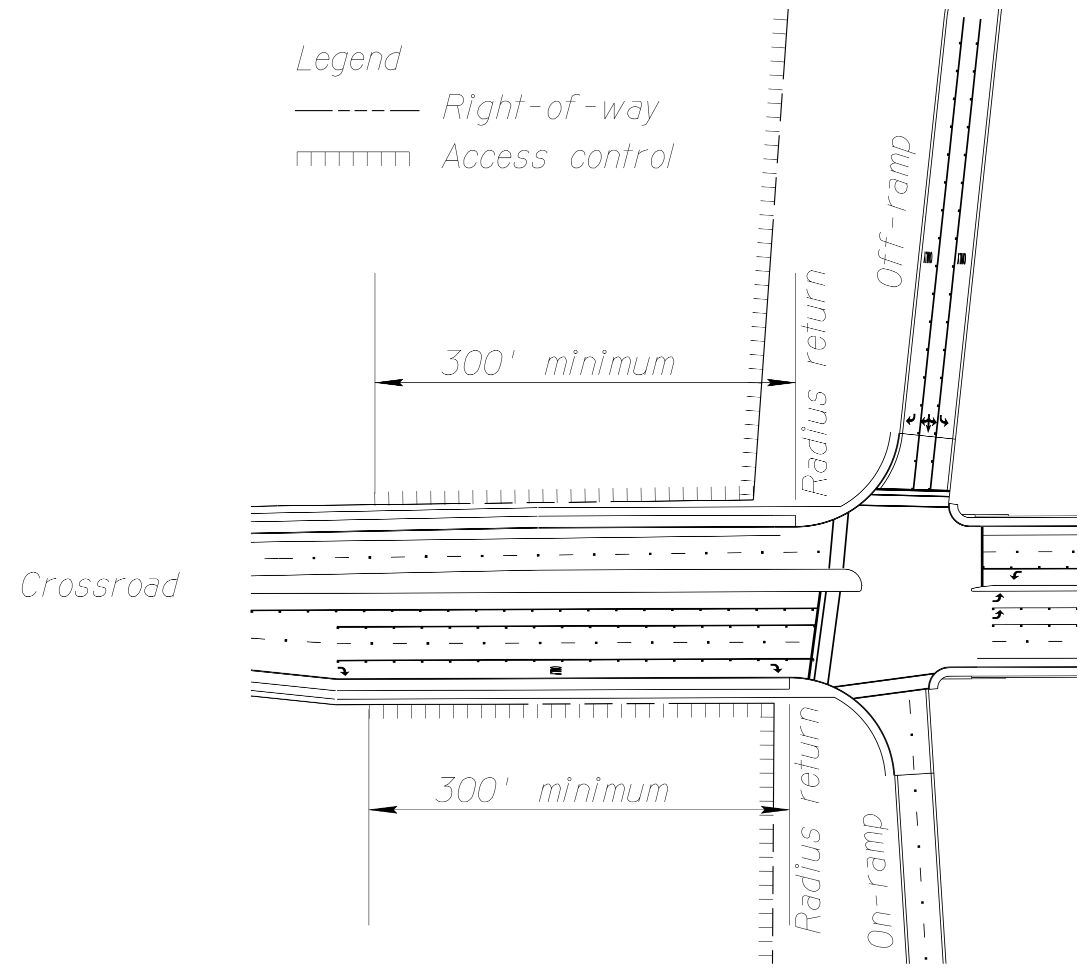
The use of parallel drop- and add-lanes at spacing greater than 1.5 miles is consistent with the ADOT RDG and supported by the main line traffic analysis presented in Section 2.3. Providing an auxiliary lane for the full length between service traffic interchanges would increase the construction cost (extra pavement, wider bridges, etc.) and increase the right-of-way footprint. For these reasons, the proposed design includes the auxiliary lane application as presented in Table 3.6.

3.5.2 Access Control

The turn lanes proposed at the service traffic interchange intersections (ramps and crossroads) are presented in Section 2.5, *Service Traffic Interchange Analysis*. The crossroads at service traffic interchanges have been widened to allow for the additional turn lanes. The limits of PCCP and access control along the crossroad at service traffic interchanges is designated as 300 feet beyond the ramp terminal radius return. A typical application of the access control is shown in Figure 3.13. The right-of-way and access control lines for the specific project interchanges are presented on the roadway plan sheets in Appendix A.

Coordination with ADOT Right-of-Way Group would continue through final design to evaluate the opportunities for acquiring more access control at the proposed service traffic interchanges. Examples of the challenges faced with respect to access control near the proposed interchanges include:

- Driveways for existing residential, commercial, and industrial developments would be located within 750 feet of the proposed interchanges at Van Buren Street, Buckeye Road, Broadway Road, Baseline Road, and Desert Foothills Parkway. There are also existing driveways along 59th Avenue that would be located within the access control area along the frontage roads.



South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.13
Typical Access Control

- Existing or planned signalized intersections would be located within 1,320 feet of the proposed interchanges at Lower Buckeye Road, Broadway Road, Southern Avenue, Baseline Road, Dobbins Road, and Elliot Road.

3.6 Streets and Intersections

All but one of the major streets that the freeway would cross with a grade separation (others streets would be terminated as discussed in the following) are under the jurisdiction of COP. The lone exception is Ivanhoe Street, which is located east of 51st Avenue in the Dusty Lane community and is maintained by the Maricopa County Department of Transportation (MCDOT). The crossroad classifications presented in Table 3.7 were determined by reviewing COP Street Classification Map (COP 2007) and by discussions with representatives of COP and MCDOT.

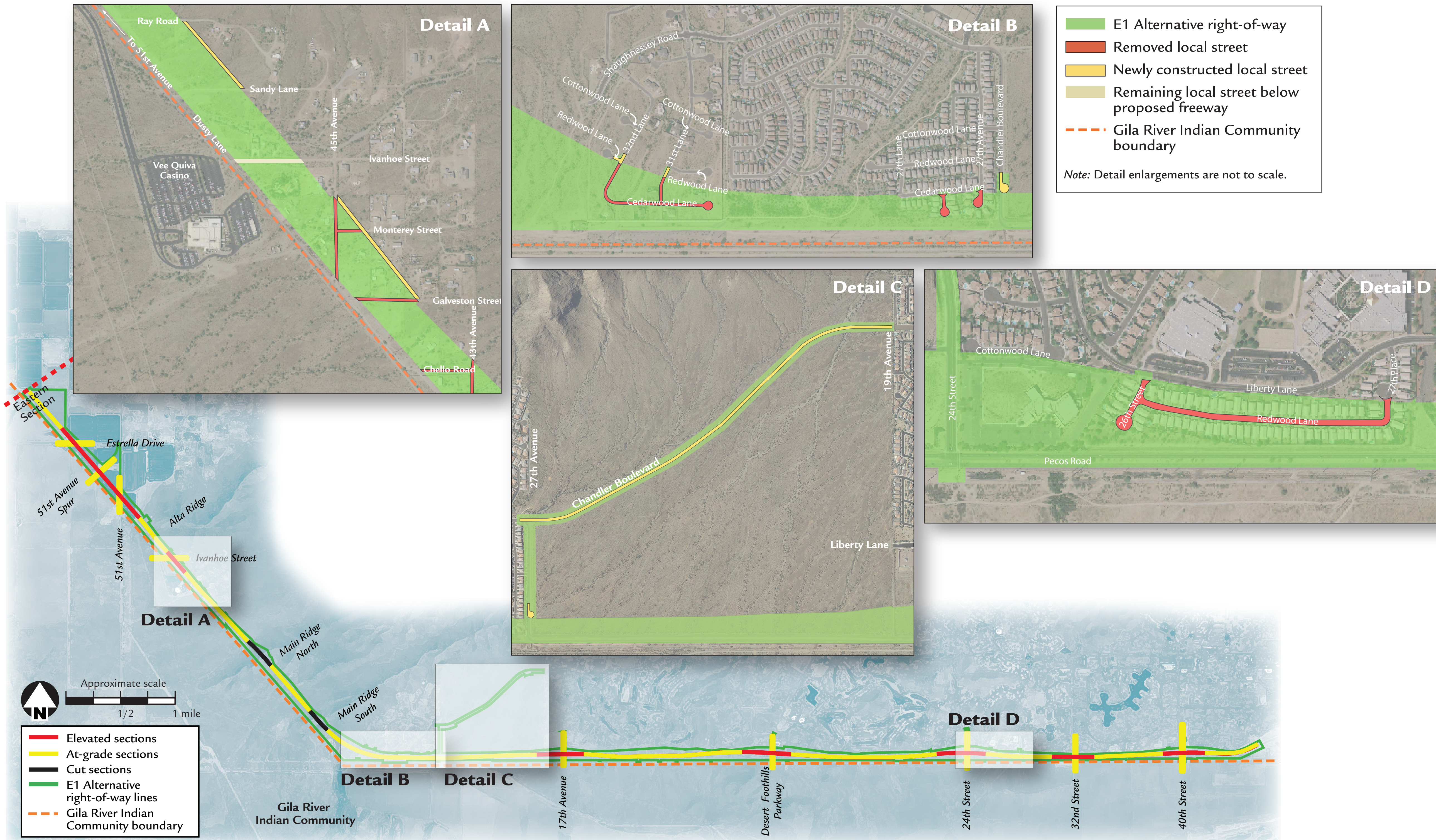
Crossroad typical sections were determined by matching the street classification with the appropriate city and county standard details (additional information regarding the street classifications, typical sections, and design controls are presented in Tables 2.5 and 3.5). Many existing crossroads have not been improved to their ultimate typical section. In these instances, at the direction of the city and county, the proposed crossroad centerline was centered on section lines when possible.

Table 3.7 – Crossroad Classifications

Crossroad	Classification	Crossroad Profile at SR 202L	SR 202L Profile at Crossroad	Crossing Type
40th Street	Arterial street	At grade	Elevated	CDI
32nd Street	Arterial street	At grade	Elevated	Grade separation only
24th Street	Arterial street	At grade	Elevated	CDI
Desert Foothills Parkway	Arterial street	At grade	Elevated	CDI
17th Avenue	Arterial street	At grade	Elevated	CDI
Ivanhoe Street	Collector street	At grade	Elevated	Grade separation only
51st Avenue	Arterial street	At grade	Elevated	Grade separation only
51st Avenue Spur	Arterial street	At grade	Elevated	CDI
Estrella Drive	Arterial street	At grade	Elevated	Grade separation only
Elliot Road	Arterial street	At grade	Elevated	CDI
Dobbins Road	Arterial street	At grade	Elevated	CDI (modified)
Baseline Road	Major arterial street	At grade	Elevated	CDI
Southern Avenue	Arterial street	At grade	Elevated	CDI
Broadway Road	Arterial street	At grade	Elevated	Half-diamond interchange
Lower Buckeye Road	Arterial street	At grade	Elevated	Half-diamond interchange
59th Avenue	Arterial street	At grade	Elevated	Grade separation only
Buckeye Road	Major arterial street	At grade	Elevated	CDI
Van Buren Street	Arterial street	At grade	Elevated	Half-diamond interchange
Roosevelt Street	Collector street	At grade	Elevated	Grade separation only

The proposed freeway would also cross a number of local streets that would be reconfigured by removing the street, reconstructing the street, dead-ending the street, or constructing a new street to replace connectivity. Examples of these approaches are depicted in Figures 3.14 and 3.15 and described in the following:

- Residential streets in Detail A, B, and C of Figure 3.14 and Detail B of Figure 3.15 that would be within the freeway right-of-way would be removed. Adjacent to the freeway right-of-way the streets would either be dead-ended using a cul-de-sac or new streets would be constructed to allow circulation to continue similar to the existing conditions.
- Detail C in Figure 3.14 shows the plan to construct Chandler Boulevard between 19th Avenue and 27th Avenue. This new segment is necessary to provide access to the residential neighborhood west of 27th Avenue because Pecos Road, currently their only access road, would be removed with the construction of the proposed freeway. The construction of Chandler Boulevard has been coordinated with COP and Arizona State Land Department (ASLD) which own the land to the north and south, respectively.



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.14
Local Street Reconfigurations, Eastern Section

South Mountain corridor team

South Mountain Freeway L/DCR

I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.15
Local Street Reconfigurations, Western Section

The proposed modifications to the local streets are included in the plans in Appendix A. ADOT would coordinate with COP during final design to accommodate cross street improvements at the proposed interchanges.

3.7 Horizontal and Vertical Alignments

The plans in Appendix A include detailed horizontal and vertical alignment tables for the freeway main line, ramps, and crossroads.

3.8 Traffic Design

The following sections describe the proposed concepts for guide signs, pavement marking, traffic signals, lighting, freeway management system (FMS), and vehicle counting system elements. The traffic design concepts were developed based on the guidelines presented in the following documents:

- *Manual on Uniform Traffic Control Devices* (MUTCD) (FHWA 2009)
- *Arizona Supplement to the MUTCD* (ADOT 2009)
- *ADOT Signals and Lighting Standard Drawings* (ADOT 2010c, with updates)
- *ADOT Signing and Marking Standard Drawings* (ADOT 2014, with updates)
- *ADOT FMS Design Guidelines* (ADOT 2009c)
- *ADOT Traffic Engineering PGP* (ADOT 2000, with updates)

The traffic design detail would continue to be refined through final design. Coordination would continue with adjacent projects, such as the high-capacity transit corridor to address sign locations, light pole locations, and conduit installation.

3.8.1 Signing

Guide Signs
The proposed freeway would require extensive guide signing to be installed along the corridor. The guide signs would be mounted on overhead cantilever sign structures located on the outside of the freeway lanes, overhead tubular frame structures spanning all the freeway lanes in one direction, or median sign structures (1- or 2-sided) mounted in conjunction with the median barrier wall. Guide signs used for this project would include:

- guide signs located within 2 miles of the approaches to the system traffic interchanges
- service traffic interchange sequence signs, listing the next three service traffic interchanges, with mileages
- sequential exit ramp guide signs for both system traffic interchange ramps and service traffic interchange ramps, including appropriate E11-1 (“EXIT down arrow ONLY”) and E11-1a (“EXIT ONLY”) panels

A guide sign concept plan is included in the project plans in Appendix A. Final sign locations would be determined during final design based on the locations of utilities, drainage elements, right side barrier, and other features.

Each freeway interchange would also have several overhead guide signs on the crossroad approaches to the freeway, including signs for the freeway route number with cardinal directions and destination cities, and for lane assignments at on-ramp approaches.

Overhead structures and way-finding signage would be provided as appropriate for the existing Pecos/40th Street park-and-ride (existing) and any future park-and-ride lots. The overhead signs would be placed along the freeway main line and the smaller green way-finding signs would be located on the off-ramps and adjacent major streets.

Other Signs
The appropriate regulatory, warning, and other ground-mounted guide sign locations would be determined during final design for the main line freeway, on- and off-ramps, and on interchange crossroads within approximately 500 feet of the freeway.

3.8.2 Pavement Marking

The conceptual pavement marking plan for delineating the freeway main line general purpose and HOV lanes, on- and off-ramps, and crossroad lanes is included in the project plans in Appendix A. At approaches to system traffic interchanges, there would be advance in-lane pavement markings identifying lanes connecting via directional ramps to another freeway.

3.8.3 Traffic Signals

New traffic signals would be installed at the service traffic interchange ramp and crossroad intersections. All of the service interchange crossroads are currently maintained by COP. The traffic signal design would meet ADOT standards and be coordinated with the adjacent signals. The final signal design, including ownership and maintenance responsibilities, would be determined during final design and documented in intergovernmental agreements (IGAs).

3.8.4 Lighting

The lighting design concept would provide for a uniform lighting design that adheres to all ADOT lighting standards. The desired lighting illumination level and uniformity ratio that conforms to ADOT standards would be addressed during final design.

Freeway Main Line and Ramp Lighting
Uniform lighting levels for the freeway main line would be achieved with standard pole fixtures located along the median barrier wall on 70-foot-high U-poles with two 400-watt lamps on each pole where median barrier is present. Other types would be used where the median is open. The poles would be spaced at intervals to achieve desired lighting levels.

Main line lighting at service traffic interchanges would be supplemented with added lights on the on- and off-ramps, or 100-foot high multi-light mast lights between freeway main line and on- and off-ramps.

Main line lighting at the system traffic interchange at I-10 (Papago Freeway) would require installation of multi-light high mast poles to provide adequate lighting for the various flyover ramps. Lighting at the system traffic interchange at I-10 (Maricopa Freeway) is substantially in place; however, limited areas may require additional lighting.

Along the Pecos Road section, the freeway would be adjacent to residential areas for approximately 9 miles. The lighting plan through this area would evaluate the possibility of orienting and directing lighting to avoid spillover and nuisance lighting into adjacent residential areas.

The freeway also goes through approximately 5 miles of desert terrain. The possibility of reduced or no lighting in this section would be evaluated. However, critical underground conduit crossings and connection points would be installed for future use. The current absence of power drops through this area may also limit lighting design options. Locations where electrical service is required would be determined during final design.

Guide Sign Lighting
Guide signs located within 2 miles of the approach to a major system traffic interchange no longer require guide sign lighting. The appropriate sign sheeting material would be specified during final design.

Bridge Underdeck Lighting
The majority of the bridges located along the proposed freeway would be overpasses crossing over the cross streets. Because they would be closed structures, crossroad underdeck lighting may be provided. The bridge underdeck lighting would be determined during final design. Maintenance and annual electrical costs of underdeck lighting of cross streets passing under the freeway is a local agency responsibility and would require IGAs to be established during final design.

3.8.5 Freeway Management System

The location of the FMS trunkline conduit, pull boxes, detectors, ramp meters, and other FMS elements would be determined during final design. The full implementation of FMS, such as node buildings, dynamic message signs (including median barrier foundations), closed-circuit television, has been recommended for inclusion in the construction of the project. The hardware to support advanced traffic management is also recommended for inclusion in the project.

The installation of all FMS elements may be contingent on availability of freeway fundings. The implementation could range from the system (minimum) of underground conduits, loops, pull boxes, and cabinets to the full installation of all elements. At a minimum, all elements that would avoid future closures and traffic control should be considered for inclusion in the initial project.

3.8.6 Vehicle Counting System

ADOT's Multimodal Planning Division's Transportation Data Management System requires the installation of Type C loops and pullboxes for traffic counter systems (including speed, vehicle, and axle counts) on all main line lanes, directional ramps, on-and off-ramps, and frontage roads, and Type S loops and other related equipment for weigh-in-motion (WIM) classification systems at specified locations. Locations for loop placement would be coordinated during final design.

ADOT can use FMS RADS data for speed and some classification counts; however, FMS loops do not have capability to do axle counts. Any separate installations for axle counts and/or WIM capability would require coordination for installation placement locations during final design.

3.9 Drainage

3.9.1 Existing and Proposed Conditions

The existing conditions were researched and analyzed to prepare an accurate proposed off-site conditions analysis. A proposed conditions off-site analysis was performed to determine the magnitude of off-site flows currently affecting the proposed freeway alignment. The off-site drainage design for this project was prepared in accordance with the following guidelines:

- *ADOT Highway Drainage Design Manual Volume I-Hydrology* (ADOT 1993)
- *ADOT RDG* (ADOT 2012, with revisions and amendments)
- *Drainage Design Manual for Maricopa County, Arizona, Hydraulics* (FCDMC 2010)
- *Drainage Design Manual for Maricopa County, Arizona, Hydrology* (FCDMC 2009)

North of the Salt River, the stormwater runoff generally flows from northeast to southwest. South of the Salt River to the SMPP, the stormwater runoff generally flows from southeast to northwest. The ultimate outfall from both areas are the Gila and Salt Rivers. South of the South Mountains, runoff generally flows north to south onto Community land, ultimately outfalling into the Gila River.

Existing drainage and flood control features have been identified through field visits, aerial photography, as-built plans, and drainage reports on file with ADOT, FCDMC, and COP. Notable features include:

- The Salt River crosses the freeway alignment from east to west between Broadway Road and Southern Avenue.
- Floodplains exist along the Salt River and along the RID canal that crosses the freeway alignment from east to west between Buckeye and Lower Buckeye roads.
- The Laveen Area Conveyance Channel (LACC) crosses the freeway alignment from east to west south of Baseline Road.
- Several irrigation supply and return ditches (lined and earthen) located along the sides of major roads and agricultural fields cross the freeway alignment.

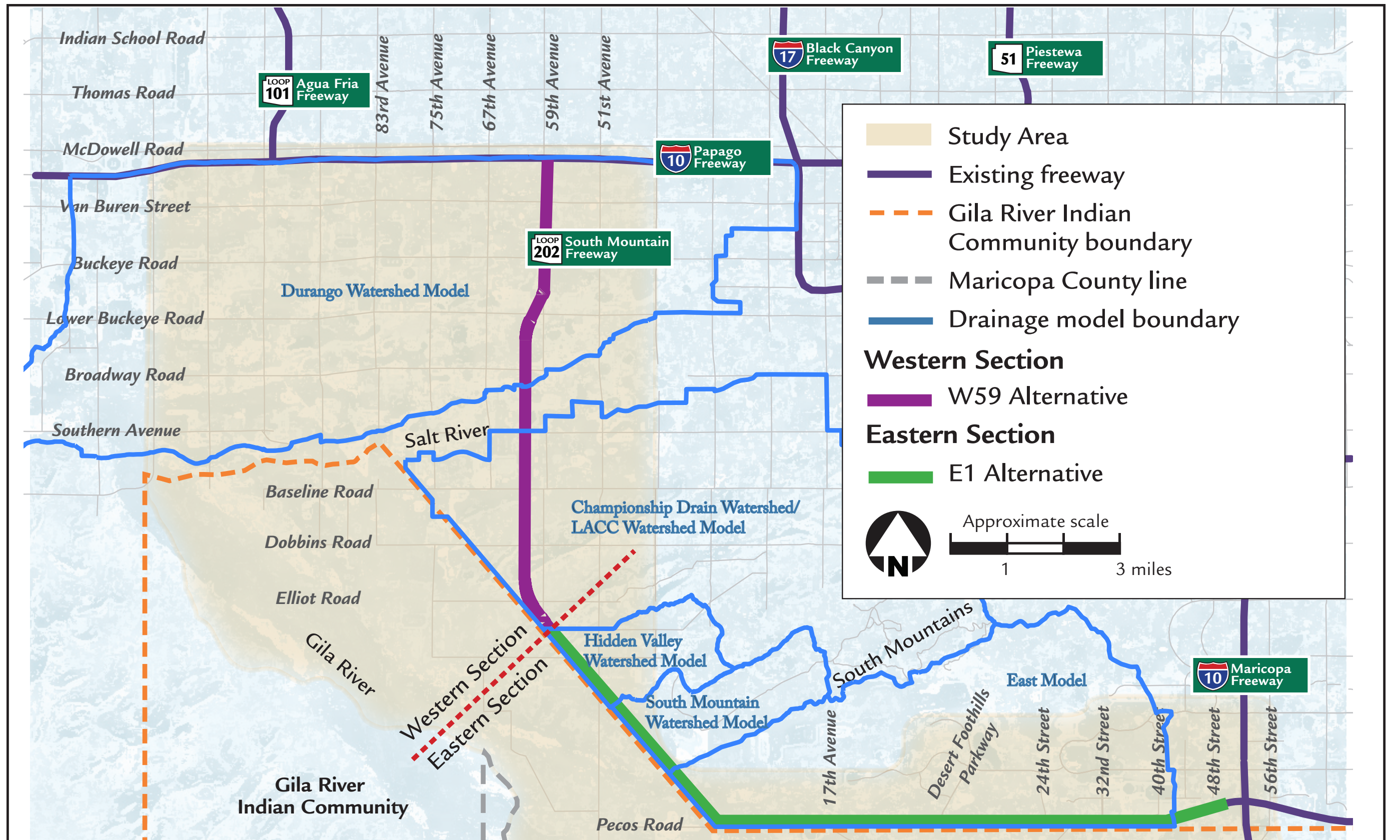
Major storm drains and retention basins that influence stormwater runoff within the Study Area include:

- 59th Avenue storm drain, I-10 (Papago Freeway to Buckeye Road
- 43rd Avenue storm drain from Baseline Road to the Salt River
- Cesar Chavez park and Aguila golf course at 35th Avenue and Dobbins Road
- Baseline Road storm drain from 7th Avenue to 43rd Avenue
- 43rd Avenue detention basin at Southern Avenue

3.9.2 Existing Studies

Several existing studies were reviewed for information regarding the stormwater runoff in the Study Area and are listed below.

- *Laveen Area Drainage Master Plan* (ADMP), 1991, prepared by Cella Barr & Associates for FCDMC. This ADMP determined conceptual designs to reduce flooding in the area between the South Mountains North Ridge and Salt River. Three Hydraulics Engineering Circular (HEC)-1 models were developed as part of the ADMP. They included the Championship Drain, Hidden Valley, and the South Mountain Models (see Figure 3.16 for model coverages). HEC-1 models were created for the existing conditions, as well as for the proposed drainage improvements.
- *Design Hydrology for the LACC*, 2002, by FCDMC. This study documented the hydrologic analysis of the LACC using the Laveen ADMP prepared by Cella Barr & Associates, September 1991, and the South Phoenix/Laveen Drainage Improvement Project, June 1997, prepared by HDR Engineering, Inc., as the basis for the existing and future condition hydrology.
- *Durango Area Drainage Master Plan* (ADMP), 2002, by Dibble and Associates for FCDMC. This ADMP determined conceptual designs to reduce flooding in the area between the Agua Fria River and 47th Avenue. Several channels, basins, and a storm drain were proposed. A HEC-1 model was created for the existing conditions and the proposed drainage improvements (Figure 3.16).
- *Candidate Assessment Report, Durango Regional Conveyance Channel* (DRCC), 2006, by Aspen Consulting Engineers for FCDMC. This report updated the ADMP described above and advanced the



South Mountain corridor team

South Mountain Freeway L/DCR
I-10 (Maricopa Freeway) to I-10 (Papago Freeway)

Figure 3.16
Drainage Model Coverages

design of the DRCC and the Sunland Channel. The updated plan for DRCC removed the channel in Phoenix, relocated the 91st Avenue Basin to 99th Avenue, and placed concrete box culverts under 91st Avenue, 99th Avenue, and 107th Avenue to connect existing retention basins. The HEC-1 model was updated for the proposed drainage improvements. Conceptual design plans were created for proposed regional basins and channels.

- *Sun Valley ADMP*, 2007, by J. E. Fuller for FCDMC. This ADMP is currently being developed to ensure responsible floodplain management and to coordinate flood control infrastructure improvements in conjunction with new development projects. The Sun Valley ADMP covers approximately 183 square miles, including the town of Buckeye and portions of unincorporated Maricopa County.

3.9.3 On-Site and Off-Site Analysis Criteria

The drainage evaluation was based on the requirements of Chapter 600 of the ADOT RDG, as discussed in the following.

- As presented in Table 603.2B, the storm drain system shall be designed for a 50-year storm frequency at depressed road locations. For nondepressed roads, the storm drain system shall be designed for a 10-year storm frequency.
- Depressed road criteria apply to any road with ponded depth (ignoring any drainage system) in excess of 30 inches. In this case, the storm drain systems shall be designed such that the hydraulic grade line is a minimum of 6 inches below top of grate.
- As presented in Table 603.2C, allowable spread on all roads shall not exceed the road gutter width, shoulder, and/or distress lane. On roads with more than one lane in each direction, the spread may encroach upon one-half of the adjacent lane for a 10 year storm frequency.
- The allowable spread should meet the criteria given in Table 603.2C; one-lane ramps shall have a 12 foot unponded width. Allowable spread on two-lane ramps shall not exceed the road gutter width, shoulder, and one-half of the adjacent lane for a 10-year storm frequency.
- Allowable ponding depth on highways shall not exceed the curb height for a 10-year storm frequency.
- The capacity of detention basins and ditches that are parallel to the road and serve to convey road drainage should be designed to meet the requirements of the 10-year storm frequency. Detention basins and ditches that intercept off-site flows should be designed for a 50-year storm frequency except where other conditions require a greater storm frequency.
- The 100-year storm frequency is also checked to ensure that water does not pond on properties adjacent to the freeway right-of-way.

3.9.4 Off-Site Drainage Design

The existing ground topographic information was reviewed to determine the high points, low points, and longitudinal slopes of the existing terrain along the upstream side of the proposed freeway. Along the Pecos Road section, existing culverts would be extended and channels/basins would be placed to convey existing flow levels to Community land. For the area between the Alta Ridge and the Pecos Road alignment, culverts would pass historic flows under the freeway to Community land. For the segment south of the Salt River and north of the South Mountains Alta Ridge, the off-site flow would be intercepted and conveyed to the LACC along the east side of the freeway in channels. For the segment north of the Salt River, the off-site flow would be intercepted and conveyed to the Salt River along the east side of the freeway in channels.

Eastern Section

Runoff generally flows from the South Mountains south through the residential and commercial developments onto Community land through pipes and culverts under the existing Pecos Road and overtopping Pecos Road. For the design of drainage facilities along the Pecos Road section of the proposed freeway, two HEC-1 analyses were prepared to determine the existing and proposed conditions. The Green and Ampt Infiltration Method and the S-Graph were used to determine rainfall losses and unit hydrograph, respectively. National Oceanic and Atmospheric Administration (NOAA) National Weather Service Atlas 14 (referred to as NOAA Atlas 14) was used to model precipitation data (U.S. Department of Commerce 2004).

Currently there is not a regional model that encompasses the Eastern Section of the Study Area. Because of the lack of detailed topography for the entire watershed, 10-foot topography was obtained from FCDMC (2000) and used along with the existing aerial photography to estimate basin boundaries and normal depth channel routing cross sections and develop the East Model (see Figure 3.16). Due to the limited development reports for this area, retention was estimated by locating major retention basins on field visits and approximating their depth and retention capacity. It was also assumed that any commercial, industrial, school, or multi-family property retained the 100-year 2-hour storm.

Over 70 culverts are located under Pecos Road between I-10 (Maricopa Freeway) and Chandler Boulevard. Culvert locations, sizes, lengths, and materials were determined based on as-built plans, topography, aerial photography, and site visits. The existing conditions analysis concluded that flow from the 50-year and 100-year storms enter Community land from either the existing pipes and culverts under Pecos Road, sheet flow in the absence of infrastructure, or a combination of culvert conveyance and the overtopping of Pecos Road. The existing culverts are relatively shallow and therefore do not have much storage behind them. The flow that does not enter the culvert overtops the current road alignment.

The development of the proposed drainage facilities assumed that the flows with the proposed freeway in place would be required to remain the same as the flows in the existing conditions (no increase in runoff to downstream properties over existing conditions). A proposed conditions HEC-1 model was prepared to indicate the locations where the flows would be crossing due to the extension of the culverts. At some instances the existing culverts were not sufficient to convey the same amount of flow as in existing conditions. This happens in locations where there is not the same amount of headwater depth available or because of the losses thru the longer culverts. At these instances the number of barrels were increased or the existing culverts were abandoned or replaced with new culverts. First-flush basins would be located along the alignment to treat the freeway runoff.

In some locations, the proposed culverts and basins would be located within the SRP utility easement south of Pecos Road. In these cases, ADOT would need to acquire a *consent to use* permit from SRP prior to construction and submit plans to SRP for review and approval. SRP design guidelines would be used in developing the proposed drainage facilities (SRP 2004 and 2008a).

The results of this conceptual off-site drainage design are shown on the plans in Appendix A. The 100-year storm was checked and assured that the building of the freeway would not adversely affect any properties upstream (i.e. ponding areas outside of the proposed right-of-way). If the extension of the existing culverts were evaluated to affect upstream properties, and the existing model indicated that the flow enters the Community via culvert and/or overtopping, the number of culverts were increased or the culverts were replaced with more efficient culvert sizes.

Coordination with the Community regarding the proposed drainage design is underway and would continue as design progresses. Preliminary drainage concepts were transmitted to the Community's Department of Environmental Quality and Land Use Planning and Zoning on April 26, 2010 and ADOT attended a meeting with the Community's Flood Control Management Task Force on July 15, 2010. During this time, the Community expressed their concerns regarding the quality, quantity, and location of on-site and off-site runoff that would flow onto Community land after the freeway is constructed.

Western Section

With the drainage channel layouts determined, a flow analysis was performed for each subsection to quantify the flows. Consistent with the approach noted previously, the hydrology data was based on the Durango ADMP (north of the Salt River), LACC (south of the Salt River), and Laveen ADMP (south of the Alta Ridge and north of the Main Ridge South). For the existing models, two different design storm frequencies (100-year, 6-hour storm and 100-year, 24-hour storm) were analyzed. ADOT designs off-site drainage facilities sufficient for a 50-year storm and checks that the 100-year storm would not adversely affect any properties upstream. To conceptually design the off-site drainage system, the scenario expected to generate the most flow was chosen because it would be the most conservative in terms of right-of-way needs and construction costs. An in-depth discussion of how this was completed is detailed in the following paragraphs.

For the design using the existing models, the proposed freeway was overlaid onto the HEC-1 schematics indicating the subbasin layouts and the flow routings for the existing scenarios in the Durango ADMP, LACC, and Laveen ADMP models. The Durango Model was prepared using NOAA Atlas 14 precipitation data. The existing HEC-1 model was modified to more accurately represent the area with the constructed freeway. These modifications included basin boundaries, routes, diverts and combination points, and the addition of channel routes, culverts, and detention and first-flush basins for the subbasins affected. The channel design was based primarily on the existing HEC-1 and the local topographic information (contours and existing and proposed structures). Updating of land use and routing for the area affecting the freeway may be necessary during final design. A HEC-River Analysis System (RAS) analysis was prepared to model the channel size and culvert sizes within the channel. The proposed design assumes that the channel would be placed in culverts to cross under crossroads. Potential utility conflicts have been identified for the proposed culverts, including:

- South of the Salt River there are Salt River Project (SRP) and privately owned irrigation lines along the major crossroads. These irrigation channels serve the existing farming activities in the area. It is anticipated that these lines would be removed, relocated, or piped prior to construction and as the land transitions from agricultural to suburban residential and commercial uses.
- North of the Salt River the drainage channel would cross a 90-inch COP sewer line under Broadway Road, irrigation lines along Lower Buckeye Road, the RID canal, sewer and major telecommunication lines under Broadway Road, the UPRR tracks including a Kinder Morgan pipe line, and sewer and irrigation along Van Buren Street.

Because it has not been determined if some or all of these conflicts can be avoided, a contingency item for siphons has been included in the estimate of probable costs at each of these major conflict points. If siphons are needed to eliminate conflicts, the channel width upstream of the siphon may need to be widened. Additional information on utilities and the segments can be found in Section 3.11, *Utilities*, and Section 3.16, *Implementation Plan*, respectively.

The LACC model and the Hidden Valley model, from the Laveen ADMP, were combined and used to design the channel from approximately 51st Avenue to the Salt River. The Championship Drain model was updated in 2002 for the design of the LACC. The update did not re-evaluate land use or routing except in the basins affecting the LACC. Much development has occurred in this area since 1991 when the models were developed. The models use the Green and Ampt and the Clark method to determine rainfall losses and unit hydrograph, respectively. In addition NOAA Atlas 2 was used for the precipitation data. According to FCDMC and since the development of these models the Clark Unit Hydrograph has been deemed insufficient for determining runoff quantities for basin areas greater than 10 square miles in Maricopa County. For the purpose of this study, the channel design was based on these original models. The land use and routing were updated to prepare a more accurate model for the freeway drainage design. This updated model uses the NOAA Atlas 14 precipitation data as well as the S-Graph unit hydrograph method (ADOT 2010d). The same methodology was used as in the Durango Model to design the channel and basin systems.

After these flows were determined, the preliminary channel design was prepared. Concrete-lined channels were chosen based on their use with recent projects in the region, costs, and anticipated flow patterns. This type of channel allows a minimum longitudinal slope of 0.001 feet per feet and maximum side slopes of 2-to-1 (horizontal to vertical). All of the drainage channels were designed as trapezoidal channels with 2-to-1 side slopes and varying bottom widths and depths. Flowline elevations were computed by comparing the existing ground elevations and allowable channel slopes and maintaining 1 foot of freeboard above the calculated water surface for the 50-year storm. The top of the freeboard was set to the existing ground level to ensure that all surface flow would be able to gravity drain into the channel. For channels requiring a shallow flow depth, freeboard was maintained by widening the channel bottom. Channel velocities, required cover at culvert crossings, and total channel depth were all major factors in the channel design.

HEC-RAS analysis was completed for the Durango and Laveen models using the computed flows. All of the culverts were conceptually designed as reinforced concrete box culverts (RCBC) with a minimum longitudinal slope of 0.005 feet per feet. The box sizes and numbers were determined for each significant crossing. At the request of ADOT Maintenance, all RCBC heights were assumed to be a minimum of 6 feet. In the Durango model the channel conveys the flow south to the Salt River. There is a large basin located south of Broadway to allow for first flush flows to be retained. The channel in the Laveen model is divided into 2 channels. The channel segment from 51st Avenue to the LACC would convey flow north to the LACC. There is a very large basin located south of Dobbins Road to attenuate the flow into the LACC. North of the LACC a smaller channel would convey any flow intercepted to the Salt River.

The area in-between the Hidden Valley model and the East model was originally called the South Mountain model in the Laveen ADMP. Due to the small size of this model it was completely redone using NOAA Atlas 14 and the S-Graph unit hydrograph. The flow from this model is passed onto Community land via culverts and bridges.

3.9.5 On-Site Drainage Design

An urban freeway section with curb and gutter was assumed for the on-site drainage analysis. The road cross section is proposed as normal crown geometry, except in areas of superelevation, allowing runoff to flow toward the outside. Catch basins and storm drain systems would be used to collect drainage flows.

ADOT Standard C-15.91, C-15.92, and C-15.80 catch basins are used to intercept the flows along the main line. Runoff collected in the catch basins would be conveyed in storm drains. First flush detention basins are included to collect on-site drainage prior to discharging. The basins are sized to collect and treat the first one-half-inch of runoff from ADOT's right-of-way. Collection of on-site stormwater was determined by ADOT's Best Management Practices. Currently, ADOT is revising its stormwater policy and the basin design would need to be evaluated during final design.

Storms greater than the 5-year, 2-hour storm frequency would be routed to the off-site drainage channel along the north or east side of the freeway and would be conveyed to a discharge point.

The infrastructure needed for the on-site drainage system would be determined during final design. The following describes site specific considerations:

- The proposed bridge over the Salt River would have a high point near the center of the bridge and would drain both north and south. The deck drainage stormwater would flow toward the abutments and would be routed through first flush basins or other treatment facilities prior to discharge to the river. Drainage inlets within the bridge deck connected with hanging storm drain pipes under the bridge would be used to keep spread rates within acceptable limits. Preliminary scour calculations have been performed on the proposed structure to assess their stability in the Salt River environment. The scour depth is estimated to be 50 to 60 feet.
- The improvements along I-10 (Papago Freeway) associated with the new system traffic interchange would be designed to drain into the existing on-site drainage system. I-10 is depressed in this area and the existing pavement drainage is collected in catch basin inlets and conveyed through lateral pipes into interceptor systems, which, in turn, deliver it to pump stations. The runoff is pumped into Papago Channel, located on the north side of I-10 (ADOT 2008d). The proposed improvements would include extensions of existing facilities in areas that would be widened and construction of new inlets and pipes to capture runoff from the new ramps and access roads. Any on-site drainage design modifications along I-10 would be coordinated with the METRO high capacity transit corridor project.

3.9.6 Section 404 of the Clean Water Act

The USACE administers Section 404 of the Clean Water Act (CWA), which regulates the discharge of dredged or fill material into waters of the United States (jurisdictional waters), including wetlands. The USACE regulates jurisdictional waters through permitting using nationwide and individual permits.

Types of waters of the United States (U.S.) that are regulated include wetlands, ephemeral washes, perennial streams, springs, riverbeds, and special aquatic sites. Functional values are a key component of the waters of the U.S. determination and the associated permitting and mitigation.

The proposed freeway would require the placement of structures such as bridge substructures into jurisdictional waters leading to the discharge of dredged or fill material into the Salt River. The proposed freeway would also cross ephemeral washes, and some of these washes may be channelized to control stormwater runoff and direct it toward culverts, allowing stormwater to cross under the freeway.

As committed to in the DEIS, a field delineation of jurisdictional waters for the Selected Alternative (E1 and W59) was conducted in the summer of 2013 to identify jurisdictional waters and to define the jurisdictional limits for the CWA Section 404 permitting. A preliminary jurisdictional determination was submitted to USACE in January 2014 in accordance with USACE and ADOT guidelines. USACE issued a preliminary jurisdictional determination in March 2014. The preliminary jurisdictional delineation of the E1 Alternative identified 49 ephemeral washes as jurisdictional waters. It is anticipated that the E1 Alternative would permanently affect between 1 and 2 total acres of jurisdictional waters (ephemeral washes), and there is the potential that greater than 0.5 acre of impacts may occur at individual wash crossings. The preliminary jurisdictional delineation for the W59 Alternative identified two drainage features as jurisdictional waters; the Salt River and the LACC. An evaluation of the crossing of the Salt River and the associated fill from the bridge piers placed in the riverbed was used to anticipate the type of USACE permit needed. Disturbances to jurisdictional waters caused by the W59 Alternative would be less than 0.5 acre. Temporary construction zones may result in additional impacts on jurisdictional waters. Once these zones have been identified, a determination would be made by USACE, ADOT, and FHWA regarding whether additional permitting and mitigation would be warranted. Because the impact acreage is based on conservative design limits, it is anticipated that design refinement and construction sequencing would result in a reduction of impacts on jurisdictional waters. CWA permitting would be determined during the final design phase.

It is anticipated that the W59 Alternative would qualify for a CWA Section 404 Nationwide Permit #14, *Linear Transportation Projects*, because of the type of activity and amount of fill that would be placed into jurisdictional waters. ADOT would comply with all terms and conditions of the CWA permitting as established by USACE. If an Individual Permit under Section 404 of the CWA would be required for the E1 Alternative, the March 18, 2013, FHWA, ADOT, and USACE Memorandum of Agreement, amended from the original Memorandum of Agreement, effective June 18, 2012, would be implemented, which applies to transportation projects that are FHWA actions under NEPA and that require USACE permits under Section 404 of the CWA (USACE 2013). The Memorandum of Agreement commits FHWA, USACE, and ADOT to establish priority review of federally funded projects with the goal of achieving timely design and implementation of highway improvements while ensuring the design and implementation are sensitive to the protection of aquatic resources under USACE's jurisdiction.

If an individual permit were required, ADOT would prepare a water quality certification application in accordance with Section 401 of the CWA as part of the Section 404 permitting process. The application would be submitted for review and approval by ADEQ. The steps outlined below would be addressed by ADOT to satisfy provisions of Section 404(b)(1) of the CWA in accordance with Section 404 (USACE 2013):

- minimize impacts by limiting the degree or magnitude of the freeway and its implementation by using appropriate technology or by taking affirmative steps to avoid or reduce impacts
- rectify impacts by repairing, rehabilitating, or restoring the affected environment
- reduce impacts over time through preservation and maintenance operations during the life of the freeway
- compensate for impacts by replacing, enhancing, or providing substitute resources or environments
- monitor impacts and take appropriate corrective measures

3.10 Bridge Structures and Walls

The proposed freeway alignment would cross a number of existing roads and major waterways and pass through both urban developments and desert terrain. Fifty-three bridge sites are proposed for SR 202L (South Mountain Freeway). All of the arterial street structures can be classified as overpass structures. General characteristics of each bridge are presented in Table 3.8.

A preliminary bridge type was assumed for all overpass structures based on the span-to-depth ratios, constructibility considerations such as the use of falsework or local traffic detouring, and minimization of impacts to the road profile grade. Some sites have unique characteristics that required additional evaluation of the bridge type best suited to meet the special needs of that site. Examples of the special needs include active railroad facilities, construction within waterways, and construction over existing roads. Overpass structures with similar site characteristics are presented in a general discussion. Sites that required additional investigation are discussed individually following the general discussion.

Retaining walls and sound walls would be required along the proposed freeway. Retaining walls are used along the freeway to constrain the right-of-way required and at bridge structures that require full-height abutments. Potential sound walls are proposed along certain sections of the freeway to mitigate noise-related impacts from the operation of the freeway.

3.10.1 General Discussion of Overpass Structures

The outside-to-outside width of the proposed freeway is typically 146 feet. Bridge structures matching the freeway typical section would include two superstructures with 2 inches of separation centered on the construction centerline. Each superstructure would typically have three 12-foot lanes, one 12-foot HOV lane, a 12-foot outside shoulder, an 11-foot-4-inch inside shoulder, a 1-foot, 5-inch-wide, 32-inch-tall F-shape barrier at the outside shoulder, and a 1-foot, 7-inch-wide, 42-inch-tall F-shape concrete barrier at the median shoulder, for a total superstructure width of 74 feet, 4 inches and a total overall bridge width of 148 feet, 10 inches. Some bridge structure widths would vary as a result of auxiliary lanes or pavement tapers.

The majority of the overpass structures along the main line would span existing or proposed roads. The bridge span lengths were determined based on the ultimate typical section for each road from COP Street Classification Map (see Table 2.5). Side slopes of 2-to-1 were projected from the edge of sidewalk to the face of the bridge abutment to establish the bridge span lengths. A minimum vertical clearance of 16 feet, 6 inches has been maintained. At these sites, a two-span structure was evaluated.

Multiuse overpass structures have been identified at five locations that would accommodate pedestrian, equestrian, and wildlife crossings beneath the proposed freeway. At these sites, 2-to-1 or flatter side slopes and a minimum 14-foot vertical clearance has been provided. Where off-road vehicle traffic is anticipated, a minimum 16-foot clearance has been provided.

One superstructure type that could meet most of the site considerations for the overpass structures is a cast-in-place, post-tensioned (CIP PT) concrete box girder. This structure type can accommodate a variety of span lengths while maintaining a suitable span-to-depth ratio. CIP PT structures are typically used for spans ranging from 100 feet to over 250 feet, with span-to-depth ratios between 1-to-20.5 and 1-to-25. These span-to-depth ratios give the appearance of a slender superstructure that is aesthetically attractive. This structure type has historically been an economical alternative for overpasses and commonly used in the Phoenix metropolitan area. Because many of the overpass sites have few if any site constraints, a CIP PT concrete box girder could be constructed on falsework or soffit fill. Traffic on an existing road would be temporarily diverted for the soffit fill construction method or restricted if built on falsework.

There are many sites where the required span length and available vertical clearance based on the current road profile grade can accommodate a precast girder superstructure option. A more detailed analysis would be conducted during final design to determine the best structure type for the overpasses based on cost, constructibility, future widening constructibility, and other considerations.

Substructure Assumptions

For the majority of the overpass structures, stub abutments on drilled shafts in embankment were assumed. If site constraints or stub abutments were unsuitable, full height abutments on spread footings with retaining walls were assumed. For bridges on full height abutments, appropriate cost adjustments were applied. The piers were assumed to be columns on spread footings.

Cost Assumptions

The preliminary cost assumed for a CIP PT box girder structure was $100 per square-foot. The preliminary cost assumed for an AASHTO precast girder structure was $120 per square-foot. Each bridge site was then evaluated for site-specific considerations such as potential full height abutments, utility conflicts, drainage conflicts, scour, and site constraints, and the appropriate cost adjustments were applied. The cost for anchor slabs, approach slabs, and proposed sound walls, where appropriate, were added to the bridge square-foot cost for a total bridge cost, reported in Table 3.19 and Appendix B.

3.10.2 Specific Site Considerations

The following sections describe the location and proposed conditions of specific bridge sites. Also, as appropriate, any known constructibility or traffic control issues are discussed.

Multiuse Crossing Overpasses

Location

The proposed freeway would cross through areas of natural desert terrain that is habitat for various wildlife species. Several locations have been identified where planned drainage facilities would be enhanced from culverts to multiuse bridge overpasses to allow wildlife, pedestrians, equestrians, etc., to cross under the freeway. The bridge proposed between the South Mountain Main Ridge South and Main Ridge North (approximately MP 63.69) is discussed in more detail below.

Proposed Conditions

The proposed structures at this site would have six spans and a total bridge length of approximately 639 feet. Initially, two crossing locations were identified in this area. It was determined to be more advantageous to use one longer crossing instead of two crossings close together. The minimum vertical clearance provided would be 16 feet to accommodate equestrians. The minimum clearance would not be

Table 3.8 – Bridge Summary

Location	Main Line Station	Number of Spans	Structure Length	Structure Width[a]	Skew Angle (degrees)	Abutment Type[b]	Estimated Cost ($)	Segment[c]	Additional Constraints and Comments
40th Street overpass	2079+01	2	220 feet	148 feet, 10 inches	2	Stub	$3,594,000	1	—[d]
32nd Street overpass	2132+21	2	185 feet	148 feet, 10 inches	1	Stub	$3,028,000	1	—
24th Street overpass	2185+81	2	200 feet	148 feet ,10 inches	0	Stub	$3,275,000	1	—
Desert Foothills Parkway overpass	2282+09	2	201 feet	148 feet, 10 inches	2	Stub	$3,290,000	2	—
17th Avenue overpass	2385+25	2	202 feet	148 feet, 10 inches	1	Stub	$3,307,000	2	—
Multiuse overpass at MP 62.95 (WB SR 202L)	2495+95	3	273 feet	74 feet, 10 inches	0	Stub	$2,182,000	3	—
Multiuse overpass at MP 62.98 (EB SR 202L)	2498+15	3	353 feet	74 feet, 10 inches	0	Stub	$2,777,000	3	—
Multiuse overpass at MP 63.69 (WB SR 202L)	2529+65	6	639 feet	74 feet, 10 inches	0	Stub	$4,921,000	3	—
Multiuse overpass at MP 63.72 (EB SR 202L)	2531+65	6	639 feet	74 feet, 10 inches	0	Stub	$4,921,000	3	—
Multiuse overpass at MP 64.24	2564+85	2	151 feet	148 feet, 10 inches	0	Stub	$2,966,000	3	—
Ivanhoe Street overpass	2607+63	1	106 feet	148 feet, 10 inches	39	Full-height	$2,826,000	3	Overhead power lines along crossroad
Multiuse overpass at MP 65.47	2628+17	2	179 feet	Varies	0	Stub	$3,537,000	3	—
Multiuse overpass at MP 65.79 (WB SR 202L)	2645+35	3	279 feet	74 feet, 10 inches	0	Stub	$2,209,000	3	—
Multiuse overpass at MP 65.79 (EB SR 202L)	2647+16	3	303 feet	Varies	0	Stub	$2,693,000	3	—
51st Avenue overpass (WB)	2660+30	2	242 feet	Varies	49	Stub	$2,594,000	3	Overhead power lines along crossroad; bridge width flares towards 51st Avenue ramps
51st Avenue overpass (EB SR 202L)	2660+40	2	277 feet	Varies	49	Stub	$3,056,000	3	Overhead power lines following crossroad.
51st Avenue Spur overpass	2676+23	2	205 feet	148 feet, 10 inches	1	Stub	$3,345,000	3	—
Estrella Drive overpass	2694+43	2	223 feet	Varies	43	Stub	$4,451,000	4	Overhead power lines along crossroad; bridge width flares towards 51st Avenue ramps
Elliot Road overpass	3030+75	2	210 feet	148 feet, 10 inches	21	Stub	$3,595,000	4	Overhead power lines following crossroad
Dobbins Road Ramp B overpass WB	3077+68	3	324 feet	74 feet, 10 inches	45	Stub	$2,700,000	5	
Dobbins Road Ramp B overpass EB	3078+92	3	324 feet	74 feet, 10 inches	45	Stub	$2,700,000	5	
Dobbins Road overpass	3085+60	1	126 feet	148 feet, 10 inches	15	Full-height	$3,198,000	5	—
Dobbins Road Ramp C overpass WB	3091+23	3	290 feet	74 feet, 10 inches	45	Stub	$2,446,000	5	
Dobbins Road Ramp C overpass EB	3092+29	3	382 feet	74 feet, 10 inches	45	Stub	$3,149,000	5	
LACC overpass	—	3	279 feet	148 feet, 10 inches	3	Stub	$5,268,000	5	12-foot minimum horizontal clearance from edge of LACC; 16-foot minimum vertical clearance
Baseline Road Ramp A over LACC	—	3	279 feet	34 feet, 10 inches	0	Stub	$1,084,000	5	—
Baseline Road Ramp B over LACC	—	3	279 feet	26 feet, 10 inches	0	Stub	$887,000	5	—
Baseline Road overpass	—	2	208 feet	148 feet, 10 inches	9	Stub	$3,723,000	5	—
Southern Avenue overpass (NB and SB SR 202L)	3194+74	2	193 feet	148 feet, 10 inches	4	Stub	$3,189,000	6	Overhead power lines along crossroad
Salt River bridge (NB and SB SR 202L)	3209+	26	3,326 feet	Varies	27	Stub	$59,924,000	7	Requires deck drains
Broadway Road Ramp A	—	4	413 feet	35 feet, 2 inches	0	Stub	$1,235,000	8	—
Broadway Road Ramp B	—	4	488 feet	27 feet, 2 inches	0	Stub	$1,297,000	8	—

(continued on next page)

Table 3.8 – Bridge Summary (continued)

Location	Main Line Station	Number of Spans	Structure Length	Structure Width[a]	Skew Angle (degrees)	Abutment Type[b]	Estimated Cost ($)	Segment[c]	Additional Constraints and Comments
Broadway Road overpass (NB and SB SR 202L)	3253+82	2	209 feet	148 feet, 10 inches	0	Stub	$3,910,000	8	Overhead power lines at north and south edges of crossroad, sound wall
Lower Buckeye Road overpass	3307+75	2	229 feet	148 feet, 10 inches	22	Stub	$4,024,000	8	Overhead power lines at north and south edges of crossroad, sound wall
SB 59th Avenue frontage road overpass	3327+47	1	170 feet	Varies	37	Stub	$4,092,000	8	—
RID canal overpass	3336+15	1	135 feet	172 feet, 10 inches	0	Full-height	$4,105,000	8	Substructure to remain outside the RID canal right-of-way, sound wall
NB 59th Avenue frontage road over RID	—	1	54 feet	38 feet, 7 inches	0	—	—	8	Existing structure to be evaluated
SB 59th Avenue frontage road over RID	—	1	60 feet	38 feet, 7 inches	13	Stub	$371,000	8	Box beam bridge
Buckeye Road overpass	3361+56	2	241 feet	148 feet, 10 inches	1	Full-height	$3,869,000	9	—
UPRR Bridge overpass	3388+42	1	139 feet	172 feet, 10 inches	9	Full-height	$4,068,000	9	See UPRR requirements section
NB 59th Avenue frontage road over UPRR	—	1	139 feet	41 feet, 2 inches	7	Full-height	$890,000	9	See UPRR requirements section
SB 59th Avenue frontage road over UPRR	—	1	139 feet	41 feet, 2 inches	9	Full-height	$886,000	9	See UPRR requirements section
Van Buren Street overpass	3414+96	2	221 feet	148 feet, 10 inches	15	Stub	$3,853,000	9	Gas line located north of south abutment in toe of embankment, sound wall
NB SR 202L over NB 59th Avenue frontage road	—	1	166 feet	75 feet, 2 inches	49	Full-height	$1,797,000	9	—
HOV Ramp over NB 59th Avenue frontage road	—	1	157 feet	Varies	51	Full-height	$1,392,000	9	—
SB SR 202L over NB 59th Avenue frontage road	—	1	166 feet	Varies	54	Full-height	$2,017,000	9	Sound wall on west edge deck
Ramp NW over Roosevelt Street	—	1	130 feet	43 feet, 2 feet	15	Full-height	$763,000	9	—
Ramp NE over Roosevelt Street	—	1	132 feet	43 feet, 2 feet	17	Full-height	$775,000	9	—
Ramp ES over Roosevelt Street	—	1	128 feet	43 feet, 2 feet	7	Full-height	$901,000	9	Sound wall on west edge deck
Ramp WS over Roosevelt Street	—	1	129 feet	49 feet, 2 feet	11	Full-height	$863,000	9	—
HOV Ramp over Roosevelt Street	—	1	129 feet	61 feet, 2 feet	11	Full-height	$1,073,000	9	—
Ramp ES	—	9	1,510 feet	43 feet, 2 inches	0	Partial	$11,668,000	9	Sound wall on west edge deck
Ramp NW	—	13	2,470 feet	43 feet, 2 inches	0	Partial	$16,100,000	9	—
Ramp WS	—	7	1,210 feet	43 feet, 2 inches	0	Partial	$7,952,000	9	—
Eastbound Access Road	—	3	362 feet	32 feet, 2 inches		Partial	$1,337,000	9	—
HOV Ramp	—	9	1130 feet	61 feet, 2 inches	0	Partial	$10,782,000	9	Assumed AASHTO girders, Straddle piers

Notes: [a] The distance is measured to the outside of each structure.; [b] Full-height abutments would require retaining walls.; [c] See Section 3.16, *Implementation Plan*, for more information on the segments; [d] No comments or not applicable
MP = milepost, NB = northbound; SB = southbound; NW = north-to-west; NE = north-to-east; ES = east-to-south; WS = west-to-south

provided along the entire bridge, but where crossing is most likely to occur. The abutments would be stub abutments on drilled shafts with a 2-to-1 fill slope. The piers would be founded on spread footings.

Typical superstructure types for this configuration would be either a PT box girder or a precast “I” girder bridge. The bridge type would be further investigated during the design process. An advantage to using precast “I” girders would be that repetitive span lengths would reduce the cost and minimize the site disturbance by eliminating the need for falsework or soffit fill required to construct a PT box girder.

Dobbins Road Off-ramp Underpasses

Location

At Dobbins Road, a modified diamond interchange has been proposed. The proposed freeway would cross over Dobbins Road near 62nd Avenue. The northbound and southbound off-ramps would cross under the freeway to the opposite side of the freeway. At Dobbins Road, the ramp ramps would be present in only the southwest and northeast corners (see Figure 2.13 for an example).

Proposed Conditions

The modified interchange would include a single span structure at Dobbins Road and two overpass structures at each of the off ramp crossings due to the severity of the ramp skew with the freeway. The Dobbins Road structure would be 126 feet long with full-height abutments placed at the back of the sidewalks. At both ramp crossings the eastbound and westbound roadways would be carried over the ramps on separate three-span structures. At the northbound off-ramp, Ramp B, the structures are both 324 feet long with a 45 degree skew and stub abutments. At the southbound off-ramp, Ramp C, the eastbound structure is 382 feet long and the westbound structure is 290 feet long. Both bridges are at a 45 degree skew with stub abutments.

Laveen Area Conveyance Channel Bridge

Location

The proposed freeway would cross over the LACC just south of Baseline Road. The LACC serves as a flood control channel for COP and Maricopa County (the channel is maintained by COP, but FCDMC has review authority on any proposed changes). Maintenance roads are located on each side of the channel requiring a minimum 16 feet of vertical clearance to be maintained. An existing trail would need to be maintained or rerouted during construction.

Proposed Conditions

The LACC includes a 50-foot-wide low-flow channel with 50-foot-wide side slopes on each side for a total channel width of 150 feet. There is a 12-foot maintenance road on each side of the channel.

Because the LACC serves as a flood control channel, the structure type and construction methods chosen need to consider minimizing the impact to this facility during and after construction. Using a structure type that requires falsework would present a substantial risk in the case of an unexpected flood. Use of a precast prestressed girder alternative would eliminate the need for any shoring or falsework. Span arrangements that located pier foundations outside of the 50-foot-wide channel were investigated.

The proposed freeway would cross the realigned LACC on a tangent at an approximate 3-degree skew angle. The structure would be three spans with a total length of approximately 279 feet. The structure is assumed to have stub abutments on drilled shafts with a minimum 2-to-1 fill slope and round pier columns on drilled shafts located outside of the low-flow channel, but on the side slopes. The round pier columns would limit impacts to the channel hydraulics.

Baseline Road Ramp A and Ramp B would also require bridge structures over the LACC.

Salt River Bridge

Location

The proposed freeway would cross over the Salt River between Broadway Road and Southern Avenue just west of 59th Avenue. In the area of the crossing, the Salt River has been subject to gravel mining operations for many decades. A major gravel mining operation is located just east (upstream) of the proposed freeway alignment. This mining operation has excavated to approximately 35 feet below the existing Salt River low-flow channel. The effects of the gravel mining operation on river stability and mechanics result in a total scour depth of 50 to 60 feet for the bridge piers. This scour depth is subject to change based on gravel mining activities which are currently taking place.

There are no existing utilities within the limits of the proposed structure. Fiber optic lines are located on both the east and west side of the proposed freeway alignment, but are not expected to affect the bridge construction.

Proposed Conditions

The proposed horizontal alignment within the reach of the Salt River is tangent, and the two bridge structures (eastbound and westbound) would be parallel to each other. The cross slope of each bridge would be at normal crown (2 percent). Over the length of the bridge, the proposed vertical alignment begins at the center of a 1,000-foot sag vertical curve at the south end of the bridge and progresses through a 1,500-foot crest vertical curve.

While the floodplain of the Salt River is very wide near the proposed freeway alignment, a 3,326-foot structure could be used to span the 100-year storm frequency floodway and limit water surface elevation increase within the floodplain to the designated floodway elevation with channel improvements. The necessary channel improvements include grading the river bottom to remove an existing deposit which is much higher that the remainder of the channel. This would open up the conveyance below the bridge and avoid an unacceptable rise in the floodway elevation. Additionally, bank protection would need to be constructed at each abutment.

The Salt River crossing would consist of two bridges with a 63-foot separation measured from edge-to-edge of deck. Each superstructure would consist of three 12-foot lanes, a 12-foot HOV lane, a 12-foot auxiliary lane, a 12-foot outside shoulder, and a 12-foot inside shoulder for a clear road width of 84 feet. The superstructure width in each direction would include a 1-foot, 5-inch-wide, 32-inch-tall F-shape barrier at the edge of each side for a total bridge width of 86 feet, 10 inches.

Southern Avenue Ramps C and D extend approximately 450 feet and 850 feet onto the bridges, respectively. A flare of approximately 25 feet would be required to accommodate these ramp tapers and would affect 4 and 6 spans, respectively. Broadway Road Ramps A and B would start approximately 1,000 feet and 1,300 feet from the north end of the bridge, respectively. A portion of the bridge would be flared for the ramps affecting 8 and 13 spans, respectively. The ramps would become individual bridges starting at a shared pier with the main line bridge.

The proposed freeway alignment crosses the Salt River at approximately a 27-degree skew angle. Substructure units would consist of round columns on large diameter drilled shafts placed on this skew angle to minimize impacts to the hydraulics of the river. Based on recent construction project with similar conditions, the shafts were assumed to be between 6 and 8 feet in diameter.

A number of structure types could be used for the Salt River bridge. Many of these systems, however, would require shoring or falsework within the river, which would present a substantial risk in the case of an unexpected flood. While the structural requirements, aesthetics, economic feasibility, construction considerations, and long-term serviceability of these systems would be fully reviewed during the bridge type selection phase of the design process, the traditional solution for similar river crossings throughout the region has been the precast, prestressed concrete girder. The total bridge length would be 3,326 feet, with a total of 26 spans. For this length of structure, deck drains would be required to collect drainage and convey it off the proposed structure.

Constructibility and Traffic Control

The bridge site can be accessed using the proposed freeway alignment from either Southern Avenue or Broadway Road. Access to the river channel would be necessary during construction, therefore, appropriate environmental permits (see Section 3.9.6, *Section 404 of the Clean Water Act*) would be required.

Roosevelt Irrigation District Canal Overpass

Location

The proposed freeway main line and the 59th Avenue frontage roads would cross over the RID Canal just north of Lower Buckeye Road. At the freeway crossing there is a 24-foot-wide maintenance road on either side of the canal that must be maintained.

At the RID Canal, the proposed freeway main line bridge would span the entire RID right-of-way and provide the required 16.5 feet of vertical clearance over the canal maintenance roads. This can be achieved with a single span pre-cast girder or a cast-in-place box girder structure. The frontage road bridges would cross the RID Canal at grade and would need to provide 18 inches of freeboard to the canal high water level. At the ends of the frontage road bridges a crossing of the frontage road is required to maintain access to the RID maintenance roads.

Proposed Conditions

Pre-cast girder and cast-in-place box girder structures were evaluated at this location based on their inherent advantages and disadvantages. A pre-cast girder can be erected quickly with minimal impacts to the canal. However, it is limited in span length to approximately 135 feet, which would require partial or full height abutments. A cast-in-place box girder can easily span the canal and maintenance roads and be long enough to use stub abutments thus reducing substructure cost. However, it may be difficult to span the canal with falsework during construction and maintain access to the RID maintenance road. The cost of the two structure types would be comparable at this location. To minimize potential impacts to the canal during construction, this report uses an AASHTO pre-cast girder superstructure at this location.

The 59th Avenue frontage roads would cross over the RID canal at grade. The northbound frontage road crosses the RID canal at the same location as the existing 59th Avenue crossing. At this time, it is assumed that the existing structure can be used. The existing structure would be evaluated to determine if modifications or a new structure are needed. The southbound frontage road would require a shallow structure depth to minimize impacts to the road profile. It is proposed to use side-by-side box beams with abutments placed just behind the canal lining for a total structure length of 60 feet. The box beams would have a 6-inch concrete deck topping for a structure depth of approximately 2 feet, 9 inches. The abutment cap beam would be supported by drilled shafts.

Union Pacific Railroad Bridge

Location

The proposed freeway main line and the 59th Avenue frontage roads would cross over the UPRR approximately 1 mile south of I-10 (Papago Freeway). The UPRR right-of-way is 100 feet wide. Currently, the railroad maintains one main line track at this location. Also within the railroad right-of-way are two Kinder Morgan petroleum gas lines and four fiber optic lines, all parallel to the tracks.

Proposed Conditions

The horizontal alignment of the proposed freeway at the UPRR crossing would be on a horizontal curve with 3 percent superelevation. The alignment crosses the UPRR at approximately a 9-degree skew angle. The UPRR bridge would be located within a 1,000-foot crest vertical curve. Conduit for ADOT's FMS and lighting would be included in the structure.

UPRR has indicated it plans to add one additional main line track on either the north or south side of the existing main line track in the future. The railroad also requires provisions for maintenance access roads on both sides of the ultimate track configuration. The *Burlington Northern Santa Fe (BNSF)–UPRR Guidelines for Grade Separation Projects* (BNSF 2007) further directs that:

- substructure units shall be placed at least 25 feet from the centerline of the nearest track
- absolute minimum horizontal clearance, requiring special review and approval, shall be 18 feet from the centerline of track to the face of the required pier protection wall
- a fence is required on the outside barriers of the structures.
- structures shall provide a minimum vertical clearance of 23 feet, 4 inches, with a reduction to 21 feet allowable for temporary conditions during construction

Given the UPRR track layout requirements and presence of the Kinder Morgan gas lines, it was decided to completely span the UPRR right-of-way. The resulting configuration for all three bridges would require full height abutments on spread footings and single span girders, 139 feet long, as measured from centerline bearings. Generally, the type of structure best suited for conditions over an active railroad has been a precast prestressed concrete girder. The girders would be erected quickly and falsework can be eliminated with the use of stay-in-place deck forms. This reduces the time of construction within the railroad right-of-way. For these reasons, this bridge type is proposed for this site.

Constructibility and Traffic Control

Given that the majority of the area surrounding the proposed UPRR bridge site is private property, access to the site would likely be obtained along the alignment from Van Buren Street, ½ mile to the north, or Buckeye Road, ½ mile to the south. Because the depth of the gas lines is unknown, shoring may have to be installed outside of the UPRR right-of-way to protect the gas lines in-place during construction of the abutment footing.

3.10.3 I-10 (Papago Freeway) and SR 202L System Traffic Interchange Structures

The system traffic interchange at I-10 (Papago Freeway) would require realignment of on- and off-ramps for the existing service traffic interchanges at 51st, 59th, and 67th avenues. The structures within the system traffic interchange consist of three flyover ramp bridges, and one ramp structure. Structures are also required south of the interchange where the directional ramps cross over Roosevelt Street and at 63rd Avenue where the addition of access roads requires replacement of the existing underpass. Future investigations for the directional ramps would account for site-specific constraints, possible construction sequencing, placement of piers, utility conflicts, and providing minimum vertical and horizontal clearances.

The structure type most commonly used at a system traffic interchange in Arizona has been a CIP PT box girder. Ramp NW and Ramp WS require a structure type that can span 200 to 240 feet. The CIP PT box girder can easily span this distance. To build this type of structure over I-10 would require a falsework system to span the existing lanes with possible lane closures and detours.

If a falsework system can not be used due to clearance constraints, other superstructure options would be precast girders or structural steel. Precast girders such as Blub Tees or Tub girders can be constructed using cast-in-place pier tables and splicing methods. These girders are not currently fabricated in Arizona, but are used in many other western states. Structural steel does not require falsework, but vertical clearance greater than 16 feet, 6 inches, would be required by ADOT to reduce potential damage from truck impact and fire.

Roosevelt Street Overpasses

Location

The proposed system traffic interchange ramps to and from I-10 (Papago Freeway) would cross over Roosevelt Street just south of I-10 before converging together to become the South Mountain Freeway main line. Roosevelt Street has been identified by COP as a collector street with one 12-foot lane and a 6-foot shoulder in each direction. It also has a standard curb and sidewalk width of 6 feet, 7 inches on each side, for a total width from back of sidewalk to back of sidewalk of 49 feet, 2 inches.

Proposed Conditions

Five overpass structures would be provided at Roosevelt Street for Ramps ES, WS, NW, and NE and the DHOV ramp.

All structures are assumed to be single-span precast girders that can be erected with minimum disruption to traffic. The bridge lengths would vary from 128 to 132 feet depending on the skew angles which vary from 7.5 to 17 degrees. The bridge abutments would be full-height on spread footings.

Ramp North-to-West

Location

Ramp NW carries traffic from northbound SR 202L (South Mountain Freeway) to westbound I-10 (Papago Freeway) on a horizontal curve and is located on the third level of the system traffic interchange. The ramp would cross over the 67th Avenue off-ramp, I-10 main line, 59th Avenue underpass, eastbound access road, Ramp WS, and the DHOV ramp.

Proposed Conditions

The proposed Ramp NW bridge would consist of two 12-foot lanes and a 6-foot and 10-foot shoulder. The ramp would have a 42-inch F-shape barrier on each side. The total bridge width would be 43 feet, 2 inches. The bridge includes 13 spans with a total length of approximately 2500 feet. The bridge length and number of spans may be revised pending further refinement.

The Ramp NW bridge begins at the ramp's western end, on the beginning of a horizontal curve and a rising vertical tangent. The ramp immediately spans the 67th Avenue off-ramp, 59th Avenue overpass, and the I-10 main line requiring piers to be located at the shoulders and in the main line median. Near the midpoint of the structure, Ramp NW enters a crest vertical curve. The ramp then spans the eastbound access road, Ramp WS, and the DHOV ramp. Ramp NW ends just after crossing over the DHOV ramp.

Ramp NW superstructure is assumed to be a CIP PT box girder. The cost per square-foot for this structure is assumed to be $150.

Additional refinements to span lengths, pier and hinge locations would occur during final design. Also, deck drainage would need to be analyzed to determine the location of deck scuppers and downdrains.

Ramp East-to-South

Location

Ramp ES carries traffic from eastbound I-10 (Papago Freeway) to southbound SR 202L (South Mountain Freeway) on a horizontal tangent and partial horizontal curve and is located on the third level of the system traffic interchange. The ramp crosses over the relocated 67th Avenue on-ramp, eastbound access road, and 59th Avenue.

Proposed Conditions

The proposed Ramp ES bridge would consist of two 12-foot lanes and a 6-foot and 10-foot shoulder. The ramp would have a 42-inch F-shape barrier on each side. The total bridge width would be 43 feet, 2 inches. The bridge is proposed to have nine spans with a total length of approximately 1,510 feet.

The Ramp ES bridge begins at the ramp's western end on a horizontal tangent and a rising vertical tangent. A critical area for vertical and horizontal clearance is at the beginning of the structure where it passes over the 67th Avenue on-ramp then over the eastbound access road. Ramp ES crosses over the 67th Avenue on-ramp at a sharp skew angle requiring piers to be placed close to the edge of the ramp. One pier would also be on the edge of the eastbound access road. As Ramp ES crosses over 59th Avenue a pier has been located in the median of 59th Avenue.

A sound wall would be located on the west side of the bridge attached to the bridge barrier. Cost of the sound wall is included in the unit cost of the bridge, increasing the unit cost to $178 per square foot.

At least one hinge would be required due to the length of the structure. Additional refinements to span lengths, pier and hinge locations to account for construction sequencing and traffic control needed to construct the bridge would occur during final design. Also, deck drainage would need to be analyzed to determine the location of deck scuppers and downdrains.

Ramp West to South

Location

Ramp WS carries traffic from westbound I-10 (Papago Freeway) to southbound SR 202L (South Mountain Freeway) on a horizontal curve and is located on the second level of the system traffic interchange. The ramp would cross under Ramp NW then over the eastbound access road, and the I-10 main line.

Proposed Conditions

The proposed Ramp WS bridge would consist of two 12-foot lanes and a 6-foot and 10-foot shoulder. The ramp would have a 42-inch F-shape barrier on each side. The total bridge width would be 43 feet, 2 inches. The bridge is proposed to have seven spans with a total length of approximately 1,210 feet.

The Ramp WS bridge begins at the ramp's southern end on a horizontal curve. The ramp bridge begins just south of the eastbound access road that passes under span two.

Ramp WS crosses the I-10 main line on a large skew and would require spans of over 200 feet. Piers would be located along the shoulders of the I-10 roadway and between the barriers separating the HOV lanes from general purpose lanes.

Additional refinements to span lengths and hinge and pier locations would occur during final design. Also, deck drainage would need to be analyzed to determine the location of deck scuppers and downdrains.

DHOV Ramp

Location

The DHOV Ramp carries traffic between I-10 and SR 202L in the north-to-east and west-to-south directions. The ramp would pass over the eastbound access road, eastbound I-10 main line, and the eastbound HOV lanes.

Proposed Conditions

The proposed DHOV Ramp bridge would consist of one 12-foot lane and a 6-foot and 10-foot shoulder for each direction of traffic, separated by a 42-inch F-shaped median bridge barrier. The ramp would also have a 42-inch F-shape barrier on the outside shoulders. The total bridge width would be 61 feet, 2 inches. The bridge would have a total length of approximately 1,130 feet.

The DHOV Ramp may be either a CIP PT box girder or a precast AASHTO I-girder depending on when the ramp is to be constructed. If it is constructed with the system traffic interchange, either structure type could be used. If it is built in the future, an AASHTO I-girder would be used to minimize impacts to the existing roadways. For a precast girder option, four straddle piers would be required to span eastbound I-10 and the HOV lanes.

For this cost estimate the precast girder structure type was assumed due to the high cost involved with constructing the straddle piers.

3.10.4 Walls

The proposed freeway would require both sound walls and retaining walls at various locations along the corridor. Locations and heights of the walls have not been finalized, but the following information has been assumed.

Retaining Walls

The majority of the retaining walls are used along the SR 202L main line to minimize the right-of-way needed for construction and to contain the abutment embankments of the directional ramps at the I-10 (Papago Freeway) and SR 202L (South Mountain Freeway) system traffic interchange. Walls are also required parallel to the I-10 alignment along the edges of the access roads and service traffic interchange ramps and at bridge sites that need full-height abutments. As the design is refined through the design process, the retaining wall locations and heights would be updated and designated with a naming convention. Preliminary retaining wall locations are shown on the roadway plan sheets presented in Appendix A.

The type of retaining wall that has been assumed to be a cantilever wall on a spread footing. Another type of wall that could be used is a mechanically stabilized earth (MSE) wall. MSE walls are most economical in fill situations for heights between 12 feet and 25 feet. It is important that the construction of MSE walls adhere to the wall specifications, proper quality control reviews, and be protected from vehicular impact. The type of wall best suited for each site condition would be determined as the design progresses.

Sound walls

The noise mitigation proposed for this corridor is documented in the *Noise Report* (ADOT 2011g). The report identifies preliminary locations for sound walls along the proposed freeway. The sound wall system in the Eastern Section of the Study Area (along the Pecos Road alignment) would begin near 48th Street and would extend approximately 8 miles, ending near the bend in the freeway alignment. In general, walls would be placed along the edge of the freeway lanes at the top of embankment. The height of the walls would be approximately 18 feet between crossroads and approximately 14 feet along bridges. The sound walls would be designed to a maximum height of 20 feet based on ADOT's noise abatement policy. In the Western Section of the Study Area, noise walls are located along the freeway adjacent to residential neighborhoods. The sizes and placement would be similar to the Eastern Section. Preliminary sound wall locations are shown on the roadway plan sheets presented in Appendix A.

The type of sound wall that has been assumed is the ADOT standard concrete or masonry wall. These types of wall have been widely used for ADOT projects throughout the region and are suitable for heights up to 25 feet. These walls can accommodate many types of architectural treatments.

3.11 Utilities

A number of utilities cross over or under the proposed freeway and may require relocation or adjustments prior to construction. The study team distributed preliminary plans to each utility company as part of this study and has held utility coordination meetings. Discussion with the utility companies would continue throughout the design process with plans for any relocations and/or adjustments finalized during the later stages of the design process. The final utility designs shall be in accordance with the *Policy for Accommodating Utilities on Highway Rights-of-Way* (ADOT 2009b). The following sections present contact information and design considerations by owner. The types, sizes, locations of utilities documented in the following and in more detail in the *South Mountain Freeway Existing Utility Inventory* (ADOT 2015b) are based on:

- as-built plans, maps, and drawings
- visual observations from site visits, aerial mapping, and photographs
- discussions with utility company representatives
- utility designation (2011 for western section, 2015 for eastern section)
- written feedback from utility company representatives

3.11.1 City of Phoenix - Sewer

Contact: Jami Erickson; 602-261-8229; 200 West Washington Street, 8th Floor; Phoenix, AZ 85003

Design Considerations: Phoenix sewer lines running parallel to the freeway would be protected in place or relocated in a utility corridor along the freeway. Phoenix sewer lines running along crossroads could be affected by bridge piers and the freeway drainage channel concrete box culverts. These impacts would be further evaluated as design progresses.

3.11.2 City of Phoenix- Water

Contact: Jami Erickson; 602-261-8229; 200 West Washington Street, 8th Floor; Phoenix, AZ 85003

Design Considerations: A 48-inch water line runs parallel approximately 200 feet west of the proposed freeway alignment through the mountain areas. The water line construction used a tunnel bore and concrete encasement through the mountains. Although the proposed freeway would not directly affect the water line, it should be monitored for disturbance during excavation and blasting activities.

For large diameter water mains that are Prestressed Concrete Cylinder Pipe (PCCP), COP requires 4 feet of undisturbed soil to be maintained in all directions around the main. These are sensitive pipes that get structural support for the soil. Additionally, all pipes need to be checked for additional loading with addition of nearby structures or changes in the fill height or removal of existing fill. New water and sewer mains may be required due to the demolition of existing commercial or industrial structures.

Phoenix water lines running parallel to the freeway would be protected in place or relocated in a utility corridor along the freeway. Phoenix water lines running along crossroads could be affected by bridge piers and the freeway drainage channel concrete box culverts. These impacts would be further evaluated as design progresses.

3.11.3 AT&T - Telephone

Contact: Rosemary Hamill; 925-977-2413; 2741 North Main, Walnut Creek, CA 94597

Locations: An AT&T underground fiber optic line runs west-to-east within the RID canal right-of-way. The canal and line is located along the Durango Street alignment between Lower Buckeye Road and Buckeye Road within Segment 8.

Design Considerations: The AT&T fiber optic line would not be impacted directly by the freeway main line because it would span the RID canal right-of-way on bridge overpasses. There are possible conflicts with the southbound 59th Avenue frontage road and the planned siphon under the canal for the freeway drainage channel. Both would be designed to avoid the AT&T line.

3.11.4 Century Link - Telephone

Contact: South of Broadway Road: Karen Brown; 480-768-4398; 135 W. Orion Street, 1st Floor, Room 100, Tempe, AZ, 85283;
North of Broadway Road: John Nevlis; 602-630-6891; 5025 N. Black Canyon Highway, Phoenix, AZ 85015

Design Considerations: CenturyLink telephone lines running parallel to the freeway would be protected in place or relocated in a utility corridor south of the freeway.

CenturyLink telephone lines running along crossroads could be affected by bridge piers and the freeway drainage channel concrete box culverts. These impacts would be further evaluated as design progresses.

There is a controlled environment vault located below ground at the corner of Van Buren Street and 59th Avenue within the Roosevelt Irrigation District well site perimeter wall. There are remote terminals located at 51st Avenue and Estrella Drive as well as at 59th Avenue and Van Buren Street. Repeater facilities have also been identified near 59th Avenue and Buckeye Road.

The two lines that cross I-10 would be protected in place and would not be affected because the bridges would remain.

3.11.5 Sprint - Telephone

Contact: Colin Sword; 602-417-0970; 401 W. Harrison Street, Phoenix, AZ, 85003

Design Considerations: The Sprint underground fiber optic line running west-to-east along Lower Buckeye could be affected by bridge piers and the freeway drainage channel concrete box culverts. These conflicts would be further evaluated as design progresses.

3.11.6 COX Communications- Cable

Contact: Randy Sims; 623-328-4058; 1550 W. Deer Valley Road Mail Station DV2-01, Phoenix, AZ, 85027

Design Considerations: The COX lines running parallel to the freeway would be protected in place or relocated in a utility corridor along the freeway. COX lines running along crossroads could be affected by bridge piers and the freeway drainage channel concrete box culverts. These impacts would be further evaluated as design progresses.

There are also COX lines that cross I-10 that may be affected by the widening of I-10.

3.11.7 El Paso Natural Gas - Gas

Contact: Gary Zieske; 602-438-4237; 7776 South Pointe Parkway West, Suite 185, Phoenix, AZ 85044

Design Considerations: An El Paso Natural Gas 16-inch gas line runs north-to-south and crosses the proposed freeway alignment approximately 800 feet east of 51st Avenue. The gas line continues south onto Community land. The westbound freeway lanes are on embankment and the eastbound lanes are on bridge structure as the freeway main line crosses over the El Paso Natural Gas line. The gas line should remain in its current location and be protected in place during construction. Protective encasement or alternative bridge placement may be required for the sections within ADOT right-of-way.

3.11.8 Kinder Morgan – Petroleum

Contact: J. Heath Towsend; 602-455-8830; 49 N. 53rd Avenue, Phoenix, AZ 85032

Design Considerations: The gas lines along 51st Avenue could be impacted by bridge piers or due to the reconstruction of 51st Avenue and the freeway drainage channel concrete box culvert crossing under the roads. The widening of I-10 may impact the line that crosses I-10 near 75th Avenue.

The lines within the UPRR right-of-way would not be impacted directly by the freeway main line because it would span the entire right-of-way width on a bridge overpass. Potential conflicts due to the reconstruction of the 59th Avenue frontage roads and the freeway drainage channel concrete box culvert crossing under the railroad would be further evaluated as design progresses.

3.11.9 Southwest Gas – Gas

Contact: East side: Yvonne Aguirre; 602-484-5338; 9 South 43rd Avenue; Phoenix, AZ 85009
West side: Howard Warren; 480-730-3843; 9 South 43rd Avenue; Phoenix, AZ 85009

Design Considerations: The gas lines running parallel to the freeway would be protected in place or relocated in a utility corridor along the freeway. The gas lines running along crossroads could be affected by bridge piers and the freeway drainage channel concrete box culverts. These impacts would be further evaluated as design progresses.

3.11.10 Salt River Project – Power Distribution

Contact: Kyle Reid; 602-236-4842; P.O. Box 52025, MS XCT-341, Phoenix, AZ, 85072

Design Considerations: The overhead power distribution lines and poles running parallel to the freeway along Pecos Road would be protected in place or relocated (likely buried) in a utility corridor south of the freeway.

The overhead power distribution lines running along crossroads would be affected by the freeway main line. The lines would be relocated (likely buried) to avoid this impact. The relocation design would be coordinated with the design of the freeway drainage channel concrete box culverts so that there are no further conflicts. New services would be required and would be coordinated during final design

3.11.11 Salt River Project – Power Transmission

Contact: Floyd Hardini; 602-809-5753; 998 East Washington Street, Phoenix, AZ, 85281

Design Considerations: SRP has a 500 kV overhead power line that runs adjacent to the proposed freeway alignment from 44th Street to Elliot Road. The proposed freeway would not directly affect this line. However, there are a number of poles and towers along the corridor that would require adequate access (gates off crossroads) and maintenance areas (35 feet by 60 feet). In addition, there are towers within the mountainous areas that would need relocated access roads because the proposed freeway cuts off the existing roads. The existing roads cross through private land. Coordination with SRP regarding these access roads would continue through the design phase.

The easements for the 69kV lines along Pecos Road must be preserved. Some 69kV crossings will need to be raised. The 69kV line crossing of the freeway east of 40th Street would be relocated to clear the new freeway.

The 500 kV line near 51st Avenue should not be affected by the relocation of a crossing Western 230kV line. SRP and Western have coordinated the preliminary design associated with this conflict.

Coordination with SRP is underway and would continue, including the evaluation of potential conflicts with other overhead power lines and poles, as design progresses.

3.11.12 Arizona Public Service – Power Transmission

Contact: Bobby Garza; 602-371-7989; 2133 West Peoria Avenue, Phoenix, AZ, 85040

Design Considerations: Near 42nd Street alignment, the poles would be realigned to the west and would cross over the freeway and return to the pole located south of the freeway. The power lines along the Elwood Street alignment would need to be raised to allow the freeway to pass underneath. The two poles nearest the freeway would be replaced with new poles to provide the additional vertical clearance.

3.11.13 Western Area Power Administration – Power Transmission

Contact: Matt Mueller; 602-605-2498; 615 S. 43rd Avenue, Phoenix, AZ 85009

Design Considerations: A Western 230 kV overhead power line crosses the proposed freeway alignment approximately 1200 feet east of 51st Avenue. Two Western power poles associated with the line are located within the proposed ADOT right-of-way. Near 51st Avenue, the pole located between the freeway main line directions of travel would be realigned to the northwest and raised to cross over the freeway. The H-poles located on the south side of the freeway would remain

A Western 230 kV overhead power line crosses the proposed freeway alignment at the Elwood Street alignment (the half-mile between Broadway Road and Lower Buckeye Road) between 63rd and 59th avenues. A Western pole associated with the line is located at the eastern edge of the proposed ADOT right-of-way. Western has completed preliminary design for the relocation of the conflicting lines in both locations. The power lines along the Elwood Street alignment would need to be raised to allow the freeway to pass underneath. The two poles nearest the freeway would be replaced with new poles to provide the additional vertical clearance.

3.11.14 Salt River Project – Irrigation

Contact: Harold Biever; 602-236-2877; 3160 W. Alma School Road, Mesa, AZ 85210

Design Considerations: The numerous SRP drains and laterals along the crossroads and agricultural properties within segments western section of the project would need to be relocated or piped prior to construction. Some of these may have been previously piped during road widening or adjacent development. Coordination has taken place and would continue as the design progresses. Wells would be avoided or relocated as described in a subsequent section.

The eight piped laterals (siphons) that cross I-10 would be relocated (extended to the limits of the I-10 right-of-way) prior to construction of segment 9. Because the relocation work is limited to the SRP annual dry-up period the coordination for this work has been accelerated in the design process.

3.11.15 Roosevelt Irrigation District – Irrigation

Contact: Ken Craig, RID; 623-386-2046; 103 W. Baseline Road, Buckeye, AZ 85326
Melody Zyburt, Stantec; 602-707-4773; 8211 S. 48th Street, Phoenix, AZ 85044

Design Considerations: The Roosevelt Canal crosses the proposed freeway alignment at the half-mile between Lower Buckeye Road and Buckeye Road (Durango Street alignment). The Salt Canal is a lateral that runs along the south side of Van Buren Street as it crosses the proposed freeway alignment. The lateral is in a buried pipe at this location and ties to an RID well located on the southeast corner of Van Buren Street and 59th Avenue.

The freeway main line would span the entire RID right-of-way for the Roosevelt Canal. The operations and maintenance roads on each side of the canal would be protected in place and provided 16.5 feet of vertical clearance. The northbound and southbound 59th Avenue frontage roads would bridge the canal at-grade while providing adequate freeboard clearance. The operations and maintenance roads would be provided access across the frontage roads. The freeway drainage channel would cross under the canal in a siphon.

The Salt Canal would not be impacted directly by the freeway main line because it would span the lateral on a bridge overpass. Potential conflicts due to the freeway drainage channel concrete box culvert crossing under Van Buren Street would be further evaluated as design progresses. The RID well would be avoided or relocated as described in a subsequent section. RID would need access and vertical and horizontal clearance adjacent to the well site for maintenance vehicles.

3.11.16 Union Pacific Railroad – Railroad

Contact: Alex Papovici; 602-322-2510; 631 South 7th Street, Phoenix, AZ 85034

Design Considerations: The UPRR main line crosses the proposed freeway alignment at the half-mile between Buckeye Road and Van Buren Street (Harrison Street alignment). The freeway main line and northbound and southbound 59th Avenue frontage roads would span the entire UPRR right-of-way and provide 23.5 feet of vertical clearance to the top of rail. The freeway drainage channel would cross under the railroad in a concrete box culvert.

Frequent communication would take place during design and review of the proposed freeway. The design of the UPRR bridge overpass has been accelerated ahead of the overall project design phase to expedite the permit approval process.

In 2012, Caljet approached ADOT to discuss their plans to potentially introduce a new at-grade railroad crossing just east of the Van Buren Street traffic interchange. If this crossing moves forward, coordination would be required during design to determine the necessary interconnection and preemption of traffic signals and associated design features.

3.11.17 Miscellaneous Owners – Wells

Locations: The *Water Resources Report* (ADOT 2011h) identified 124 wells (25 in the Eastern Section and 99 in the Western Section) that would be potentially affected by the proposed freeway. The well locations were obtained from the Arizona Department of Water Resources (ADWR) database, which identifies wells as monitoring, piezometer, production, geotechnical, observation, domestic, test, irrigation, and abandoned. Abandoned wells have been included in the total above. If a well were adversely affected by roadway construction, well abandonment and compensation (e.g., drilling a new well) may be required.

Design Considerations: The disposition of each well would be determined during the right-of-way acquisition process. ADOT's first choice would be replacement of the acquired well by paying well owners to replace the acquired well. This would involve negotiations with the well owner and a payment to the owner for associated replacement well costs. These costs could include, but not necessarily be limited to:

- costs of any hydrologic studies that may be required – according to ADWR regulations, if the replacement well is relocated within 660 feet of the existing well, no hydrologic study would be required
- costs of exploratory drilling and final well development
- costs of reconnecting the new well to the existing distribution system

ADOT's next choice would be to hire a contractor to perform the necessary studies on well placement and to drill a new well (not considered a replacement well by ADWR and assumed to be farther than 660 feet from the original well location). The well would then be provided to the acquired well owner. The preference would be to locate the new well on the former well owner's property; if additional right-of-way would be required for the new well location, however, these costs would be included in negotiations. It is assumed that a new well location could be found that would produce water comparable in quality and quantity to the acquired well and that no change in the existing groundwater right would result.

It is understood that finding a suitable location for a new well may be difficult. In the event that well replacement was not possible, ADOT would still replace the water that would be lost through the acquisition.

3.12 Geotechnical Conditions

3.12.1 Preliminary Pavement Design

The main line pavement structural section used for cost estimating purposes was 13 inches of PCCP over 4 inches of aggregate base Class 2 with AR-ACFC surfacing. An asphaltic concrete base 4 inches thick is assumed under PCCP in the cut section through the South Mountains. The ramp and crossroad PCCP sections assumed a depth of 10 inches and asphaltic concrete sections assumed a depth of 6 inches over 9 inches of aggregate base. The I-10 pavement would require a doweled PCCP section. These pavement sections are consistent with recent regional freeway construction projects.

During final design, a geotechnical report would be developed to analyze the existing ground and embankment material properties as well as the projected traffic, especially truck traffic, for the freeway. The final pavement design would be developed in accordance with current ADOT Materials Group, Pavement Design Section guidance.

3.12.2 Blasting Effects

Near the South Mountains and in the foothills along Pecos Road, bedrock would be encountered during the construction of the proposed freeway. As a result, blasting would be required to fragment the rock material for removal. The facilities potentially affected by the flyrock, airblast, and ground motion associated with blasting include:

- residences adjacent to the proposed freeway
- a COP 48-inch water pipe located parallel and adjacent to the freeway through the South Mountains
- SRP 500 kV overhead power lines located parallel and adjacent to the freeway through the South Mountains

Safety measures, responsibilities, and requirements associated with controlled blasting and the use of explosives are described in the ADOT *Standard Specifications for Road and Bridge Construction* (ADOT 2008e).

SRP has specific requirements for blasting near their facilities. They include plan review, pre-blast survey, and monitoring. Floyd Hardin, Manager, SRP Line Asset Management (602-236-8327) is the contact for coordinating these activities (SRP 2008b and 2011)

A specific vibration-related concern with regard to COP 48-inch water line was also reviewed by the project team. The evaluation was based on the existing conditions (water line construction as-builts, geotechnical conditions), proposed construction (cut depths) and relevant guidance on controlled blasting effects. The complete analysis can be found in the technical memorandum, *Issues Regarding Controlled Blasting City of Phoenix South Mountain Water Transmission Main Reach 3B Tunneled Segment* (ADOT 2008f). The recommendations included identification of criteria to evaluate potential impacts, monitoring methods, and special provision preparation and blasting plan review.

3.13 Earthwork

The proposed freeway—including the main line, system and service traffic interchanges, drainage channels, and basins—was modeled to determine earthwork quantities. A summary of the earthwork quantities, broken down by major segments, is presented in Table 3.9. Notable observations from the table and the earthwork calculations include:

- Although the freeway is generally aboveground throughout the corridor, a large amount of material is produced. The major sources include:
  - Segment 2 from the foothills near Desert Foothills Parkway
  - Segment 3 from the cuts through the South Mountains
  - Segment 5 from the large drainage basins
  - Segment 8 from the drainage channel and large drainage basin south of Broadway Road
  - Segment 9 from the side slopes along I-10 (Papago Freeway)
- The rolling profile results in a fairly consistent need for embankment along freeway corridor of approximately 1,000,000 cubic yards per mile.
- The project would require almost 11 million cubic yards of borrow material. A specific borrow source has not been identified. Coordination between ADOT and FCDMC has identified a large amount of borrow material currently being stored near the Salt River.
- The borrow total in Table 3.9 assumes that 20 percent of the almost 2.7 million cubic yards of rock cut material would not be suitable for use in embankment.

Table 3.9 – Earthwork Quantity Summary

Road Segment		Length (miles)	Total Excavation[a] (cubic yards)	Total Embankment[b] (cubic yards)	Net Borrow (-)/ Waste (+) (cubic yards)
1	I-10 (Maricopa Freeway) to 24th Street	3.0	604,000	2,157,000	-1,553,000
2	24th Street to 17th Avenue	3.8	1,191,000	2,960,000	-1,769,000
3	17th Avenue to 51st Avenue	5.5	3,858,000	4,779,000	-2,526,000[c]
4	51st Avenue to Elliot Road	1.7	794,000	1,153,000	-359,000
5	Elliot Road to Baseline Road	2.0	2,042,000	153,000	1,889,000
6	Baseline Road to Salt River (south side)	1.0	580,000	1,087,000	-507,000
7	Salt River Bridge	0.6	53,000	100,000	-47,000
8	Salt River (north side) to Buckeye Road	2.4	1,089,000	2,759,000	-1,670,000
9	Buckeye Road to I-10 (Papago Freeway) including I-10 system traffic interchange	1.9	2,632,000	4,645,000	-2,013,000
	Total	**21.9**	12,843,000	22,905,000	-8,555,000

Notes: The following assumptions were used: 12 percent shrink factor, 0.3 feet ground compaction factor, 2 feet of topsoil plating, and 3 feet of overexcavation and recompaction under embankments.
[a] Total excavation includes road excavation, drainage excavation, embankment overexcavation, and other excavation for topsoil overexcavation, pipe trenches, bridge structures, drilled shafts, and concrete box culvert structures less the shrink factor.
[b] Total embankment includes road embankment and other embankment for overexcavation fill, compaction, and topsoil replacement in cut sections.
[c] Assumes 20 percent of rock cut in Segment 3 is not suitable embankment material.

3.14 Right-of-way

SR 202L (South Mountain Freeway) would require approximately 1,818 acres of land. The acquisition process would be in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and implementation of Code of Federal Regulations (49 CFR Part 24).

ADOT began acquiring land within the original alignment right-of-way in 1988. Between 1988 and 2001, ADOT acquired approximately 293 acres. The majority, 258 acres, were located in the Eastern Section of the Study Area along Pecos Road. In 2006, ADOT began protective and hardship land acquisition in the new alignment right-of-way. Between 2006 and April 2011, ADOT purchased 317 acres (294 in the Western Section and 23 in the Eastern Section). Overall, ADOT owns approximately 43 percent of the total land that would be need for the proposed freeway. The agency would continue the acquisition process on a case-by-case basis through the project development process.

The right-of-way cost estimate includes individual cost estimates for each property identified within the proposed right-of-way footprint. The individual property cost estimates have three components: acquisition, relocation, and demolition. The ADOT Right-of-way Group completed the estimates in November 2011.

The right-of-way cost estimate is presented for the entire corridor (W59 and E1 Alternatives) in Table 3.10. The costs are further divided by segments and presented in Section 4.0 along with the construction cost.

Table 3.10 – Right-of-Way Cost Estimate, by Element

Right-of-Way Element	Estimated Cost ($)
Acquisition	443,000,000
Relocation	45,000,000
Demolition	16,300,000
Other costs[a]	145,700,000
Total	$650,000,000

Notes: [a] Other costs include right-of-way surveys, appraisals, and potential legal fees and court settlements associated with the condemnation process

3.15 Enhancement Opportunities

The proposed project would create opportunities for ADOT and local jurisdictions to identify additional enhancements. Examples of enhancements are both procedural and project-specific. A procedural enhancement could include the engagement of select members of the public to participate in the design phase or through public art projects in the corridor. Project-specific examples that have been proposed by other agencies include the use of excess R/W for park-and-ride lots or bicycle/multiuse paths, the construction of pedestrian overpasses, the construction of direct HOV ramps to strategic arterial streets, and the use of off-site drainage basins for recreational facilities. During the design phase, ADOT, local municipalities, the Community, Valley Metro, and MAG would work together to identify and create enhancement opportunities. MAG policy would determine how enhancements would be funded.

3.16 Constructibility and Traffic Control

This section provides an overview of the proposed construction staging for four locations that have special circumstances that required additional investigation into the constructibility and traffic control. Detailed traffic control plans would be developed during final design based on guidance from the MUTCD (FHWA 2012), *Arizona Supplement to the MUTCD* (ADOT 2012), and the ADOT *Traffic Control Guidelines* (ADOT 2010e),

3.16.1 Pecos Road Section

For approximately 9 miles from the eastern terminus with I-10 (Maricopa Freeway) to Chandler Boulevard (27th Avenue alignment), the proposed freeway would replace Pecos Road. Pecos Road is currently a heavily traveled road that provides access to a number of residential developments in western Ahwatukee Foothills Village. A number of public comments have been received through the study process regarding the impacts to Pecos Road during construction of the freeway. If Pecos Road were closed, the only alternative route would be Chandler Boulevard, which is already a heavily congested road. Therefore, the project team developed a construction staging plan that would keep four lanes of traffic on Pecos Road open (two in each direction) during construction between Chandler Boulevard and I-10 (Maricopa Freeway).

Construction would generally follow the same process throughout the area:

- Stage 1: traffic remains on existing Pecos Road
  - construct any temporary paving and remove one side of crossroad
  - construct westbound SR 202L main line including bridges, ramps, and sound walls
  - widen one side of crossroad
  - construct major drainage items as possible
  - construct temporary eastbound on- and off-ramps
- Stage 2: Pecos Road traffic shifts to westbound SR 202L main line
  - remove Pecos Road and other side of crossroad
  - construct final eastbound on- and off-ramps and eastbound SR 202L main line
- Stage 3: Pecos Road traffic remains on westbound SR 202L main line
  - construct final portions of eastbound SR 202L main line and crossroads
  - construct final drainage items

The proposed construction phasing would be best completed starting in the east and going west. The implementation of this portion of the freeway would be a factor to consider along with the construction phases because each section would need to tie back into existing portions of Pecos Road. Providing continuous outlets for drainage would be an important factor to consider during the construction staging development. An alternate to the use of temporary eastbound ramps would be to add temporary pavement along the westbound ramps and have both directions of travel use the eastbound ramps to access the crossroads. This may limit the number of lanes of traffic, but would reduce speeds and keep traffic isolated from other construction areas.

3.16.2 51st Avenue Service Traffic Interchange

The construction of the 51st Avenue service traffic interchange includes the realignment of 51st Avenue and the construction of a new spur road. 51st Avenue was modified to provide a perpendicular intersection with the freeway that would reduce the right-of-way footprint and impacts to adjacent land. The construction phasing at this location includes the following steps:

- Stage 1: traffic remains on existing 51st Avenue
  - construct temporary pavement as needed.
  - construct 51st Avenue widening in area of final road
  - shift traffic to new 51st Avenue pavement
  - remove 51st Avenue in areas overlapping proposed improvements
- Stage 2: traffic on temporary pavement along existing 51st Avenue alignment
  - construct realigned 51st Avenue and bridges over existing 51st Avenue, 51st Avenue spur, and Estrella Drive
  - remove temporary pavement and sections outside of realigned area
- Stage 3: shift traffic to realigned 51st Avenue
  - construct SR 202L main line and ramps

3.16.3 59th Avenue section

The freeway construction between Lower Buckeye Road and I-10 (Papago Freeway) includes splitting the existing 59th Avenue road into one-way frontage roads on the outside of the freeway main line. The construction of this section of freeway would be complex due to traffic flow on 59th Avenue, mid-mile bridges over the RID canal and the UPRR tracks, and construction of the off-site channel between the freeway and the northbound frontage roads. The construction phasing includes the following steps:

- Stage 1: traffic remains on existing 59th Avenue and crossroads
  - construct southbound 59th Avenue frontage road and southbound on- and off-ramps
  - widen one side of crossroads
- Stage 2: shift southbound traffic to southbound 59th Avenue frontage road and shift northbound 59th Avenue traffic to old southbound lanes
  - remove and reconstruct northbound 59th Avenue frontage road
  - construct other side of crossroad
  - construct main line bridge overpass
  - construct northbound frontage road and northbound on- and off-ramps including box culverts
- Stage 3: shift traffic to frontage road and crossroad ultimate facilities
  - construct drainage channel and remaining freeway main line

3.16.4 I-10 (Papago Freeway) System Traffic Interchange

The construction of the I-10 (Papago Freeway) system traffic interchange would require extensive traffic control and construction planning because the construction would occur with traffic present on I-10 and 59th Avenue. The construction would require the removal and reconstruction of service interchange ramps and access roads as well as the construction of structures over I-10. The construction staging plan for this location includes the following steps:

- Stage 1: close 59th Avenue ramps
  - remove all four 59th Avenue ramps
  - remove 63rd Avenue bridge
- Stage 2: bridge construction
  - construct Ramp NW flyover, Ramp ES flyover, Ramp WS flyover and DHOV ramps
  - relocate and reconstruct any portions of the existing I-10 channel

    - construct bridges over Roosevelt Street
- Stage 3: access road and ramp construction
    - remove eastern 67th Avenue ramps and western 51st Avenue ramps
    - construct eastbound and westbound access roads
    - construct new 59th and 67th Avenue ramps
    - construct remaining portions of system ramps

The staging plan generally prioritizes the most complex bridges in the early phases to minimize the construction duration.

3.17 Implementation Plan

In summer 2013, ADOT received an unsolicited public-private partnership (P3) proposal to construct the South Mountain Freeway from a group of private companies. Constructing the freeway as a toll road was not considered in the proposal. On July 31, 2014, ADOT announced that if the Selected Alternative in the ROD is an action alternative, the South Mountain Freeway would be procured as a single project using a P3 approach. The Design-Build-Maintain delivery mechanism would include a long-term maintenance component but would not include a private finance option.

Historically, the freeway corridor has been divided into segments to establish a construction implementation plan. The segments were determined by considering issues such as traffic operations and continuity, drainage, and contract management. The initial implementation plan began with construction of the western segments at I-10 (Papago Freeway) continuing south to the Salt River. The construction would then begin along Pecos Road at the I-10 (Maricopa Freeway) system traffic interchange and continue west through the South Mountains and connecting with the north-south segments. Since the delivery of the project would be as a single project, construction implementation and sequencing of segments are now at the discretion of the design-build-maintain contractor.

It is anticipated that construction would begin in 2016 and would take approximately 3.5 years, ending in late 2019 or early 2020.

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4. Estimate of Probable Costs

The estimate of probable project costs for constructing the proposed 8-lane SR 202L (South Mountain Freeway) is $1.65 billion (2015 dollars). The estimate of probable cost is based on the cost risk assessment completed for the project in October 2014. A detailed estimate with quantities and unit costs for major items is presented in Appendix B. Table 4.1 provides a summary of the total cost by major item.

Table 4.1 – Summary of Probable Costs

Item description	Cost
Earthwork	$134,250,000
Base and surface treatment	101,904,034
Drainage	60,513,090
Structures	225,525,593
Traffic Engineering	98,887,464
Roadside Development	125,488,344
Incidentals	218,287,122
Subtotal A	964,855,747
Unidentified items (5% of Subtotal A)	48,242,787
Subtotal B (Subtotal A + Unidentified items))	1,013,098,534
Indirect Cost Allocation (10.39% of Subtotal B)	155,003,114
Construction Engineering (6% of Subtotal B)	60,785,912
Construction Contingencies (6% of Subtotal B)	60785,912
Total Estimated Construction Cost	1,289,673,472
Stipend and Public Involvement	8,578,666
Retired Risk	(100,000,000)
Right-of-way	448,600,000
Total Estimated Project Cost	1,646,852,138

The latest unit cost information from recent ADOT construction projects were used to develop the estimate of probable costs. Assumptions used in developing the cost estimate are listed below:

- Borrow (in-place) assumes a borrow site has not been identified.
- Traffic control varies by segment based on the anticipated complexity of the construction operations.
- Sound wall quantities are based on locations and heights determined by the preliminary noise analysis.
- Fencing includes rock fall containment fences at cuts through the South Mountains.

4.1 Available Funding

The *2035 Regional Transportation Plan (RTP)* (MAG 2014) includes a budget of $1.8 billion for the South Mountain Freeway programmed between fiscal year 2014 and 2026. The latest ADOT 5-year facilities construction program which covers fiscal year 2015 to 2019 includes $1.62 billion ($538 million for right-of-way, $76 million for design, and $1 billion for construction) for the South Mountain Freeway (ADOT 2014a).

4.2 Long-term Maintenance Cost

The projected annual maintenance cost for SR 202L (South Mountain Freeway) was calculated to provide future budgeting guidance for ADOT's Phoenix Maintenance District. The calculation included an average pavement width of 168 feet (includes travel lanes, shoulders, and auxiliary lanes), a total project length of 22 miles, and an annual maintenance cost per lane-mile of $17,400. Combining these factors and inflating to the projected opening year of 2020 results in an annual maintenance cost of approximately $8 million.

4.3 Value Analysis Studies

Previous cost estimates for the proposed freeway approached $2.4 billion leaving a project shortfall of almost $500 million. Discussions began as far back as 2009 to develop cost-savings measures for the proposed freeway. Previous design changes, such as the 59th Avenue alignment and switch from ten lanes to eight lanes, that have been adopted were primarily proposed to reduce the cost of the project. More recently, formal value analysis studies have been completed by ADOT and MAG.

In March 2011, a value engineering review of the South Mountain Freeway corridor was conducted. The review team included ADOT, FHWA, and consultant representatives with expertise in construction, maintenance, and roadway, drainage, and structural design. The purpose of the review was to develop recommendations for potential cost-saving measures that could be implemented along the corridor. In all, over 15 recommendations were presented by the review team. The recommendations would be further evaluated as design progresses (ADOT 2011i).

In October 2011, MAG completed the *SR 202L/South Mountain Freeway Review*, which used a multi-disciplinary approach to evaluate cost-savings measures for the project. A primary conclusion from the report was that "...due to the extent of the funding gap, reducing or eliminating minor components at select locations is not going to sufficiently address the cost differential. A philosophical change to the design approach is recommended, in which it is optimized for functionality, safety, and cost. Optimization includes taking a practical design approach and maximizing the return on infrastructure investment, rather than adhering to current project design standards."

The current cost estimate is reflective of the incorporation of many of the cost-savings measures. As the design process progresses, a focus should remain on potential areas for further cost savings, such as:

- Options to optimize the freeway profile to better balance earthwork
- Options to minimize the off-site drainage infrastructure
- Options to minimize structure lengths (especially the multiuse crossings)
- Options to avoid the need for siphons at I-10 and at arterial street crossings
- Options to minimize or avoid utility relocations

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5. Social, Economic, and Environmental Concerns

Information related to the affected environment, environmental consequences, mitigation, and resources affected by the proposed freeway are provided in the *Final Environmental Impact Statement/Section 4(f) Evaluation*. Additionally, the technical reports listed below are available for review at ADOT.

- Air Quality Assessment
- Biological Resources Report
- Economics Report
- Energy Report
- Floodplains Report
- Geotechnical Report
- Hazardous Materials Report
- Jurisdictional Waters Report
- Land Use Report
- Noise Report
- Prime and Unique Farmland Report
- Cumulative and Secondary Impacts Report
- Section 4(f) and Section 6(f) Report
- Social Conditions Report
- Title VI and Environmental Justice Report
- Traffic Overview
- Utilities Report
- Visual Resources Report

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