MARICOPA ASSOCIATION of GOVERNMENTS

COMMUTER RAIL SYSTEM STUDY

FINAL REPORT • MAY 2010

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May 2010

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Acronyms

ABR	Absolute Block Register
ABS	Automatic Block Signaling
ACE	Altamont Commuter Express
ADA	Americans with Disabilities Act
ADOT	Arizona Department of Transportation
ARRA	American Recovery and Reinvestment Act of 2009
ASU	Arizona State University
CMAQ	Congestion Mitigation and Air Quality
COASTER	The San Diego Coast Express Rail
CWT	continuous welded rail
DASH	Downtown Area Shuttle
DMU	Diesel Multiple Unit
DTC	Direct Traffic Control
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HBW	home-based work
HCT	High Capacity Transit
HOV	high occupancy vehicle
HSIPR	High-Speed Intercity Passenger Rail
HURF	Highway Users Revenue Fund
I-10	Interstate 10
JPA	Joint Powers Authority
LBG	Lights, Bells and Gates
LHC	Locomotive Hauled Coaches
LRT	light rail transit
MAG	Maricopa Association of Governments
MARY	Maryville Area Ride for You
MAX	Maricopa Xpress
MC	Maricopa County
METRO	Valley Metro Rail, Inc.
MnDOT	Minnesota Department of Transportation
MOU	Memorandum of Understanding
mph	miles per hour
MPO	Metropolitan Planning Organization
NEPA	National Environmental Policy Act
NTD	National Transit Database
O&M	operating and maintenance
PCJPB	Peninsula Corridor Joint Powers Board
PMT	Project Management Team
PRIIA	Passenger Rail Investment and Improvement Act of 2008
PRT	Project Review Team
PTC	Positive Train Control
RPTA	Regional Public Transportation Authority
RTD	Regional Transportation District
RTP	Regional Transportation Plan
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SHF	State Highway Fund

SRT	System Review Team
SS	Stop Sign
STAN	Statewide Transportation Acceleration Needs
STB	Surface Transportation Board
STP	Surface Transportation Program
TAZ	transportation analysis zone
The T	The Fort Worth Transportation Authority
TRID	Transit Revitalization Investment District
UPRR	Union Pacific Railroad
VLT	Vehicle License Tax
VMT	Vehicle Miles Traveled
XB	Railroad Crossbuck

ES.1.0 COMMUTER RAIL SYSTEM STUDY OVERVIEW

The purpose of this Commuter Rail System Study is to define an optimized network of commuter rail corridors and the necessary elements needed to implement a regional commuter rail system. The System Study provides a detailed evaluation of potential commuter rail links to the East Valley (including the Tempe, Chandler, and Southeast Corridors) and links to the West Valley by incorporating the findings of the Grand Avenue and Yuma West Corridor Development Plans, both of which are being produced in conjunction with this System Study.

This Study compares a set of Stand-Alone Alternatives (single corridors) and a set of Interlined Alternatives (combined corridors). The comparison of alternatives takes into account a number of factors, including ridership forecasts, travel time savings, cost-effectiveness and ease of implementation or constructability. The comparison of alternatives reveals three distinct tiers of Study System alternatives – top, middle and lower – based on their performance relative to the set of evaluation factors. The Study concludes with recommendations for a phased approach to the implementation of regional commuter rail service as well as the implementation steps needed to realize full build out of the system.

ES.1.1 How does this Study Relate to Previous Studies?

This Study builds on previous local and regional planning work to consider the feasibility of operating commuter rail service on existing freight rail lines. In 2003, the Maricopa Association of Governments (MAG) completed the High Capacity Transit (HCT) Study. The study recommended a transit network designed to meet the travel demand needs of the region in the forecast year of 2040. A key finding of this study was that commuter rail corridors may potentially serve a critical function in addressing future travel needs in the region. In 2008, following the HCT Study, MAG developed the Commuter Rail Strategic Plan to provide a framework and specific steps for implementing commuter rail in the MAG region and northern Pinal County. The Strategic Plan developed a commuter rail system concept that would radiate from downtown Phoenix and be oriented around the five existing freight rail lines in the study area. These corridors include:

- Grand Avenue Corridor (BNSF Railway Company)
- Yuma West Corridor (Union Pacific Railroad (UPRR))
- Tempe Corridor (UPRR)
- Chandler Corridor (UPRR)
- Southeast Corridor (UPRR)

This MAG Commuter Rail System Study further defines and evaluates these five commuter rail corridors.

ES.2.0 DESCRIPTION OF COMMUTER RAIL

ES.2.1 Why is there a Need for a Commuter Rail System?

Demands on the Phoenix region's highway system have resulted in increased travel time for commuters, as well as less predictable travel times that vary with congestion levels. These problems will only worsen in the future as the region continues to grow. Recent and planned public transportation investments in bus, bus rapid transit (BRT) and light rail transit (LRT) will help mitigate these problems, but cannot do so alone. Commuter rail service in the Phoenix region would complement and build upon existing and planned bus, BRT and LRT service. Specifically, commuter rail service would (1) offer an alternative transit mode that has the advantage of using existing rail corridors, (2) use a transit technology that is appropriate for longer distance travel, and (3) allow for transfers to other transit systems.

Rail Runner Express Commuter Train; Albuquerque, NM
Source: MRCOG/HDR.

Sounder Commuter Train; Seattle, WA
Source: MAG.

Commuter rail systems are generally used in congested urban areas to improve travel time, mitigate congestion, add convenience, and provide an alternative means of travel – particularly in times of increasing energy prices. Commuter rail trains typically provide service between suburbs to urban centers for the purpose of reaching activity centers, such as employment, special events, and intermodal connections. Designed to primarily meet the needs of regional commuters in the AM and PM peak travel times, commuter rail service typically occurs at lower frequency than light rail transit. The distance of a typical commuter rail corridor is also longer than that of light rail, ranging from 30 to 50 miles, with passenger stations generally spaced five to 10 miles apart.

ES.2.2 What Type of Rail Vehicles Would be Used?

The Project Team evaluated Locomotive Hauled Coaches (LHC) and Diesel Multiple Unit (DMU) technologies to determine which type of commuter rail vehicles would be most appropriate for the MAG commuter rail system. At this time, an "off-the-shelf" DMU that would be appropriate for use in the Phoenix region is unavailable. Although both Siemens and a new manufacturer – US Railcar – have announced their intention to manufacture DMUs for the US market, it is uncertain when this technology will become available. Therefore, FRA-compliant locomotive hauled coaches (LHCs) are the assumed vehicle technology for all commuter rail alternatives under consideration.

LHCs are powered by one diesel-electric locomotive engine and are configured for push-pull operation. In push-pull service, the locomotive pulls the train in one direction and pushes the train in the opposite direction. A cab car with operating controls is put on one end of the train and a locomotive at the other end. Trains of LHCs may range from two-car to 12-car consists. LHC commuter rail systems are currently in service in several US cities, a few of which include Seattle, Salt Lake City, and Dallas-Fort Worth.

Example of LHC vehicles in San Diego, California.
Source: EGGER.

LHCs are equipped with comfortable seating and passenger amenities. The seated capacity of each double-deck passenger car, typically used in LHC commuter rail operations, is approximately 140 passengers; therefore, a four-car train (three coaches and one cab control car) would seat approximately 560 passengers.

ES.2.3 Where Would Passenger Stations be Located?

The Project Team conducted an evaluation of station target areas for each of the five commuter rail corridors under consideration in the System Study. Using the station locations identified in the 2003 MAG High Capacity Transit Study and those recommended by MAG staff, the Project Team characterized and assessed potential station target areas based on a set of evaluation criteria. These criteria included:

- potential station boardings,
- demographic and employment projections,
- land use,
- connectivity with existing and planned transportation systems, and
- major activity centers.

For the purposes of the evaluation, general station target areas are identified by major intersections along each commuter rail corridor. At this level of analysis, specific parcels are not identified for potential station locations.

ES.3.0 DESCRIPTION OF SYSTEM STUDY ALTERNATIVES

ES.3.1 What Stand-Alone Alternatives Were Considered?

The Project Team developed Stand-Alone Alternatives as single commuter rail corridors, each with 30-minute peak and 60-minute off-peak headways and specified travel times. Table ES-1 lists the characteristics of each Stand-Alone Alternative.

Table ES-1: Characteristics of Stand-Alone Alternatives – 2030

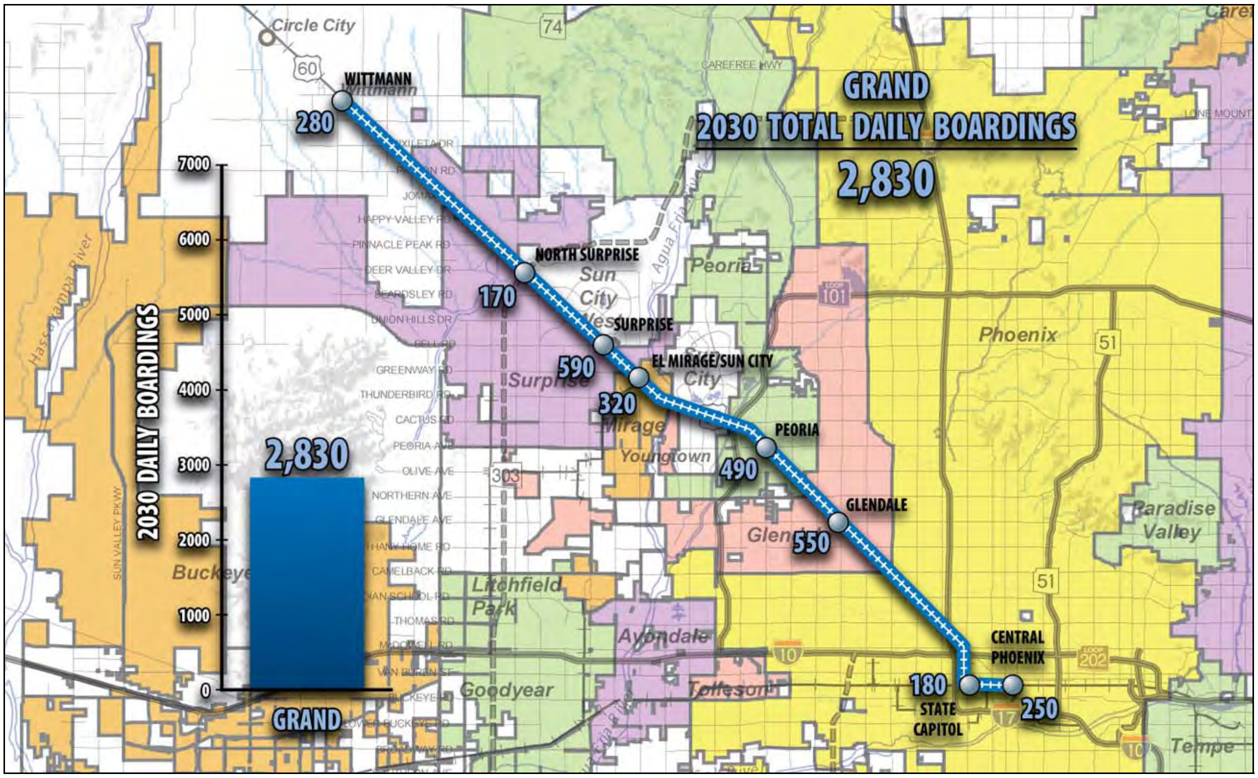
Corridor	Route Description	Distance	Travel Time
Grand	Service between Central Phoenix and Downtown Wittmann*	36 miles	43 min.
Yuma	Service between Central Phoenix and Downtown Buckeye**	31 miles	47 min.
SE	Service between Central Phoenix and Downtown Queen Creek	34 miles	46 min.
Tempe	Service between Central Phoenix and West Chandler	18 miles	29 min.
Chandler	Service between Central Phoenix and Sun Lakes	31 miles	49 min.

* End-of-line shortened to downtown Wittmann. Downtown Wickenburg and West Wickenburg stations deferred to future years due to low ridership forecasts.
** End-of-line shortened to downtown Buckeye. Arlington station deferred to future years due to low ridership forecasts.
Source: URS Corp., 2009.

ES.3.2 How Many Riders Would Each Stand-Alone Alternative Carry in 2030?

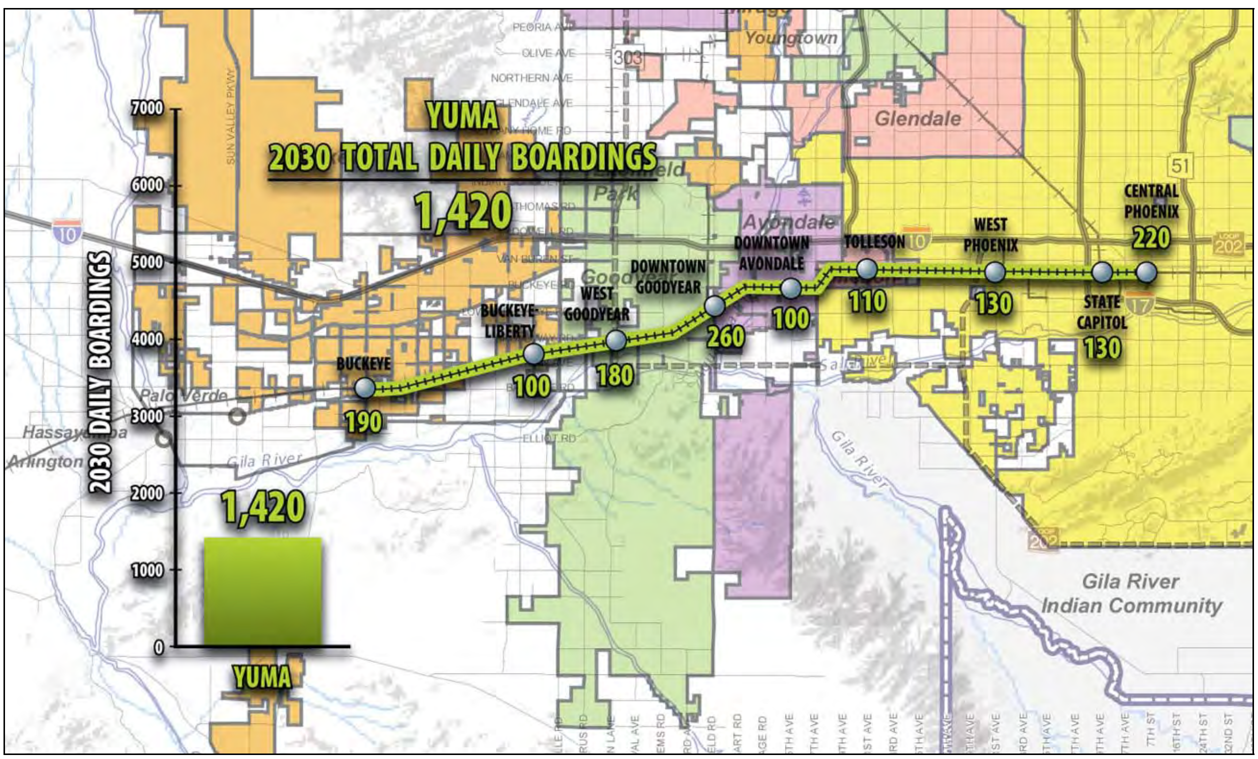
Figures ES-1 through ES-5 illustrate each of the five Stand-Alone Alternatives and the ridership forecast results. Ridership forecasting results for the Stand-Alone Alternatives indicate that the SE Corridor, with 6,450 daily boardings, would be the strongest individual corridor in the commuter rail system. The SE Corridor has 56 percent more boardings than the next strongest corridor, which is the Grand Corridor, with 2,830 daily boardings.

Figure ES-1: Grand Avenue Ridership Forecast Results



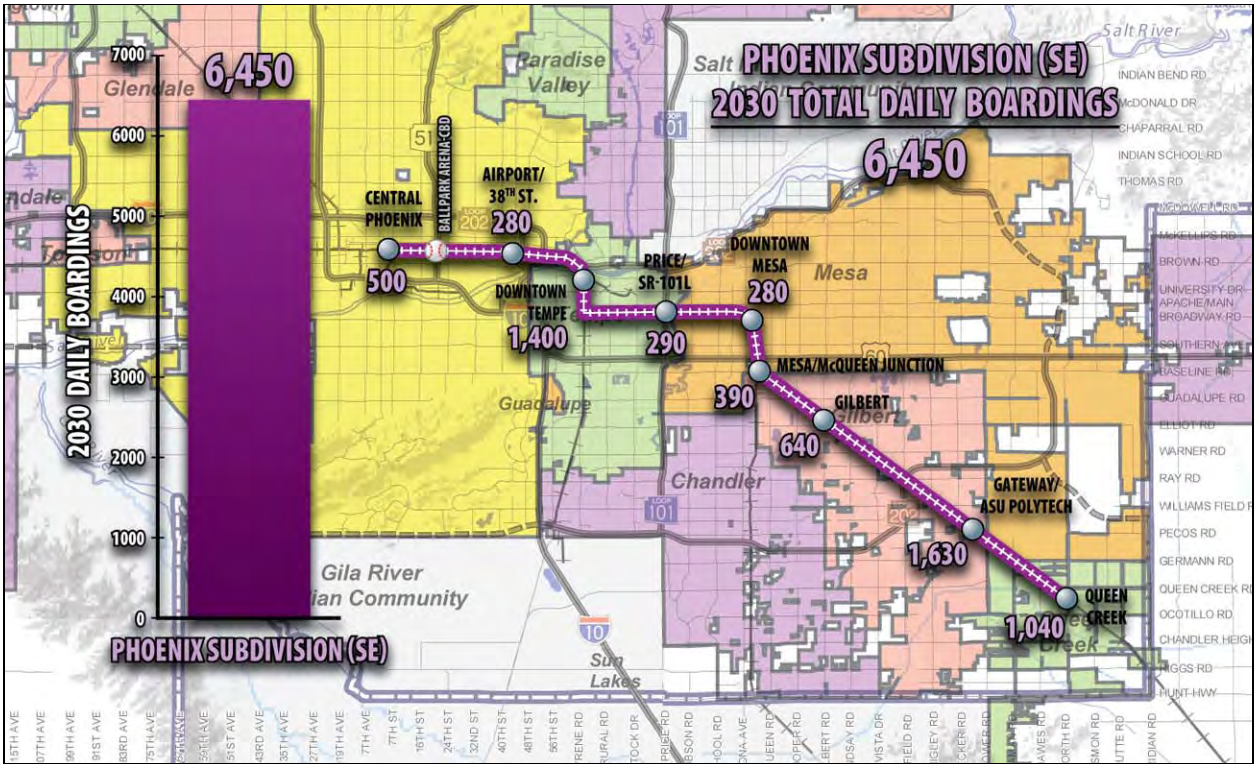
Source: URS Corp., 2009.

Figure ES-2: Yuma West Ridership Forecast Results



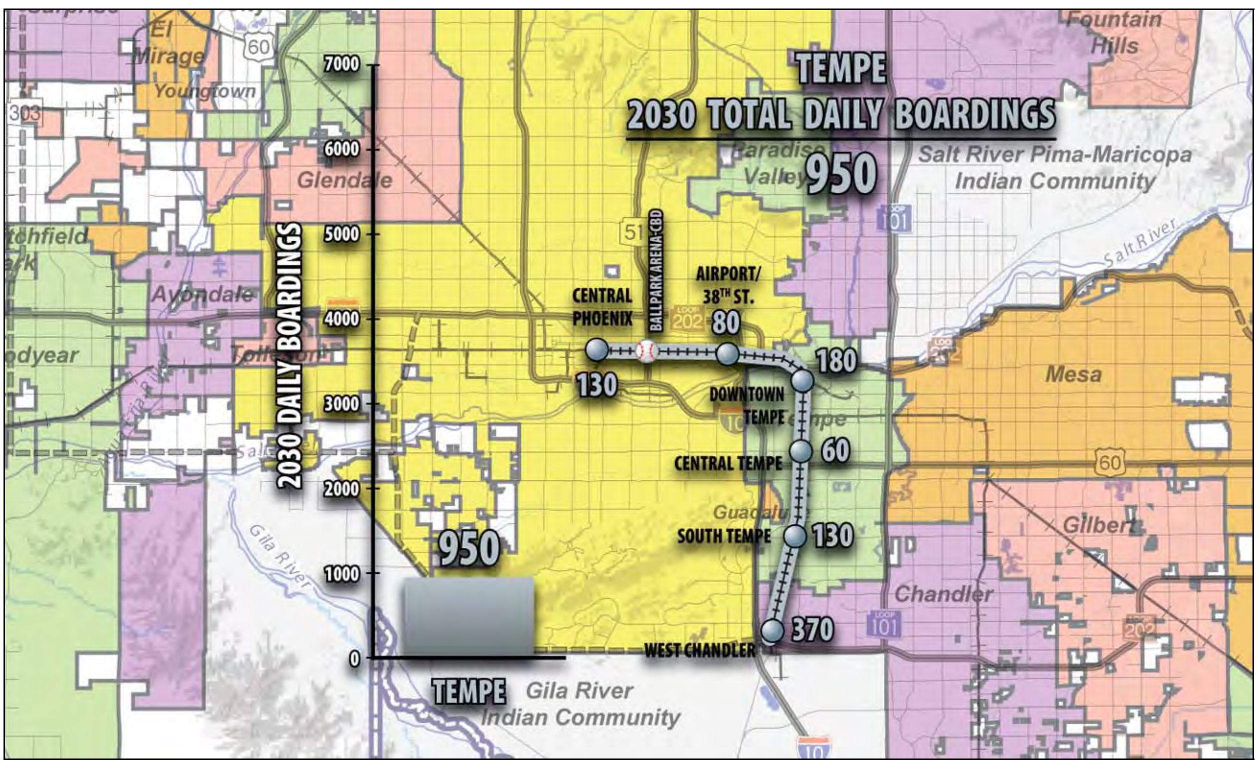
Source: URS Corp., 2009.

Figure ES-3: SE Ridership Forecast Results



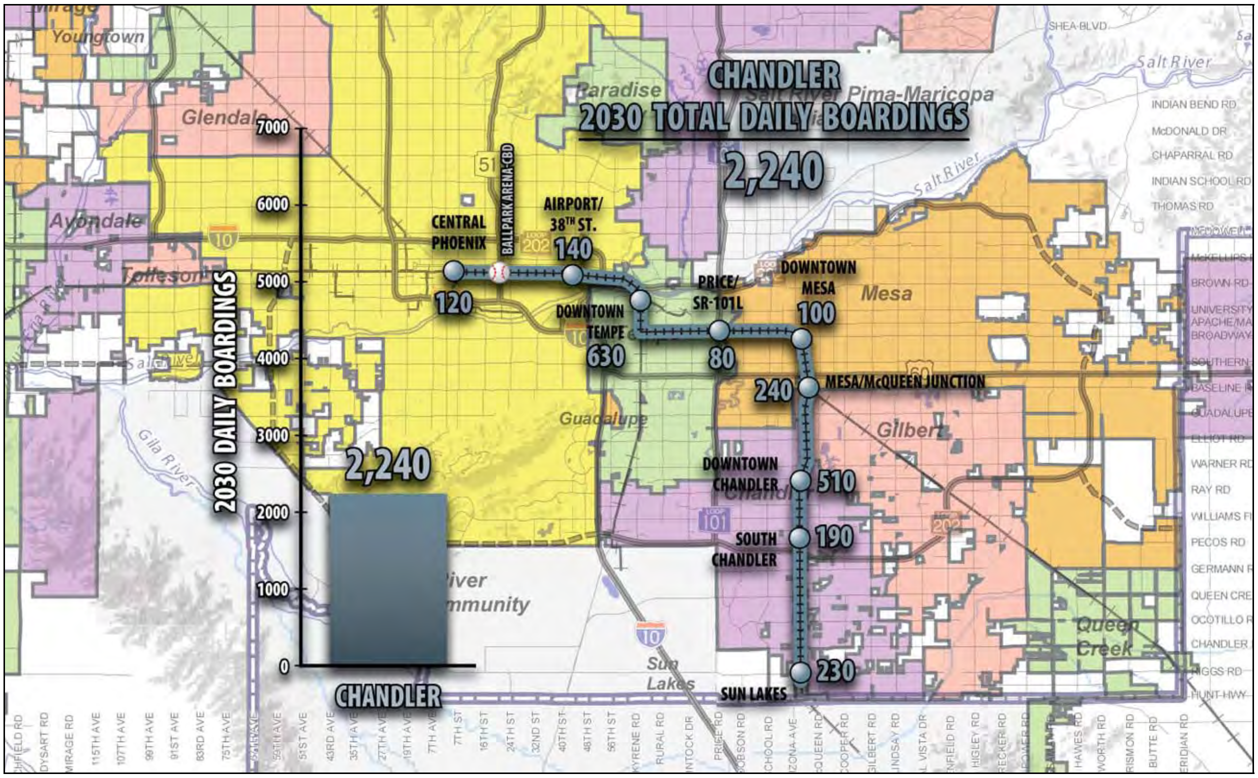
Source: URS Corp., 2009.

Figure ES-4: Tempe Ridership Forecast Results



Source: URS Corp., 2009.

Figure ES-5: Chandler Ridership Forecast Results



Source: URS Corp., 2009.

ES.3.3 What is the Cost of Each Stand-Alone Alternative?

Capital and operating and maintenance (O&M) cost estimates were developed for each Stand-Alone Alternative. Capital costs include the cost to obtain right-of-way, construct the commuter rail tracks and stations, procure vehicles and make needed infrastructure improvements. O&M costs include the annual cost to operate each alternative based on service plans. Table ES-2 lists the cost of each Stand-Alone Alternative.

Table ES-2: Capital and Annual O&M Costs for Stand-Alone Alternatives

Stand-Alone Alternative	Capital Cost*	Annual O&M Cost*
Grand	$600 million	$11 million
Yuma	$365 million	$12 million
SE	$477 million	$18 million
Tempe	$372 million	$5 million
Chandler	$449 million	$11 million

* Cost in 2009 US dollars.
Source: Gannett Fleming and URS Corp., 2009.

ES.3.4 What Interlined Alternatives Were Considered?

Interlined Alternatives were developed by connecting two or more corridors together into several series of continuous routes. These interlined routes were then combined into systems as 2-, 3-, or 4-Corridor Interlined Alternatives. Rather than requiring a transfer in Central Phoenix, the Interlined Alternatives would provide a one-seat ride between corridors. Each Interlined Alternative was developed with 60-minute off-peak headways; and either 20-minute, 30-minute or 40-minute peak headways (alternative headways were needed in various portions of interlined routes primarily to keep headways at a manageable level in overlapping segments near Central Phoenix). Table ES-3 lists the characteristics of Interlined Alternatives.

Table ES-3: Characteristics of Interlined Alternatives

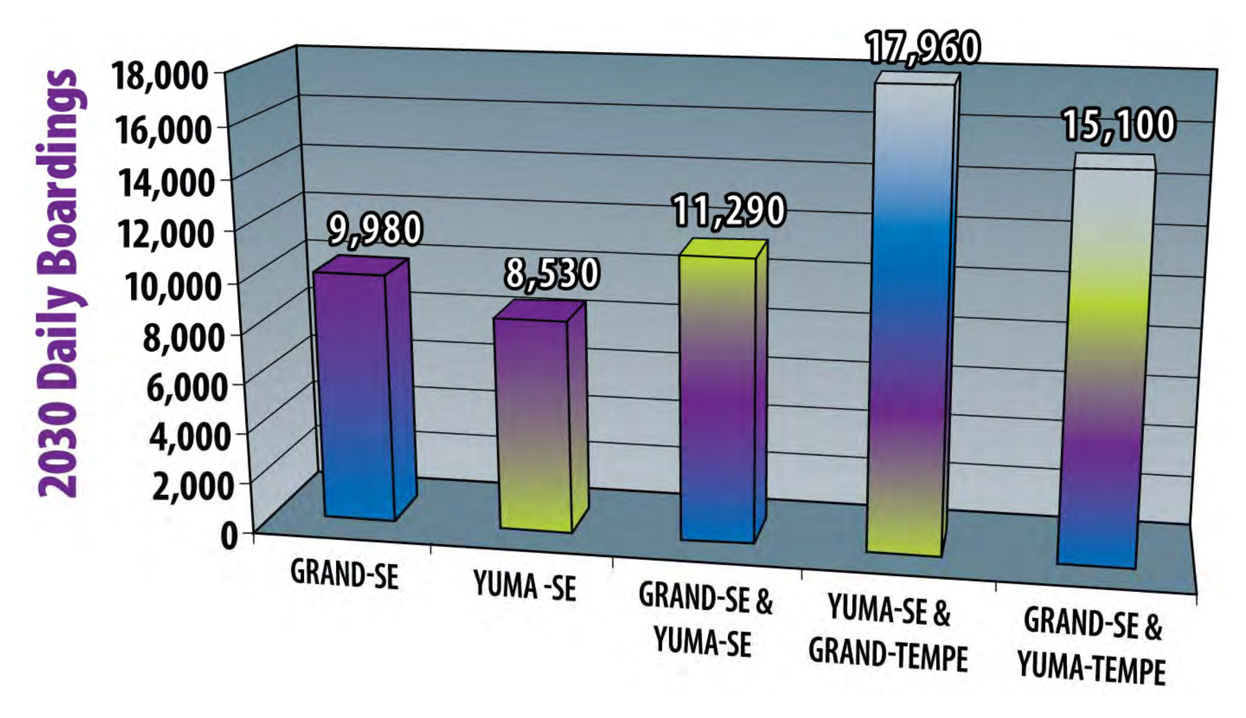
Corridors	Route Description	Distance	Travel Time
2-Corridor Interlined Alternatives			
Grand Interlined with SE	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	68 miles	89 min.
Yuma Interlined with SE	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	63 miles	93 min.
3-Corridor Interlined Alternatives*			
Grand Interlined With SE and Yuma Interlined With SE	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	68 miles	89 min.
	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	63 miles	93 min.
4-Corridor Interlined Alternatives*			
Yuma Interlined with SE and Grand Interlined with Tempe	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	63 miles	93 min.
	Service between Downtown Wittmann and West Chandler with a stop in Central Phoenix	54 miles	72 min.
Grand Interlined with SE and Yuma Interlined with Tempe	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	68 miles	89 min.
	Service between Downtown Buckeye and West Chandler with a stop in Central Phoenix	48 miles	76 min.

* The Project Team developed ridership forecasts that substituted the Chandler Corridor for the SE Corridor in the 3-Corridor and 4-Corridor Alternatives. Ridership forecasting results however indicated that substituting the Chandler Corridor for the SE Corridor would result in significantly fewer daily boardings, (62 percent to 74 percent of those estimated for the SE Corridor in 2030), and were therefore not carried forward for further consideration.
Source: URS Corp., 2009.

ES.3.5 How Many Riders Would Each Interlined Alternative Carry in 2030?

Ridership forecasting results for the Interlined Alternatives ranged from 8,540 daily boardings with the interlining of the Yuma and SE Corridors to 17,940 daily boardings with the interlining of the Yuma and SE and Grand and Tempe Corridors. Figure ES-6 illustrates these ridership forecast results.

Figure ES-6: Ridership Forecasts for Interlined Alternatives



Source: URS Corp., 2009.

ES.3.6 What is the Cost of Each Interlined Alternative?

Table ES-4 lists the capital and O&M cost of each Interlined Alternative.

Table ES-4: Capital and Annual O&M Costs of Interlined Alternatives

Interlined Alternative	Capital Cost*	Annual O&M Cost*
2-Corridor Interlined Alternative		
Grand Interlined with SE	$1.1 B	$56.4 M
Yuma Interlined with SE	$834.4 M	$52.1 M
3-Corridor Interlined Alternative		
Grand Interlined with SE and Yuma Interlined with SE	$1.4 B	$98.2 M
4-Corridor Interlined Alternatives		
Yuma Interlined with SE and Grand Interlined with Tempe	$1.6 B	$104.5 M
Grand Interlined with SE and Yuma Interlined with Tempe	$1.6 B	$102.6 M

* Cost in 2009 US dollars.
Source: Gannett Fleming and URS Corp., 2009.

ES.4.0 COMPARISON OF SYSTEM STUDY ALTERNATIVES

System Study Alternatives were fully evaluated with a set of evaluation criteria and measures in order to characterize, compare and prioritize each Stand-Alone and Interlined Alternative.

ES.4.1 What Evaluation Factors Were Used to Compare Alternatives?

Table ES-5 presents the comparison factors for System Study alternatives. While the Stand-Alone Alternatives were subjected to the complete list of evaluation factors, the Interlined Alternatives were primarily evaluated using measures of cost-effectiveness.

Table ES-5: Comparison Factors for Alternatives

Categories	Factor	Stand-Alone Alternatives	Interlined Alternatives
Primary Mode Choice	End-to-end travel time savings	X	
	Boardings per revenue mile	X	X
Rider Perception	Connections to activity centers	X	
System/Policy Compatibility	Land use compatibility	X	
	VMT reduction in corridor	X	
	VHT reduction in corridor	X	
Cost Effectiveness	Capital cost per mile	X	X
	Annual O&M cost per passenger trip	X	X
Implementation/ Constructability	Ease of implementation/ constructability	X	
	Compatibility with freight railroads	X	
	Benefit to adjacent or crossing highway infrastructure	X	

Source: URS Corp., 2009.

ES.4.2 How Did the Stand-Alone Alternatives Rank in Comparison to Each Other?

The comparison of alternatives revealed three distinct tiers of Study System alternatives – top, middle and lower – based on their performance relative to the set of evaluation factors. The factors that proved to be major discriminators included ridership, travel time savings, cost effectiveness, and implementation/constructability. Table ES-6 is a summary of Stand-Alone Alternatives rankings and discriminators.

Table ES-6: Summary of Stand-Alone Alternatives – 2030

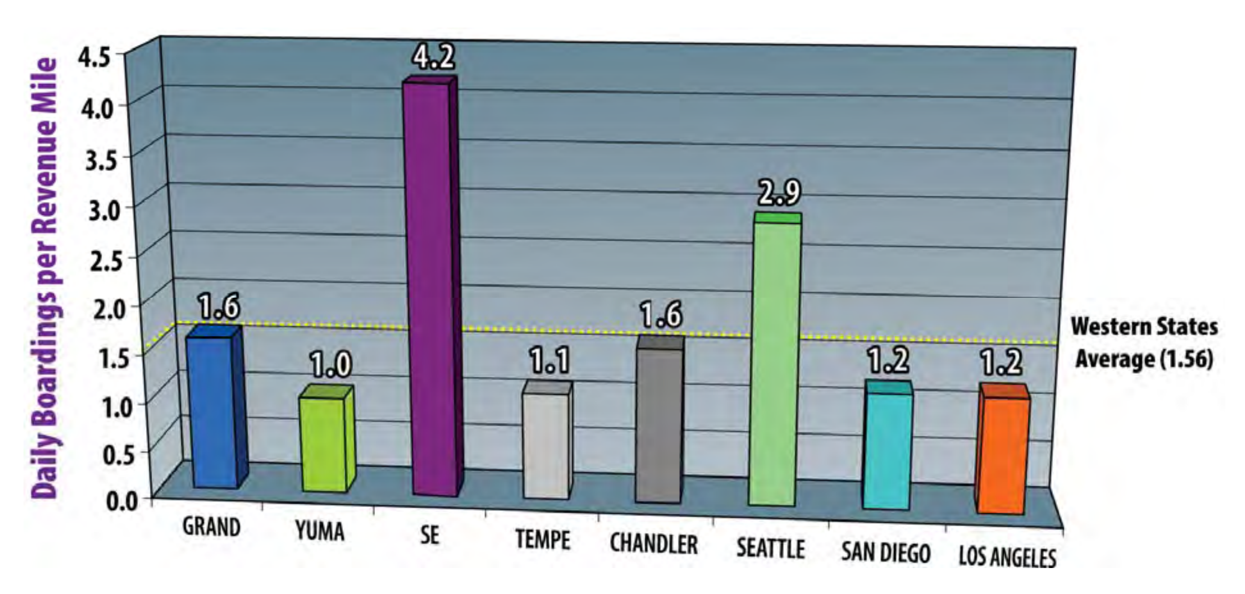
Stand-Alone Alternative	Ranking	Major Discriminators
SE	Top Tier	• 2 to 4 times the number of boardings per revenue mile as all other corridors • 18 minute end-to-end travel time savings* • Second lowest capital cost per mile • Lowest O&M cost per passenger trip
Grand Avenue	Middle Tier	• Boardings per revenue mile are close to Western States average • 24 minute end-to-end travel time savings* • Moderate capital cost per mile • Second lowest O&M cost per passenger trip
Tempe & Chandler	Middle Tier	• Low to moderate boardings per mile • Moderate to high capital cost per mile • High O&M cost per passenger trip
Yuma West	Lower Tier	• Lowest capital cost per mile due to relatively few infrastructure improvements, but lowest boardings per revenue mile • Minimal travel time savings • Highest O&M cost per passenger trip

* Compared to travel time for single-occupancy vehicle.
Source: URS Corp., 2009.

ES.4.2.1 Total Daily Ridership Forecast – 2030

The measure of total daily riders per corridor revenue mile reflects the usefulness and attractiveness of the commuter rail corridor as a primary mode choice on a daily basis. According to the evaluation results, and as shown in Figure ES-7, with 4.2 daily boardings per revenue mile, the SE Corridor has between two and four times the number of boardings per revenue mile as all the other corridors evaluated. In addition, both the Grand and Chandler Corridor boardings per revenue mile are close to the average of 1.56 daily boardings per revenue mile for commuter rail systems in Western States[1]. The Yuma and Tempe Corridors are well below this average, with 1.0 and 1.1 daily boardings per revenue mile respectively.

Figure ES-7: Daily Boardings per Revenue Mile – 2030



Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

ES.4.2.2 Travel Time Savings

The total travel time from one end of a commuter rail route to the terminal station should provide a time advantage over travel along parallel roadway corridors. The greater the time savings, the greater the passenger benefit and the more riders the system is likely to attract. An evaluation of travel time savings per corridor revealed that only two of the commuter rail corridors would offer any significant travel time savings. The Grand Corridor would save commuters an estimated 24 minutes between Wittmann and Central Phoenix, while the SE Corridor would save commuters an estimated 18 minutes between Queen Creek and Central Phoenix.

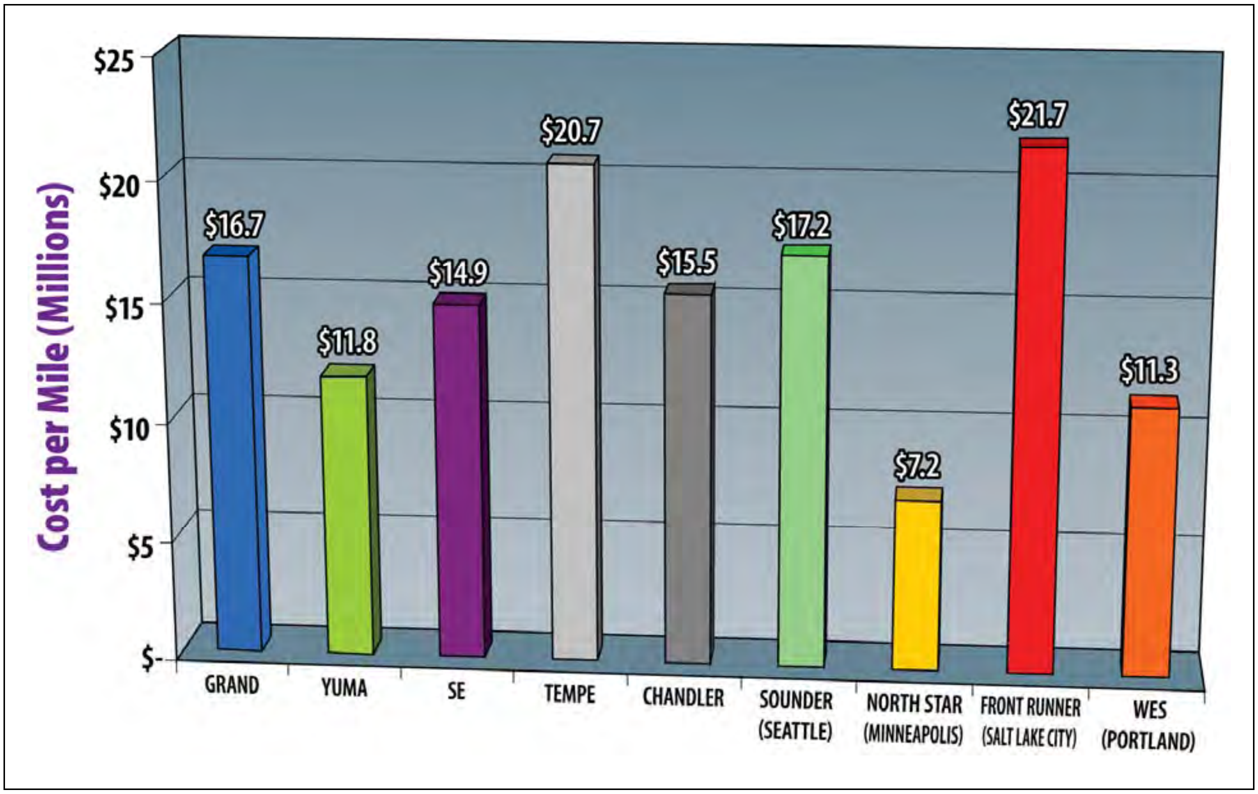
[1] National Transit Database, Transit Profiles 2007.

ES.4.2.3 Cost Effectiveness

The estimated costs to build, operate and maintain a commuter rail corridor on a per mile basis is a strong indicator of the cost effectiveness of a corridor. With the exception of the Yuma Corridor, the cost per mile increases closer to downtown Phoenix due to more expensive infrastructure needs related to limited right-of-way and required infrastructure improvements.

Capital Cost per Mile: As shown in Figure ES-8, total capital cost per mile ranges from approximately $12 million per mile for the Yuma Corridor to $21 million per mile for the Tempe Corridor.

Figure ES-8: Capital Cost per Mile*



* Grand, Yuma, SE, Tempe, and Chandler Corridor costs in 2009 US dollars. Sounder cost in 2003 US dollars, North Star cost in 2009 US dollars, Front Runner cost in 2008 US dollars and WES cost in 2009 US dollars.
Source: URS Corp., 2009.

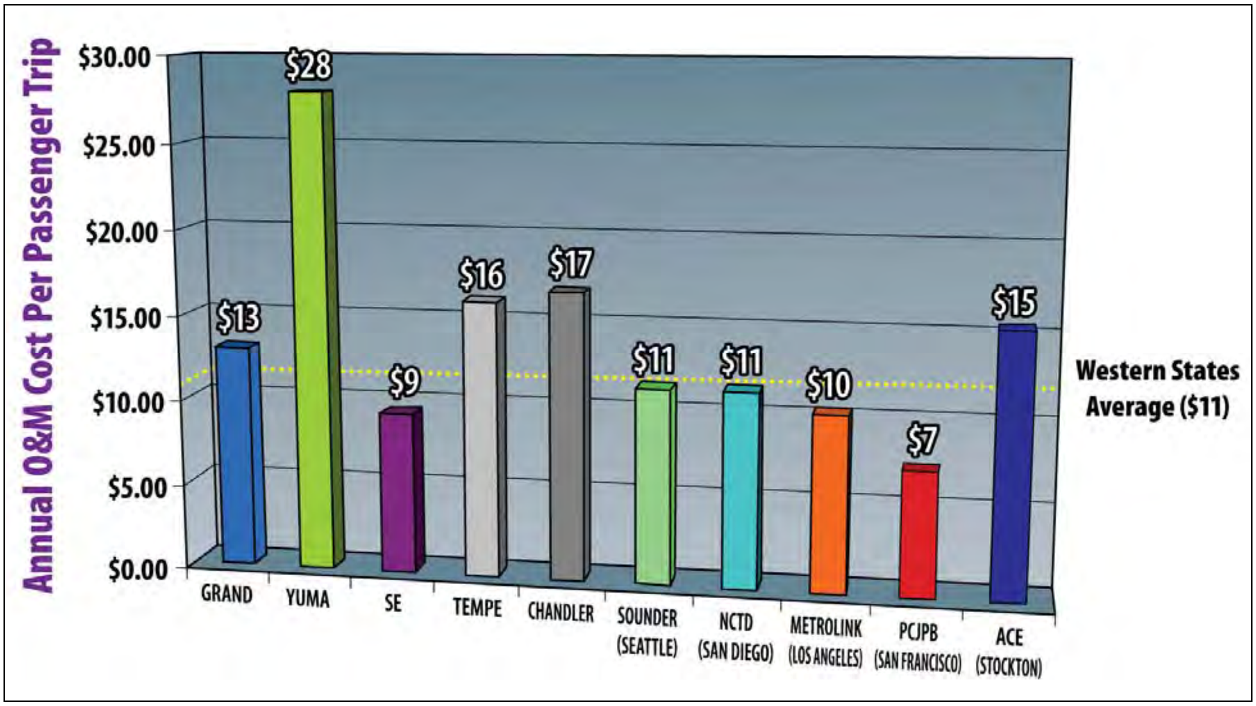
The primary variable on per-mile capital costs for commuter rail systems is the quality of existing track and infrastructure - including the track itself, the need for additional tracks and passing sidings to accommodate both commuter rail and freight rail traffic, and other features such as bridges, culverts, and other major capital items. For example, the Northstar system in Minnesota has a relatively low capital cost per mile because that system is using an existing high-quality double-track alignment. The FrontRunner system in Utah has a relatively high cost per mile because it was required to install a significant amount of new track.

Evaluation results indicate that all corridors, with the exception of the Yuma Corridor, would be more expensive to construct on a per mile basis than the peer city average of $14.4 million per mile.

O&M Cost per Passenger Trip: The estimated cost to operate a commuter rail corridor on a per passenger trip basis is also a relevant indicator of cost effectiveness. Figure ES-9 illustrates the annual O&M cost per passenger trip for the five Stand-Alone Base Alternatives as well as peer cities commuter rail systems. As shown in Figure ES-9, the annual O&M cost per annual passenger trip for the five corridors ranges from $9 per passenger trip for the SE Corridor to $28 per passenger trip for the Yuma Corridor. According the National Transit Database, Transit Profiles 2007, the average annual O&M cost per passenger trip for commuter rail systems in the Western States is approximately $11 per passenger trip. Therefore, only the SE Corridor falls below this average, while the Grand Corridor is close to this peer city average, with a cost of $13 per passenger trip.

It should be noted that these annual O&M costs would likely be reduced by the recovery of farebox revenue. Farebox recovery is the percent of commuter rail O&M costs paid for by passenger fares. According to National Transit Database, the national average farebox recovery for commuter rail systems was 37 percent in 2007.

Figure ES-9: Annual O&M Cost per Passenger Trip*



* Grand, Yuma, SE, Tempe, and Chandler Corridor costs in 2009 US dollars. Sounder, North Star, Front Runner, and WES cost in 2006 US dollars.
Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

ES.4.2.4 Implementation or Constructability

From an implementation standpoint, compatibility with railroad infrastructure may be an issue for all commuter rail corridors. Commuter rail service along the Grand Corridor may be the least compatible, as it would need to negotiate through several BNSF Railway Company facilities, including Mobest Yard, Desert Lift and Auto Facility. On the other hand, commuter rail service along the Yuma Corridor would need to negotiate through only one major facility, the Campo Yard. For the East Valley corridors, a major constraint may be negotiating service through the Phoenix Harrison Street Yard and its ancillary facilities located in downtown Phoenix.

While the Grand Avenue Corridor may have the most freight railroad facilities to contend with, it may also provide the greatest benefit to adjacent roadway infrastructure. Other corridors may be required to install constant warning devices at gated crossings, but the implementation of commuter rail service along Grand Avenue would likely require several new grade separations. These would likely be required to mitigate existing and projected safety and congestion problems.

ES.4.3 How Did the Interlined Alternatives Rank in Comparison to Each Other?

Table ES-7 is a summary of Interlined Alternatives rankings and discriminators.

Table ES-7: Summary of Interlined Alternatives

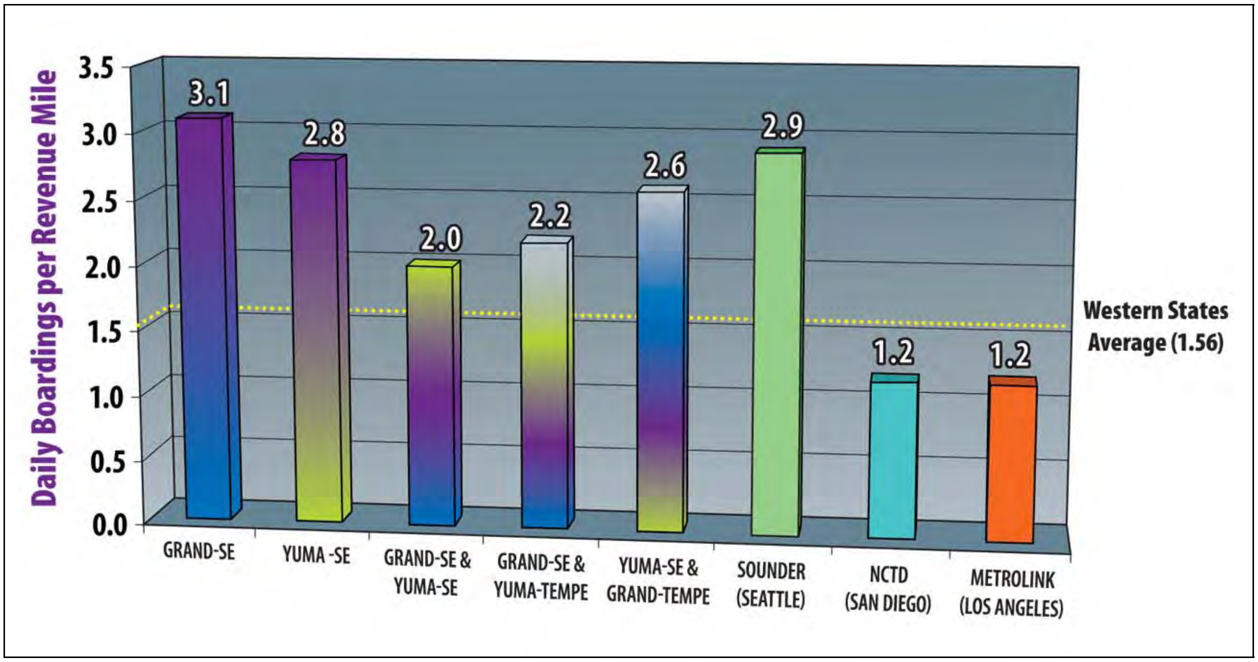
Interlined Alternative	Ranking	Major Discriminators
Grand-SE	Top Tier	• Highest boardings per mile • High capital cost per mile • Lowest O&M cost per passenger trip
Yuma-SE	Top Tier	• Moderate boardings per mile • Lowest capital cost per mile • Moderate O&M cost per passenger trip
Grand-SE & Yuma-Tempe and Yuma-SE & Grand-Tempe	Middle Tier	• Low to moderate boardings per mile • Moderate capital cost per mile • Moderate O&M cost per passenger trip
Grand-SE & Yuma-SE	Lower Tier	• Lowest boardings per mile • Moderate capital cost per mile • Highest O&M cost per passenger trip

Source: URS Corp., 2009.

ES.4.3.1 Total Daily Ridership Forecast

The measure of total daily riders per revenue mile for regional Interlined Alternatives reflects the attractiveness and productivity of the commuter rail system as a primary mode choice on a daily basis. Ranging from 2.0 to 3.1 boardings per revenue mile, the overall productivity of all the Interlined Alternatives, as shown in Figure ES-10, is higher than the Western States commuter rail system average of 1.56 boardings per revenue mile. Daily ridership forecasts are greatest when the most productive East Valley and West Valley Corridors – Grand and SE – are combined to achieve 4.2 daily boardings per revenue mile. And, with the exception of the SE Corridor, (which would have 4.2 daily boardings per revenue mile as a Stand-Alone Base Alternative), each Interlined Corridor increases the overall commuter rail system productivity.

Figure ES-10: Interlined Alternatives Daily Boardings per Revenue Mile – 2030

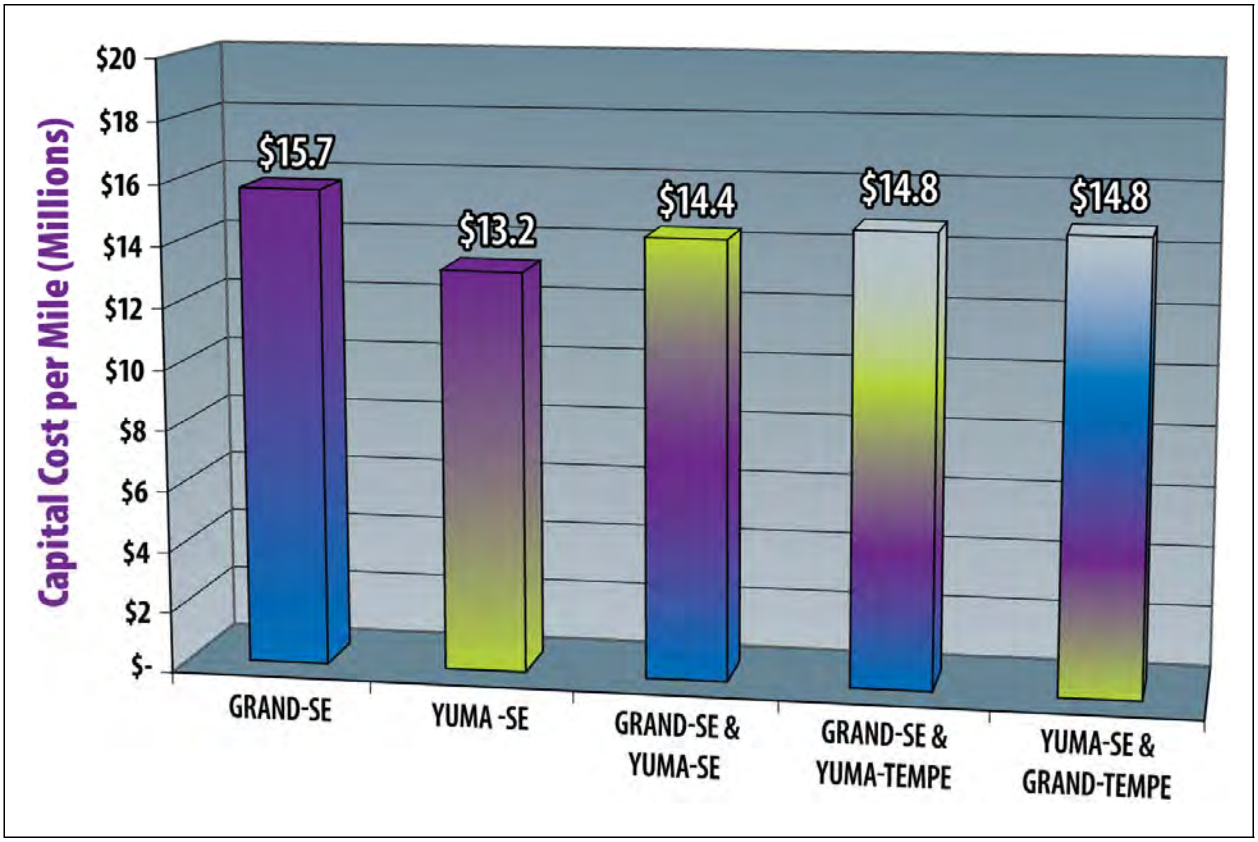


Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

ES.4.3.2 Capital Cost per Mile

As shown in Figure ES-11, total capital cost per mile ranges from approximately $13.2 million per mile when the Yuma and SE Corridors are interlined to $15.7 million per mile with the interlining of the Grand and SE Corridors. The interlining of the Yuma and SE Corridors is the least expensive Interlined Alternative on a per mile basis because, unlike the other Interlined Alternatives, it does not include the costly rail infrastructure upgrades required in Central Phoenix. Conversely, the interlining of the Grand and SE Corridors is the most expensive on a per mile basis because it is the only Interlined Alternative that does not include the less-costly Yuma Corridor.

Figure ES-11: Interlined Alternatives Total Capital Cost per Mile*



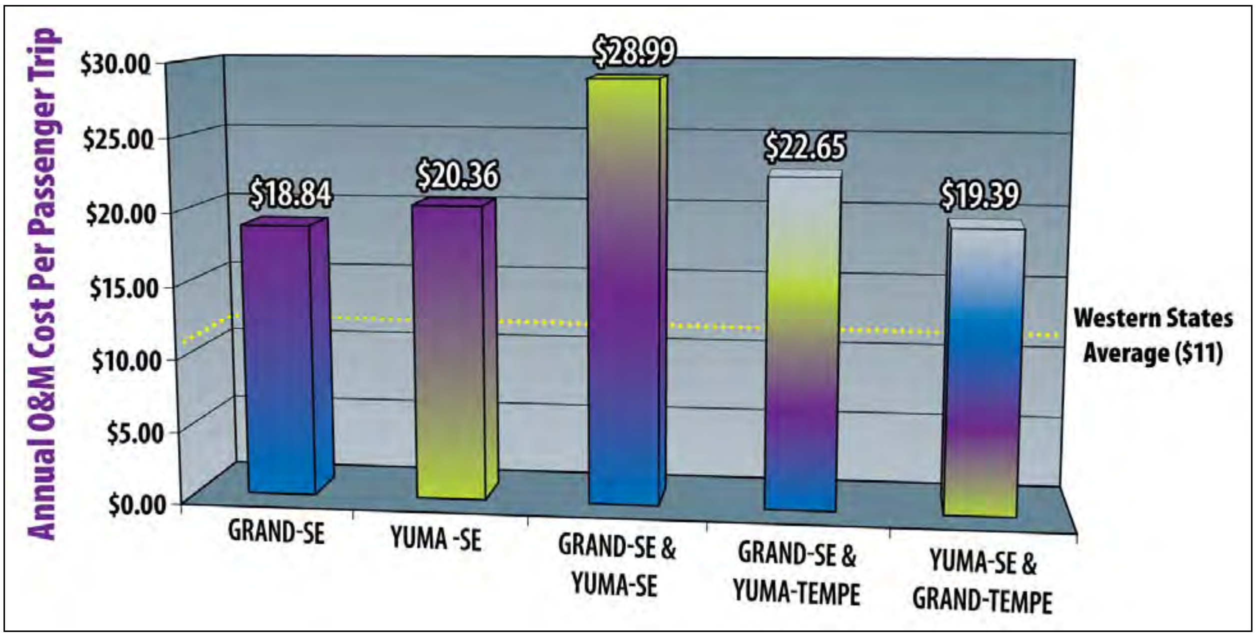
* Cost in 2009 US dollars.
Source: URS Corp., 2009.

ES.4.3.3 O&M Cost per Passenger Trip

The estimated cost to operate a commuter rail corridor on a per passenger trip basis is also a relevant indicator of cost effectiveness. As shown in Figure ES-12, the annual O&M cost per annual passenger trip for the five Interlined Alternatives ranges from approximately $19 per passenger trip for the interlining of the Grand and SE Corridors to approximately $29 per passenger trip for the interlining of the SE Corridor with both the Grand and Yuma Corridors. In general, any Interlined Alternative that includes the Yuma Corridor tends to have an elevated cost per user due to the Yuma Corridor's relatively low ridership. According the National Transit Database, Transit Profiles 2007, the average annual O&M cost per annual passenger trip for commuter rail systems in the Western States is approximately $11 per passenger trip. Therefore, all Interlined Alternatives are well above this average.

These annual O&M costs would likely be reduced by the recovery of farebox revenue. As mentioned earlier, the national average farebox recovery for commuter rail systems was 37 percent in 2007.

Figure ES-12: Interlined Annual O&M Cost per Passenger Trip – 2030



Source: URS Corp., 2009.

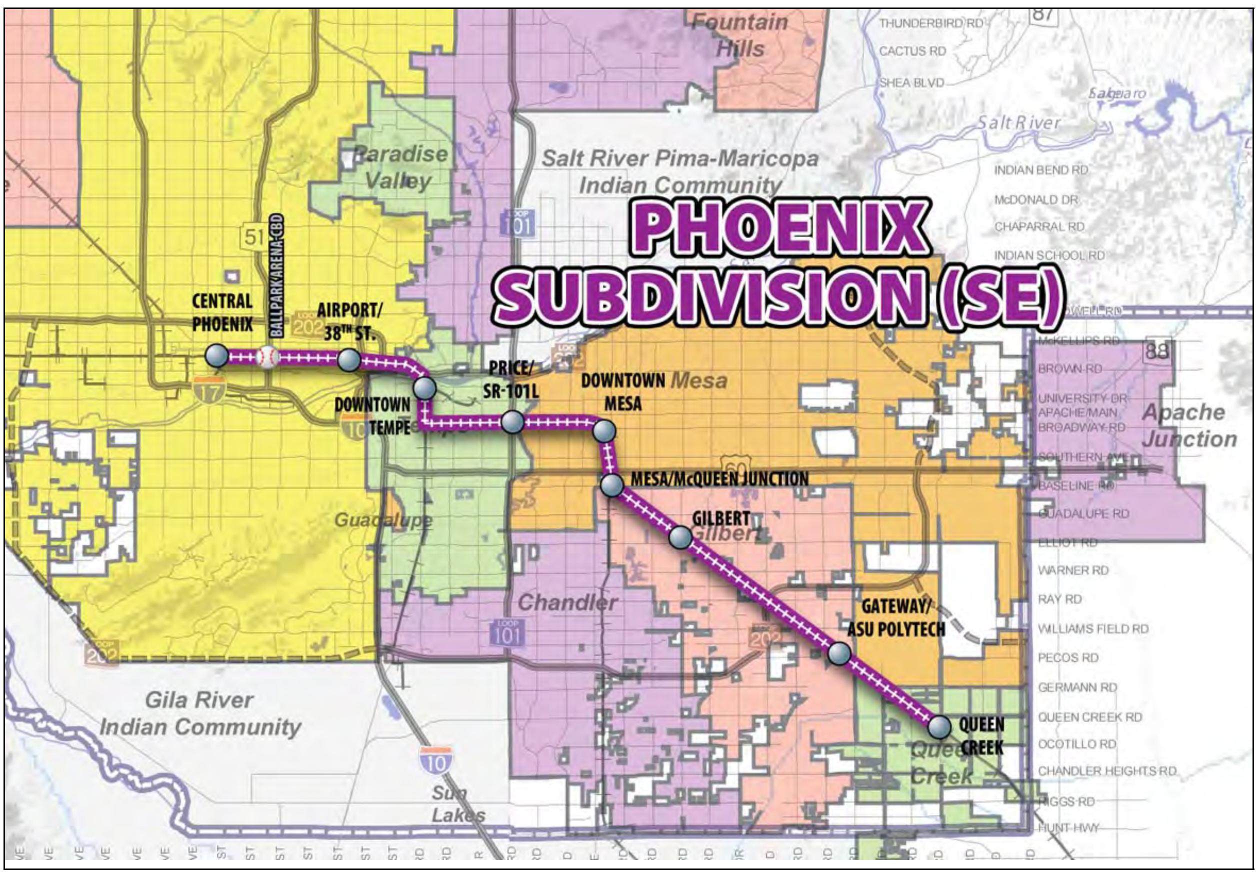
ES.5.0 SYSTEM STUDY ALTERNATIVES PHASING RECOMMENDATIONS

The categorizing of alternatives by tiers helps to prioritize corridors for implementation of the full commuter rail system. Assuming limited financial resources are available for full system build-out of all commuter rail corridors concurrently, a phased implementation approach would be used. This approach is much like the phased implementation of Phoenix's 57-mile light rail system. Project Team recommendations for the sequencing of corridor implementation to achieve full system build-out are described below.

ES.5.1 Which Segment of the Commuter Rail System Should be Implemented First?

The ranking of alternatives helps to determine the priority in which each corridor should be implemented for build-out of the full regional commuter rail system. Based on the Stand-Alone Alternatives ranking, the Project Team recommends the following:

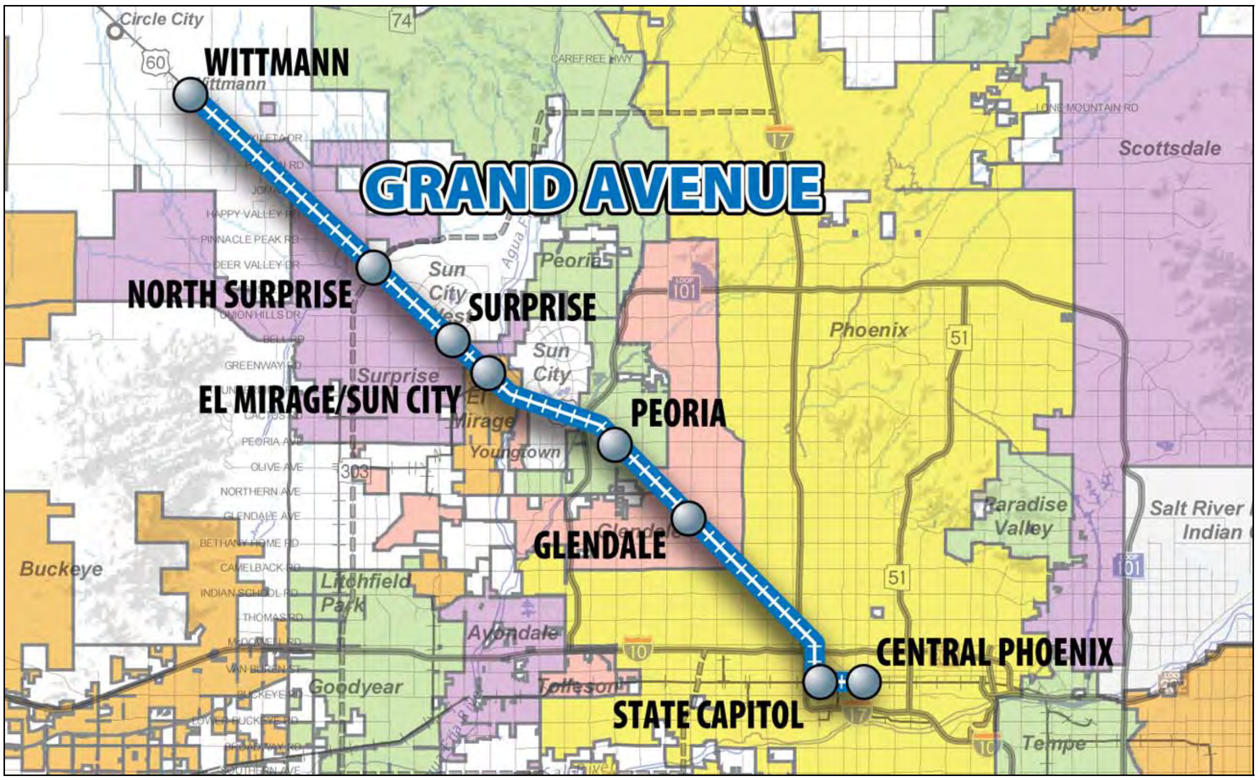
Start-Up Service Scenario 1: Build the SE Corridor.
The SE Corridor offers the highest ridership by a significant margin, offers substantial travel time savings, and is cost-effective.



Source: URS Corp., 2009.

While the SE Corridor ranking far exceeded those of the other corridors, if use of all or a portion of the UPRR right-of-way is a fatal flaw due to costs and/or agreements to get through rail yards in Central Phoenix, then alternative options for the first segment of the regional commuter rail system should be considered. Alternative start-up service scenarios include the following:

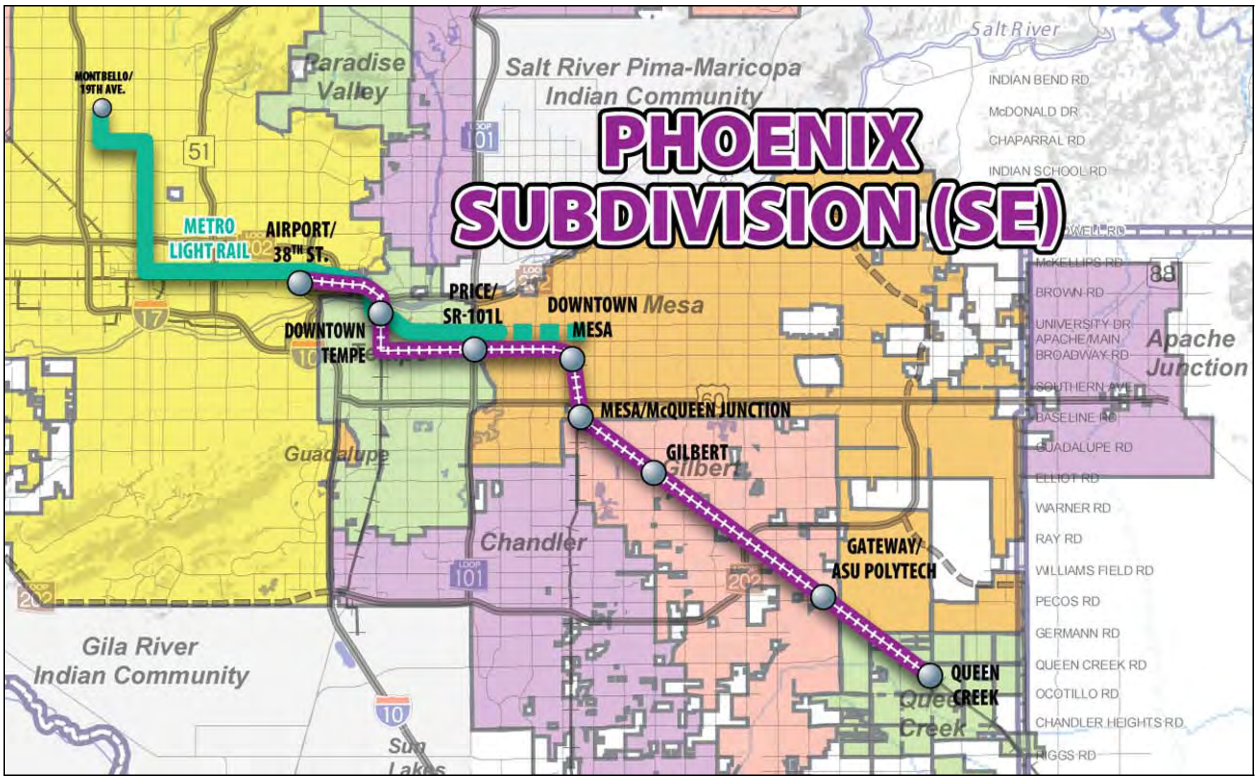
Start-Up Service Scenario 1A: Build the Grand Avenue Corridor.
The Grand Avenue Corridor offers ridership that is on par with other commuter rail systems in operation throughout the Western US, offers substantial travel time savings, and is moderately cost-effective. Implementation of commuter rail may result in the relocation of some freight facilities, consistent with BNSF Railway Company long-range plans.



Source : URS Corp., 2009.

Start-Up Service Scenario 1B: Build SE Corridor segment between Queen Creek and downtown Mesa/downtown Tempe/Airport & 38th Street

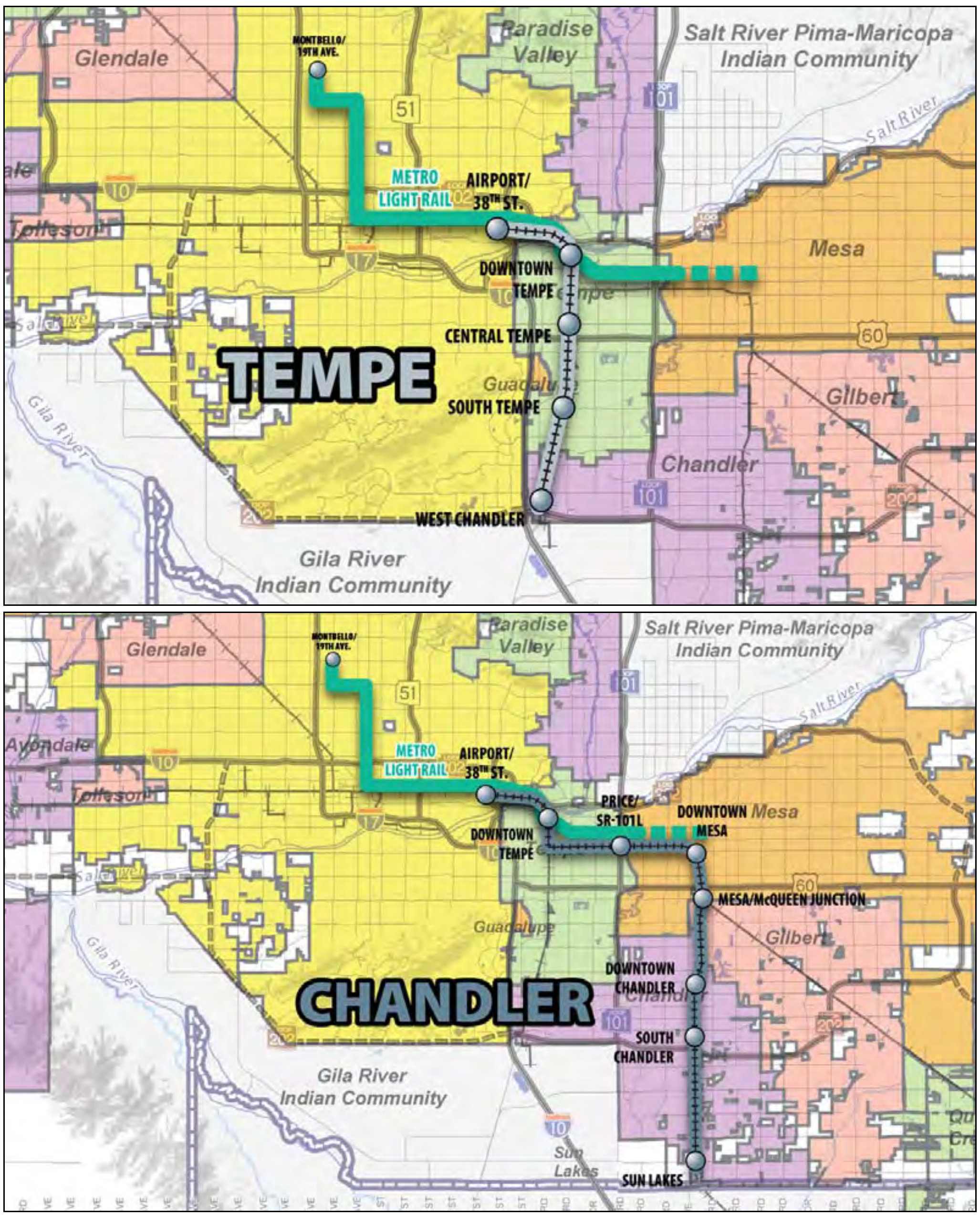
This scenario would require a transfer to LRT either in downtown Mesa, downtown Tempe, or the vicinity of the airport. Ridership forecasting shows large origin-destination traffic in Tempe and the airport is generally considered an emerging employment hub. A future LRT station in downtown Mesa may also provide a possible connection to commuter rail. (Details regarding potential transit connections in the Sky Harbor Airport area are provided in Section 4.4.2.3). Either one of these options would improve mobility in the East Valley while avoiding some of the more challenging operational and right-of-way constraints in downtown Phoenix. However, Scenario 1B would require a forced transfer for many riders, which would increase travel times and decrease overall ridership.



Source: URS Corp., 2009.

Start-Up Service Scenario 1C: **Build Tempe Corridor segment between West Chandler and downtown Tempe/Airport & 38th Street**
- or -
Build Chandler Corridor segment between Sun Lakes and downtown Mesa/downtown Tempe/Airport & 38th Street

Like Scenario 1B, this scenario would require a transfer to LRT either in downtown Mesa (for the Chandler Corridor), downtown Tempe, or the vicinity of the airport. While ridership on these corridors is not as strong as on the SE Corridor, if (1) right-of-way constraints limit use of the SE Corridor, or (2) inter-city rail plans suggest these corridors are suitable for passenger service between Phoenix and Tucson, then Tempe or Chandler may become higher priority commuter rail corridors.



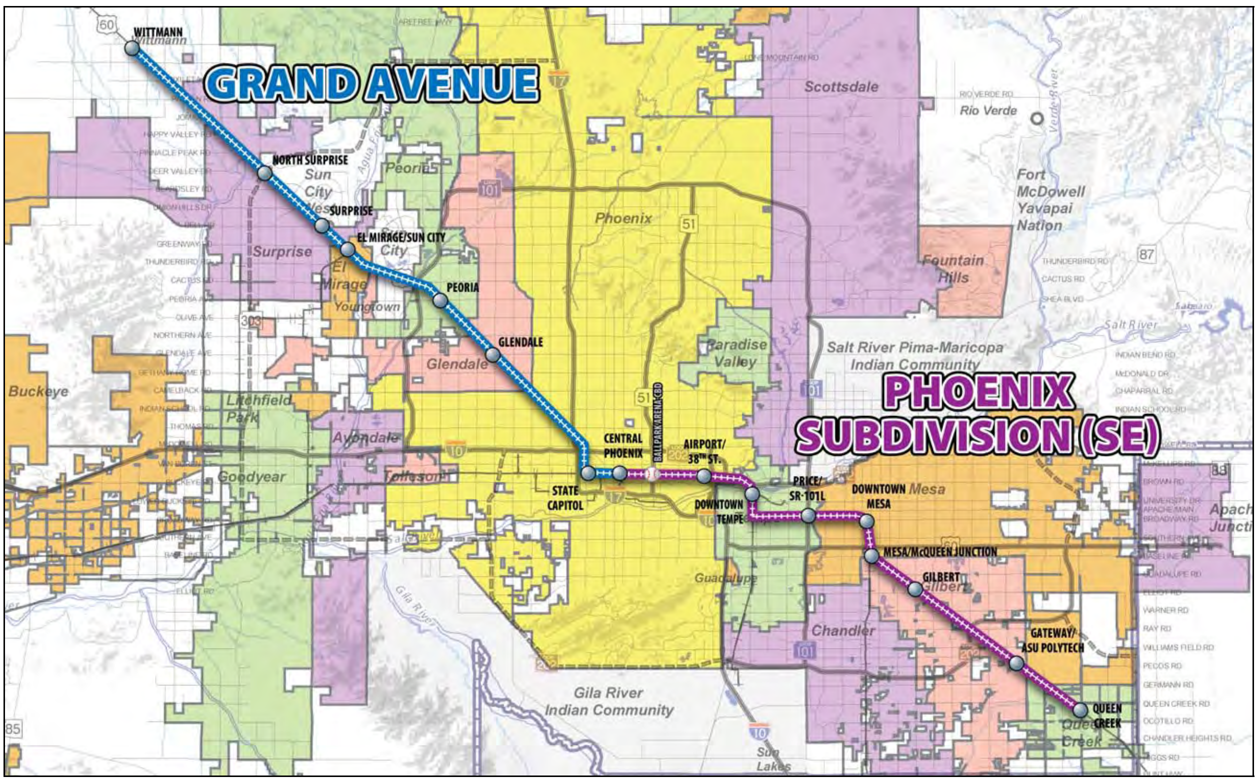
Source: URS Corp., 2009.

ES.5.2 Which Segment of the Commuter Rail System Should be Implemented Second?

The ranking of Interlined Alternatives helps to determine which combination of corridors would be most effective and should therefore be considered first for interlining with the start-up corridor. If, as in Scenario 1A, the SE Corridor is built first, then the Project Team recommends the following:

Interlined Service Scenario 1: **Build the Grand Avenue Corridor (interline with the SE Corridor).**

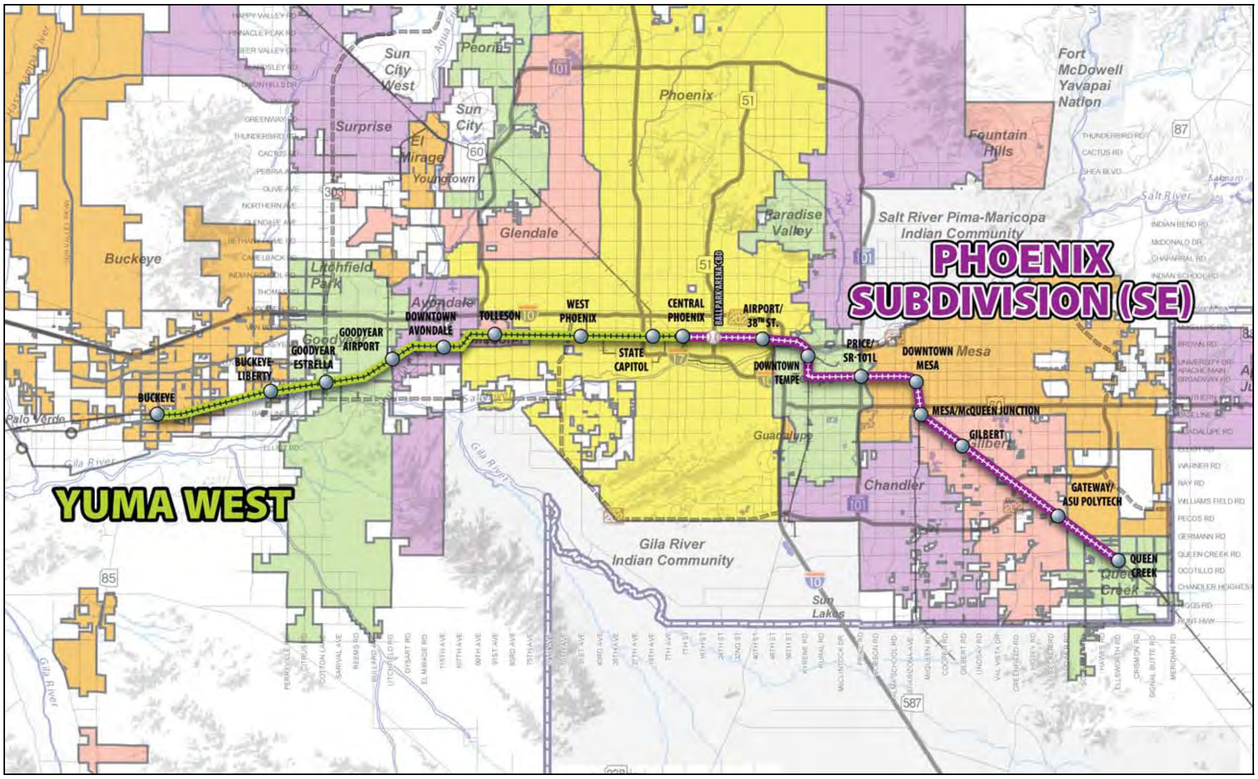
Ridership is greatest when the most productive East Valley and West Valley Corridors – Grand Avenue and SE – are combined.



Source: URS Corp., 2009.

Interlined Service Scenario 2: Build the Yuma West Corridor (interline with the SE Corridor).

The combination of Yuma with the SE Corridor results in the lowest capital cost per mile of any interlined combination. This integrated alignment also has good overall ridership and the second-highest boardings per revenue mile of any combination.



Source: URS Corp., 2009.

ES.5.3 In What Order Should the Remaining Segments of the Commuter Rail System be Implemented?

Phased implementation of the remainder of the corridors will be highly dependent on a number of factors. The alternatives evaluation revealed no single outstanding performer among the Tempe, Chandler, and Yuma Corridors. Therefore, considerations for future phasing to achieve build-out of the regional commuter rail system will include such factors as:

- Development patterns;
- Changes in travel demand;
- Community support;
- Potential funding sources (as described in more detail in Section 4.8); and
- Potential integration with Phoenix/Tucson intercity rail.

ES.6.0 IMPLEMENTATION STEPS

For implementation of the commuter rail corridors recommended in the System Study, a number of action items related to future coordination with the railroads, system governance and funding acquisition are required.

ES.6.1 What Type of Agreement with the Railroads Would be Needed to Operate Commuter Rail Service?

As envisioned, commuter rail service in the MAG region would share right-of-way currently owned by the UPRR and BNSF Railway Company, preferably utilizing the same track. To enable this, a rail access agreement of some type would be required. Unless conditions change, a Capacity Rights Agreement is expected to be the likely avenue for implementing commuter rail service along any of the System Study corridors. Capacity Rights Agreements may be a real estate interest such as a lease or easement, or a contractual or license right. The purchaser is not acquiring the line, but rather is only acquiring the right to operate a specified number of trains. Further coordination with the UPRR and BNSF Railway Company is critical to determining the appropriate approach to contractual relationships to operate commuter rail. The railroads' projections of future freight activity along the corridors would need to be integrated into the overall agreement.

ES.6.2 Who Would Operate the Commuter Rail Service?

One option for the operation of commuter rail service would be to contract with a private operator. Operations could be contracted to an independent contractor, such as Amtrak or a private contractor like Herzog, which operates several commuter rail systems throughout the U.S., including the New Mexico Railrunner and the San Diego Coaster. An owner railroad – the BNSF Railway Company or UPRR – could also operate passenger rail service under the terms of a Capacity Rights or other agreement. Currently, the BNSF Railway Company operates passenger service for three commuter rail systems, including the Metra Chicago-Aurora Line in Illinois, the Sounder in Seattle and the Northstar in Minnesota.

ES.6.3 How Would Regional Commuter Rail Service be Governed?

One of the most significant issues to be resolved for the implementation of commuter rail in the MAG region is the question of who would be the responsible party for managing, designing, constructing and operating the system. Implementation of a commuter rail system will require a governance structure that reflects the financial, political, and representational patterns of the areas served by commuter rail.

The existing structure of transit service providers in the Phoenix metropolitan region is a complex mix of historical operations such as the City of Phoenix transit system, the Regional Public Transportation Authority or RPTA (commonly known as Valley Metro) and Valley Metro Rail Inc. (METRO), a nonprofit, public corporation charged with the design, construction, and operation of the Valley's light rail system. Defining appropriate governance structures for a commuter rail system would depend upon opportunities that arise for cooperation and use of railroad right-of-way. This could be for one commuter rail project or a series of projects. Each agency would have to participate in the process to define the appropriate structure.

Table ES-8 summarizes the potential advantages and disadvantages of each type of governance structures under consideration.

Table ES-8: Summary of Advantages and Disadvantages of Governance Structures

Governance Structure Option	Potential Advantages	Potential Disadvantages
Regional Transit Authority/District (Multi-Modal)	• One transit service provider would create greater efficiencies and coordination between all transit modes to help ensure integrated regional system.	• May lack focus; if RPTA's role is expanded to include commuter rail, as it has typically focused on bus and paratransit services. • May be cumbersome political process to expand taxing authority to outlying areas (could create an issue of taxing equity), particularly if services are expanded to Pinal County. • Would present a learning curve for RPTA to manage a rail program.
Regional Rail Authority/District (Single-Purpose)	• Single focus on commuter rail, rather than competition for resources being distributed among transit modes, may help ensure success. • With creation of new taxing district, all funding partners would be equally represented from the outset. • Could be added to METRO organizational responsibilities.	• Would require close coordination with METRO and RPTA to ensure integrated regional transit system. • Adds another entity to the mix. • If formed by popular vote, would be unable to serve jurisdictions which do not vote to join, leaving gaps in representation/service. • Cost and start-up time to form new authority may be greater.
Joint Powers Authority	• Would provide maximum flexibility in the formation and responsibilities of a governing body. • Does not require legislative authority. • If METRO mission is expanded, JPA will benefit from similar rail expertise with LRT.	• May result in potential overlapping responsibilities among or within representative entities. • Each participating entity would be required to secure its own funding source through annual appropriations or voter-approved taxes, which may result in less-stable funding. • May start "turf war" between entities if a new JPA is formed. • Would present a learning curve as LRT and commuter rail are "different animals," and serve different markets.
Division of State Department of Transportation	• A state agency could apply for funding from federal programs that a local entity may not be able to obtain. • Could empower single railroad negotiator and greater coordination for unified statewide	• ADOT has not traditionally been an operator of systems, and there could be an institutional learning curve. • May rely primarily on state legislative appropriations. • May bring into question equity between regions of the state.

Table ES-8: Summary of Advantages and Disadvantages of Governance Structures

Governance Structure Option	Potential Advantages	Potential Disadvantages
	passenger rail service.	• Increases state influence over local/regional decisions.
Division of Metropolitan Planning Organization	• MAG could continue its role as lead implementation agency and pass-through funding entity.	• Could require continued/greater collaboration and coordination among existing transit authorities. • Northern Pinal County is part of Central Arizona Association of Governments, or CAAG, (not within MAG region). Unless limited to commuter rail operations, Pinal County jurisdictions would be involved in other modal planning for the region. This may add confusion within the MAG and CAAG transportation planning processes. • Would require expansion of MAG charter. • MPOs typically don't have an operations mindset. Would require establishment of new operational division within MAG.

Source: URS Corp., 2009.

ES.6.4 What Governance Structures Have Peer Cities Established for Commuter Rail Systems?

Table ES-9 illustrates the array of institutional arrangements that characterize typical commuter rail governance structures throughout the U.S.

Table ES-9: Existing Governance Models

Governance Structure	Governing Authority/District	Commuter Rail Service Description
Regional Transit Authority/District (Multi-Modal)	Sound Transit District, Washington	Sounder between Seattle and Everett and Seattle and Tacoma
	Tri-County Metropolitan District, Oregon	Westside Express Service (WES) between Wilsonville, Tualatin, Tigard and Beaverton
Regional Rail Authority/District (Single-Purpose)	Sonoma-Marin Area Rail Transit, California	Planned commuter rail between Cloverdale in Sonoma County and the San Francisco-bound ferry terminal in Larkspur, Marin County.
Joint Powers Authority	Peninsula Corridor Joint Powers Board, California	Caltrain between San Francisco, San Jose, and Gilroy
	South Florida Regional Transit Authority, Florida	Tri-Rail between Miami, Fort Lauderdale and West Palm Beach
	Virginia Railway Express, Virginia	Virginia Railway Express (VRE) between northern Virginia suburbs and Alexandria, Crystal City and downtown Washington, D.C.
Division of State Department of Transportation	Maryland Transit Administration, Maryland	Maryland Area Regional Commuter (MARC) between Maryland and Union Station in Washington, D. C., operating along three rail
Division of Metropolitan Planning Organization	New Mexico Mid-Region Council of Governments, New Mexico	Rail Runner Express between Albuquerque, Santa Fe, and Belen

Source: URS Corp., 2009.

ES.6.5 What Funding Options are Available to Implement Commuter Rail?

The initial step to develop a funding implementation strategy is to gauge possible or probable funding options from governments at the federal, state and local levels. The policy positions of the involved agencies and possible implementation responsibilities should be thoroughly considered, as should those of other local entities included in the project area. Ultimately, the critical financial issue at the local level is the annual requirement for local funds to meet capital, operating, and maintenance costs.

Tables ES-10 through ES-13 list the federal, state, local and private funding sources and their relative viability for use in the System Study corridors.

Table ES-10: Federal Funding Sources

Federal Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Federal Transit Administration Section 5307	Supports transportation capital costs including preventive maintenance	Low. The MAG region's allocation is currently programmed to support a host of other transit projects; future funds could be allocated to commuter rail. This is an annual programming allocated by formula; if and when commuter rail is added to the region, its data would enter into the formula calculation.
Federal Transit Administration Section 5309 New Starts	Supports transportation capital costs	Moderate. The application of Section 5309 is feasible, but the New Starts alternatives analysis planning requirements will require a significant evaluation and time. However, New Starts regulations have been relaxed recently and additional funding will likely be provided nationwide in the next authorization bill.
Federal Railroad Administration Section 130	Supports transportation capital uses only, primarily for the use of improving grade crossings	Low. The State's allocation of Section 130 funding is relatively small and may likely only support a portion of a safety improvement project.
Congestion Mitigation and Air Quality (CMAQ) Funds	Supports transportation capital uses only	Low. A commuter rail project application will contend with many other capital projects in the MAG region.
Surface Transportation Program (STP) Funds	Supports transportation capital uses only	Low. A commuter rail project application will contend with many other capital projects in the MAG region.
Federal Railroad Administration High Speed and Passenger Rail Program	Supports transportation capital uses only	Low. May only address some intercity components of commuter rail or related rail projects.

Source: URS Corp., 2009.

Table ES-11: State Funding Sources

State Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Highway User Revenue Fund (HURF)	Supports transportation capital uses only	Low. Funding is driven by fuel taxes and vehicle license taxes, which may not be sustainable sources in the future. In order to use HURF, State statute changes would be required.
Vehicle License Tax (VLT)	Supports transportation capital and/or operations	Low. The MAG region's allocation is currently programmed. The revenue generated from the tax may not be a sustainable source of funding in the future.
Statewide Transportation Acceleration Needs (STAN) Account	Supports transportation capital and/or operations	Low. Expected that this source will be eliminated to address budget issues.
New Dedicated Statewide Transportation Funding (e.g. statewide tax)	Supports transportation capital and/or operations	Low. Unclear if new tax would be considered viable in the future.

Source: URS Corp., 2009.

Table ES-12: Local and Regional Funding Sources

Local or Regional Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Maricopa County Transportation Excise Tax (Sales Tax)	Supports capital and/or operations	Moderate. Although the revenue generated from the current tax (Proposition 400) is programmed, future propositions are expected to occur.
Vehicle Miles Travelled (VMT) Tax	Supports capital and/or operations	Moderate. Typically used for roadway maintenance. Commonly unpopular with voters because of perceived invasion of privacy. Would be considered to be a more consistent funding alternative to a gas tax.
Payroll Tax	Potentially support capital and/or operations	Low. Existing State, and potentially Federal, tax codes must be modified to support these uses.
Motor Vehicle Sales Tax	Potentially support capital and/or operations	Low. The MAG region's allocation programmed. The revenue generated from the tax may not be a sustainable source of funding in the future.
Vehicle Rental Tax	Supports capital and/or operations	Low. Special uses for the surcharges collected for this tax will require County, and possibly State, law modification for the purpose of commuter rail.
Local Gas Tax	Potentially supports capital and/or operations	Low. The MAG region's allocation is currently programmed. The revenue generated from the tax may not be a sustainable source of funding in the future. State tax codes will likely require modification to authorize uses.
Vehicle License Tax by District	Supports capital and/or operations	Moderate. The VLT by district concept would require significant political support since it has not been implemented. State and/or County tax codes will likely require modification to authorize districts and uses.

Source: URS Corp., 2009.

Table ES-13: Private Funding Sources

Private Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Public Value Capture: Benefits Assessment Districts	Potentially support capital and/or operating uses	Low. Setting up the finance mechanism for such a public investment will require State and County statute or code modification.
Public Value Capture: Tax Increment Financing	Potentially support capital and/or operating uses	Low. The authorization of such a mechanism will require political support and State law modification.
Public-Private Partnerships	Potentially support capital and/or operating uses	Moderate. ADOT is investigating new PPP opportunities. This approach is being used sparingly in other cities given uncertain nature of financial markets, but may be more viable in the future.

Source: URS Corp., 2009.

ES.6.6 How Have Peer Cities Funded Commuter Rail Systems?

Peer cities and regions that have implemented commuter rail systems have used a variety of funding sources and mechanisms. Table ES-14 provides a summary of peer city approaches to funding. Recently developed commuter rail systems are built with a combination of federal funding, state budget commitments, and local tax monies. The Rail Runner in New Mexico is an anomaly, in that state and local sources funded the capital costs of commuter rail (exclusive of federal funding, although CMAQ funding contributes to operating costs), and thus the system was built more quickly than other recent commuter rail systems. Colorado's FasTracks and Minnesota's Northstar are continually evaluating public-private partnerships for future projects; this approach may also be a viable contributor to funding sources in Arizona.

Table ES-14: Comparison of Commuter Rail Facilities and Transit Funding

State: County	Operating Authority	Commuter Rail Facility	Key Funding Sources (inclusive of all transit services provided by operating authority)
Colorado: Denver	Regional Transportation District (RTD)	FasTracks	Dedicated Regional Sales Tax; Federal Funding (Section 5309 New Starts program); Private Contributions
Utah: Weber, Davis, and Salt Lake	Utah Transit Authority	FrontRunner	Dedicated Local Sales Tax; Federal Funding (Section 5309 New Starts program)
Texas: Tarrant and Dallas	The Fort Worth Transportation Authority (The T)/Dallas Area Rapid Transit	Trinity Railway Express	Dedicated Local Sales Tax; Federal Funding (CMAQ)
California: San Diego	San Diego Metropolitan Transit System	The San Diego Coast Express Rail (COASTER)	Dedicated Local Sales Tax
New Mexico: Valencia, Bernalillo, and Sandoval	Rio Metro	Rail Runner	Funded by the State of New Mexico; Federal Funding (CMAQ), Dedicated Local Sales Tax.
Minnesota: Anoka, Benton, Hennepin, and Sherburne	Minnesota Department of Transportation (MnDOT) and the Northstar Corridor Development Authority	Northstar	Various dedicated funding for counties in Minnesota (only 17% of Northstar construction costs from local governments/transit agencies); State Funding; Federal Funding (Section 5309 New Starts program).

Source: MAG, 2008; URS, 2009.

ES.6.7 What Near-Term Implementation Steps are Needed?

Table ES-15 summarizes the near-term implementation steps, including the step, potential responsible parties, and timeframe.

Table ES-15: Summary of Near-Term Implementation Steps

Item	Responsible Party	Partners	Timeframe
1) Periodic Ridership Forecasting Updates • MAG to re-run the MAG ridership forecasting model with the latest socioeconomic data to generate updated commuter rail boardings estimates. • Incorporate findings into the corridor prioritization and implementation process.	MAG	Local jurisdictions	Ongoing
2) Coordination with UPRR and BNSF Railway Company • Maintain points of contact and communication protocols. • Develop partnership to investigate options for determining compensation, capacity improvements, and level of service. • Advance design and operating concepts. Plan drawings should be further developed in coordination with the UPRR and BNSF Railway Company to form the basis for any long-term agreement with railroads.	ADOT MAG UPRR BNSF Railway Company	Local jurisdictions METRO RPTA	Ongoing
3) Address Enabling Legislation regarding Liability and Indemnification. • Progress on this issue may facilitate more effective coordination with railroads.	ADOT (as a statewide issue)	MAG UPRR	2010-2013
4) Coordination of Infrastructure Improvements with the Railroads, ADOT and Local Jurisdictions. • BNSF Railway Company is planning freight rail infrastructure improvements that would reduce freight activity into downtown Phoenix and thereby free up space on the rail mainline. • ADOT and local jurisdictions are planning for extensive roadway upgrades throughout the region that may improve the viability and safety of corridors for both freight and passenger rail service.	MAG Local jurisdictions ADOT	UPRR BNSF Railway Company METRO RPTA	Ongoing
5) Identify Funding Commitments. • Define new revenue streams that would be dedicated to development and ongoing operation of the commuter rail system. • A phased approach and cost-sharing agreements may segment or defer expenditures.	MAG ADOT Legislature	Local jurisdictions	2010-2015
6) Initiate Process for Federal Funding. • Process for FTA New Starts funding requires	MAG	Local jurisdictions	Following identification of

Table ES-15: Summary of Near-Term Implementation Steps

Item	Responsible Party	Partners	Timeframe
completion of Alternatives Analysis and NEPA compliance. • Local match funding should be identified prior to initiating this process with FTA.			local funding commitments
7) Develop and Implement Governance Plan. Most likely approaches include: • Formation of a new Commuter Rail Authority, • Designation of an existing agency as the Commuter Rail Authority (RPTA, METRO, MAG, ADOT), or • Establishment of a new Joint Powers Authority (JPA) with a provision for representation appropriate to the corridor or system to be implemented.	MAG ADOT	METRO RPTA Local jurisdictions	Following identification of local funding commitments
8) Preserve Future Options. • System Study commuter rail corridors are assumed to occur within the existing railroad right-of-way; however right-of-way preservation of future commuter rail extensions may reduce the costs for growing a future regional system.	Commuter Rail Authority or JPA	Local jurisdictions UPRR BNSF Railway Company MAG CAAG ADOT	Ongoing
9) Local Planning Efforts. Prior to securing project financing, local governments can take steps to lay the foundation for commuter rail implementation, including: • Partner with the UPRR, BNSF Railway Company, and ADOT to upgrade existing at-grade railroad crossings along System Study corridors. • Control regulatory actions within station areas, including the planning, zoning, and development permitting process, to facilitate the development of commuter rail stations. • Use other implementation tools such as infrastructure construction (for example, streets and utilities), land purchase and assembly, and creation of urban design guidelines to facilitate transit-supportive development.	Local jurisdictions	MAG ADOT	Ongoing

Source: URS Corp., 2009.

ES.6.8 What Long Term Implementation Steps are Needed?

The identification of funding commitments and determination of the appropriate governance structure for commuter rail, which are likely to influence each other, will set the stage for moving into the next level of investment in commuter rail within the MAG region. With progress on these key steps, the region will be in a position to move forward on other recommendations from the Strategic Plan, as described below.

- Formalize partnership with the railroads.
- Secure sources of funding including federal, state, regional and local public funding, as well as private sector participation.
- Design, construct, and operate initial commuter rail system.
- Continue planning to develop seamless transportation system and meet regional sustainability goals.

1.0 STUDY OVERVIEW

1.1 Introduction

The Phoenix metropolitan area has experienced unprecedented population growth over the last several decades, impacting all aspects of community development and straining the capacity of the Valley's transportation system. As the population in the Maricopa County and northern Pinal County region continues to grow, more residents will be commuting along already congested roadway networks that are only expected to worsen in the years ahead. To address this future travel demand and provide a faster and more reliable travel option for commuters, a system of commuter rail corridors radiating from downtown Phoenix to the northwest, west and south/southeast are being investigated. This potential network of commuter rail corridors, as shown in Figure 1-1, is the subject of the Commuter Rail System Study.

This chapter provides an overview and background information on the need and potential benefits of commuter rail and the planning effort that was undertaken to produce this Study. The chapter is organized as follows:

- Section 1.2 provides the history of commuter rail planning in the region that has led to the development of this System Study.
- Section 1.3 summarizes the purpose of the System Study.
- Section 1.4 describes the need for a regional commuter rail system and provides information on commuter rail technology.
- Section 1.5 summarizes the potential benefits of implementing commuter rail, including proposed goals to guide further development of a commuter rail system in the region.
- Section 1.6 describes the planning process through which this Commuter Rail System Study was developed.
- Section 1.7 describes the organization of the remainder of this report.

1.2 Background

In 2003, the Maricopa Association of Governments (MAG) completed the High Capacity Transit (HCT) Study. The study recommended a transit network designed to meet the travel demand needs of the region in the forecast year of 2040. A key finding of this study was that commuter rail corridors may potentially serve a critical function in addressing future travel needs in the region. In 2008, following the HCT Study, MAG developed the Commuter Rail Strategic Plan to provide a framework and specific steps for implementing commuter rail in the MAG region and northern Pinal County. The Strategic Plan developed a commuter rail system concept that would radiate from downtown Phoenix and be oriented around the five existing freight rail lines in the study area. These corridors include:

- Grand Avenue Corridor (BNSF Railway Company - Grand Avenue)
- Yuma West Corridor (UPRR Mainline - Yuma/West)
- Tempe Corridor (UPRR Mainline - Tempe Industrial Lead)
- Chandler Corridor (UPRR Mainline - Chandler Branch)

- Southeast Corridor (UPRR Mainline – Southeast)
- Potential Extensions/northern Pinal County

1.3 Purpose of the System Study

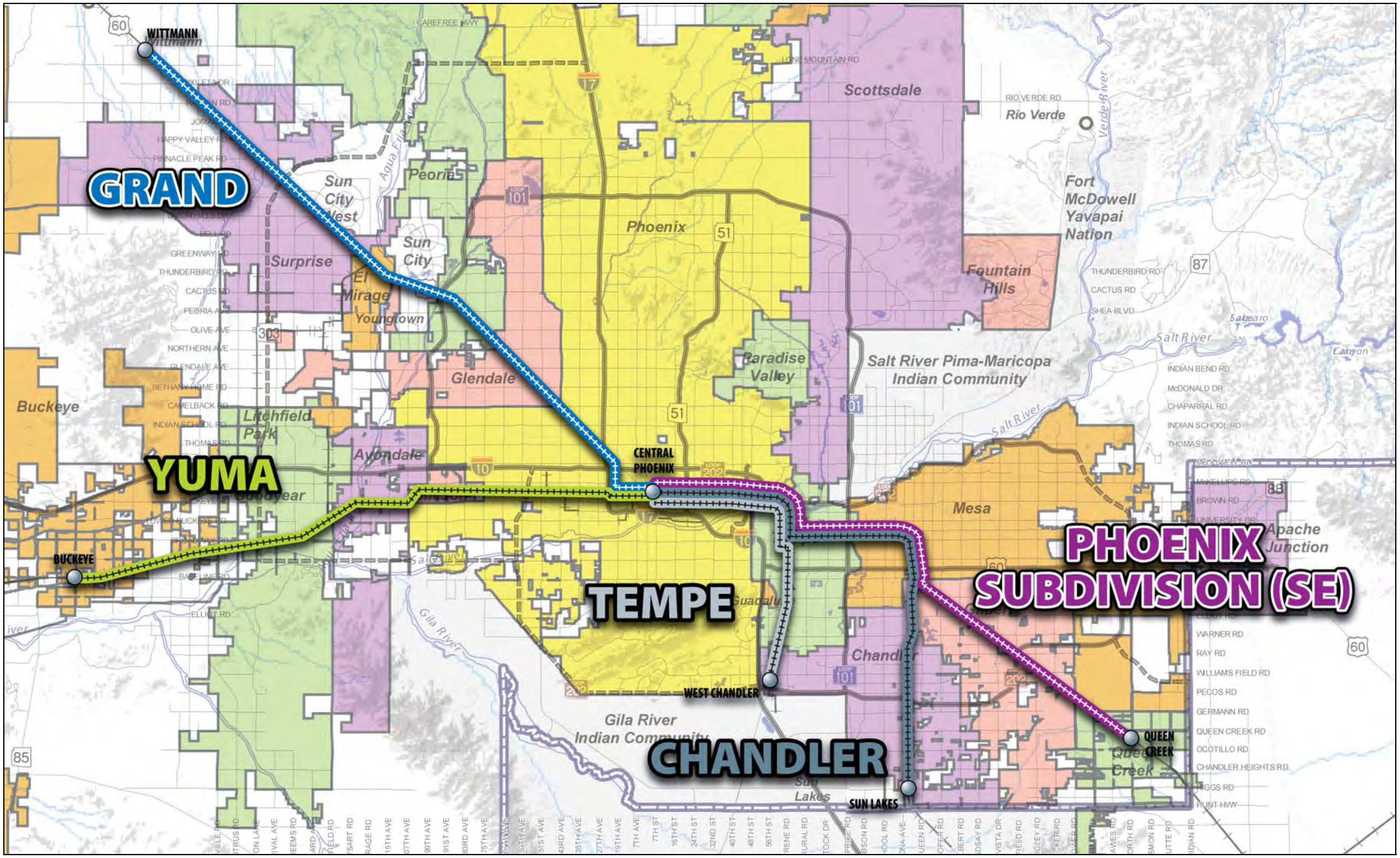
The Commuter Rail System Study builds on the work of the Strategic Plan by defining an optimized network of corridors and the necessary elements needed to implement commuter rail service in the MAG region and northern Pinal County. The System Study provides a detailed evaluation of potential commuter rail links to the East Valley (including the Tempe, Chandler, and Southeast Corridors) and links to the West Valley by incorporating the findings of the Grand Avenue and Yuma West Corridor Development Plans, both of which are being produced in conjunction with this System Study. This Study concludes with recommendations for an optimized commuter rail system and potential future extensions.

1.4 Need for a Commuter Rail System

Demands on the Phoenix region's highway system have resulted in increased travel time for commuters, as well as less predictable travel times that vary with congestion levels. These problems will only worsen in the future as the region continues to grow. Recent and planned public transportation investments in bus and light rail transit (LRT) will help to mitigate these impacts, but cannot do so alone. Commuter rail service in the Phoenix region would complement and build upon existing and planned bus and LRT service. Specifically, commuter rail service would (1) offer an alternative transit mode that has the advantage of using existing rail corridors, (2) use a transit technology that is appropriate for longer distance travel, and (3) allow for transfers to other transit systems.

Commuter rail systems are generally used in congested urban areas to improve travel time, mitigate congestion, add convenience, and provide an alternative means of travel – particularly in times of increasing energy prices. Commuter rail trains typically provide service between suburbs to urban centers for the purpose of reaching activity centers, such as employment, special events, and intermodal connections. Commuter rail trains are optimized for maximum passenger capacity, allowing for approximately 140 passengers per car, and are equipped with comfortable seating and passenger amenities. Designed to primarily meet the needs of regional commuters in the AM and PM peak travel times, commuter rail service typically occurs at lower frequency than LRT. The distance of a typical commuter rail corridor is also longer than that of light rail, ranging from 30 to 50 miles, with passenger stations generally spaced 5 to 10 miles apart. See Figure 1-2 for examples of commuter rail trains.

Figure 1-1: MAG Commuter Rail System Study Corridors



Source: URS Corp., 2009.

Figure 1-2: Commuter Rail Train Examples

Rail Runner Express Commuter Train; Albuquerque, NM
Source: MRCOG/HDR.

Sounder Commuter Train; Seattle, WA
Source: MAG.

1.5 Potential Benefits and Goals of Commuter Rail

There are a series of potential benefits associated with commuter rail service as described below.

Improved mobility, particularly reduced travel time for the commuter. The ability of a commuter rail system to improve mobility throughout the region, especially during peak hours of congestion, can result in shorter trips for commuters as compared with single-occupancy vehicles. In addition, commuter rail service can solidify connections between suburban population growth areas and key destinations by providing a faster and more efficient travel option. Improved travel options can allow families and individuals to chose more freely where to live, knowing that they can commute to work, special events, or other destinations reasonably. Therefore, proximity to commuter rail or other transit options may be a significant amenity for many residents and employers who would benefit from improved mobility.

Provide a higher quality commuter experience. As previously mentioned, a trip on a commuter rail train can reduce personal vehicle trips and daily commute times. Commuter rail service and stations can be designed to meet passenger needs, reduce individual carbon footprints, and provide a pleasant environment for travel during what is normally a time of peak congestion and delays.

Provide connections to employment or activity centers for everyday life. Commuter rail service can efficiently connect passengers directly to employment or activity centers. Activity centers may include employment areas, medical facilities, educational institutions, shopping, or special events centers. In evaluating the feasibility of commuter rail corridors, MAG is considering the overall impacts on connectivity throughout the region, including linkages to other modes for travel. These links may include connectivity to other commuter rail service lines, park-and-ride facilities, and other transit modes such as local or regional bus service and LRT.

Opportunities to support local development in station areas. A well-designed approach to station development can assure that commuter rail is a neighborhood asset and supports local businesses throughout the corridor. Transit-oriented development may provide opportunities for mixed use development and public-private partnerships to support local economic development goals. Local jurisdictions may view commuter rail as an opportunity to facilitate the conversion of underutilized areas along the corridor to meet local development goals.

The process of defining and evaluating commuter rail system corridors builds on previous work in the MAG Commuter Rail Strategic Plan that established the goals for commuter rail in the region. The Strategic Plan outlined a series of five goals to serve as a guiding framework for future commuter rail planning and implementation in the region:

Goal 1: Employ Commuter Rail to Shape Regional Growth

Goal 2: Improve Transportation Mobility Opportunities by Implementing Commuter Rail

Goal 3: Provide a Seamless and Cost Effective Commuter Rail Option

Goal 4: Promote Sustainability through the Implementation of Commuter Rail

Goal 5: Increase Public/Private Cooperation to Implement Commuter Rail

The preparation of this System Study is guided by these five overall project goals and used in the development of corridor evaluation criteria, as described in more detail in Chapter 3.

1.6 System Study Process

The study process to develop this System Study followed a series of steps for each potential commuter rail corridor:

- Review of previous transportation studies and plans.
- Initiation of stakeholder involvement, which continued throughout the planning process.
- Inventory of the existing BNSF Railway Company Railway or UPRR conditions.
- Development of conceptual commuter rail operating plans.
- Identification of infrastructure improvements needed for the implementation of commuter rail service.
- Development of capital cost estimates.
- Development of annual operating cost estimates.

The development of conceptual operating plans was informed by site visits and ridership forecasting. Projected ridership results influenced decisions about service levels and phasing, fleet size, and target station areas. Chapter 3 summarizes the operating plans and results of the forecasting effort. Additional information on the methodology for cost estimating is also provided in Chapter 3 and Appendix A: Methodology for Cost Estimating.

The stakeholder involvement component of the planning process was extensive. Throughout the entire study process, several groups met regularly to review project information and provide feedback. These groups included:

Project Management Team (PMT). The PMT included representatives from MAG, the Regional Public Transportation Authority (RPTA), Valley Metro Rail, Inc. (METRO), and the Arizona Department of Transportation (ADOT). These agencies plan and/or operate highways and bus, paratransit, and LRT services throughout the region. ADOT also conducted a Statewide Rail Framework Study concurrently with this effort. The PMT met monthly to review study information and coordinate ongoing planning activities.

System Review Team (SRT). The SRT included representatives from the local jurisdictions throughout the MAG region. This group met quarterly throughout the year-long study process. The SRT provided feedback on study information and updated MAG's Project Team on ongoing planning efforts in their communities. Throughout the planning process, MAG also met separately with individual jurisdictions upon request, to review land use issues and future plans.

Stakeholder Meetings. Stakeholder meetings were conducted quarterly to review and provide input into the planning process. This group had the broadest representation, as it included representatives of jurisdictions from throughout the MAG region, state agencies, and interest groups. These meetings were open to the public and media.

In addition, the development of the Commuter Rail System Study for the entire region occurred concurrently with the preparation of two corridor development plans for the West Valley – the Grand Avenue Corridor Development Plan and the Yuma West Corridor Development Plan. Additional information regarding these corridors is available in each of these final reports.

1.7 Organization of the System Study

The remaining chapters of the System Study are organized as follows:

Chapter 2: Existing and Future Conditions. Describes existing and future conditions along each of the five corridors. Includes a summary of demographics, land use, railroad conditions, highway characteristics, transit service and corridor travel patterns.

Chapter 3: Alternative Development and Evaluation. Presents commuter rail system alternatives, including service plans, ridership forecasts and costs. Describes the process used to develop evaluation criteria and the evaluation results for each of the five corridors as (1) stand-alone commuter rail alignments and (2) interlined commuter rail alignments. Includes a ranking of alternatives as top-tier, middle-tier and lower-tier alternatives.

Chapter 4: Implementation Strategy. Presents the recommended commuter rail system prioritization and implementation phasing. Reviews the necessary future coordination with the railroads, governance options for commuter rail, funding options, and implementation steps.

Chapter 5: References. Provides a list of sources used in the System Study.

Appendix A: Methodology for Cost Estimating. Describes the assumptions used to develop capital and operating and maintenance (O&M) costs for each corridor.

Appendix B: Evaluation of Potential System Study Commuter Rail Corridor Extensions. Presents existing and future conditions for potential future commuter rail corridor extensions. Evaluates ridership potential for each potential extension and compares results between extensions.

Appendix C: System Study Station Target Area Evaluation. Describes rationale for selection of station target areas and provides station target area screening results. The evaluation focuses on station target areas within the East Valley corridors.

Appendix D: Southeast, Tempe, and Chandler Corridor Commuter Rail Design Concepts. Illustrates potential design concepts and infrastructure requirements for commuter rail in each corridor.

Appendix E: Systems Study Railroad Conditions and Issues. Illustrates potential design concepts and infrastructure requirements for commuter rail in each corridor with consideration for freight operations, stations, passing sidings, at-grade crossings, bridges, and other physical characteristics of each corridor.

Appendix F: Commuter Rail Vehicle Technology. Summarizes characteristics of commuter rail transit technology, including vehicle features, technology used in other systems, potential acquisition options and average costs.

Appendix G: System Study Operations Plan. Describes service plans for each commuter rail corridor, including service levels, travel time, fleet size, and potential infrastructure improvements.

Appendix H: System Study Corridor Evaluation Criteria. Describes the set of evaluation criteria used to characterize, compare and rank each alternative.

Appendix I: Commuter Rail Maintenance Facility Description and Evaluation. Presents the requirements for commuter rail maintenance and layover facilities and summarizes considerations for advance planning of these facilities.

Appendix J: Commuter Rail Governance and Operating Structures. Describes and evaluates potential governance strategies for the MAG commuter rail system.

Appendix K: Conceptual Memorandum of Understanding. Illustrates a typical Memorandum of Understanding (MOU) for a railroad partnership that would address key points of negotiation such as compensation, capacity improvements, and level of service.

Appendix L: Ridership Forecasting Methodology. Describes how the ridership forecasts were generated and provides a summary of forecasting results.

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2.0 EXISTING AND FUTURE CONDITIONS

2.1 Introduction

The purpose of this chapter is to provide an overview of current and projected demographic and travel characteristics within the potential commuter rail corridors located along existing railroad lines throughout the MAG region. The focus is on how the communities along the corridors are expected to evolve over the next several decades, the implications for transportation demand and mobility, and the multimodal options for meeting demand and improving service in the region.

The corridors being evaluated include railroads operated by both BNSF Railway Company and the Union Pacific Railroad (UPRR). The five separate corridors analyzed include Grand Avenue (BNSF Railway Company); Yuma West (UPRR); Southeast (UPRR); Tempe (UPRR); and Chandler (UPRR). The System Study Planning Area is defined as a two mile buffer surrounding each of the five existing railroad lines (see Figure 2-1).

This chapter is organized as follows:

- Section 2.2 provides an overall summary of the findings related to existing and future conditions within each potential commuter rail corridor in order to compare results between corridors.
- Sections 2.3 through 2.7 summarize existing and future conditions for the Grand Avenue Corridor (Section 2.3), Yuma West Corridor (Section 2.4), Southeast Corridor (Section 2.7), Tempe Corridor (Section 2.5), and the Chandler Corridor (Section 2.6). The following elements are described for each of the corridors:
  - Demographics;
  - Land Use;
  - Railroad Characteristics;
  - Highway Characteristics;
  - Transit Service; and
  - Travel Patterns.
- Section 2.8 presents potential future corridor extensions to the five current commuter rail corridors. Appendix B: Evaluation of Potential System Study Commuter Rail Corridor Extensions, provides greater detail on each extension.

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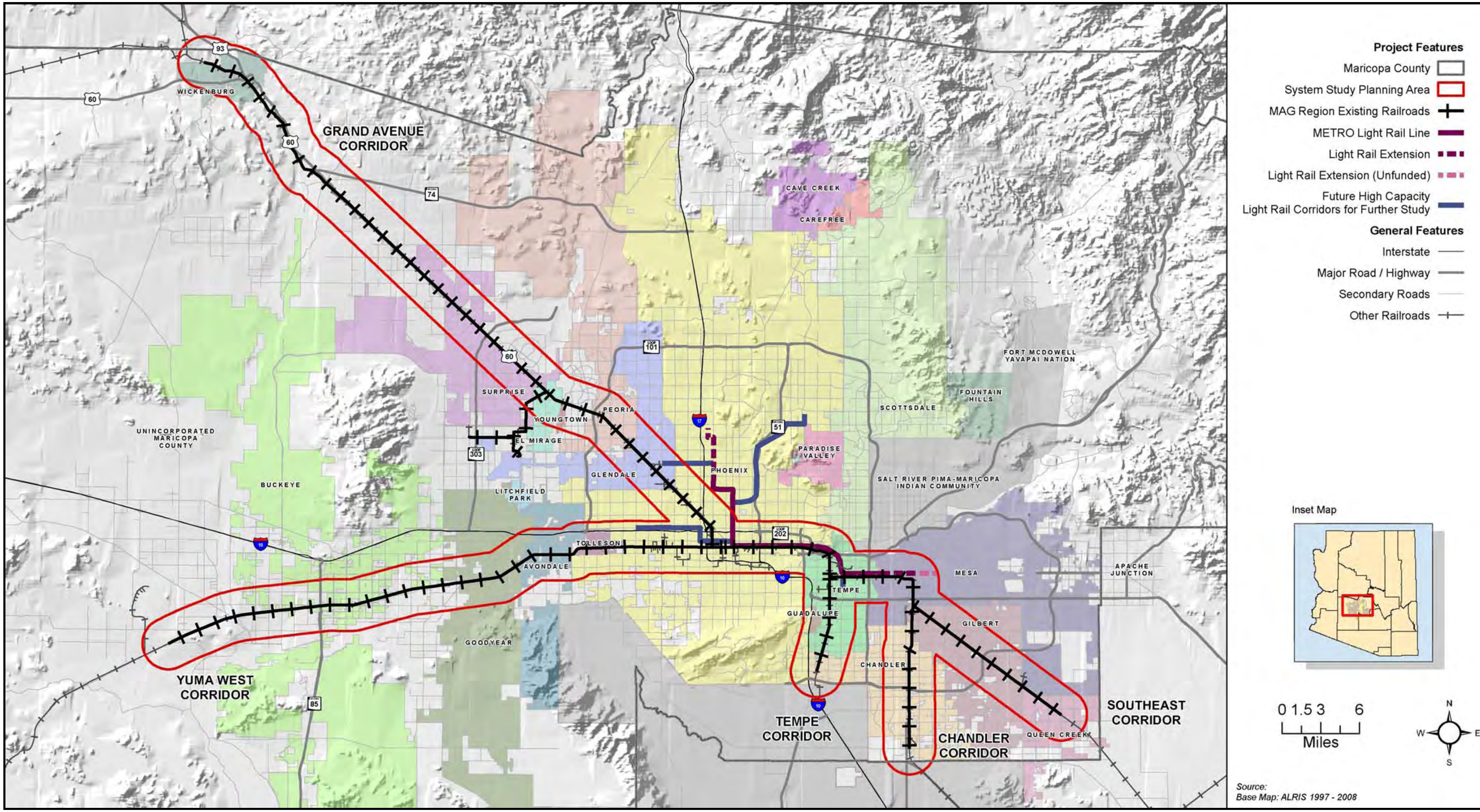
Figure 2-1: MAG Region Existing Railroads



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2.2 Summary of Findings

The purpose of this section is to provide an overall summary of the characteristics of the five potential commuter rail corridors within the MAG region. Findings identified as part of the existing and future conditions evaluation are organized by the individual elements that were examined in order to compare results between corridors.

2.2.1 Demographics

- Significant population and employment growth is expected by 2030 in the outlying areas of the Grand Avenue, Yuma West and Southeast Corridors.
- The Tempe and Chandler Corridors are projected to experience less significant growth in population and employment than the other corridors located within the System Study, as they are closest to build-out conditions already. The existing and planned population and employment densities throughout the corridors helped the Project Team evaluate and compare the alignments as well as identify station target areas.

2.2.2 Land Use

- The outer limits of the Grand Avenue, Yuma West and Southeast Corridors are largely undeveloped.
- In the future, the majority of development that is expected to occur in the Grand Avenue, Yuma West and Southeast Corridors will be residential development.
- The Tempe and Chandler Corridors are not expected to experience a significant change in land use patterns in the future.

2.2.3 Railroad Characteristics

- Each corridor within the System Study Planning Area has multiple at-grade and grade separated railroad crossings.
- The Grand Avenue Corridor is the only corridor in the System Study Planning Area in which the railroad is directly adjacent to a major highway throughout the entire span of the study corridor.
- Each corridor within the System Study Planning Area has multiple freight railroad facilities and customers that could potentially affect future commuter rail service.

2.2.4 Highway Characteristics

- All corridors within the System Study Planning Area are located near travel paths along major highways that provide connections into downtown Phoenix.
- All corridors within the System Study Planning Area will experience significant roadway improvements adding capacity and assisting in maintaining traffic flow and travel times into downtown Phoenix.
- Despite planned improvements, travel times and congestion levels in each corridor will continue to increase in the future.

2.2.5 Transit Service

- Portions of the Grand Avenue, Yuma West, and Southeast Corridor have significant transit service in areas near downtown Phoenix.

- The outlying areas of the Grand Avenue, Yuma West, and Southeast Corridors have limited existing transit service and little planned in the future.
- The Tempe and Chandler Corridors have more robust levels of transit service throughout their respective corridors, particularly within City of Tempe, which has a dedicated transit sales tax. While this service is expected to improve, several planned transit services within the RTP may be deferred to a future implementation date, which has not been defined at this time.

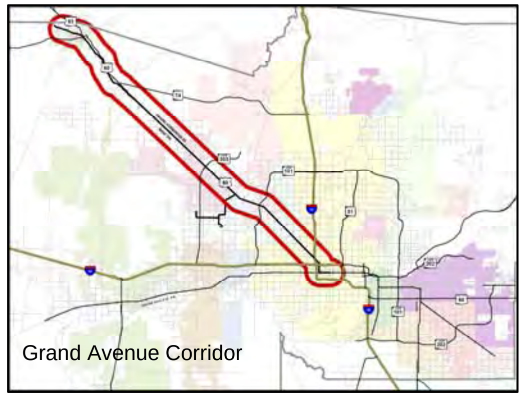
2.2.6 Travel Patterns

- The outlying areas of the Grand Avenue and Yuma West Corridors are expected to experience a decrease in the percentage of home-based work trips destined to areas near downtown Phoenix between 2007 and 2030. Most future trips are expected to be shorter intra-corridor trips rather than longer trips bound for Central Phoenix.
- Travel patterns in the Tempe, Chandler, and Southeast Corridors are expected to remain relatively consistent between 2007 and 2030.

2.3 Grand Avenue Corridor

The 54-mile Grand Avenue Corridor has been defined by a two-mile radius surrounding the BNSF Railway Company line between Union Station in downtown Phoenix and the Town of Wickenburg within Maricopa County. The cities, towns and unincorporated areas that fall within this corridor include:

- City of Phoenix;
- City of Glendale;
- City of Peoria;
- Town of Youngtown;
- City of El Mirage;
- City of Surprise;
- Town of Wickenburg; and
- Portions of unincorporated Maricopa County, including Sun City and Sun City West.


Grand Avenue Corridor

2.3.1 Demographics

Comprised of a combination of seven cities and towns, this corridor had a 2007 population of approximately 690,000 people, with an expected 41 percent increase to nearly 980,000 people by 2030. Of the municipalities located within the corridor, Surprise is expected to experience the greatest increase in population in the corridor between 2007 and 2030, with an increase of over 180 percent. Other municipalities expected to experience significant population growth within the corridor over the same time period are Wickenburg, with a 57 percent increase, and Phoenix, with a 29 percent increase in population.

The Grand Avenue Corridor is also expected to experience an increase in employment from just over 365,000 jobs in 2007 to nearly 560,000 jobs in 2030, resulting in an increase of 52 percent. Of the municipalities that make up the corridor, Surprise is expected to experience the greatest increase in employment in the corridor between 2007 and 2030, with a 425 percent increase. Other municipalities expected to experience significant employment growth are El Mirage and Wickenburg, with a 162 percent and 96 percent increase in jobs in the corridor respectively.

Table 2-1 and Table 2-2 identify the existing and forecasted population and employment projections within the Grand Avenue corridor.

Table 2-1: Grand Avenue Corridor Population Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	292,234	376,719	29%
City of Glendale	131,989	146,742	11%
City of Peoria	81,289	94,851	17%
Town of Youngtown	6,388	7,359	15%
City of El Mirage	33,282	38,717	16%
City of Surprise	84,967	237,676	180%
Town of Wickenburg	8,622	13,562	57%
Unincorporated Maricopa County	53,766	63,291	18%
Total	**692,537**	**978,647**	**41%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

Table 2-2: Grand Avenue Corridor Employment Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	258,578	329,168	27%
City of Glendale	38,364	49,549	29%
City of Peoria	25,052	42,603	70%
Town of Youngtown	1,659	2,042	23%
City of El Mirage	3,081	8,072	162%
City of Surprise	18,193	95,576	425%
Town of Wickenburg	4,905	9,620	96%
Unincorporated Maricopa County	16,071	20,837	30%
Total	**365,903**	**557,917**	**52%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

2.3.2 Land Use

The Grand Avenue Corridor contains a variety of land uses as shown in Figure 2-2. Table 2-3 summarizes the existing land uses as of the year 2004, as well as future land use within the Grand Avenue corridor distinguished by land use category. Existing land use in the corridor is currently 51 percent vacant land, most of which is located northwest of SR 303L. Through build-out, a large percentage of that land is expected to become residential, making up 70 percent of the corridor land use.

Table 2-3: Grand Avenue Corridor Existing and Future Land Use

Land Use Category	Existing Land Use (2004)		Future Land Use (Build-out)	
	Acres	Percent of Total	Acres	Percent of Total
Residential (<1 du/acre)	5,325	3.5%	35,312	23.1%
Residential (1 – 4 du/acre)	6,223	4.1%	42,358	27.7%
Residential (> 4 du/acre)	28,741	18.8%	29,475	19.3%
Commercial	4,419	2.9%	8,624	5.6%
Industrial	7,411	4.9%	7,804	5.1%
Mixed Use	1,147	0.8%	5,923	3.9%
Office	688	0.5%	1,290	0.8%
Open Space / Recreation	13,260	8.7%	13,410	8.8%
Public / Private Institutions	5,270	3.5%	6,704	4.4%
Transportation / Parking	1,902	1.2%	1,860	1.2%
Vacant	78,374	51.3%	0	0.0%
Total	**152,760**	**100.0%**	**152,760**	**100.0%**

Source: MAG, 2007c; 2007d.

Those locations within the Grand Avenue Corridor that have the potential to generate ridership based on land use have been identified as activity centers, the majority of which are located near downtown Phoenix. Activity centers throughout the corridor include:

- Downtown Phoenix;
- ASU downtown campus;
- Phoenix Memorial Hospital;
- Grand Canyon University;
- Downtown Glendale;
- Glendale Community College; and
- Downtown Wickenburg.

Additional activity centers located throughout this corridor, and the relationship they have with potential station locations have been identified in Appendix B: Grand Avenue Corridor Station Target Area Evaluation of the Grand Avenue Corridor Development Plan.

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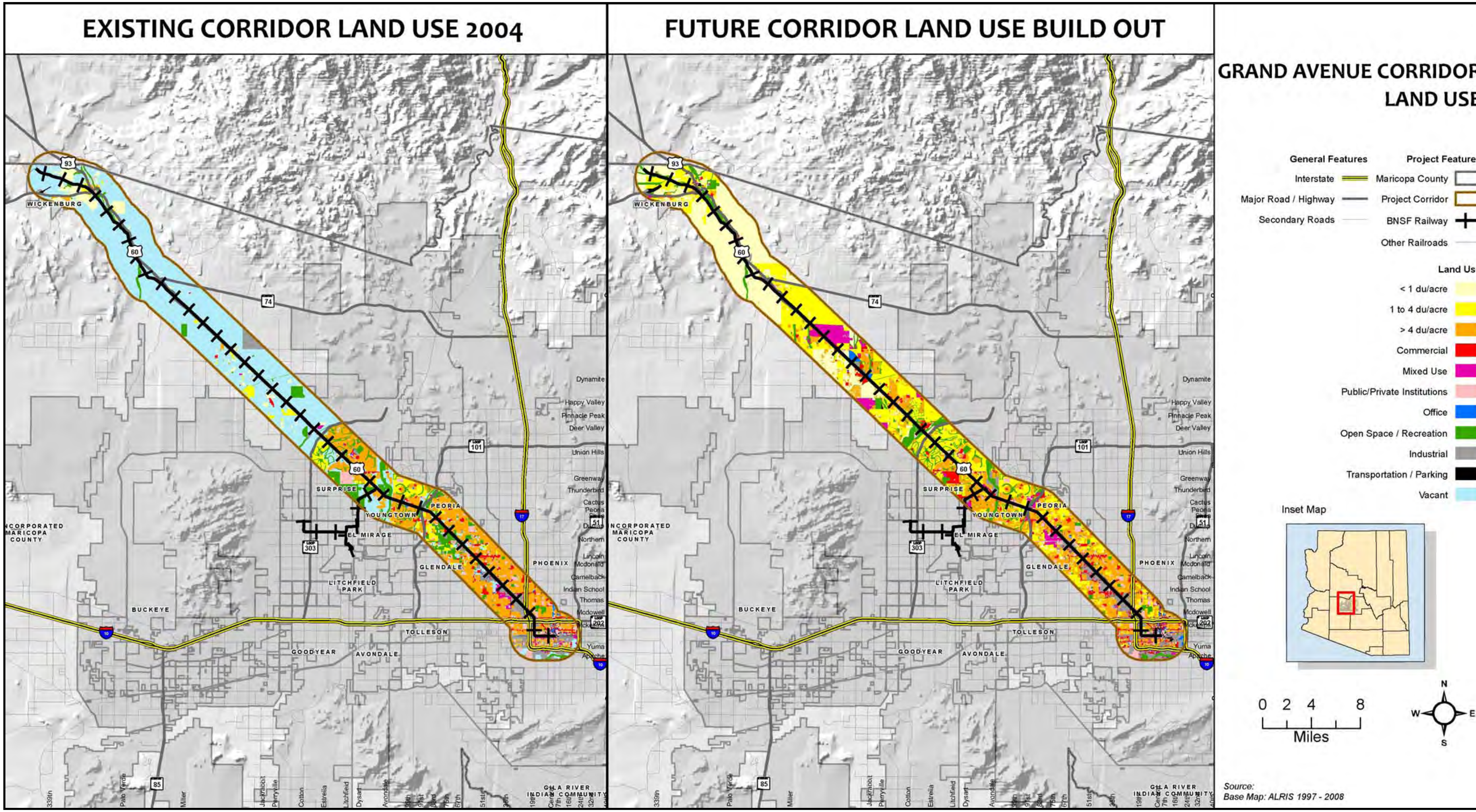
Figure 2-2: Grand Avenue Corridor – Land Use



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2.3.3 Railroad Characteristics

The Grand Avenue Corridor follows the BNSF Railway Company line from downtown Phoenix to the Town of Wickenburg. The corridor is approximately 54 miles long and is located adjacent and parallel to Grand Avenue/US 60. The Grand Avenue Corridor is primarily an un-signalized single track with sidings located throughout to allow trains to pass as necessary.

Mobest Yard at Grand Avenue and 19th Avenue
Source: MAG.

The diagonal nature of Grand Avenue and the presence of the railroad have created multiple complex six-legged intersections that also include at-grade track crossings. There are also a number of grade separated crossings throughout the corridor which lessen the impact to traffic on the adjacent highway. In total, there are 51 at-grade track crossings and 18 grade separated crossings. There is also one active Quiet Zone located at the intersection of 163rd Avenue and Grand Avenue in the City of Surprise. In addition, there are two pending applications for Quiet Zones located in Sun City at the intersection of Meeker Boulevard and Grand Avenue and at the intersection of RH Johnson Boulevard and Grand Avenue.

Providing commuter rail service that does not interfere with the on-going operations of major BNSF Railway Company facilities will be key in the implementation of commuter rail in the Grand Avenue Corridor. Several existing BNSF Railway Company facilities are located throughout the corridors and are shown in Figure 2-3 they include:

- **Phoenix Yard** (MP 193.7);
- **Mobest Yard** (MP 191.6);
- **Alhambra Yard** (MP 188.3);
- **Desert Lift Intermodal Facility** (MP 186.8);
- **Glendale North /South Yards** (MP 183.7);
- **BNSF Railway Company Automobile Distribution** (MP 174.1) ;
- **Ennis Wye** (MP 173.6); and
- **Future Surprise Logistics Center** (MP 157.2).

In an effort to expand capacity and reduce the number of trains accessing the downtown area, BNSF Railway Company is developing and exploring options to build additional facilities northwest of the downtown Phoenix area. Some of the activity currently conducted in the Mobest Yard and Desert Lift Intermodal Facility could potentially be relocated. Should these efforts be realized, Mobest Yard would still operate freight rail activity in some capacity, but freight congestion at these two facilities would be reduced. BNSF Railway Company is also looking at the possibility of adding and upgrading existing siding throughout the corridor which include opportunities in both Peoria and Glendale. These railroad infrastructure improvements would allow for enhanced freight service as well as facilitate needed improvements should potential commuter rail service be implemented.

For a more detailed description of Grand Avenue Corridor railroad conditions and existing and planned facilities, see Appendix E: Systems Study Railroad Conditions and Issues.

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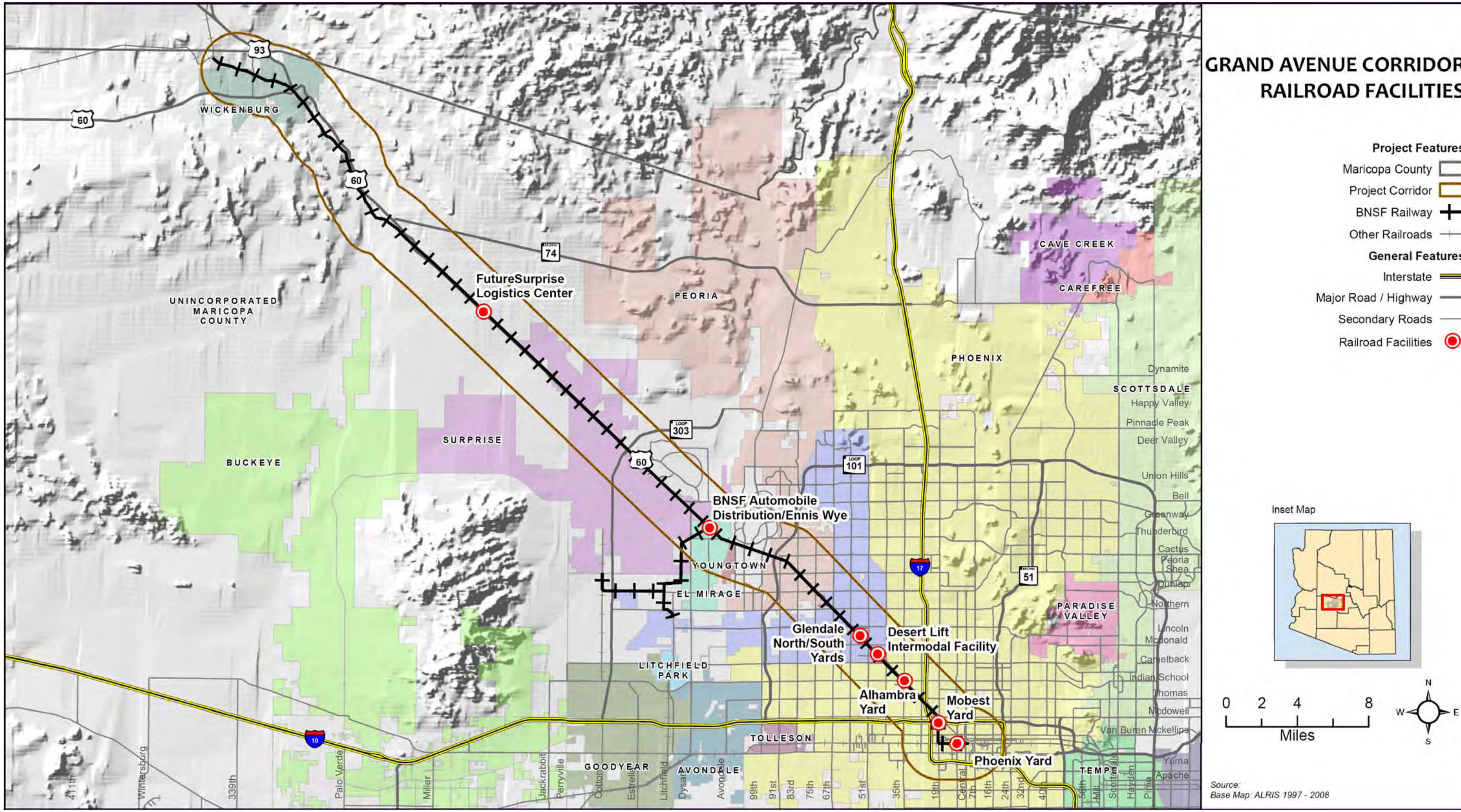
Figure 2-3: Grand Avenue Corridor – Railroad Facilities



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2.3.4 Highway Characteristics

The diagonal southeast-northwest orientation of Grand Avenue has created multiple skewed, six-legged intersections that have resulted in excessive delays and safety concerns at north-south and east-west arterial crossings. The presence of the railroad adjacent to the roadway corridor generates additional congestion through delays created by at-grade railroad crossings.

There have been several improvements made to the regional transportation network throughout this corridor. In an effort to reduce delay and improve safety, grade separations have been constructed to eliminate six-legged intersections at select locations between SR 101 and McDowell Road. With the exception of the Indian School Road crossing, which was constructed in the early 1970's, the remaining grade separated roadways have been completed since 2007. Grade separations have been constructed at the following intersections:

- Grand Avenue over 27th Avenue/Thomas Road;
- Indian School Road over 35th Avenue/Grand Avenue/BNSF Railway Company;
- Grand Avenue over 43rd Avenue/Camelback Road;
- 51st Avenue over Bethany Home Road/Grand Avenue/BNSF Railway Company;
- Maryland Avenue over Grand Avenue/BNSF Railway Company;
- Grand Avenue under 59th Avenue/Glendale Avenue;
- 67th Avenue over Northern Avenue/Grand Avenue/BNSF Railway Company; and
- Olive Avenue over 75th Avenue/Grand Avenue/BNSF Railway Company.

In an effort to address the current and expected increase in congestion throughout the corridor, MAG identified multiple roadway improvements for Grand Avenue between SR 303 and McDowell Road in the MAG Regional Transportation Plan 2007 Update (RTP 2007 Update). The RTP improvements include the addition of general purpose lanes, additional grade separations, and other improvements that will be implemented throughout the planning period for the RTP. A summary and timeline of these improvements are shown in Table 2-4.

Table 2-4: Grand Avenue Corridor Future Roadway Improvements

Phase	Improvement	Extent	Date
Phase I: 2006-2010	Widen Grand Avenue to three lanes in each direction,	99th to 83rd Avenues	2010
Phase I: 2006-2010 (Additional improvements under study)	Widen Grand Avenue to three lanes in each direction.	SR 303 to 99th Avenue	2011
Phase I: 2006-2010	Right turn lanes, Sidewalks, Landscaping,	SR 101 to McDowell Road	DCR completed October 2008
Phases I, II: 2006-2015	Construct El Mirage Road over Grand Avenue	Paradise Lane to Thunderbird Road	2015
Phases II, IV: 2006-2010	Unspecified improvements to be identified after future studies	SR 101 to Van Buren Street	TBD

Source: ADOT, 2008a.

2.3.4.1 Travel Characteristics: Travel Time, Volume and Congestion

The travel path identified to analyze the Grand Avenue Corridor follows the Grand Avenue/US 60 alignment between downtown Phoenix and the Town of Wickenburg. For the purposes of this analysis the intersection of Washington Street and Central Avenue in Phoenix and the intersection of US 93 and US 60 in Wickenburg were used as endpoints to measure travel characteristics. The travel path for the corridor totals 53 miles and was broken down into two segments in order to compare travel characteristics on both ends of the corridor. Table 2-5 compares the travel characteristics of the two segments for the AM peak period in 2007 and 2030.

Table 2-5: Grand Avenue AM Peak Period Travel Characteristics (2007 – 2030)

2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: US 60/US 93 to Grand Ave/Bell Rd	32 miles	38 minutes	2	900 – 4,100 vehicles
Segment #2: Grand Ave/Bell Rd to Downtown Phoenix	21 miles	77 minutes	2 – 5	1,600 – 7,100 vehicles
Total Trip	**53 miles**	**115 minutes**	**-**	**900 – 7,100 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: US 60/US 93 to Grand Ave/Bell Rd	32 miles	52 minutes	2 – 3	2,200 – 7,800 vehicles
Segment #2: Grand Ave/Bell Rd to Downtown Phoenix	21 miles	60 minutes	2 – 5	3,200 – 9,200 vehicles
Total Trip	**53 mile**	**112 minutes**	**-**	**2,200 – 9,200 vehicles**

Source: MAG, 2009a, 2009b.

Between 2007 and 2030, travel characteristics in the AM peak travel period are expected to change significantly throughout the corridor. Between the intersection of US 93 and US 60 and the intersection of Grand Avenue and Bell Road, traffic volume along Grand Avenue is expected to nearly double and travel time in this segment will increase by 14 minutes. While the overall volume is also expected to increase between Bell Road and downtown Phoenix, the total trip time is projected to decrease by 17 minutes, relieving what is currently a severely congested area. This travel time improvement can be attributed to the ongoing upgrades to US 60/Grand Avenue as previously described.

Similar to the AM peak period travel characteristics, PM peak period travel time, volume and congestion were analyzed. Table 2-6 shows the comparison between 2007 and 2030 PM peak period travel characteristics in the Grand Avenue Corridor.

Table 2-6: Grand Avenue PM Peak Period Travel Characteristics (2007 – 2030)

2007 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to Grand Ave/Bell Rd	21 miles	77 minutes	2 – 5	2,000 – 8,600 vehicles
Segment #2: Grand Ave/Bell Rd to US 60/US 93	32 miles	40 minutes	2	1,600 – 5,200 vehicles
Total Trip	**53 miles**	**117 minutes**	**-**	**1,600 – 8,600 vehicles**
2030 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to Grand Ave/Bell Rd	21 miles	63 minutes	2 – 5	3,700 – 11,000 vehicles
Segment #2: Grand Ave/Bell Rd to US 60/US 93	32 miles	65 minutes	2 – 3	3,200 – 9,000 vehicles
Total Trip	**53 miles**	**128 minutes**	**-**	**3,200 – 11,000 vehicles**

Source: MAG, 2009a, 2009b.

In 2007, travel time between downtown Phoenix and Bell Road in the PM peak period was 77 minutes. Given planned infrastructure improvements in this segment of Grand Avenue however, the travel time is expected to improve by 2030 with a decrease of 14 minutes. Conversely, travel between Bell Road and Wickenburg took 40 minutes in 2007 and is expected to increase to 65 minutes by 2030. This anticipated increase in travel time can be attributed to the projected socioeconomic growth and shift in land use to more residential development within this segment of the corridor. While PM peak travel volumes between downtown Phoenix and Bell Road will increase roughly 20 percent, traffic volumes between Bell Road and Wickenburg are expected to nearly double by 2030.

The level of congestion throughout the corridor is expected to change in the future. In 2007, the segment of the corridor between Wickenburg and Bell Road shows little to no congestion in both the AM and PM peak periods. Those levels are both expected to increase to moderate and severe congestion respectively by 2030. Figure 2-4 shows the travel path for the Grand Avenue Corridor as well as the level of congestion and travel times in both the AM and PM peak period in 2007 and 2030. Note that levels of congestion within downtown Phoenix are shown, but actual travel times for this area are not shown in this figure.

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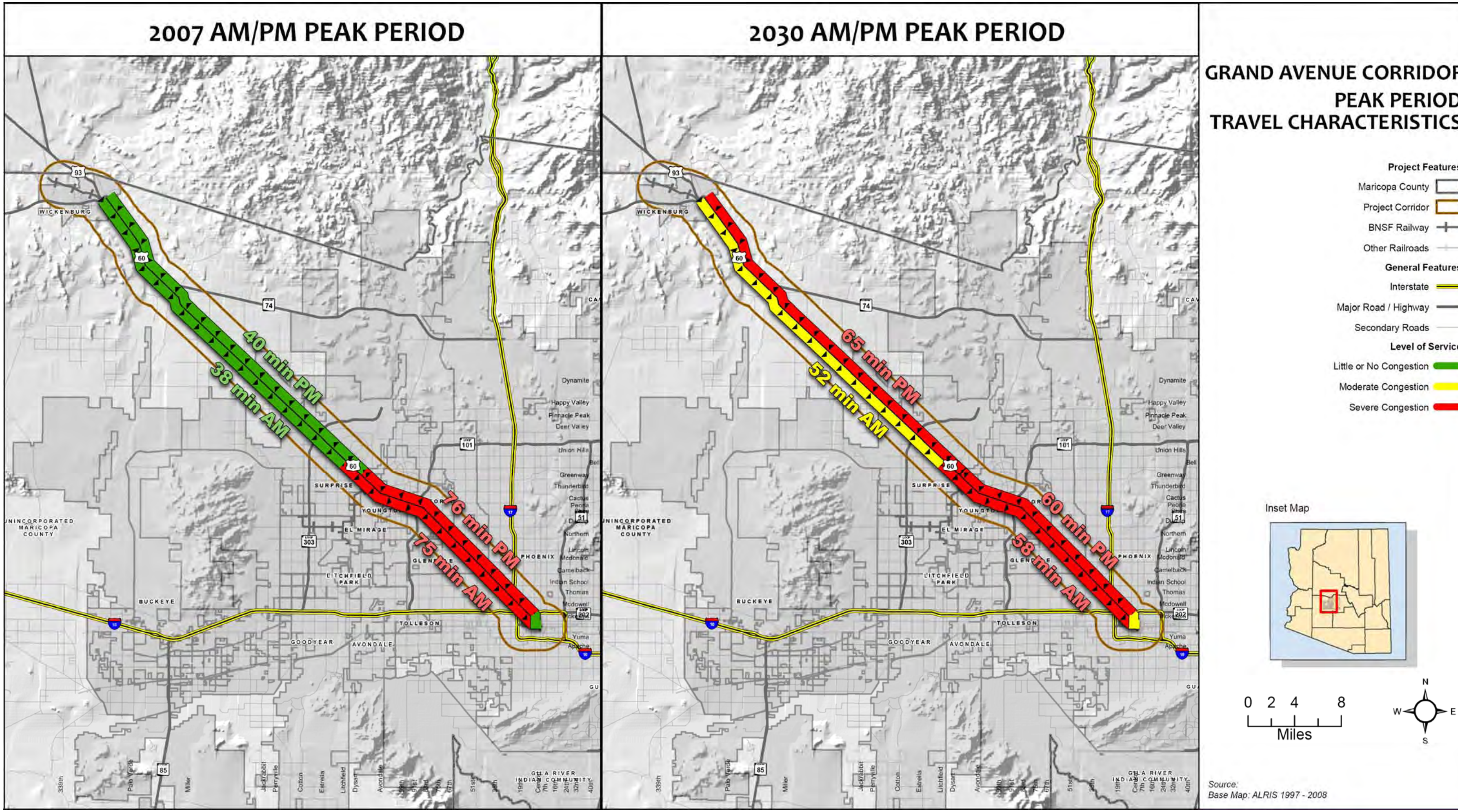
Figure 2-4: Grand Avenue Corridor – Peak Period Travel Characteristics



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2.3.5 Transit Service

Transit service in the Grand Avenue Corridor includes fixed route bus service and numerous transit passenger facilities.

2.3.5.1 Fixed Route Bus Service

Fixed route bus service within the Grand Avenue Corridor is comprised of local bus, circulators, a regional connector, and express bus service. Figure 2-5 depicts both the existing and funded regional transit network of local/Supergrid bus, circulators, and regional connectors that will be in operation by 2030 within the corridor.

2.3.5.1.1 Local Bus

Within the Grand Avenue Corridor, local bus service is provided seven days a week. Sixteen local bus routes currently serve the corridor with the Grand Avenue Limited as the only local bus route that directly serves Grand Avenue. This limited stop route provides only Monday through Friday service, with four inbound (to downtown Phoenix) AM trips and four outbound (from downtown Phoenix) PM trips.

The RTP identifies a total of 12 Supergrid routes that are planned to operate in the Grand Avenue Corridor by 2030.

2.3.5.1.2 Circulators

Two circulator routes currently operate in the Grand Avenue Corridor, both of which are operated by the City of Glendale, and known as the Glendale Urban Shuttle (GUS).

2.3.5.1.3 Regional Connectors

The only regional connector that operates in the Grand Avenue Corridor is the Wickenburg Connector or Route 660. This route provides service Monday through Saturday between the Town of Wickenburg and Arrowhead Towne Center in Glendale.

2.3.5.1.4 BRT/Express Bus

Two express routes (Routes 571 and 572) operate within the Grand Avenue Corridor; however, there are no stops located along Grand Avenue. The RTP identifies one future express bus route that will be funded with Proposition 400 revenues within the corridor, the Loop 303 Express, which will operate between Arrowhead Towne Center and the Desert Sky Mall via SR-303.

There is no existing or planned arterial BRT service operating within the Grand Avenue Corridor. Figure 2-5 shows both the existing and planned express bus system that will be in operation by 2030.

2.3.5.2 High Capacity Transit

Currently there are no high capacity transit services in the Grand Avenue Corridor. However, the RTP identifies a 5-mile high capacity transit extension from the Central Phoenix / East Valley LRT Starter Line (CP/EV LRT Starter Line) west along Glendale Avenue to approximately Grand Avenue (known as the Glendale Extension).

2.3.5.3 Transit Passenger Facilities

Existing and planned transit facilities located within the Grand Avenue Corridor are comprised of both transit centers and park-and-rides.

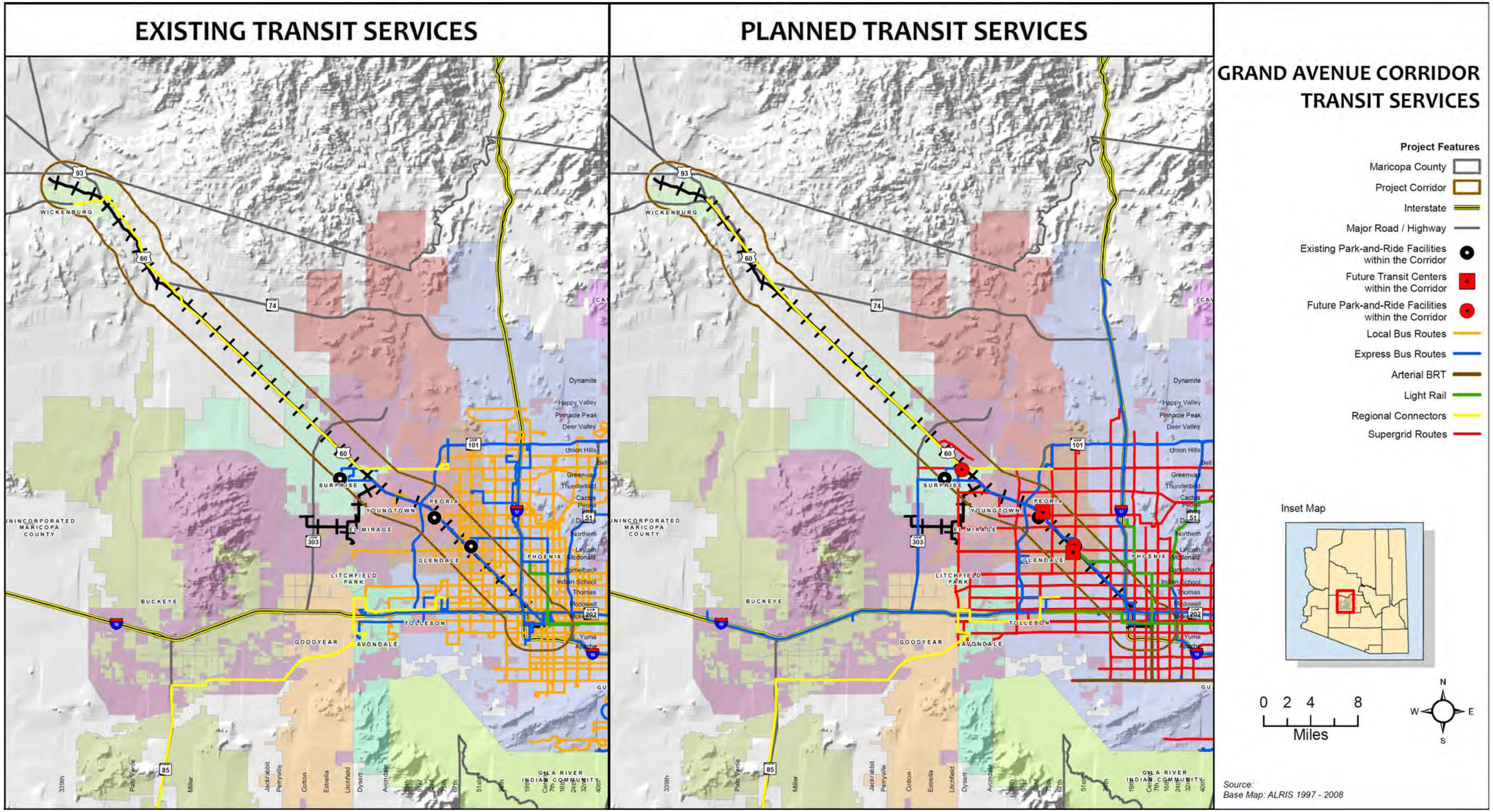
2.3.5.3.1 Transit Centers

There are no existing transit centers in the Grand Avenue Corridor; however, two transit centers are planned by 2030. The planned transit centers will serve the City of Glendale and the City of Peoria, respectively, and are shown in Figure 2-5.

2.3.5.3.2 Park-and-Ride Facilities

There are a total of three existing park-and-ride facilities in the project corridor that provide transit riders with access to local bus service, circulators, and express bus routes. By 2030, two additional park-and-ride facilities will be in operation. Figure 2-5 identifies existing and future facilities.

Figure 2-5: Grand Avenue Corridor – Transit Services



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2.3.6 Travel Patterns

Home-based work (HBW) trips originating within the Grand Avenue Corridor were analyzed for 2007 and 2030. The purpose of this analysis was to understand the destinations of HBW trips that originated within the project corridor. Destinations that were identified as part of this analysis include:

- Within the Grand Avenue Corridor;
- Within the area of the System Study; and
- Outside the limits of the System Study.

An analysis of HBW trips showed that in 2007, just over 183,000 trips originated within the Grand Avenue Corridor, with 49 percent of these trips remaining within the corridor. Of the remaining trips, 14 percent were destined to other locations within the limits of the System Study, while 37 percent were destined to locations outside the limits of the System Study planning area. In 2030, the number of HBW trips originating in the Grand Avenue Corridor increased by 46 percent to nearly 269,000 trips. A comparison of HBW trips between 2007 and 2030 shows that the percentage of trips traveling to areas other than the Grand Avenue Corridor stayed relatively the same. The number of trips originating within the Grand Avenue Corridor for 2007 and 2030 are identified in Table 2-7.

Table 2-7: Home-Based Work Trips Originating within the Grand Avenue Corridor

Destination Area	2007		2030	
	HBW Trips	Percent	HBW Trips	Percent
Within Grand Avenue Corridor	89,807	49%	125,699	47%
Within the System Study	25,044	14%	31,543	12%
Outside the System Study	68,436	37%	111,473	41%
Total	**183,287**	**100%**	**268,715**	**100%**

Source: MAG, 2009a; 2009b.

2.3.7 Summary

The Grand Avenue Corridor is expected to experience significant changes in the demographic makeup of the corridor between 2007 and 2030. During this time the corridor is expected to experience a 41 percent increase in population and a 52 percent increase in employment. The majority of the growth expected to occur will take place between the City of Surprise and the Town of Wickenburg. Coinciding with this population and employment growth, land use development is expected to be largely residential, increasing from 26 percent in 2007 to 70 percent in the future. Similar to population and employment, the majority of change in land use is expected to occur north of the City of Surprise.

There are significant railroad facilities along the Grand Avenue Corridor that will impact future development of commuter rail service. BNSF Railway Company plans for facilities within the corridor include shifting existing yard activities north to the Ennis Wye and the construction and use of the future Surprise Logistics Center, which will diminish the need for trains to enter the downtown Phoenix area.

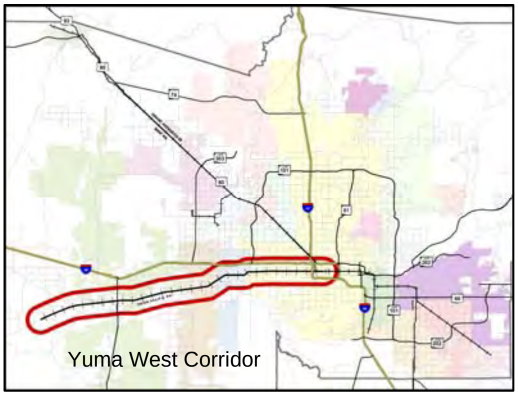
The BNSF Railway Company line is located immediately adjacent to Grand Avenue for the vast majority of the corridor. The level of congestion along Grand Avenue north of the City of Surprise is currently low; however that level is expected to increase to moderate and severe levels of congestion by 2030. Overall travel time from Wickenburg to downtown Phoenix is not expected to change much between 2007 and 2030. Due to planned highway improvements, travel time between downtown Phoenix and Surprise will actually decrease, while the segment of the corridor between Surprise and Wickenburg will increase due to population and employment growth within the area.

Transit services within the Grand Avenue Corridor are located primarily south of SR 303 and are limited north of that point. The implementation of future Supergrid routes and the development of the Glendale Extension of the CP/EV Light Rail Starter Line will increase transit services in the future.

Travel patterns within the corridor are expected to remain similar between 2007 and 2030.

2.4 Yuma West Corridor

The 45-mile Yuma West Corridor has been defined by a two-mile radius surrounding the UPRR between Union Station in downtown Phoenix and the Arlington siding located in the western portion of the Town of Buckeye's Municipal Planning Area (MPA). The cities, towns and unincorporated areas that fall within this corridor include:



- City of Phoenix;
- City of Tolleson;
- City of Avondale;
- City of Goodyear;
- Town of Buckeye; and
- Portions of unincorporated Maricopa County.

2.4.1 Demographics

The Yuma West Corridor had a 2007 population of approximately 372,000 people. Municipalities will experience a combined average increase in population within the corridor of 103 percent from 2007 to 2030, growing to approximately 753,500 people over that time period. The municipalities expected to experience the most significant population growth within the corridor by 2030 are the Town of Buckeye, with a 538 percent increase, and the City of Goodyear, with a 178 percent increase. Population is also expected to increase in areas of unincorporated Maricopa County by 282 percent within the corridor.

The Yuma West Corridor is also expected to experience a significant increase in employment between 2007 and 2030. With an expected 76 percent increase in employment to approximately 477,000 jobs, the Yuma West Corridor will continue to grow through and beyond the year 2030. Of the municipalities that make-up the corridor, the Town of Buckeye is expected to experience the greatest employment growth, with a 543 percent increase in jobs in the corridor. Other municipalities expected to experience significant employment growth are the City of Goodyear and the City of Avondale, with a 265 percent increase and 190 percent increase in jobs in the corridor respectively. In addition, the portions of unincorporated Maricopa County located within the Yuma West Corridor are expected to experience a 234 percent increase in employment.

Table 2-8 and Table 2-9 show both the existing and forecasted population and employment within the Yuma West corridor.

Table 2-8: Yuma West Corridor Population Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	239,403	353,356	48%
City of Tolleson	7,073	10,190	44%
City of Avondale	59,592	85,816	44%
City of Goodyear	30,409	84,626	178%
Town of Buckeye	32,924	210,056	538%
Unincorporated Maricopa County	2,459	9,399	282%
Total	**371,860**	**753,443**	**103%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

Table 2-9: Yuma West Corridor Employment Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	216,767	294,313	36%
City of Tolleson	13,955	22,314	60%
City of Avondale	13,924	40,327	190%
City of Goodyear	14,918	54,432	265%
Town of Buckeye	8,766	56,360	543%
Unincorporated Maricopa County	2,817	9,398	234%
Total	**271,147**	**477,144**	**76%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

2.4.2 Land Use

The Yuma West Corridor contains a variety of land uses stretching from downtown Phoenix to the Town of Buckeye. Table 2-10 summarizes existing land uses as of the year 2004 as well as future land use at build-out within the Yuma West corridor distinguished by land use category. The most prevalent existing land use in the corridor is Open Space/Recreation, which comprises nearly 57 percent of the total corridor. Other significant existing land uses include vacant land and residential, comprising 21 percent and nine percent of the total corridor land uses respectively. As shown in Figure 2-6, much of the vacant land within the corridor is projected to be developed as residential land uses, with almost 50 percent of the total corridor comprising residential uses by 2030.

Table 2-10: Yuma West Corridor Existing and Future Land Use

Land Use Category	Existing Land Use (2004)		Future Land Use (Build-out)	
	Acres	Percent of Total	Acres	Percent of Total
Residential (<1 du/acre)	703	0.6%	21,206	17.3%
Residential (1 – 4 du/acre)	2,124	1.7%	17,114	14.0%
Residential (>4 du/acre)	8,332	6.8%	21,897	17.9%
Commercial	1,475	1.2%	8,310	6.8%
Industrial	9,394	7.7%	19,082	15.6%
Mixed Use	569	0.5%	13,157	10.7%
Office	395	0.3%	1,777	1.5%
Open Space / Recreation	69,412	56.6%	11,218	9.2%
Public / Private Institutions	2,479	2.0%	6,081	5.0%
Transportation / Parking	2,569	2.1%	2,705	2.2%
Vacant	25,095	20.5%	0	0.0%
Total	**122,547**	**100.0%**	**122,547**	**100.0%**

Source: MAG, 2007c, 2007d.

Those locations within the Yuma West Corridor that have the potential to generate ridership based on land use have been identified as activity centers. Activity centers that have been identified throughout the corridor include:

- Downtown Phoenix;
- Downtown Avondale;
- Goodyear Spring Training Complex;
- Phoenix-Goodyear Airport;
- Downtown Buckeye; and
- Palo Verde Generating Station.

Additional major activity centers within the corridor, or located outside the two-mile radius, include the Phoenix International Raceway, State Fair Grounds, University of Phoenix Stadium, Jobing.com Arena, and the Cricket Pavilion. Additional activity centers located throughout this corridor, and the relationship they have with potential station locations have been identified in Appendix B: Conceptual Station Planning Technical Memorandum of the Yuma West Corridor Development Plan.

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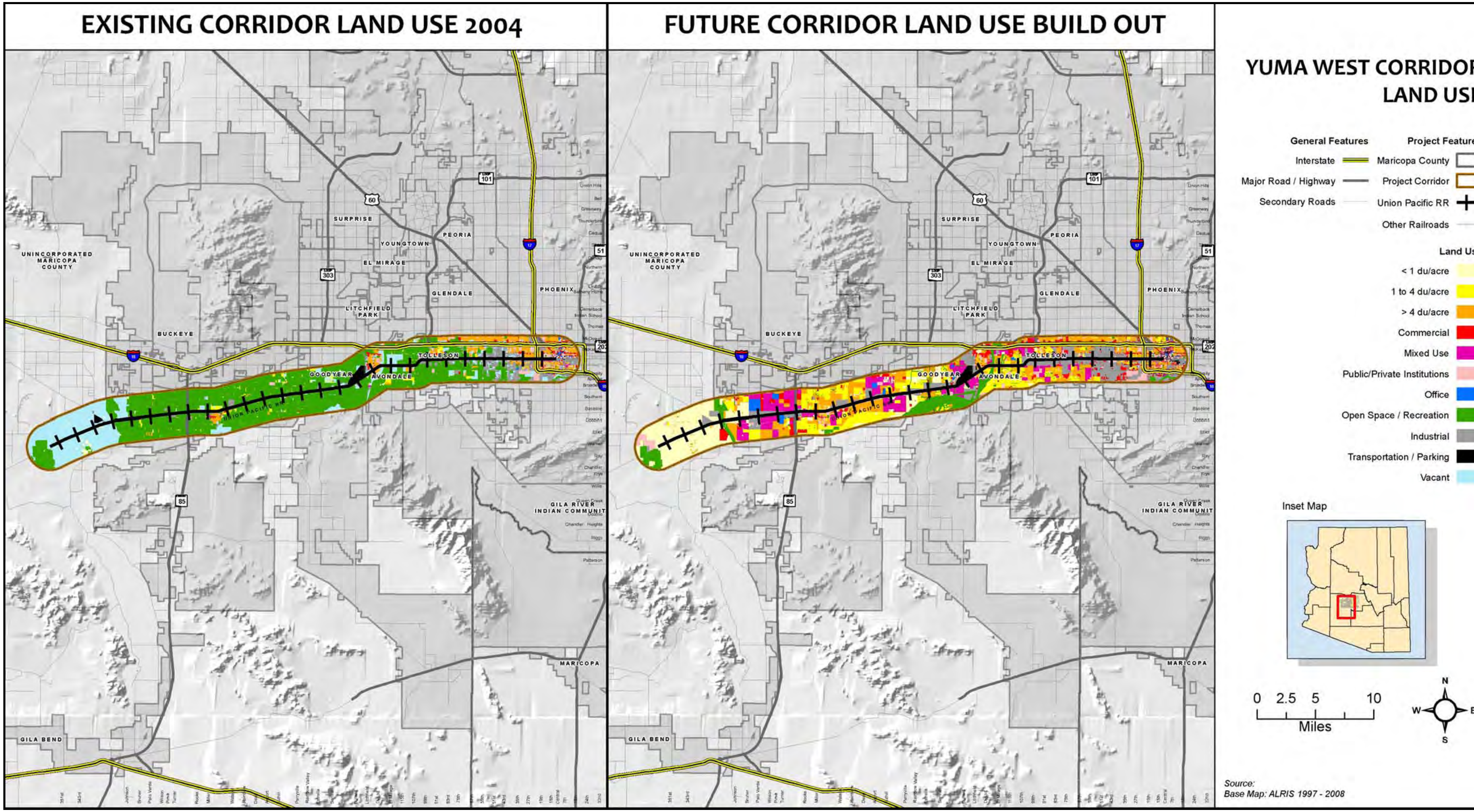
Figure 2-6: Yuma West Corridor – Land Use



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2.4.3 Railroad Characteristics

For the purposes of this study, the Yuma West Corridor refers to the segment of the UPRR Phoenix Subdivision that extends from Union Station in downtown Phoenix to Arlington, a distance of approximately 45 miles. The Phoenix Subdivision formerly hosted Amtrak's *Sunset Limited*, but since June 1996, the train uses the Gila Line, or Sunset main line, through Maricopa south of Phoenix.

Buckeye Depot Site located in Buckeye, AZ
Source: MAG.

When the Yuma West Corridor was used by Amtrak, the line was controlled by Direct Train Control (DTC) and Automatic Block Signals (ABS). The maximum operating speed was 60 mph for passenger trains. The line is single track with a few sidings and frequent industrial leads and spur tracks. There are no existing Quiet Zones located in the Yuma West Corridor.

The portion of the Phoenix Subdivision within the corridor currently averages a total of approximately three local/switching trains a day. Union Pacific is continuing to make improvements throughout the corridor and to date has completed the construction of Campo Yard, added three additional tracks and a trans-load track to the Phoenix Yard, and made improvements to the Phoenix Auto Facility.

Additional UPRR facilities located throughout the Yuma West Corridor are shown in Figure 2-7 and include:

- **Union Station** (MP 906.0);
- **Campo Yard** (MP 902.0);
- **Litchfield Junction** (MP 889.3);
- **Buckeye Yard** (MP 875.7); and
- **Palo Verde Nuclear Power Plant Spur** (MP 859.3).

Union Pacific has identified various potential future improvements throughout the Yuma West Corridor and the Phoenix Subdivision which include building a new yard in west Buckeye to serve customers in the West Valley. In addition, according to the ADOT State of Arizona 2007 Railroad Inventory and Assessment Report (2007), a private developer has expressed interest in building a cement manufacturing and distribution plant near 99th Avenue and Buckeye Road in Tolleson. These railroad infrastructure improvements would allow for enhanced freight service as well as facilitate needed improvements should potential commuter rail service be implemented.

For a more detailed description of Yuma West Corridor railroad conditions and existing and planned facilities, see Appendix E: Systems Study Railroad Conditions and Issues.

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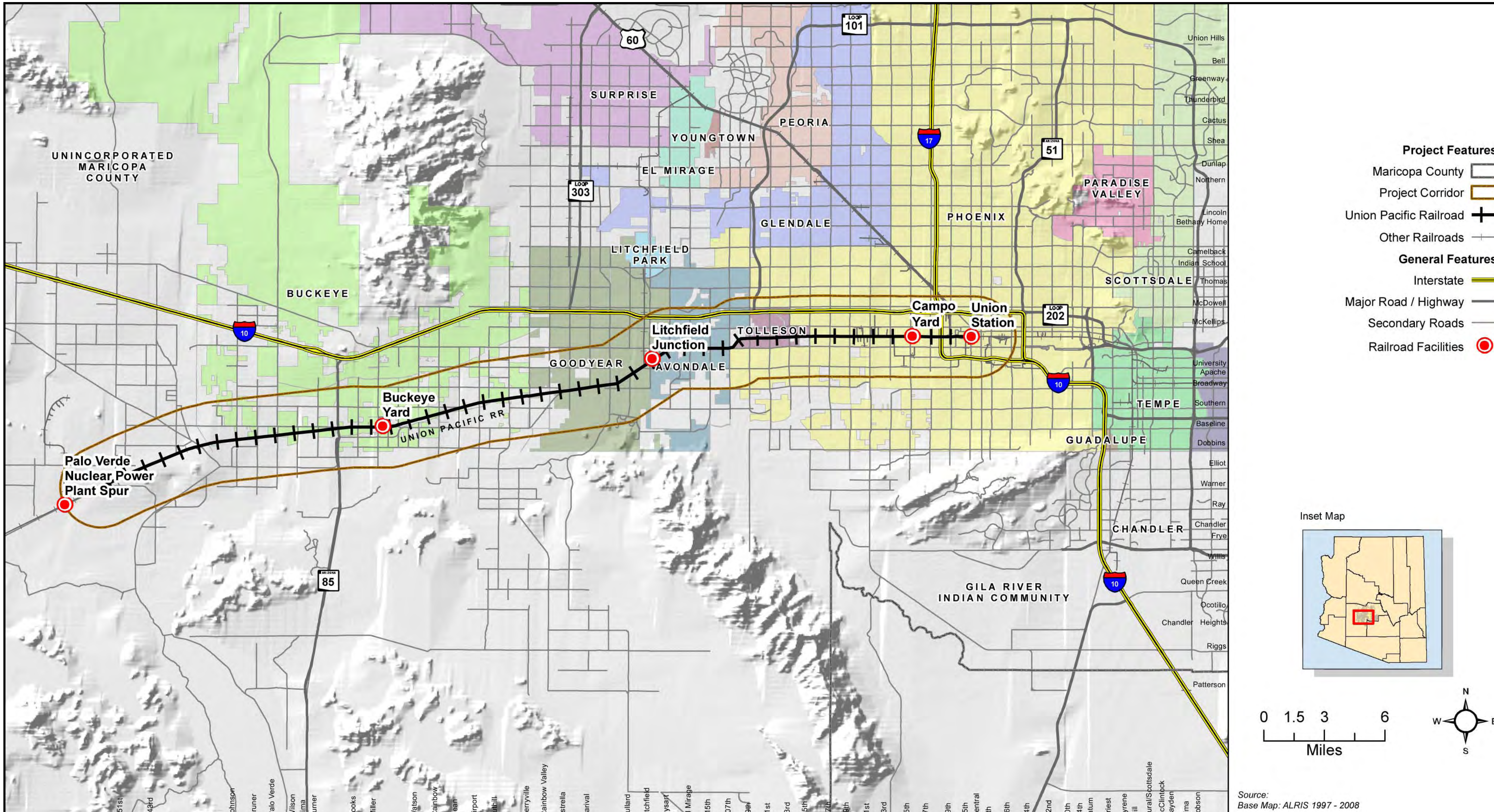

Figure 2-7: Yuma West Corridor – Railroad Facilities

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2.4.4 Highway Characteristics

The primary travel path for those living at the western edge of the Yuma West Corridor and Maricopa County commuting into downtown Phoenix is the eastbound I-10. In its current state, I-10 ranges from four to eight general use lanes in addition to a High Occupancy Vehicle (HOV) lane extending from approximately SR 101 into downtown Phoenix.

In an effort to address the current and expected increase in congestion throughout the corridor, MAG has identified multiple roadway improvements for the Yuma West Corridor in the RTP 2007 Update. In addition to general maintenance, there have been future highway improvements identified for this section of I-10. By 2028 the number of highway travel lanes will range from four to ten general purpose lanes and will include an HOV lane extending from SR 303 into downtown Phoenix. These improvements include the construction of additional general purpose lanes, HOV lanes, and three new traffic interchanges.

2.4.4.1 Travel Characteristics: Travel Time, Volume and Congestion

The travel path identified to analyze the Yuma West Corridor follows the I-10 alignment between downtown Phoenix and the western edge of the Town of Buckeye. For the purposes of this analysis, the intersection of Washington Street and Central Avenue in downtown Phoenix and the intersection of Narramore Road and 355th Avenue in western Buckeye were used as endpoints to measure travel characteristics. The travel path for this corridor totals 51 miles and was broken down into two segments in order to compare travel characteristics on both ends of the corridor. Table 2-11 compares the travel characteristics of the two segments for the AM peak period in 2007 and 2030.

Table 2-11: Yuma West AM Peak Period Travel Characteristics (2007 – 2030)

2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Narramore Rd/355th Ave to I-10/SR 303	29 miles	37 minutes	1 – 2	100 – 6,700 vehicles
Segment #2: I-10/SR 303 to Downtown Phoenix	22 miles	36 minutes	2 – 5	1,900 – 25,000 vehicles
Total Trip	**51 miles**	**73 minutes**	**-**	**0 – 25,000 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Narramore Rd/355th Ave to I-10/SR 303	29 miles	43 minutes	2 – 3	300 – 16,500 vehicles
Segment #2: I-10/SR 303 to Downtown Phoenix	22 miles	38 minutes	3 – 5	3,000 – 31,500 vehicles
Total Trip	**51 miles**	**81 minutes**	**-**	**300 – 31,500 vehicles**

Source: MAG, 2009a; 2009b.

Between 2007 and 2030, travel characteristics in the AM peak travel period are expected to slightly change. Between the intersection of Narramore Road and 355th Avenue and the intersection of I-10 and SR 303, traffic volume is expected to more than double and travel time in this segment will increase by six minutes. Overall traffic volume is also expected to increase between SR 303 and downtown Phoenix along I-10, however the travel time along this segment of the corridor is projected to only slightly increase, making the total trip time in 2030 approximately 81 minutes as apposed to 73 minutes in 2007. The anticipated increase in traffic volume and overall trip time can be related to the socioeconomic and land use expectations surrounding the municipalities in the western portions of this corridor.

Similar to the AM peak period travel characteristics, PM peak period travel time, volume and congestion were analyzed. Table 2-12 shows the comparison between 2007 and 2030 PM peak period travel characteristics in the Yuma West Corridor.

Table 2-12: Yuma West PM Peak Period Travel Characteristics (2007 – 2030)

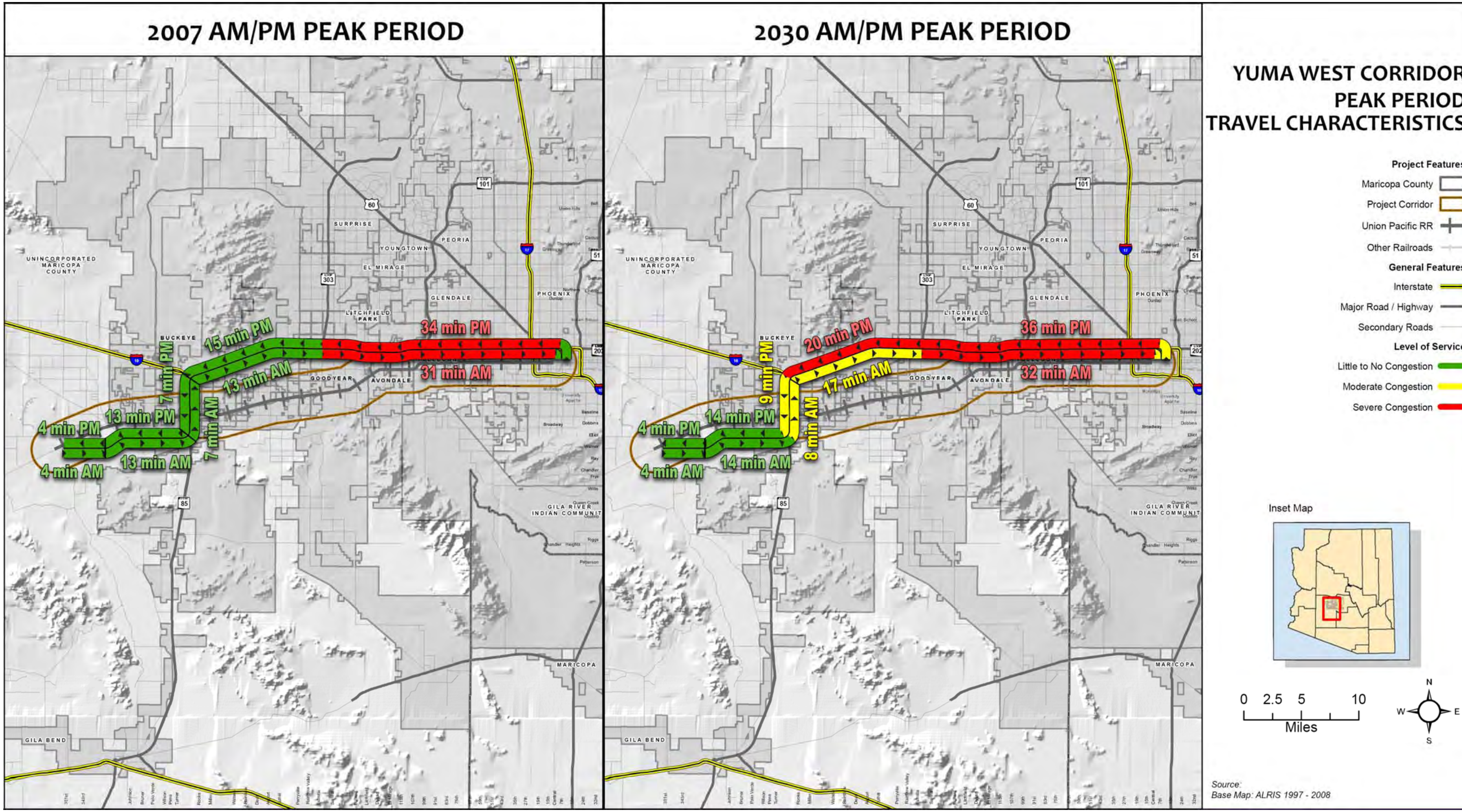
2007 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to I-10/SR 303	22 miles	37 minutes	2 – 5	2,800 – 26,300 vehicles
Segment #2: I-10/SR 303 to Narramore Rd/355th Ave	29 miles	39 minutes	1 – 2	100 – 8,000 vehicles
Total Trip	**51 miles**	**76 minutes**	**-**	**100 – 26,300 vehicles**
2030 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to I-10/SR 303	22 miles	40 minutes	3 – 5	4,200 – 32,300 vehicles
Segment #2: I-10/SR 303 to Narramore Rd/355th Ave	29 miles	47 minutes	2 – 3	400 – 17,000 vehicles
Total Trip	**51 miles**	**87 minutes**	**-**	**400 – 32,300 vehicles**

Source: MAG, 2009a; 2009b.

In 2007, travel time between downtown Phoenix and SR 303 in the PM peak period was 37 minutes. Given planned infrastructure improvements in this segment of I-10 however, the travel time is still expected to worsen by 2030 with an increase of 3 minutes. Similarly, travel time between SR 303 and the proposed end-of-line in Buckeye took 39 minutes in 2007 and is expected to increase to 47 minutes by 2030. This anticipated increase in travel time can be attributed to the projected socioeconomic growth and shift in land use to more residential development within this segment of the corridor. While PM peak travel volumes between downtown Phoenix and SR 303 are expected to increase roughly 18 percent, traffic volumes between SR 303 and Buckeye are expected to more than double by 2030.

The level of congestion throughout the corridor is expected to deteriorate in the future. In 2007, the segment of the corridor between Buckeye and SR 303 shows little to no congestion in both the AM and PM peak periods. Those levels are both expected to increase to moderate and severe congestion respectively by 2030. Figure 2-8 shows the travel path for the Yuma West Corridor as well as the level of congestion and travel times in both the AM and PM peak period in 2007 and 2030. Note that levels of congestion within downtown Phoenix are shown, but actual travel times for this area are not shown in this figure.

Figure 2-8: Yuma West Corridor – Peak Period Travel Characteristics



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2.4.5 Transit Service

Transit services that are currently provided or are planned for future implementation in the Yuma West Corridor include fixed route bus service, high capacity transit and transit passenger facilities.

Figure 2-9 depicts both the existing and planned regional transit network within the Yuma West Corridor.

2.4.5.1 Fixed Route Bus Service

Fixed route bus service within the Yuma West Corridor is comprised of local bus, circulators, regional connectors, and express bus service.

2.4.5.1.1 Local Bus

Within the Yuma West Corridor, local bus service is provided seven days a week and operates between 5:00 AM and 11:00 PM on the weekdays and between 6:00 AM and 9:30 PM on the weekends. In all, 22 local bus routes currently serve the corridor with nearly two-thirds of the routes operating a weekday peak frequency of 30 minutes or better.

The RTP identifies a total of seven Supergrid routes that are planned to operate within the Yuma West Corridor by the year 2021. The planned Supergrid routes will primarily serve the eastern half of the corridor and downtown Phoenix.

2.4.5.1.2 Circulators

Two circulator routes currently operate in the eastern portion of the Yuma West Corridor, both of which are operated by the City of Phoenix. The Downtown Area Shuttle (DASH) provides service along two separate fixed routes indentified as either a downtown or government route. In addition to the DASH service, the City of Phoenix operates the Maryvale Area Ride for You (MARY) which provides service to the village of Maryvale within the City of Phoenix.

Due to the existing lack of transit services in the cities of Goodyear and Avondale, these municipalities are currently undertaking separate feasibility studies. The purpose of these studies is to determine whether implementing circulator service would benefit the local communities.

2.4.5.1.3 Regional Connectors

The only regional connector that operates within the Yuma West Corridor is the Gila Bend Regional Connector, known as Route 685. This route provides the western most transit service within the corridor and operates Monday through Saturday between the Town of Ajo and Desert Sky Mall Transit Center in Phoenix.

2.4.5.1.4 BRT/Express Bus

Three express routes (Routes 560, 562, and 573) currently operate within the Yuma West Corridor. These routes all utilize I-10 as the primary connection to downtown Phoenix and outlying communities.

There is no existing or planned arterial BRT service operating within the Yuma West Corridor.

2.4.5.2 High Capacity Transit

Currently, Valley Metro Rail Inc. (METRO) LRT serves the Yuma West Corridor only in portions of downtown Phoenix. However, the RTP identifies an 11-mile high capacity transit extension from the CP/EV Starter Line west along I-10 to approximately the 79th Avenue Park-and-Ride. The METRO board extended the anticipated year of operation of the I-10 West Extension for fiscal year 2021 as opposed to the year 2019 as originally identified in the MAG RTP.

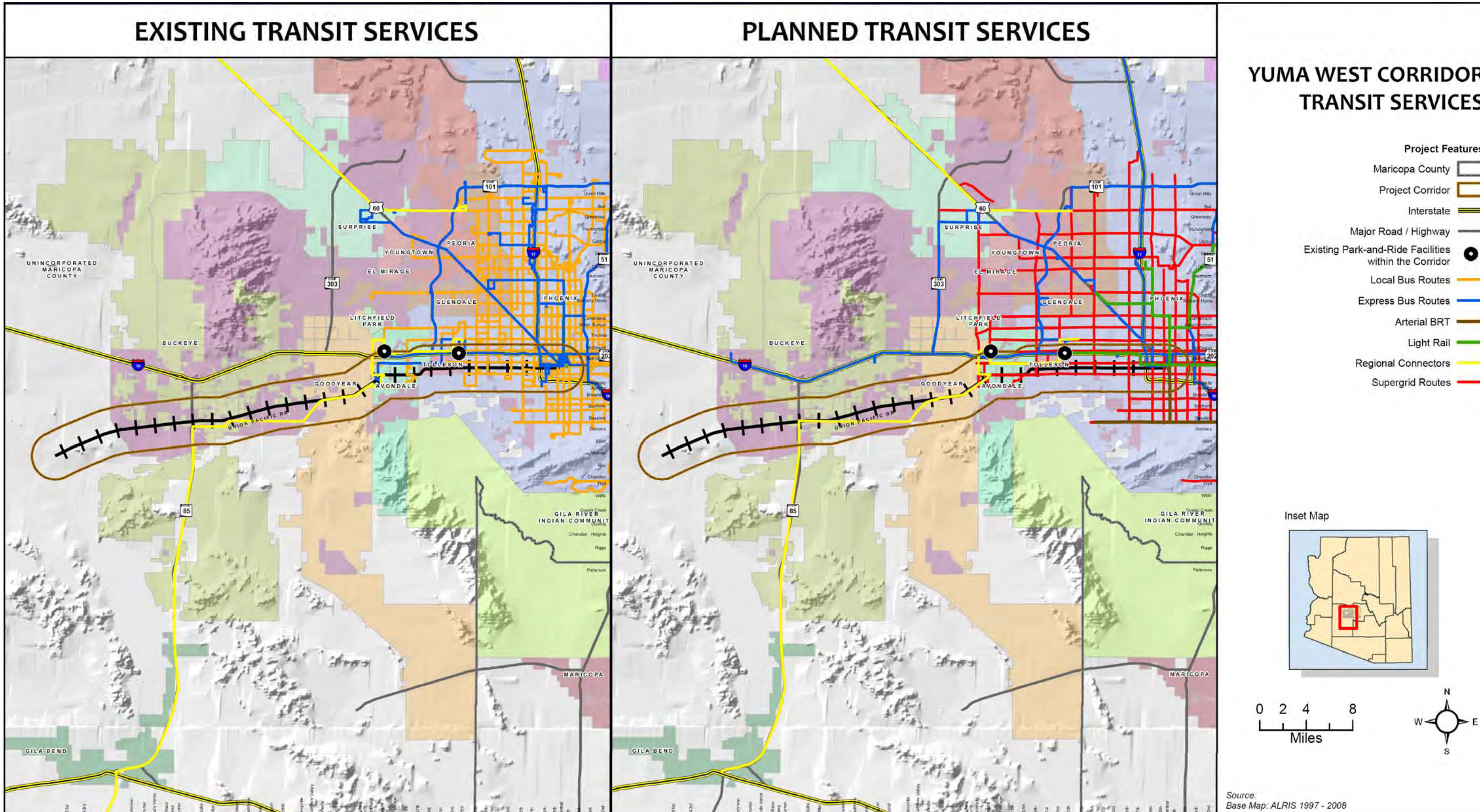
2.4.5.3 Transit Passenger Facilities

Transit facilities located within the Yuma West Corridor include park-and-ride facilities, but there are no existing or planned transit centers identified for this corridor.

2.4.5.3.1 Park-and-Ride Facilities

Two existing park-and-ride facilities are located within the Yuma West Corridor. The 79th Avenue Park-and-Ride and the Goodyear Park-and-Ride, both located off I-10, provide connections with transit service in the West Valley. Valley Metro currently has no plans to develop additional park-and-ride facilities in the Yuma West Corridor. Figure 2-9 identifies the existing facilities.

Figure 2-9: Yuma West Corridor – Transit Services



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2.4.6 Travel Patterns

Home-based work trips originating within the Yuma West Corridor were analyzed for 2007 and 2030. The purpose of this analysis was to understand the destinations of those HBW trips that originated within the corridor. Destinations that were identified as part of this analysis include trips:

- Within the Yuma West Corridor;
- Within the area of the System Study; and
- Outside the limits of the System Study.

An analysis of HBW trips showed that in 2007, just over 105,000 trips originated within the Yuma West Corridor, with 53 percent of these trips remaining within the corridor. Of the remaining trips, 23 percent were destined to other locations within the limits of the System Study, and 24 percent were destined to locations outside the limits of the System Study planning area. In 2030, the number of HBW trips originating in the Yuma West Corridor increased by 103 percent to nearly 215,000 total trips. A comparison of HBW trips between 2007 and 2030 shows that the percentage of HBW trips traveling to locations outside the System Study planning area increased by 9 percent, while trips within the limits of the System Study decreased by seven percent. The number of total HBW trips originating within the Yuma West Corridor for 2007 and 2030 are identified in Table 2-13.

Table 2-13: Home-Based Work Trips Originating within the Yuma West Corridor

Destination Area	2007		2030	
	HBW Trips	Percent	HBW Trips	Percent
Within Yuma West Corridor	56,271	53%	109,708	51%
Within the System Study	24,097	23%	34,596	16%
Outside the System Study	25,316	24%	70,594	33%
Total	**105,684**	**100%**	**214,898**	**100%**

Source: MAG, 2009a; 2009b.

2.4.7 Summary

The Yuma West Corridor is expected to experience significant changes in the demographic makeup of the corridor between 2007 and 2030. During this time the corridor is expected to experience a 103 percent increase in population and a 76 percent increase in employment. The majority of the change expected to occur will take place west of SR 101. Similar to the Grand Avenue Corridor, the change in future land use in the Yuma West Corridor is anticipated to largely be an increase in residential development. Similar to population and employment growth projections, the majority of change in land use is expected to occur west of SR 101.

Railroad facilities within the corridor include significant yards and junctions used during railroad operations, but are otherwise limited. There are several potential future railroad improvements identified within the corridor, including new yards and manufacturing plants which have been initiated by both Union Pacific and private developers.

The primary travel path identified for this analysis from Buckeye into downtown Phoenix is I-10. Despite significant expansion planned by 2030, congestion along I-10 is expected to increase. As a result future travel times between downtown Phoenix and the Town of Buckeye are expected to increase as well.

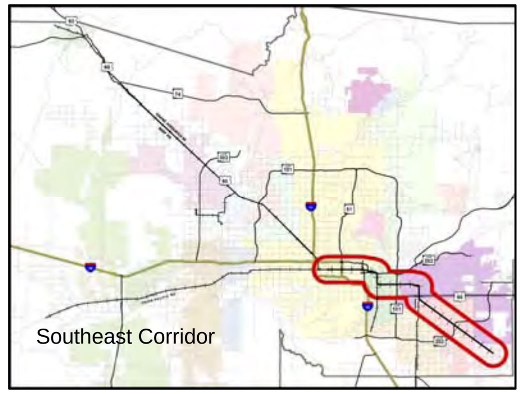
Transit services within the Yuma West Corridor are located primarily east of SR 303 and are limited west of that point. The implementation of Supergrid routes and the development of the I-10 West Extension of the CP/EV Starter Line will increase transit services in the future. Limited transit services west of SR 303 are expected remain through 2030.

Travel patterns within the corridor are largely expected to remain similar between 2007 and 2030.

2.5 Southeast Corridor

The 36-mile Southeast Corridor has been defined by a two-mile radius surrounding the UPRR line between Union Station in downtown Phoenix and the intersection of Ellsworth Road and Rittenhouse Road in Queen Creek. The cities, towns, and Indian Communities that fall within the Southeast Corridor include:

- City of Phoenix;
- City of Scottsdale;
- City of Tempe;
- City of Mesa;
- City of Chandler;
- Town of Gilbert;
- Town of Queen Creek; and
- Salt River Pima-Maricopa Indian Community.



2.5.1 Demographics

The Southeast Corridor had a total population of just under 698,000 people in 2007 and will experience a 32 percent increase in population to approximately 922,000 people by 2030. The most significant growth is expected to occur in Queen Creek, with a 177 percent increase in population, while the City of Phoenix and the Town of Gilbert are expected to grow by 44 percent and 42 percent respectively.

The Southeast Corridor is also expected to experience an increase in employment growth during the same period of time. The Southeast Corridor had a total of 560,000 jobs in 2007 and will experience a 39 percent increase in employment to approximately 777,000 jobs by 2030. Similar to the results seen in population growth, Queen Creek is expected to experience the most significant employment growth, with a 406 percent increase. Other municipalities expected to experience considerable employment growth are the Town of Gilbert, with a 66 percent increase, and the City of Chandler, with a 40 percent increase in employment by 2030.

Table 2-14 and Table 2-15 show the existing and forecasted population and employment growth for all municipal planning areas located within the Southeast corridor.

Table 2-14: Southeast Corridor Population Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	171,530	247,222	44%
City of Scottsdale	11,473	11,893	4%
City of Tempe	114,907	139,164	21%
City of Mesa	196,263	212,834	8%
City of Chandler	19,536	20,482	5%
Town of Gilbert	161,720	230,438	42%
Town of Queen Creek	21,351	59,129	177%
Salt River Pima-Maricopa Indian Community	807	808	0%
Total	**697,587**	**921,970**	**32%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

Table 2-15: Southeast Corridor Employment Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	245,734	326,922	33%
City of Scottsdale	5,275	5,670	7%
City of Tempe	131,674	169,871	29%
City of Mesa	102,500	127,473	24%
City of Chandler	11,221	15,678	40%
Town of Gilbert	57,610	95,775	66%
Town of Queen Creek	5,454	27,570	406%
Salt River Pima-Maricopa Indian Community	742	7691	937%
Total	**560,210**	**776,650**	**39%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

2.5.2 Land Use

The Southeast Corridor includes a variety of land uses as it stretches between downtown Phoenix and downtown Queen Creek as shown in Figure 2-10. Table 2-16 summarizes existing land uses as of the year 2004 as well as future land use at build-out within the Southeast corridor distinguished by land use category. The most prevalent existing land use in the corridor is residential, which comprised 33 percent of the total corridor. Other significant existing land uses are Open Space/Recreation at 26 percent and vacant land occupying 11 percent of the corridor. At build-out, the land use mix is expected to be similar to existing uses, with residential uses comprising 47 percent of the total corridor.

Table 2-16: Southeast Corridor Existing and Future Land Use

Land Use Category	Existing Land Use (2004)		Future Land Use (Build-out)	
	Acres	Percent of Total	Acres	Percent of Total
Residential (<1 du/acre)	561	0.6%	4,122	4.6%
Residential (1 – 4 du/acre)	6,765	7.6%	15,590	17.4%
Residential (>4 du/acre)	22,242	24.8%	22,364	25.0%
Commercial	4,848	5.4%	8,209	9.2%
Industrial	7,490	8.4%	10,551	11.8%
Mixed Use	2,468	2.8%	3,263	3.6%
Office	1,094	1.2%	1,869	2.1%
Open Space / Recreation	23,479	26.2%	8,225	9.2%
Public / Private Institutions	5,179	5.8%	8,194	9.2%
Transportation / Parking	5,573	6.2%	7,143	8.0%
Vacant	9,831	11.0%	0	0.0%
Total	**89,530**	**100.0%**	**89,530**	**100.0%**

Source: MAG, 2007c, 2007d.

Those locations within the Southeast Corridor that have the potential to generate ridership based on land use have been identified as activity centers. Activity centers in the Southeast Corridor include:

- Downtown Phoenix;
- Arizona State University;
- Downtown Tempe;
- East Valley Institute of Technology;
- Downtown Mesa;
- Downtown Gilbert;
- San Tan Regional Mall;
- Arizona State University Polytechnic Campus;
- Phoenix-Mesa Gateway Airport; and
- Downtown Queen Creek.

Additional activity centers specific to the Southeast Corridor that relate to potential station locations have been identified in Appendix C: System Study Station Target Area Evaluation.

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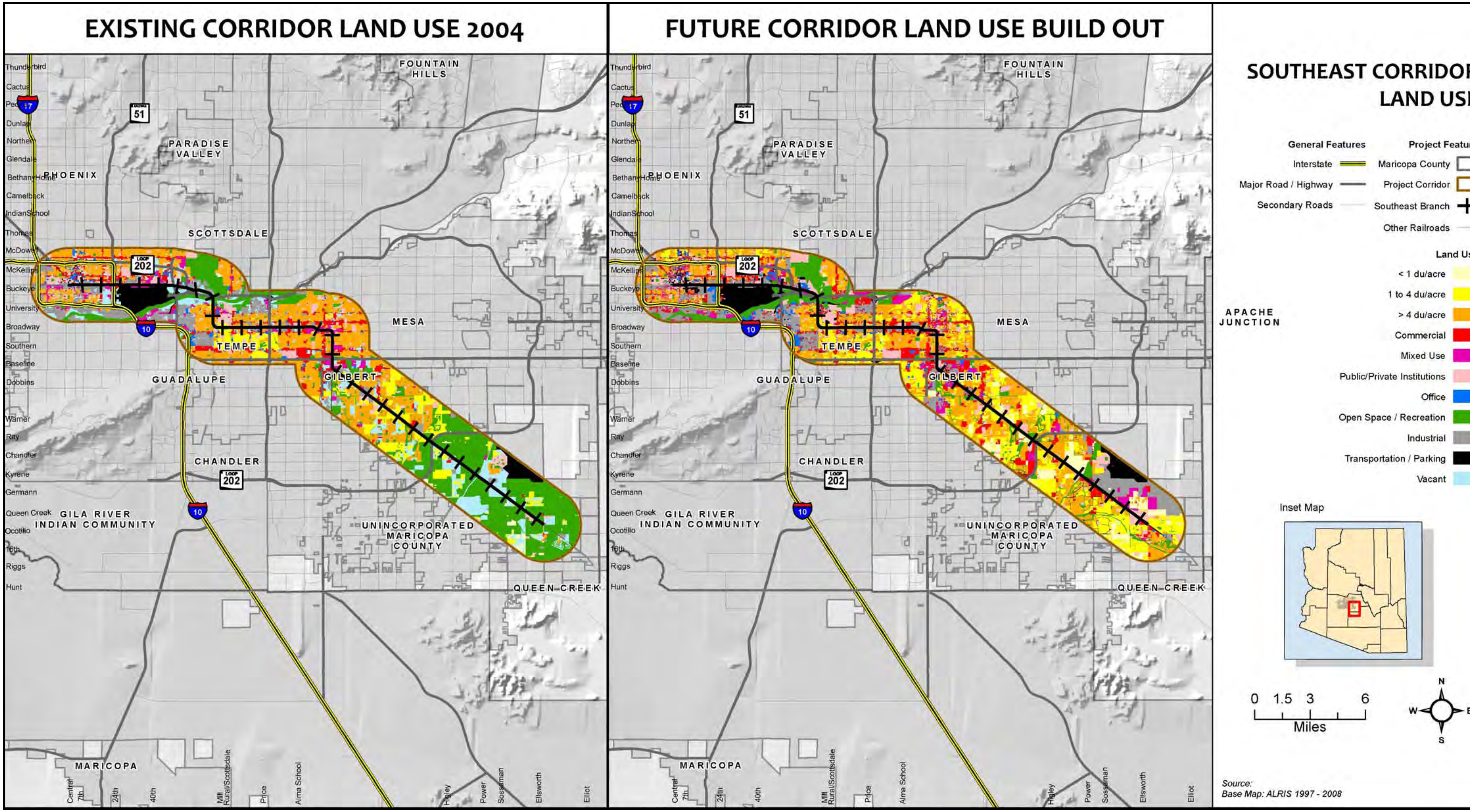
Figure 2-10: Southeast Corridor – Land Use



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2.5.3 Railroad Characteristics

The Southeast Corridor stretches approximately 36 miles from Phoenix Union Station to downtown Queen Creek, and is considered part of the UPRR Phoenix Line route used by all UPRR trains operating to or from the Phoenix area. The Southeast Corridor proposed end-of-line is located at the intersection of Rittenhouse Road and Ellsworth Road in Queen Creek (milepost 941.6). From January 2009 to spring 2010, Union Pacific installed new railroad ties and continuous welded rail (CWR) between downtown Phoenix and Queen Creek. Welded rail was also installed on 1912-era Southern Pacific Salt River-Tempe Town Lake Bridge.

Proposed end-of-line in Queen Creek, Arizona
Source: MAG.

The Southeast Corridor section of the UPRR Mainline is single track, with four sidings located throughout the corridor. The Southeast Corridor is controlled by DTC and ABS and has a maximum operating speed of 60 mph for passenger trains and 40 mph for freight trains. The railroad right-of-way is generally 100 feet in width, but varies throughout the corridor. The right-of-way width is approximately 200 feet in Gilbert, Queen Creek and Pinal County and larger where sidings are located.

Currently, there are 45 public crossings, nine private crossings, 14 bridges, and 20 overpasses and underpasses between Union Station and the proposed end-of-line in Queen Creek. There is also one pedestrian crossing located at 10th Avenue. There is one existing Quiet Zone located in the Southeast Corridor. The downtown Phoenix Quiet Zone (3rd Avenue to 4th Street) was activated in fall 2009.

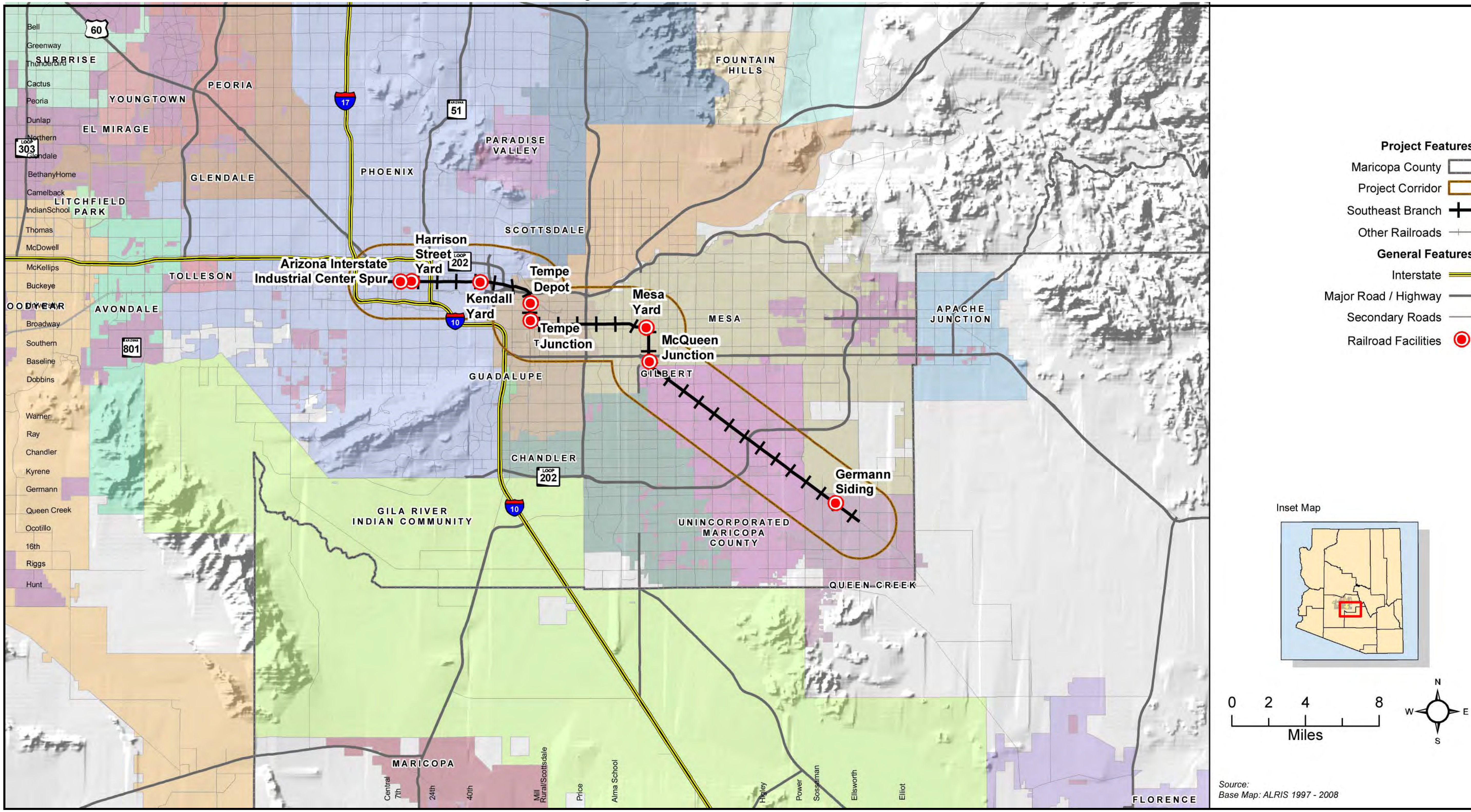
Several major railroad facilities located throughout the Southeast Corridor are shown in Figure 2-11 and include:

- **Arizona Interstate Industrial Center Spur** (MP 906.5);
- **Harrison Street Yard** (MP 907.0)
- **Kendall Yard** (MP 911.1);
- **Tempe Depot** (MP 914.3);
- **Tempe Junction** (MP 915.3);
- **Mesa Yard** (MP 921.8);
- **McQueen Junction** (MP 921.8); and
- **Germann Siding** (MP 936.2).

Union Pacific is continuing to make improvements throughout the corridor and to-date has added three additional tracks and a trans-load track to the Harrison Street Yard (MP 907.0) and has made improvements to the Phoenix Auto Facility located adjacent to the Harrison Street Yard. These railroad infrastructure improvements would allow for enhanced freight service as well as facilitate needed improvements should potential commuter rail service be implemented.

For a more detailed description of Southeast Corridor railroad conditions and existing and planned facilities, see Appendix E: Systems Study Railroad Conditions and Issues.

Figure 2-11: Southeast Corridor – Railroad Facilities



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2.5.4 Highway Characteristics

The Southeast Corridor offers many travel options connecting into downtown Phoenix. This evaluation identifies the primary travel path for commuters traveling between downtown Queen Creek and downtown Phoenix as following Ellsworth Road north to the northbound SR 202 via Elliot Road, exit SR 202 at US 60 westbound continuing on to I-10 westbound eventually ending in downtown Phoenix via the 7th Street exit from I-17. Currently, the number of lanes for this travel path varies from six to ten general use lanes in addition to HOV lanes located on portions of US 60 and I-10.

Future highway improvements for the Southeast Corridor travel path identified as part of the RTP 2007 Update include the construction of new general purpose lanes, a collector/distributer system along I-10, new HOV lanes, and other new corridor capacity improvements. In 2028 the number of highway travel lanes along this path will range from eight to 20 general purpose lanes, in addition to an HOV lane throughout the entire route.

2.5.4.1 Travel Characteristics: Travel Time, Volume and Congestion

The primary travel path connecting downtown Phoenix to the end of the Southeast Corridor in Queen Creek utilizes multiple valley freeways including: SR 202, US 60, I-10, and I-17. For the purpose of this analysis, the intersection of Washington Street and Central Avenue in downtown Phoenix and the intersection of Ellsworth Road and Rittenhouse Road in downtown Queen Creek were used as end points to measure travel characteristics. This travel path consists of 36 miles broken into two segments in order to compare results on both ends of the corridor. Table 2-17 compares AM peak period travel characteristics for the Southeast Corridor in 2007 and 2030.

Table 2-17: Southeast Corridor AM Peak Period Travel Characteristics (2007 – 2030)

2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Ellsworth Rd/ Rittenhouse Rd to SR 101/US60	23 miles	46 minutes	1 – 5	2,200 – 29,300 vehicles
Segment #2: SR 101/US 60 to Downtown Phoenix	13 miles	29 minutes	2 – 6	1,500 – 31,900 vehicles
Total Trip	**36 miles**	**75 minutes**	**-**	**1,500 – 31,900 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Ellsworth Rd/ Rittenhouse Rd to SR 101/US60	23 miles	70 minutes	1 – 5	1,800 – 33,700 vehicles
Segment #2: SR 101/US 60 to Downtown Phoenix	13 miles	32 minutes	2 – 10	1,700 – 48,500 vehicles
Total Trip	**36 miles**	**102 minutes**	**-**	**1,700 – 48,500 vehicles**

Source: MAG, 2009a, 2009b.

Between 2007 and 2030, travel characteristics in the AM peak travel period are expected to significantly change. Between the intersection of Ellsworth Road and Rittenhouse Road and the intersection of SR 101 and US 60, traffic volume is expected to increase and as a result travel time in this segment will increase by 24 minutes. While the overall traffic volume is also expected to increase between SR 101 and downtown Phoenix, the total trip time is projected to increase only three minutes. The insignificant change in travel time can be attributed to future programmed improvements along sections of I-10 which will increase the total number of general use lanes to ten in some areas.

Similar to the AM peak period travel characteristics, PM peak period travel time, volume, and congestion levels were analyzed. Table 2-18 shows the comparison between 2007 and 2030 PM peak period travel characteristics in the Southeast Corridor.

Table 2-18: Southeast Corridor PM Peak Period Travel Characteristics (2007 – 2030)

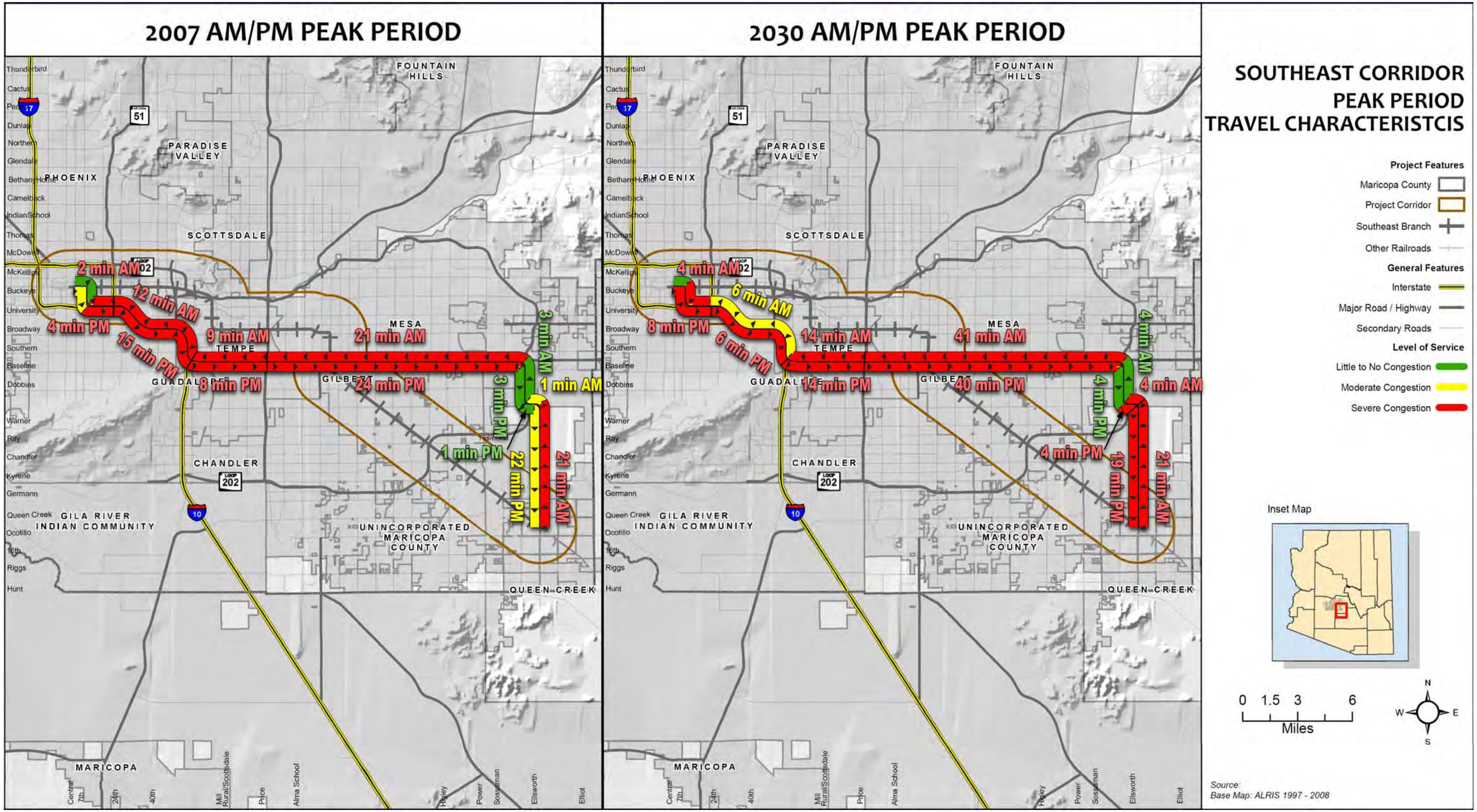
2007 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to SR 101/US 60	13 miles	31 minutes	2 – 5	1,100 – 31,600 vehicles
Segment #2: SR 101/US 60 to Ellsworth Rd/ Rittenhouse Rd	23 miles	50 minutes	1 – 6	1,400 – 31,400 vehicles
Total Trip	**36 miles**	**81 minutes**	**-**	**1,100 – 31,600 vehicles**
2030 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to SR 101/US 60	13 miles	34 minutes	2 – 10	1,800 – 51,500 vehicles
Segment #2: SR 101/US 60 to Ellsworth Rd/ Rittenhouse Rd	23 miles	67 minutes	1 – 6	2,000 – 34,100 vehicles
Total Trip	**36 miles**	**101 minutes**	**-**	**1,800 – 51,500 vehicles**

Source: MAG, 2009a, 2009b.

The 2007 travel time between downtown Phoenix and SR 101 in the PM peak period was 31 minutes. Given planned infrastructure improvements throughout this segment of the corridor, the travel time is projected to only slightly increase in the future. Conversely, travel between SR 101 and Queen Creek took 50 minutes in 2007 and is expected to increase to 67 minutes by 2030. This anticipated increase in travel time can be attributed to the overall increase in traffic volume throughout the corridor. PM peak period traffic volumes between downtown Phoenix and SR 101 will increase approximately 39 percent by 2030.

The level of congestion throughout the Southeast Corridor is expected to both improve and in some segments worsen. In 2007, the segment of the corridor between downtown Phoenix and SR 101 shows severe congestion levels in both the AM and PM peak periods. The AM peak period is projected to improve to moderate congestions levels by 2030. On the other hand, the level of congestion in the section of the corridor between downtown Queen Creek and SR 202 is expected to decrease from moderate to severe by 2030. Figure 2-12 shows the travel path within the Southeast Corridor as well as the level of congestion and travel time in both the AM and PM peak period in 2007 and 2030. Note that levels of congestion within downtown Phoenix are shown, but actual travel times for this area are not shown in this figure.

Figure 2-12: Southeast Corridor – Peak Period Travel Characteristics



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2.5.5 Transit Service

Transit services provided or planned for future implementation in the Southeast Corridor include:

- Fixed Route Bus;
- High Capacity Transit; and
- Transit Passenger Facilities.

Figure 2-13 graphically depicts both the existing and planned transit services offered within the Southeast Corridor.

2.5.5.1 Fixed Route Bus Service

Fixed route bus service within the Southeast Corridor is comprised of local bus, circulators, and express bus service. Currently, there are no regional connectors operating within the limits of this corridor.

2.5.5.1.1 Local Bus

Within the Southeast Corridor, all local routes provide service seven days a week, with the exception of Routes 104, 120, 128, and 136 which provide service Monday through Saturday, and Route 112 which only provides service Monday through Friday. In total, there are currently 39 local bus routes serving the entire Southeast Corridor. Typical service operates between 5:00 AM and 11:00 PM on weekdays and between 6:00 AM and 9:30 PM on weekends. Most local routes within this corridor operate at a peak frequency of 30 minutes or better.

The RTP identifies a total of 25 Supergrid routes that have either been recently implemented or are planned for implementation within the Southeast Corridor by 2030.

2.5.5.1.2 Circulators

Currently, ten circulator routes operate with the Southeast Corridor serving parts of Mesa, Tempe, and downtown Phoenix. No additional circulators operate within this corridor outside of those that operate within the Chandler Corridor as well. Circulator service operated within portions of this corridor includes:

- **DASH** in Phoenix;
- **FLASH** at Arizona State University;
- **Orbit** in Tempe; and the
- **BUZZ** in Mesa.

For a more detailed description of these circulators, see the description provided for the Chandler Corridor fixed route bus service in Section 2.7.5.12.

2.5.5.1.3 Regional Connectors

There are no regional connectors currently operating within the limits of the Southeast Corridor.

2.5.5.1.4 BRT/Express Bus

Within the Southeast Corridor, express bus service operates five days a week Monday through Friday. Currently, there are eight express routes within the Southeast Corridor that connect East

Valley cities to either downtown Phoenix or downtown Tempe. Of these routes, the 531, 533, and 541 provide the most similar type of service as would future commuter rail. There is no express service operating south of Elliott Road within the Southeast Corridor.

The RTP identifies nine new express bus routes within the corridor that will provide service between East Valley cities and downtown Phoenix or downtown Tempe. Of these routes, only the Santan Express will provide service comparable to that of potential commuter rail service in the Southeast Corridor. The Santan Express will connect Phoenix-Mesa Gateway Airport/ASU Polytechnic Campus located in Mesa with the State Capitol in downtown Phoenix via SR 202. The other nine routes serve the corridor in some capacity and could potentially be utilized to complement commuter rail service.

There is one arterial BRT route currently operating within the Southeast Corridor, the METRO LINK, operating along Main Street in Mesa. METRO LINK provides service between the Superstition Springs Mall near Power Road and US 60 in Mesa and the existing terminus of the CP/EV LRT line in Mesa. Within the Southeast Corridor, two future arterial BRT routes are programmed through the RTP 2007 Update. One along Chandler Blvd/Williams Field Road will provide a connection into the Arizona State Polytechnic campus at the intersection of Power Road and Williams Field Road in Mesa. The other bisects the corridor along Scottsdale/Rural Road connecting the cities of Tempe and Scottsdale.

2.5.5.2 High Capacity Transit

Currently, the only HCT service located in the Southeast Corridor is the CP/EV LRT line that extends between Mesa and downtown Phoenix. However, the RTP identifies two extensions of the CP/EV Starter Line within this corridor. One is a 2.7 mile extension along Main Street in Mesa that would extend HCT service along the existing METRO LINK route currently in service. In addition, a 2.0 mile extension centered along Rural Road to the south is also planned.

2.5.5.3 Transit Passenger Facilities

Transit facilities located within the Southeast Corridor include both transit centers and park-and-ride facilities.

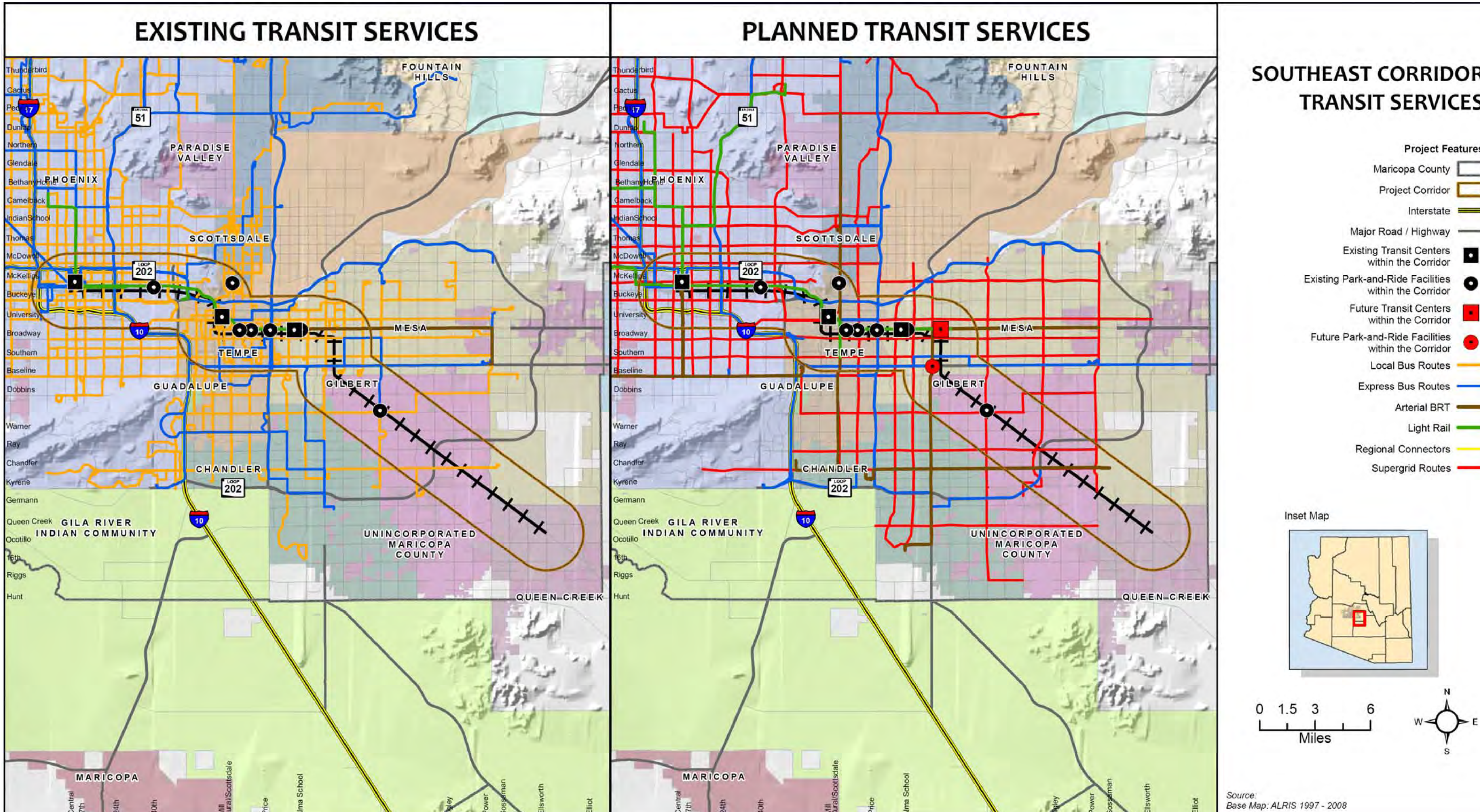
2.5.5.3.1 Transit Centers

Three existing transit centers are located in the Southeast Corridor. These include Central Station located in downtown Phoenix, the Tempe Transit Center located near ASU in downtown Tempe, and the Main Street/Sycamore Street Transit Center located at the end of the CP/EV LRT line in Mesa. In addition a Downtown Mesa transit center is planned by 2030. Figure 2-13 shows both existing and future transit centers within the Southeast Corridor.

2.5.5.3.2 Park-and-Ride Facilities

There are a total of seven existing park-and-ride facilities in the Southeast Corridor that provide transit riders with access to local bus service, circulators, or express bus routes. By 2030, one additional park-and-ride facility will be in operation. Figure 2-13 identifies both existing and future facilities.

Figure 2-13: Southeast Corridor – Transit Services



Source:
Base Map: ALRIS 1997 - 2008

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2.5.6 Travel Patterns

Home-based work trips originating within the Southeast Corridor were analyzed for 2007 and 2030. The purpose of this analysis was to understand the destinations of HBW trips that originated within the corridor. Destinations that were identified as part of this analysis include:

- Within the Southeast Corridor;
- Within the area of the System Study; and
- Outside the limits of the System Study.

An analysis of HBW trips showed that in 2007, just over 218,000 total trips originated within the Southeast Corridor, with 59 percent of these trips destined for areas within the limits of the corridor. Of the remaining trips, 15 percent were destined to other locations within the limits of the System Study, and 26 percent were destined to locations outside the planning area of the System Study. In 2030, the number of HBW trips originating in the Southeast Corridor increased by 34 percent to just over 293,000 total trips. A comparison of HBW trips between 2007 and 2030 shows that the percentage of HBW trips traveling to one of the three analyzed areas stayed relatively the same. The total number of trips originating within the Southeast Corridor for 2007 and 2030 are identified in Table 2-19.

Table 2-19: Home-Based Work Trips Originating within the Southeast Corridor

Destination Area	2007		2030	
	HBW Trips	Percent	HBW Trips	Percent
Within Southeast Corridor	129,253	59%	163,503	56%
Within the System Study	32,773	15%	44,193	15%
Outside the System Study	56,183	26%	85,393	29%
Total	**218,209**	**100%**	**293,089**	**100%**

Source: MAG, 2009a, 2009b.

2.5.7 Summary

The Southeast Corridor is expected to experience significant changes in its demographic makeup between 2007 and 2030. During this time the corridor is expected to experience a 32 percent increase in population and a 39 percent increase in employment. The majority of the change expected to occur will take place southeast of SR 202. Coinciding with population and employment growth, the change in land use is anticipated to largely be an increase in residential development, the majority of which will be located southeast of SR 202. In addition, there are significant railroad facilities along the Southeast Corridor that will impact future development of commuter rail in the corridor, including yards, junctions, and spurs.

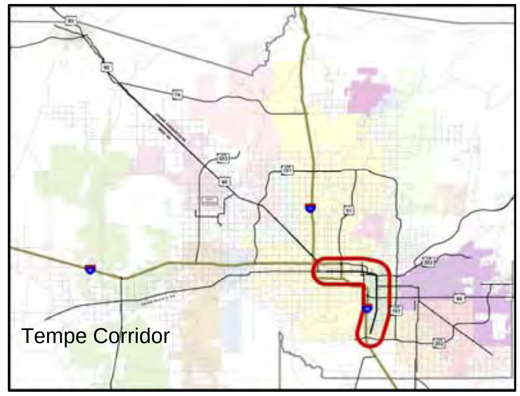
The primary travel path from the easternmost portion of the corridor into downtown Phoenix is along US 60 and I-10. Despite significant expansion planned by 2030, congestion along this route is expected to increase. As a result future travel times into downtown Phoenix are expected to increase as well. This change in travel time takes into account all programmed improvements within the corridor.

Transit services within the corridor are located primarily within the Phoenix, Tempe, and Mesa areas, while the sections of Gilbert have more limited transit services available. The implementation of Supergrid routes will increase transit services in the future, but these conditions are expected to remain similar through 2030.

Travel patterns within the corridor are largely expected to remain similar as well. Of those HBW trips originating within the corridor, there is an expected decrease in the total number of trips remaining within the limits of the Southeast Corridor between 2007 and 2030.

2.6 Tempe Corridor

The 17-mile Tempe Corridor has been defined by a two-mile radius surrounding the UPRR line between Union Station in downtown Phoenix and Chandler Boulevard in West Chandler, just south of the Tempe city limits. The cities, towns, and Indian Communities that fall within this area include:



- City of Phoenix;
- City of Scottsdale;
- City of Tempe;
- Town of Guadalupe;
- City of Chandler; and the
- Gila River Indian Community.

2.6.1 Demographics

The Tempe Corridor had a total population of approximately 416,000 in 2007 and will experience a 24 percent increase in population to approximately 518,000 people by 2030. The municipalities expected to experience the most significant population growth within the corridor during this period are the City of Phoenix, with a 33 percent increase, and the City of Tempe, with a 16 percent increase. During this same period, the population of the Gila River Indian Community within the corridor will double, although the population is expected to remain under 100 people.

The Tempe Corridor is also expected to experience an increase in employment from approximately 468,000 jobs in 2007 to approximately 614,000 jobs in 2030, resulting in an increase of 31 percent. The City of Chandler is expected to experience the greatest employment growth with a 41 percent increase within the corridor, while the City of Phoenix will experience the next largest gain with a 32 percent increase within the corridor. During this same period, the area of the corridor occupied by the Gila River Indian Community is expected to see at 165 percent increase in employment to just fewer than 11,000 jobs.

Table 2-20 and Table 2-21 show the existing and forecasted population and employment within the Tempe corridor.

Table 2-20: Tempe Corridor Population Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change
City of Phoenix	230,072	307,040	33%
City of Scottsdale	11,473	11,893	4%
City of Tempe	141,673	165,034	16%
Town of Guadalupe	5,665	5,983	6%
City of Chandler	26,909	27,442	2%
Gila River Indian Community	28	84	200%
Total	**415,820**	**517,476**	**24%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

Table 2-21: Tempe Corridor Employment Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change
City of Phoenix	272,976	361,343	32%
City of Scottsdale	5,275	5,670	7%
City of Tempe	158,851	198,716	25%
Town of Guadalupe	1,195	1,481	24%
City of Chandler	25,781	36,342	41%
Gila River Indian Community	4,061	10,778	165%
Total	**467,869**	**614,330**	**31%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

2.6.2 Land Use

The Tempe Corridor is comprised of a variety of land uses across multiple jurisdictions as shown in Figure 2-14. Table 2-22 summarizes existing land uses as of the year 2004 as well as future land use at build-out distinguished by land use category within the Tempe corridor. The most predominant existing land use is residential, accounting for 34 percent of the total corridor. Other significant uses include industrial, which comprise 14.8 percent of the corridor, and vacant land, which comprises 12.5 percent of the corridor. Overall, the distribution of future land uses within the corridor is expected to remain relatively unchanged. At build-out, residential land uses will continue to be the predominant land use, comprising approximately 35 percent of the total corridor. Industrial uses will continue to make up the next largest land use, with 16.4 percent of the total corridor.

Table 2-22: Tempe Corridor Existing and Future Land Use

Land Use Category	Existing Land Use (2004)		Future Land Use (Build-out)	
	Acres	Percent of Total	Acres	Percent of Total
Residential (<1 du/acre)	72	0.1%	468	0.9%
Residential (1 – 4 du/acre)	2,894	5.6%	5,832	11.3%
Residential (>4 du/acre)	14,521	28.2%	11,927	23.2%
Commercial	3,733	7.2%	4,974	9.7%
Industrial	7,635	14.8%	8,461	16.4%
Mixed Use	1,760	3.4%	1,710	3.3%
Office	995	1.9%	1,864	3.6%
Open Space / Recreation	6,150	11.9%	6,179	12.0%
Public / Private Institutions	3,178	6.2%	4,934	9.6%
Transportation / Parking	4,139	8.0%	5,165	10.0%
Vacant	6,437	12.5%	0	0.0%
Total	**51,514**	**100.0%**	51,514	**100.0%**

Source: MAG, 2007c, 2007d.

Those locations within the Tempe Corridor that have the potential to generate ridership based on land use have been identified as activity centers. Activity centers specific to the Tempe Corridor include:

- Downtown Phoenix;
- Arizona Station University;
- Downtown Tempe;
- Tempe St. Luke's Hospital; and
- University of Phoenix.

Additional activity centers located throughout this corridor and the relationship they have with potential station locations have been identified in Appendix C: System Study Station Target Area Evaluation.

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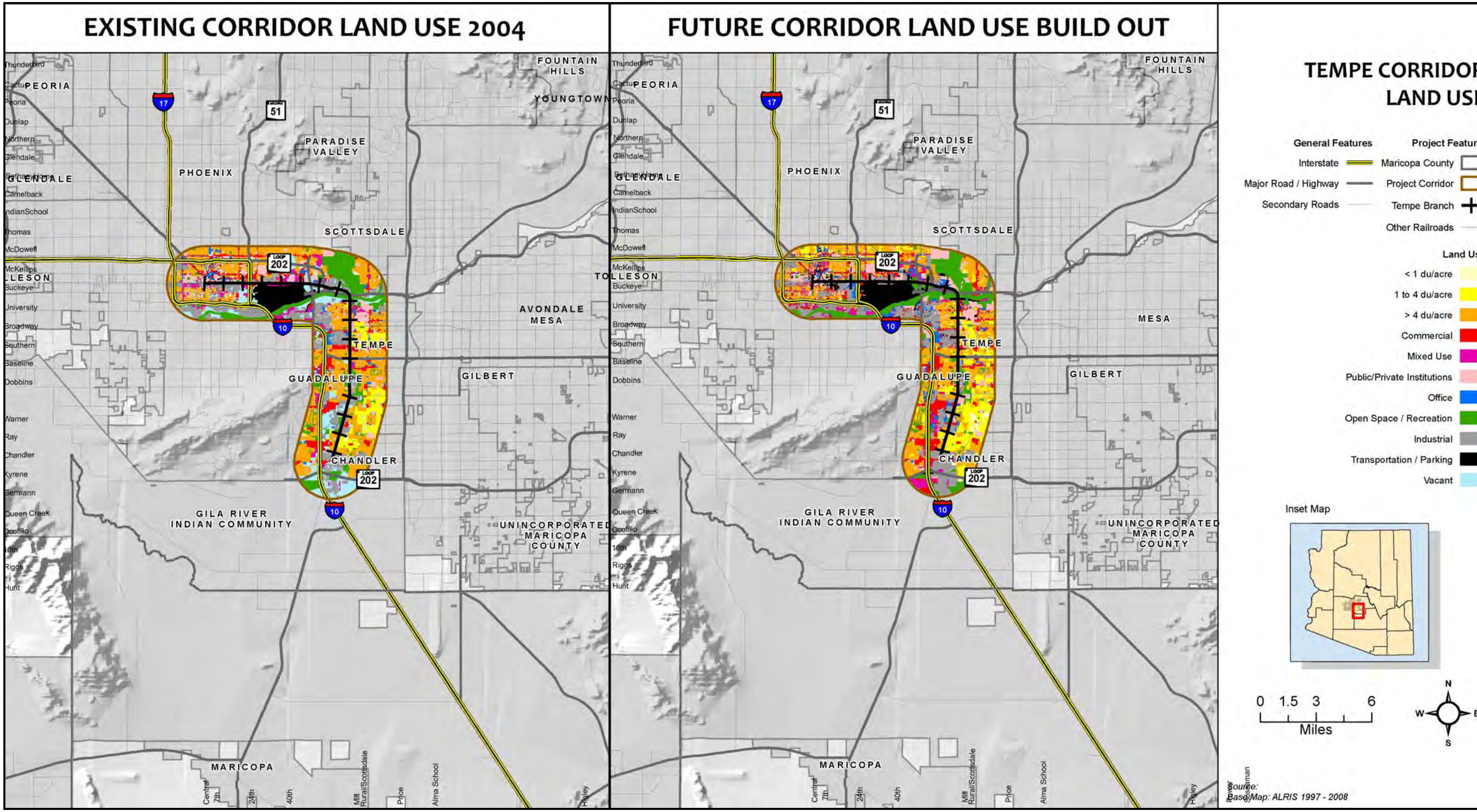
Figure 2-14: Tempe Corridor – Land Use



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2.6.3 Railroad Characteristics


Tempe Junction, southward view towards 13th Street in Tempe, Arizona
Source: MAG.

The Tempe Corridor stretches 17 miles along the UPRR line from Phoenix Union Station to Chandler Boulevard in West Chandler. This single-track corridor is divided into two segments consisting of 9.3 miles between Union Station and the Tempe Junction and another 7.7 miles extending to the suggested end–of-line at the intersection of Chandler Blvd and 56th Street. The section of the corridor between Tempe Junction and West Chandler is also referred to as the Tempe Branch or the Tempe Industrial Lead. It should be noted that commuter rail service could operate along the Tempe Branch without connecting to the UPRR mainline. This scenario is described further in Section 4.3.2. From January 2009 to spring 2010, Union Pacific installed new railroad ties and continuous welded rail (CWR) between downtown Phoenix and Tempe Junction. Welded rail was also installed on 1912-era Southern Pacific Salt River-Tempe Town Lake Bridge.

The section of the corridor between downtown Phoenix and Tempe Junction currently includes 18 public crossings, six private crossing, three bridges and 12 overpasses or underpasses.

Approximately 10 freight customers are located along the Tempe Branch section of the corridor, particularly within the vicinity of Tempe Junction (between mileposts 916 and 917). In addition, an industrial park extends south beyond the Tempe Corridor end-of-line for another 1.5 to 2.0 miles. In Spring 2010, UPRR removed approximately four miles (20,000ft) of industrial and warehouse tracks, spurs and sidings within the Tempe Industrial Park, located west of Milepost 1. This industrial park, located between Alameda and Southern, UPRR Tempe Branch and Priest Drive, was built in the late 60s through the late 1980s to serve a variety of light and heavy industrial businesses.

The Tempe Branch section of the corridor has a maximum operating speed of 20 miles per hour and operations are controlled by Absolute Block Register (ABR) designed to authorize and control train movement along the single track line.

The Tempe Branch section of the corridor includes one railroad bridge across US Highway 60 and seven culverts. In addition, there are a total of 9 at-grade railroad/highway crossings, one at-grade pedestrian crossing, and one highway overpass at SR 202L. Most of the at-grade crossings are equipped with active warning devices consisting of bells, flashers, and gates. There are no existing Quiet Zones located in the Tempe Corridor, however there is an application pending for approval to create Quiet Zones over 10 intersections located throughout the corridor.

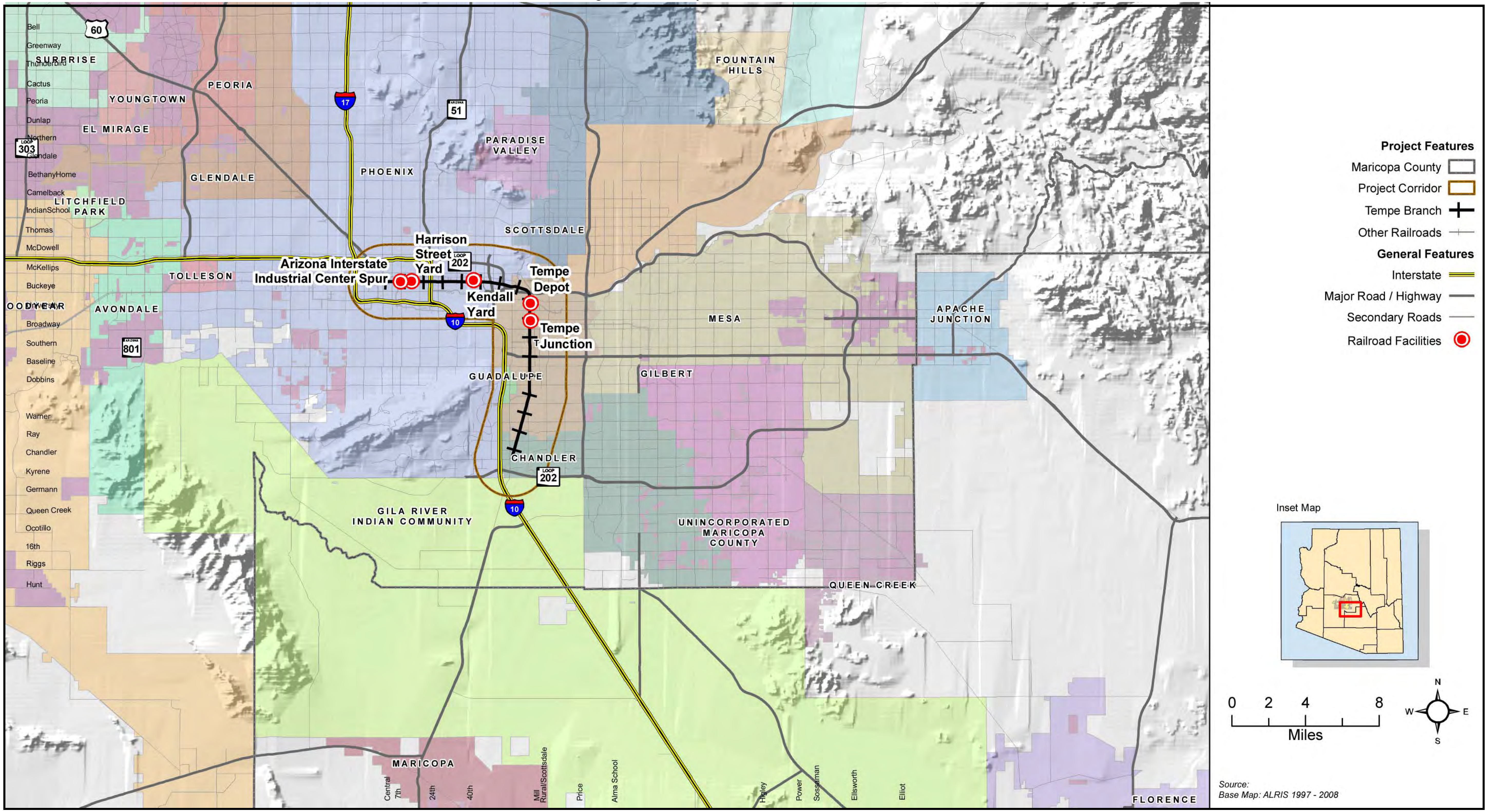
The five major railroad facilities that are located along the Tempe Corridor are shown in Figure 2-15 and include:

- **Arizona Interstate Industrial Center Spur** (MP 906.5);
- **Harrison Street Yard** (MP 907.0);
- **Kendall Yard** (MP 911.1);

- **Tempe Depot** (MP 914.3); and
- **Tempe Junction** (MP 915.3).

At the time of this analysis, no future plans for the Tempe Corridor were available to report. For a more detailed description of Tempe Corridor railroad conditions and existing and planned facilities, see Appendix E: Systems Study Railroad Conditions and Issues.

Figure 2-15: Tempe Corridor – Railroad Facilities



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2.6.4 Highway Characteristics

The location of the Tempe Corridor between downtown Phoenix and the proposed end-of-line in West Chandler offers one primary travel path along I-10 for those commuters living at or near the southern edge of Tempe or in West Chandler. Eastbound and westbound I-10 between West Chandler and downtown Phoenix is primarily five and six general use lanes respectively as well as accompanying HOV lanes in both directions. The connection to downtown Phoenix from I-10 would occur at the intersection of I-10 and I-17 where commuters would exit north on I-17 and take the 7th Street exit continuing into downtown.

In an effort to address the current and expected increase in congestion throughout the corridor, MAG has identified multiple roadway improvements for the Tempe Corridor in the RTP 2007 Update. Future improvements for this portion of I-10 and I-17 to include the construction of:

- General purpose lanes;
- Collector/distributer system along I-10 between SR 51 and Baseline Rd;
- Quiet pavement construction; and
- Traffic interchange improvements.

2.6.4.1 Travel Characteristics: Travel Times, Volume and Congestion

The travel path identified to analyze the Tempe Corridor between downtown Phoenix and West Chandler follows an alignment which combines portions of both I-17 and I-10. For the purposes of this analysis, the intersection of Washington Street and Central Avenue in downtown Phoenix and the intersection of Chandler Boulevard and 56th Street in Chandler were used as end points to measure the travel characteristics. The travel path for this corridor totals 15 miles and was broken into two segments in order to compare travel characteristics on both ends of the corridor. Table 2-23 compares travel characteristics for the AM peak period in 2007 and 2030.

Table 2-23: Tempe Corridor AM Peak Period Travel Characteristics (2007 – 2030)

2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Chandler Blvd/56th St to I-10/US 60	6 miles	13 minutes	3 – 4	1,100 – 21,100 vehicles
Segment #2: I-10/US 60 to Downtown Phoenix	9 miles	16 minutes	2 – 6	1,500 – 31,900 vehicles
Total Trip	**15 miles**	**29 minutes**	**-**	**1,100 – 31,900 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Chandler Blvd/56th St to I-10/US 60	6 miles	18 minutes	3 – 4	2,200 – 26,700 vehicles
Segment #2: I-10/US 60 to Downtown Phoenix	9 miles	14 minutes	2 – 10	1,700 – 48,500 vehicles
Total Trip	**15 miles**	**32 minutes**	**-**	**1,700 – 48,500 vehicles**

Source: MAG, 2009a, 2009b.

Between 2007 and 2030, travel characteristics in the AM peak travel period are expected to only slightly change. Between the intersection of Chandler Boulevard and 56th Street and the intersection of I-10 and US 60, traffic volume is expected to increase by 20 percent and travel time in this segment will increase by five minutes. While the overall traffic volume is also expected to increase between US 60 and downtown Phoenix, the total trip time is projected to decrease by two minutes. This travel time improvement can be attributed to future programmed improvements along I-10 which will increase the total number of general purpose lanes to ten in some areas.

Similar to the AM peak period travel characteristics, PM peak period travel time, volume, and congestion levels were analyzed. Table 2-24 shows the comparison between 2007 and 2030 PM peak period travel characteristics in the Tempe Corridor.

Table 2-24: Tempe Corridor PM Peak Period Travel Characteristics (2007 – 2030)

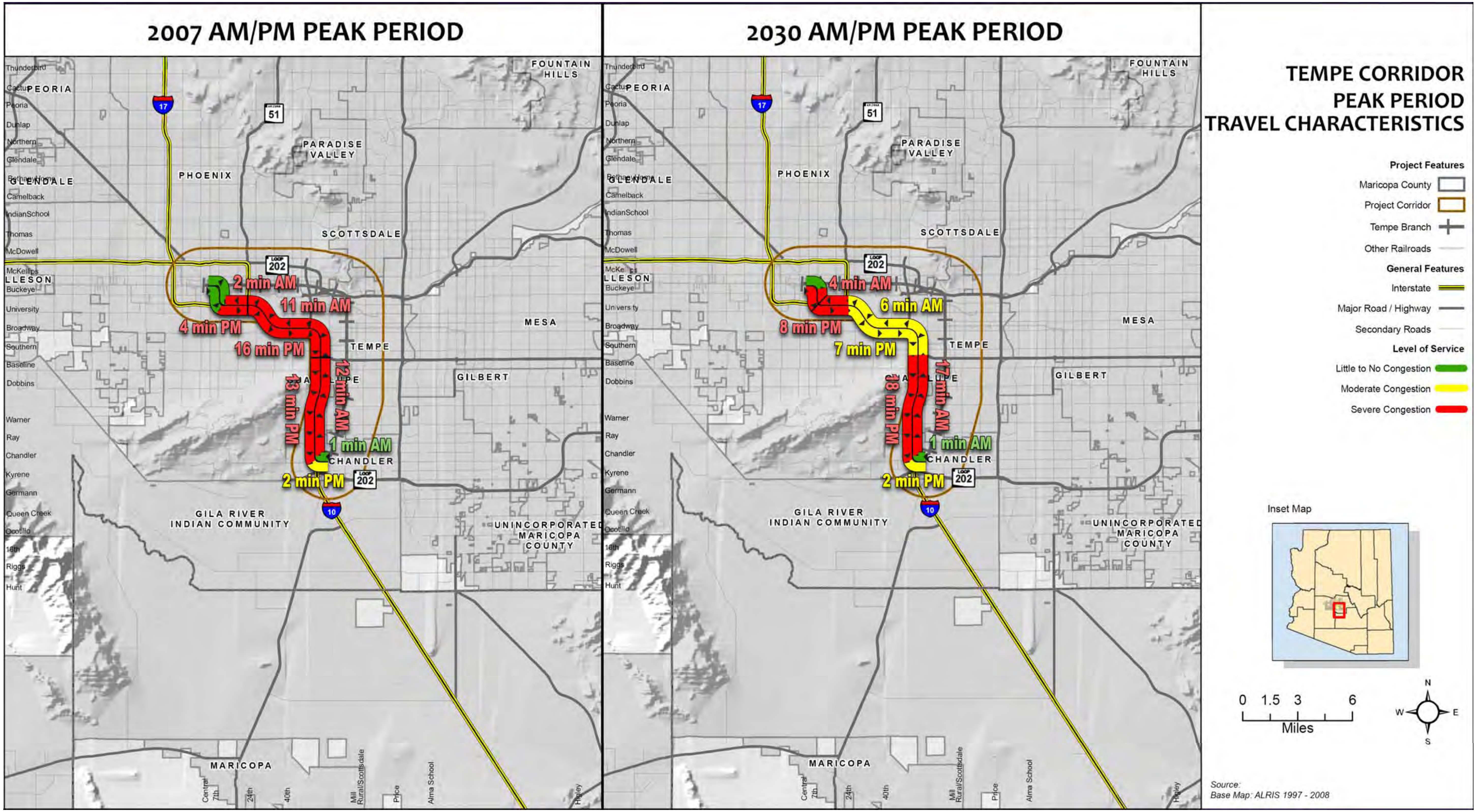
2007 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to I-10/US 60	9 miles	24 minutes	2 – 5	1,100 – 31,600 vehicles
Segment #2: I-10/US 60 to Chandler Blvd/56th St	6 miles	15 minutes	3 – 4	2,200 – 23,100 vehicles
Total Trip	**15 miles**	**39 minutes**	**-**	**1,100 – 31,600 vehicles**
2030 PM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to I-10/US 60	9 miles	21 minutes	4 – 10	1,800 – 51,500 vehicles
Segment #2: I-10/US 60 to Chandler Blvd/56th St	6 miles	20 minutes	3 – 4	3,700 – 28,200 vehicles
Total Trip	**15 miles**	**41 minutes**	**-**	**1,800 – 51,500 vehicles**

Source: MAG, 2009a, 2009b.

The 2007 travel time between downtown Phoenix and US 60 in the PM peak period was 24 minutes. Given planned infrastructure improvements throughout this segment of the corridor, the travel time is expected to slightly improve by 2030 with a decrease of 3 minutes. Conversely, travel between US 60 and West Chandler took 15 minutes in 2007 and is expected to increase to 20 minutes by 2030. This anticipated increase in travel time can be attributed to the increase traffic volume on this segment of the corridor. PM peak travel volumes between downtown Phoenix and US 60 will increase almost 40 percent by 2030.

The level of congestion throughout the Tempe Corridor is expected to improve throughout portions of the corridor in the future. In 2007, the segment of the corridor between downtown Phoenix and US 60 shows severe congestion levels in both the AM and PM peak periods. Those levels are both expected to decrease to moderate congestions levels by 2030. Figure 2-16 shows the travel path within the Tempe Corridor as well as the level of congestion and travel time in both the AM and PM peak period in 2007 and 2030. Note that levels of congestion within downtown Phoenix are shown, but actual travel times for this area are not shown in this figure.

Figure 2-16: Tempe Corridor – Peak Period Travel Characteristics



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2.6.5 Transit Service

Transit services provided or planned for future implementation in the Tempe Corridor include:

- Fixed Route Bus;
- High Capacity Transit; and
- Transit Passenger Facilities.

Figure 2-17 graphically represents both the existing and planned regional transit network within the Tempe Corridor.

2.6.5.1 Fixed Route Bus Service

Currently, fixed route bus service within the Tempe Corridor is comprised of local bus, circulators, regional connectors, and express bus service.

2.6.5.1.1 Local Bus

Within the Tempe Corridor, local bus service is provided seven days a week, operating a total of 35 routes that serve the corridor is some capacity. Local routes operate on weekdays between 5:00 AM and 11:00 PM and between 6:00 AM and 9:30 PM on the weekends. Most of the local routes operating within the Tempe Corridor operate at a peak frequency of 30 minutes or better.

The RTP identifies a total of 19 Supergrid routes that have either been recently implemented or are planned for implementation within the Tempe Corridor by 2030. Once implemented, Supergrid routes will operate in place of existing local routes within the regional network.

2.6.5.1.2 Circulators

Currently, parts of four circulator systems operate 10 routes within the Tempe Corridor, serving portions of both of the City of Phoenix and the City of Tempe. These systems include the:

- **DASH** in City of Phoenix;
- **ALEX** in City of Phoenix;
- **FLASH** at Arizona State University; and the
- **Orbit** in the City of Tempe.

These systems provide circulating transit service and operate seven days a week, with the exception of the DASH in downtown Phoenix which operates Monday through Friday.

2.6.5.1.3 Regional Connectors

One regional connector operates within the Tempe Corridor. The Maricopa Xpress (MAX) is operated by an independent contractor through the City of Maricopa. The MAX service operates two separate routes that connect to both downtown Phoenix and downtown Tempe via I-10 providing peak period service Monday through Friday only.

2.6.5.1.4 BRT/Express Bus

Within the Tempe Corridor, express bus service operates five days a week Monday through Friday. Currently, there are 10 express routes that provide service between east valley cities and downtown Phoenix. Of those routes, the 540 and the I-10 East RAPID, provide connections between downtown Phoenix and the Tempe Corridor end-of-line in West Chandler.

These routes provide similar service to that expected from a commuter rail system in this corridor.

The RTP identifies seven new express bus routes between the East Valley cities and downtown Phoenix. Two of these planned routes, the Santan Express and the Ahwatukee Express, provide connections between downtown Phoenix and the Tempe Corridor end-of-line in West Chandler. The Santan Express will connect Phoenix-Mesa Gateway Airport/ASU Polytechnic Campus located in Mesa with the State Capitol in downtown Phoenix via SR 202. The Ahwatukee Express will connect the 40th Street/Pecos Park-and-Ride to the Tempe Transit Center in downtown Tempe via I-10 and US 60. These routes will also provide similar service to that expected form a commuter rail system in this corridor.

The RTP has identified a number of arterial BRT routes that will be implemented. Within the Tempe Corridor, BRT routes are planned along Central Avenue in Phoenix, Scottsdale/Rural Road in Tempe and Chandler, and Chandler Boulevard in West Chandler.

2.6.5.2 High Capacity Transit

Currently, the only HCT service located in the Tempe Corridor is the CP/EV LRT line that extends between Mesa and downtown Phoenix. However, studies are currently underway evaluating options to extend the existing HCT network south, from the intersection of Mill Avenue and 3rd Street in Tempe.

2.6.5.3 Transit Passenger Facilities

Transit facilities located within the Tempe Corridor include both transit centers and park-and-ride facilities.

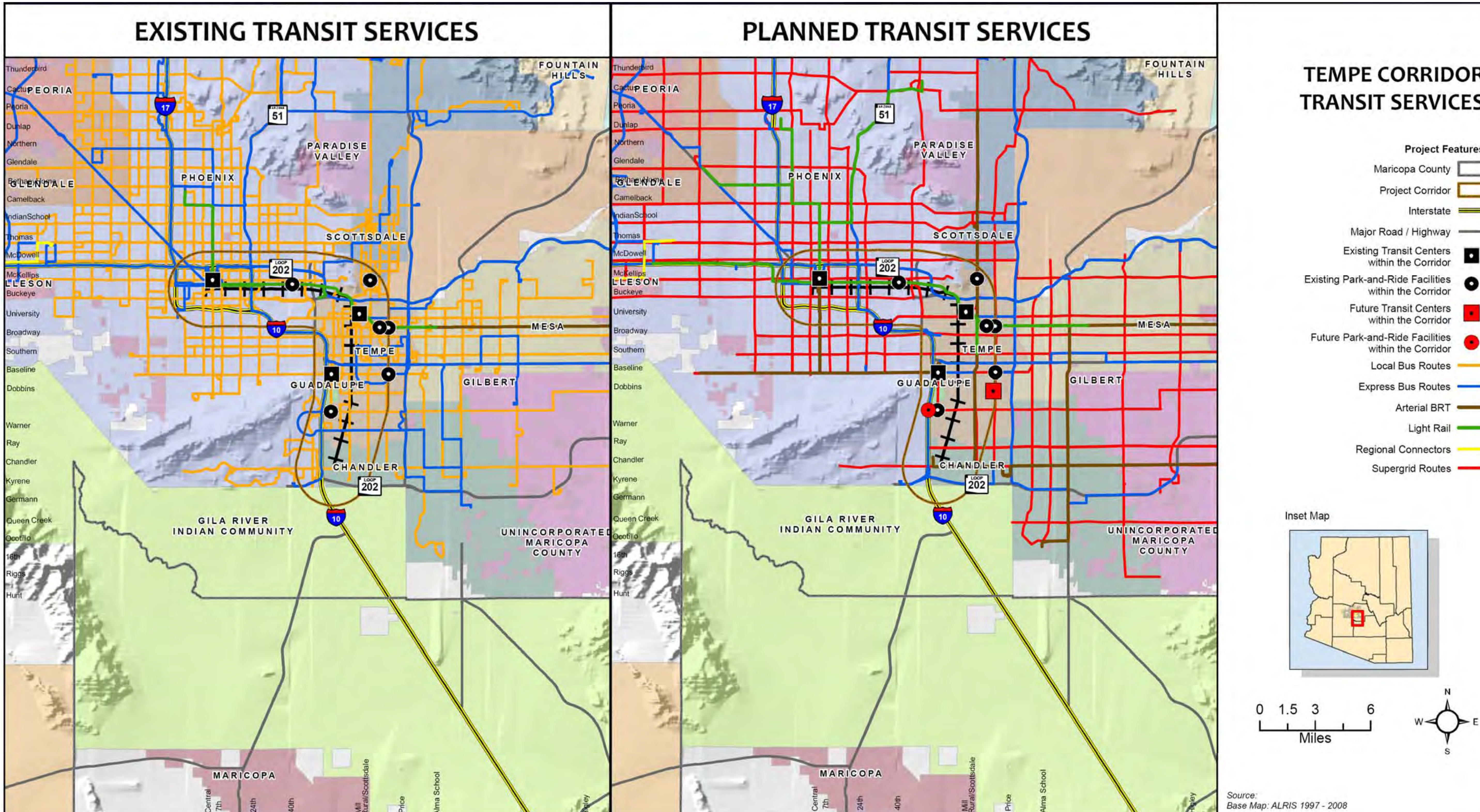
2.6.5.3.1 Transit Centers

Three existing transit centers are located in the Tempe Corridor. These include Central Station located in downtown Phoenix, the Tempe Transit Center located near ASU in downtown Tempe, and the Arizona Mills Transit Center located at Arizona Mills mall near the intersection of Baseline Road and Priest Drive in Tempe. In addition, one transit center to be located in South Tempe is planned within the corridor by 2030. However, this transit center is recommended for possible elimination from TLCP in December 2009, but remains in the RTP through 2031. Figure 2-17 shows both existing and future transit centers within the Tempe Corridor.

2.6.5.3.2 Park-and-Ride Facilities

There are a total of six existing park-and-ride facilities in the Tempe Corridor that provide transit riders with access to local bus service, circulators, or express bus routes. By 2030, one additional park-and-ride facility will be in operation. Figure 2-17 identifies both the existing and planned park-and-rides within the Tempe Corridor.

Figure 2-17: Tempe Corridor – Transit Services



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2.6.6 Travel Patterns

Home-based work trips originating within the Tempe Corridor were analyzed for 2007 and 2030. The purpose of this analysis was to understand the destinations of HBW trips that originated within the Tempe Corridor. Destinations that were identified as part of this analysis include trips:

- Within the Tempe Corridor;
- Within the System Study; and
- Outside the limits of the System Study.

An analysis of HBW trips showed that in 2007, nearly 132,000 trips originated within the Tempe Corridor, with 61 percent of these trips remaining within the corridor. Of the remaining originating trips, 14 percent were destined to other locations within the limits of the System Study, and 25 percent went to locations outside the System Study planning area. In 2030, the number of HBW trips originating in the Tempe Corridor increased by 52 percent to just over 251,000 trips daily. A comparison of HBW trips between 2007 and 2030 shows that the percentage of HBW trips traveling to the three analyzed destination areas remained relatively unchanged. The number of trips originating within the Tempe Corridor for 2007 and 2030 are identified in Table 2-25.

Table 2-25: Home-Based Work Trips Originating within the Tempe Corridor

Destination Area	2007		2030	
	HBW Trips	Percent	HBW Trips	Percent
Within Tempe Corridor	80,054	61%	98,994	59%
Within the System Study	19,019	14%	24,027	14%
Without the System Study	32,460	25%	44,003	26%
Total	**131,533**	**100%**	**167,024**	**100%**

Source: MAG, 2009a; 2009b.

2.6.7 Summary

The Tempe Corridor stretches through largely developed portions of the City of Phoenix, the City of Tempe, and the City of Chandler. These areas are not expected to experience much significant growth in population and employment between 2007 and 2030 as compared to the Grand Avenue and Yuma West Corridors. The Tempe Corridor includes a balanced mix of land uses with residential development making up the largest portion. Similar to the demographic growth in the corridor, land uses are not expected to change significantly in the future and there are very few notable railroad facilities located throughout the Tempe Corridor that will impact future development of commuter rail service.

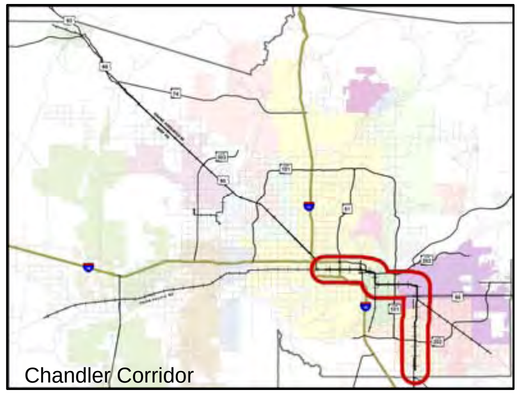
The primary travel path between downtown Phoenix and the proposed Tempe Corridor end-of-line in West Chandler is along I-10. Despite significant expansion planned by 2030, congestion along I-10 is expected to increase. As a result future travel times into downtown Phoenix are expected to increase as well. This change in travel time takes into account all RTP programmed improvements within the corridor.

Transit services are generally spread evenly throughout the corridor and include multiple forms of transit, including high-capacity services. The most concentrated areas of transit services are located in downtown Phoenix and downtown Tempe. Future service will continue this trend as well as provide increased high-capacity transit options.

Travel patterns within the Tempe Corridor are expected to remain similar between 2007 and 2030 although there is an expected decrease in overall trips within the limits of the corridor in 2030.

2.7 Chandler Corridor

The 31-mile Chandler Corridor has been defined by a two-mile radius surrounding the UPRR line between Union Station in downtown Phoenix and Riggs Road in the City of Chandler. The cities, towns, and Indian Communities that fall within this area include:



- City of Phoenix;
- City of Scottsdale;
- City of Tempe;
- City of Mesa;
- Town of Gilbert;
- City of Chandler;
- Gila River Indian Community; and the
- Salt River Pima-Maricopa Indian Community.

2.7.1 Demographics

The Chandler Corridor had a 2007 population of approximately 708,000 people. With an expected 850,000 people by 2030, the Chandler Corridor will experience a 20 percent increase in population from 2007 to 2030. The municipalities that are anticipating the most significant population growth during this time are the City of Phoenix, with a 44 percent increase, and the City of Tempe, with a 21 percent increase in population within the corridor.

The Chandler Corridor is also expected to experience employment growth of approximately 34 percent from 2007 to 2030. Of the municipalities located within the corridor, the City of Chandler is expected to experience the greatest increase in employment with a 66 percent increase within the corridor. Other municipalities expected to experience significant employment growth are the Town of Gilbert and the City of Phoenix with a 38 percent and 33 percent increase within the corridor respectively. Although the total number of jobs is only projected to be just over 7,500 by 2030, it is significant to note that employment in the areas of the Salt River Pima Maricopa Indian Community is expected to grow by 937 percent within the corridor.

Table 2-26 and Table 2-27 identify the existing and forecasted population and employment within the Chandler Corridor.

Table 2-26: Chandler Corridor Population Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	171,530	247,222	44%
City of Scottsdale	11,473	11,893	4%
City of Tempe	114,907	139,164	21%
City of Mesa	186,714	202,397	8%
Town of Gilbert	42,789	44,179	3%
City of Chandler	171,849	195,700	14%
Gila River Indian Community	2,956	4,123	39%
Salt River Pima-Maricopa Indian Community	807	808	0%
Total	**707,595**	**850,261**	**20%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

Table 2-27: Chandler Corridor Employment Change (2007 – 2030)

Jurisdiction*	2007	2030	Percent Change 2007-2030
City of Phoenix	245,734	326,922	33%
City of Scottsdale	5,275	5,670	7%
City of Tempe	131,674	169,871	29%
City of Mesa	98,079	115,728	18%
Town of Gilbert	27,975	38,504	38%
City of Chandler	52,017	86,092	66%
Gila River Indian Community	1,920	2,304	20%
Salt River Pima-Maricopa Indian Community	742	7,691	937%
Total	**564,132**	**753,465**	**34%**

* Includes portions of Municipal Planning Areas located in the Corridor study area.
Source: MAG, 2007e.

2.7.2 Land Use

The Chandler Corridor is comprised of a variety of land uses stretching from downtown Phoenix to the intersection of Arizona Avenue and Riggs Road in Chandler. Table 2-28 summarizes existing land uses as of the year 2004 as well as future land use at build-out distinguished by land use category within the Chandler corridor. In 2004, residential uses were the most prevalent land use, accounting for 39 percent of the total land use in the corridor. Other significant uses are Open Space/Recreation, accounting for approximately 19 percent of the corridor, and industrial uses comprising nine percent of the land uses in the corridor. Future projections reveal similar land use patterns to those found today, with residential uses expected to comprise 46 percent of the total land uses in the corridor.

Table 2-28: Chandler Corridor Existing and Future Land Use

Land Use Category	Existing Land Use (2004)		Future Land Use (Build-out)	
	Acres	Percent of Total	Acres	Percent of Total
Residential (<1 du/acre)	1,041	1.3%	1,562	2.0%
Residential (1 – 4 du/acre)	8,334	10.4%	16,625	20.8%
Residential (>4 du/acre)	21,821	27.2%	18,727	23.4%
Commercial	5,235	6.5%	7,516	9.4%
Industrial	7,508	9.4%	9,436	11.8%
Mixed Use	2,479	3.1%	2,757	3.4%
Office	1,128	1.4%	1,873	2.3%
Open Space / Recreation	15,130	18.9%	8,543	10.7%
Public / Private Institutions	5,235	6.5%	7,119	8.9%
Transportation / Parking	4,761	5.9%	5,927	7.4%
Vacant	7,413	9.3%	0	0.0%
Total	**80,085**	**100.0%**	**80,085**	**100.0%**

Source: MAG, 2007c, 2007d.

Those locations within the Chandler Corridor that have the potential to generate ridership based on land use have been identified as activity centers. Activity centers specific to the Chandler Corridor are:

- Downtown Phoenix;
- Arizona State University;
- Downtown Tempe;
- East Valley Institute of Technology;
- Downtown Mesa; and
- Downtown Chandler.

Additional activity centers and their relationship with potential station locations have been identified within this corridor in Appendix C: System Study Station Target Area Evaluation.

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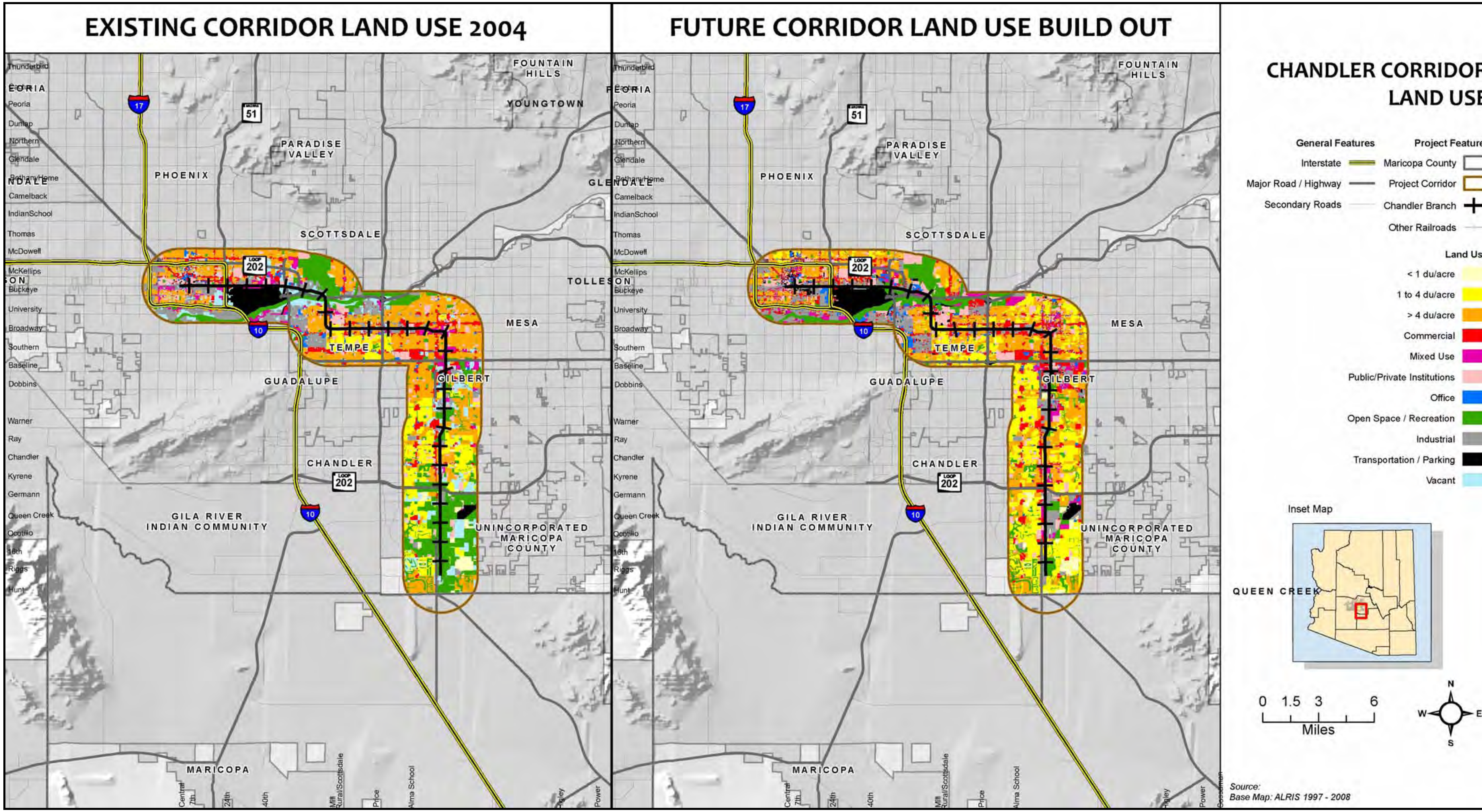
Figure 2-18: Chandler Corridor – Land Use



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2.7.3 Railroad Characteristics

McQueen Junction southbound in Mesa, Arizona
Source: MAG.

The 30.9-mile Chandler Corridor is located along the UPRR line from Phoenix Union Station to Riggs Road in Chandler. This single-track corridor is divided into two separate segments: the 17.6 mile stretch between Union Station in downtown Phoenix and the McQueen Junction located near the intersection of Baseline Road and Center Street in the City of Mesa and the 13.3 mile stretch between McQueen Junction and the proposed end-of-line at Riggs Road in Chandler. The Chandler Branch section of the corridor, also known as the Chandler Industrial Lead, begins at milepost 921.8 at McQueen Junction and ends at milepost 935.1 in south Chandler. From January 2009 to spring 2010, Union Pacific installed new railroad ties and continuous welded rail (CWR) between downtown Phoenix and McQueen Junction. Welded rail was also installed on 1912-era Southern Pacific Salt River-Tempe Town Lake Bridge.

The section of the corridor between downtown Phoenix and McQueen Junction currently includes 29 public crossings, eight private crossing, seven bridges, one pedestrian crossing and 17 overpasses or underpasses.

The Chandler Branch section of the corridor used to connect with the UPRR southeast mainline, but was relegated to branch line status in the mid 1960's. The Chandler Branch section has one 3,087 foot-long siding located near the Germann Road intersection. The right-of-way is generally 100 feet in width and is controlled by ABR with a current maximum operating speed of 25 miles per hour. The ABR is designed to authorize and control train movement along the single track line. There are no existing Quiet Zones located in the Chandler Corridor.

Currently, there are 20 public crossings, eight bridges and one overpass along the Chandler Branch of the corridor. At this time, the Chandler Branch ends at East Appleby Road (MP 932.5) because one rail has been removed from the crossing. The major railroad facilities located along the Chandler Corridor are shown in Figure 2-19 and include:

- **Arizona Interstate Industrial Center Spur** (MP 906.5);
- **Harrison Street Yard** (MP 907.0)
- **Kendall Yard** (MP 911.1)
- **Tempe Depot** (MP 914.3);
- **Tempe Junction** (MP 915.3);
- **Mesa Yard** (MP 921.8);
- **McQueen Junction** (MP 921.8); and the
- **Chandler Depot** (MP 929.3).

At the time of this analysis, no future plans for the Chandler Corridor were available to report. For a more detailed description of Chandler Corridor railroad conditions and existing and planned facilities, see Appendix E: Systems Study Railroad Conditions and Issues.

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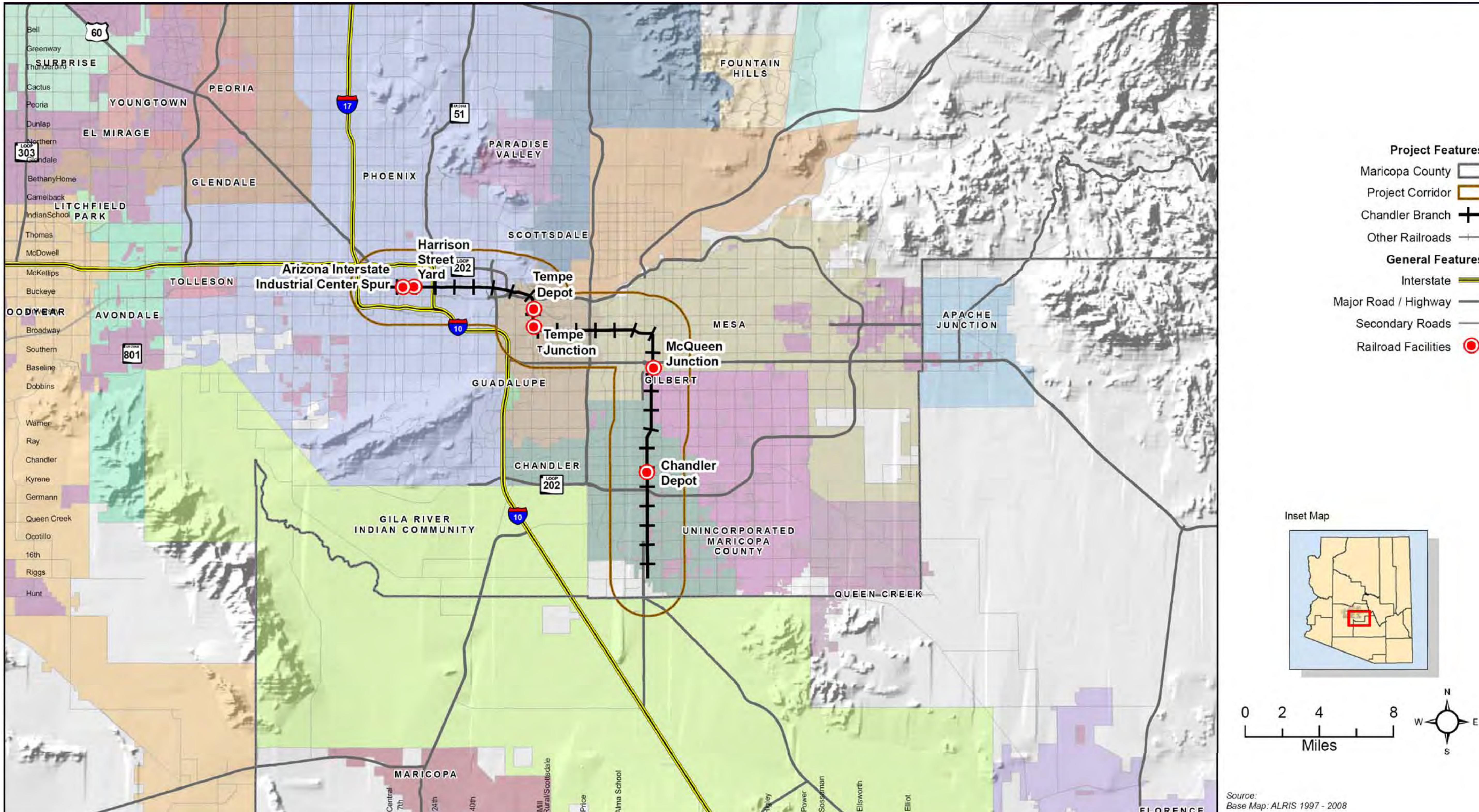
Figure 2-19: Chandler Corridor – Railroad Facilities



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2.7.4 Highway Characteristics

Throughout most of the eastern portion of Maricopa County there are various travel options connecting into downtown Phoenix. This evaluation identifies the primary travel path for commuters traveling from the southern edge of the Chandler Corridor towards downtown Phoenix as following westbound SR 202 to northbound SR 101, connecting to the westbound US 60 and I-10 eventually ending in downtown Phoenix via exiting I-17 northbound at the 7th Street exit. Currently, the number of lanes along this travel path varies from four to ten general use lanes in addition to HOV lanes in both directions on the I-10 and US 60 portions of the corridor.

In an effort to address the current and expected increase in congestion throughout the corridor, MAG has identified multiple roadway improvements for the Chandler Corridor in the RTP 2007 Update. By 2028 the number of highway travel lanes will range from four to ten general purpose lanes along portions of US 60 and I-10 and will include an HOV lane in both directions. Future improvements include the construction of additional:

- General purpose lanes;
- Collector/distributer system along I-10 between SR 51 and Baseline Rd; and
- High Occupancy Vehicle Lanes.

2.7.4.1 Travel Characteristics: Travel Time, Volume and Congestion

The travel path identified to analyze the Chandler Corridor between downtown Phoenix and South Chandler utilizes portions of five valley freeways including: SR 202, SR 101, US 60, I-10, and I-17. For the purposes of this analysis, the intersection of Washington Street and Central Avenue in downtown Phoenix and the intersection of Riggs Road and Arizona Avenue in Chandler were used as end points to measure travel characteristics. The travel path for this corridor totals 27 miles and is broken into two segments in order to compare travel characteristics on both ends of the corridor. Table 2-29 compares travel characteristics for the AM peak period in 2007 and 2030.

Table 2-29: Chandler Corridor AM Peak Period Travel Characteristics (2007 – 2030)

2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Riggs Rd/Arizona Ave to SR 101/US 60	14 miles	22 minutes	2 – 4	2,900 – 17,800 vehicles
Segment #2: SR 101/US 60 to Downtown Phoenix	13 miles	29 minutes	2 – 6	1,500 – 31,900 vehicles
Total Trip	**27 miles**	**51 minutes**	**-**	**1,500 – 31,900 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Riggs Rd/Arizona Ave to SR 101/US 60	14 miles	27 minutes	3 – 4	3,400 – 25,300 vehicles
Segment #2: SR 101/US 60 to Downtown Phoenix	13 miles	32 minutes	2 – 10	1,700 – 48,500 vehicles
Total Trip	**27 miles**	**59 minutes**	**-**	**1,700 – 48,500 vehicles**

Source: MAG, 2009a, 2009b.

Between 2007 and 2030, travel characteristics in the AM peak travel period are expected to change. Between the intersection of Riggs Road and Arizona Avenue in South Chandler and the intersection of SR 101 and US 60, traffic volume is expected to increase by 30 percent and travel time in this segment increase by five minutes. While overall traffic volume is also expected to increase significantly between SR 101 and downtown Phoenix, the total trip time is only projected to slightly increase, making the total trip time 59 minutes in 2030 compared to 51 minutes in 2007. The anticipated increase in traffic volume will be addressed by programmed freeway improvements planned to add general purpose lanes to sections of I-10, increasing the total to ten in each direction.

Similar to the AM peak period, PM peak period travel time, volume, and level of congestion were analyzed. Table 2-30 shows the comparison between 2007 and 2030 PM peak period travel characteristics in the Chandler Corridor.

Table 2-30: Chandler Corridor PM Peak Period Travel Characteristics (2007 – 2030)

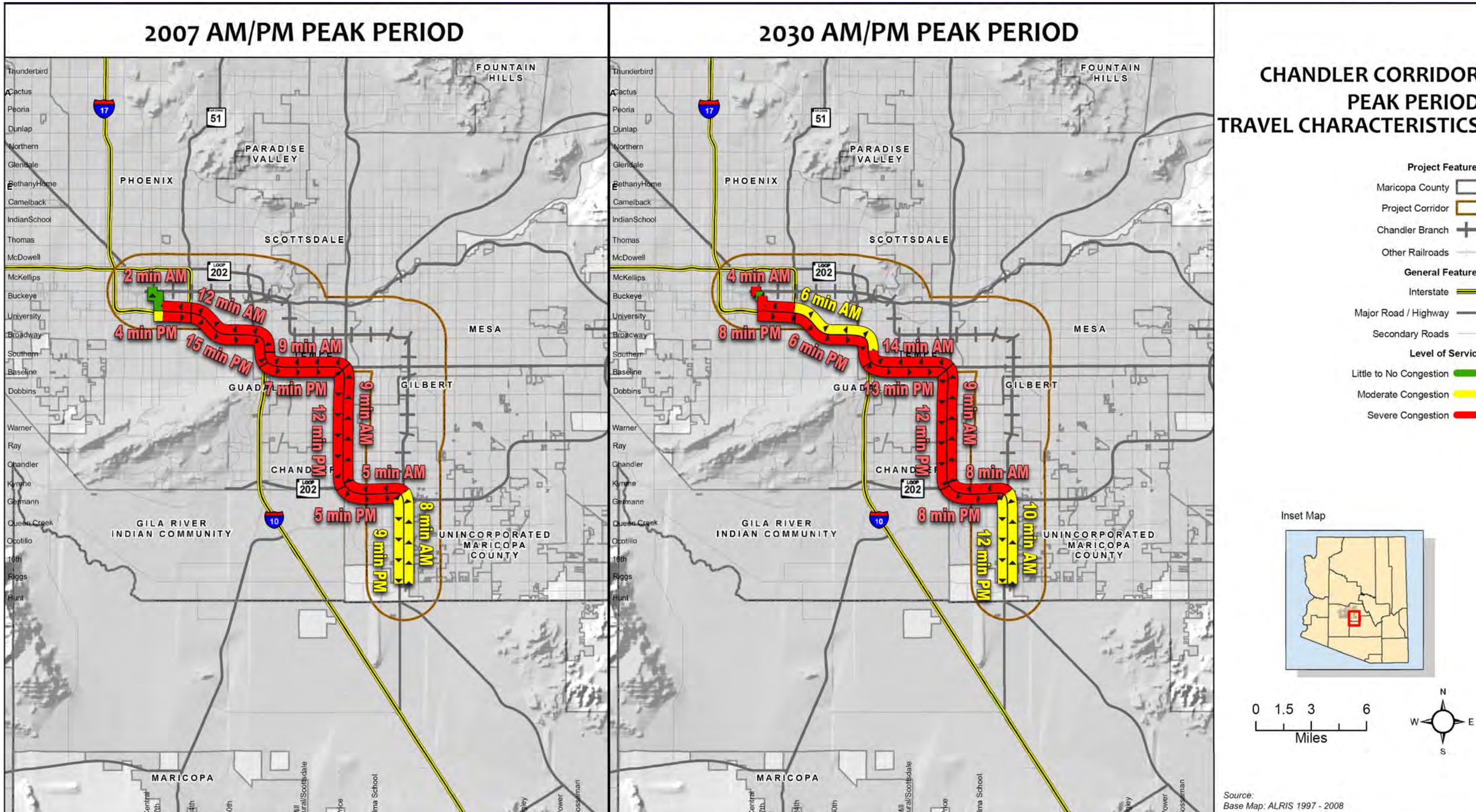
2007 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to SR 101/US 60	13 miles	30 minutes	2 – 5	1,100 – 31,600 vehicles
Segment #2: SR 101/US 60 to Riggs Rd/Arizona Ave	14 miles	26 minutes	2 – 4	3,600 – 19,400 vehicles
Total Trip	**27 miles**	**56 minutes**	**-**	**1,100 – 31,600 vehicles**
2030 AM Peak Period Travel Characteristics				
Segment	**Distance**	**Travel Time**	**Lanes**	**Traffic Volume**
Segment #1: Downtown Phoenix to SR 101/US 60	13 miles	33 minutes	2 – 10	1,800 – 51,500 vehicles
Segment #2: SR 101/US 60 to Riggs Rd/Arizona Ave	14 miles	32 minutes	3 – 4	3,400 – 26,900 vehicles
Total Trip	**27 miles**	**65 minutes**	**-**	**1,800 – 51,500 vehicles**

Source: MAG, 2009a, 2009b.

In 2007, travel time between downtown Phoenix and SR 101 in the PM peak period was 30 minutes. Given planned infrastructure improvements in this segment of the corridor however, the travel time is still expected to worsen by 2030 with an increase of three minutes. Similarly, travel time between SR 101 and South Chandler took 26 minutes in 2007 and is expected to increase to 32 minutes by 2030. PM peak travel volumes between downtown Phoenix and South Chandler will increase approximately 39 percent by 2030.

The level of congestion throughout the Chandler Corridor is expected to improve in sections in the future. In 2007, the segment of the corridor between downtown Phoenix and SR 101 shows severe congestion levels in both the AM and PM peak periods. The AM peak period level is projected to decrease to moderate congestion levels by 2030. Figure 2-20 shows the travel path for the Chandler Corridor as well as the level of congestion and travel times in both the AM and PM peak period in 2007 and 2030. Note that levels of congestion within downtown Phoenix are shown, but actual travel times for this area are not shown in this figure.

Figure 2-20: Chandler Corridor – Peak Period Travel Characteristics



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2.7.5 Transit Service

Transit services provided or planned for future implementation in the Chandler Corridor include:

- Fixed Route Bus;
- High Capacity Transit; and
- Transit Passenger Facilities.

Figure 2-21 graphically represents both the existing and planned regional transit network within the Chandler Corridor.

2.7.5.1 Fixed Route Bus Service

Currently, fixed route bus service within the Chandler Corridor is comprised of local bus, circulators, and express bus service. There are no regional connecters operating within the Chandler Corridor at this time.

2.7.5.1.1 Local Bus

Within the Chandler Corridor, 38 local routes serve the corridor in some capacity. All local routes provide service seven days a week with the exception of Route 112 which operates along Country Club Rd/Arizona Avenue. This local route operates Monday through Friday. Typical service throughout the Chandler Corridor occurs weekdays from 5:00 AM to 11:00 PM and between 6:00 AM and 9:30 PM on the weekends. Most routes operating within this corridor provide a peak frequency of 30 minutes or better.

The RTP identifies a total of 22 Supergrid routes that have either been recently implemented or are planned for implementation within the Chandler Corridor by 2030.

2.7.5.1.2 Circulators

Currently, four circulator systems operating ten total routes provide service within the Chandler Corridor, serving parts of Mesa, Tempe, and downtown Phoenix, as described here:

- Tempe: The majority of the circulator service provided throughout the Chandler Corridor serves the City of Tempe. The **Orbit** and **FLASH** systems combine to operate seven total routes, two of which, the FLASH, serve only Arizona State University. The Orbit provides service seven days a week and the FLASH operates Monday through Friday.

- Downtown Phoenix: The Downtown Area Shuttle (**DASH**) has two circulator routes that operate in downtown Phoenix. The DASH operates Monday through Friday.

- Mesa: The Mesa **BUZZ** has one route that serves Mesa Town Center and its surrounding areas. The BUZZ operates Monday through Saturday.

2.7.5.1.3 Regional Connectors

There are no regional connectors currently operating within the Chandler Corridor.

2.7.5.1.4 BRT/Express Bus

Currently, there are 11 express routes that connect East Valley cities to either downtown Phoenix or downtown Tempe. Of these routes, three connect areas surrounding downtown

Chandler and the proposed end-of-line for the Chandler Corridor to downtown Phoenix. These routes provide similar service to that expected from a commuter rail system in this corridor.

The RTP identifies ten new express routes that will be funded through Proposition 400 revenues within the corridor. Of these routes, the Santan Express is the only proposed route that will provide service comparable to that of potential commuter rail service. The Santan Express will connect Phoenix-Mesa Gateway Airport/ASU Polytechnic Campus located in Mesa with the State Capitol in downtown Phoenix via SR 202. The other nine routes serve the corridor in some capacity and could potentially be utilized to complement commuter rail service.

There is one arterial BRT route currently serving the Chandler Corridor, the METRO LINK, operating along Main Street in Mesa. METRO LINK provides service between the Superstition Springs Mall near Power Road and US 60 in Mesa and the existing terminus of the CP/EV LRT line in Mesa. The RTP has identified a number of additional arterial BRT routes that will be implemented in the future. Future BRT routes are planned along Arizona Avenue, Scottsdale Road, and Chandler Boulevard.

2.7.5.2 High Capacity Transit

Currently, the only HCT service located in the Chandler Corridor is the CP/EV LRT line that extends between Mesa and downtown Phoenix. However, the RTP identifies two extensions of the CP/EV Starter Line within this corridor. One is a 2.7 mile extension along Main Street in Mesa that would extend HCT service along the existing METRO LINK route currently in service. In addition, a 2.0 mile extension to the south centered along Rural Road is also planned for the future. Transit Passenger Facilities

Transit facilities located within the Chandler Corridor include both transit centers and park-and-ride facilities. This section will identify the existing and planned facilities throughout the corridor.

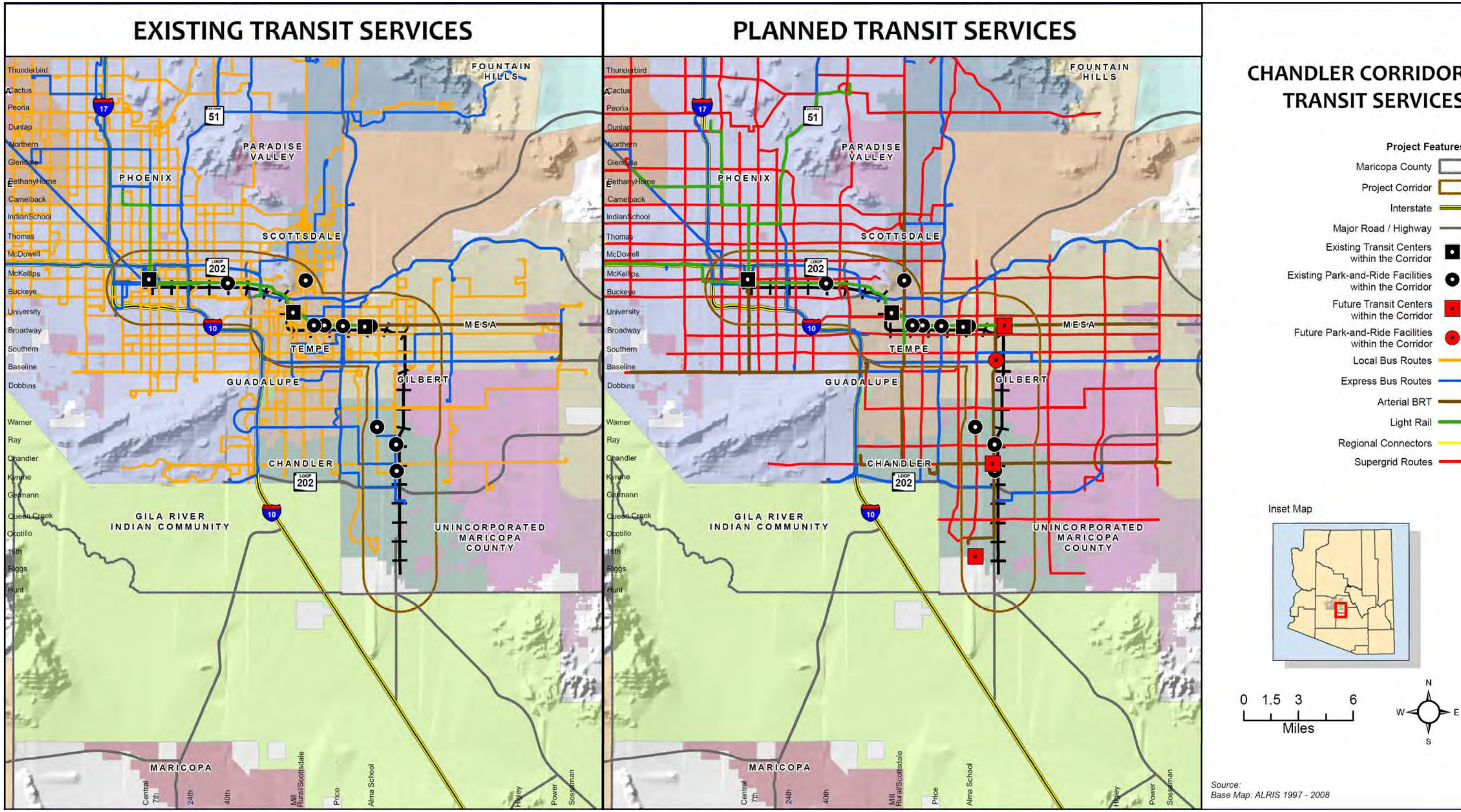
2.7.5.2.1 Transit Centers

There are currently three existing transit centers in the Chandler Corridor, two of which are also located in the Tempe Corridor. These include Central Station located in downtown Phoenix, the Tempe Transit Center located near ASU in downtown Tempe, and the Main Street/Sycamore Street Transit Center in Mesa. In addition, there are three transit centers planned for the cities of Mesa and Chandler within the corridor by 2030, as shown in Figure 2-21.

2.7.5.2.2 Park-and-Ride Facilities

There are a total of nine existing park-and-ride facilities in the Chandler Corridor that provide transit riders with access to local bus service, circulators, or express bus routes. By 2030, one additional park-and-ride facility will be in operation. Figure 2-21 identifies both the existing and future facilities.

Figure 2-21: Chandler Corridor – Transit Services



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2.7.6 Travel Patterns

Home-based work trips originating within the Chandler Corridor were analyzed for 2007 and 2030. The purpose of this analysis was to understand the destinations of HBW trips that originated within the Chandler Corridor. Destinations that were identified as part of this analysis include trips:

- Within the Chandler Corridor;
- Within the area of the System Study; and
- Outside the limits of the System Study.

An analysis of HBW trips showed that in 2007, just over 220,000 trips originated within the Chandler Corridor. Sixty percent of these trips remained within the limits of the corridor, while 15 percent were destined to other areas within the limits of the System Study. The remaining 25 percent of the total trips taken were destined to locations outside the potential service area of the entire System Study. In 2030, the number of HBW trips originating in the Chandler Corridor increased by 22 percent to just over 268,000 total trips. A comparison of HBW trips between 2007 and 2030 shows that the percentage of HBW trips traveling to the three analyzed destinations stayed relatively the same. The number of trips originating within the project corridor for 2007 and 2030 are identified in Table 2-31.

Table 2-31: Home-Based Work Trips Originating within the Chandler Corridor

Destination Area	2007		2030	
	HBW Trips	Percent	HBW Trips	Percent
Within Chandler Corridor	132,559	60%	155,217	58%
Within the System Study	32,085	15%	37,823	14%
Outside the System Study	55,817	25%	75,211	28%
Total	**220,461**	**100%**	**268,251**	**100%**

Source: MAG, 2009a, 2009b.

2.7.7 Summary

Similar to the Tempe Corridor, the Chandler Corridor is largely already developed and not expected to experience much significant growth between 2007 and 2030. During this time the corridor is expected to experience a 20 percent increase in population and a 34 percent increase in employment. The corridor includes a balanced mix of land uses with residential comprising the largest portion. Land uses are not expected to change significantly in the future. There are also some notable railroad facilities along the Chandler Corridor that will impact future development of commuter rail service.

The primary travel path from between South Chandler and downtown Phoenix is along SR 202 and I-10. Despite significant expansion planned by 2030, congestion along this route is expected to increase. As a result travel times into downtown Phoenix are expected to increase by 2030. This change in travel time takes into account all programmed improvements within the corridor.

Transit services are generally spread out evenly throughout the corridor with the exception of the southern portions of the corridor where services are less available. The implementation of Supergrid routes will increase transit services in the future, but these conditions are expected to remain similar through 2030.

Travel patterns within the corridor are largely expected to remain similar between 2007 and 2030 as well. However, there is an anticipated decrease in the total number of trips that will remain within the Chandler Corridor in the future.

2.8 Future Extensions

As part of the MAG Commuter Rail System Study, service areas beyond the current limits of the existing railroad network are also being evaluated. Figure 2-22 illustrates these potential extensions. Potential corridor extensions to the five current commuter rail corridors include the following:

- Hassayampa Extension: A conceptual commuter rail service study area between the communities of Morristown, which is located along the Grand Avenue Corridor, and the end-of-line for the Yuma West Corridor near Arlington, Arizona.
- Hidden Valley Extension: A conceptual commuter rail service study area between the City of Goodyear and Mobile. The extension would run in line with the proposed Hassayampa Freeway, south of the current Yuma West Corridor, as identified in the MAG Hidden Valley Framework Study. The proposed freeway alignment connects Mobile to the Loop 303 Extension and the City of Goodyear along the Yuma West Corridor.
- Hidden Waters-Gila Bend Extension: A conceptual commuter rail service study area between the end-of-line along the Yuma West Corridor and Gila Bend. The extension would run in line with a proposed major arterial alignment and parallels portions of SR-85 as identified in the MAG Hidden Valley Framework Study.
- Tempe Extension: A conceptual commuter rail service study area between the City of Chandler at the proposed Tempe Corridor end-of-line and the City of Maricopa. Between these two points, the extension is located primarily within the Gila River Indian Community along the existing SR-347 alignment.
- Chandler Extension: A conceptual commuter rail service study area extending between the end of the Chandler Corridor near the intersection of Riggs Road and Arizona Avenue in Chandler, and Coolidge. The extension is located primarily within the Gila River Indian Community and follows an existing abandoned UPRR rail bed.
- Southeast Extension: A conceptual commuter rail service study area that extends from the proposed Southeast Corridor end-of-line in Queen Creek to Florence. The alignment follows the existing UPRR and Copper Basin Railway alignments that are currently being used in freight rail operations.
- Superstition Vistas Extension: A conceptual commuter rail service study area between the Magma Junction, northwest of Florence and Apache Junction. The alignment generally follows the proposed Pinal County North-South Freeway as identified in the Pinal County Comprehensive Plan.

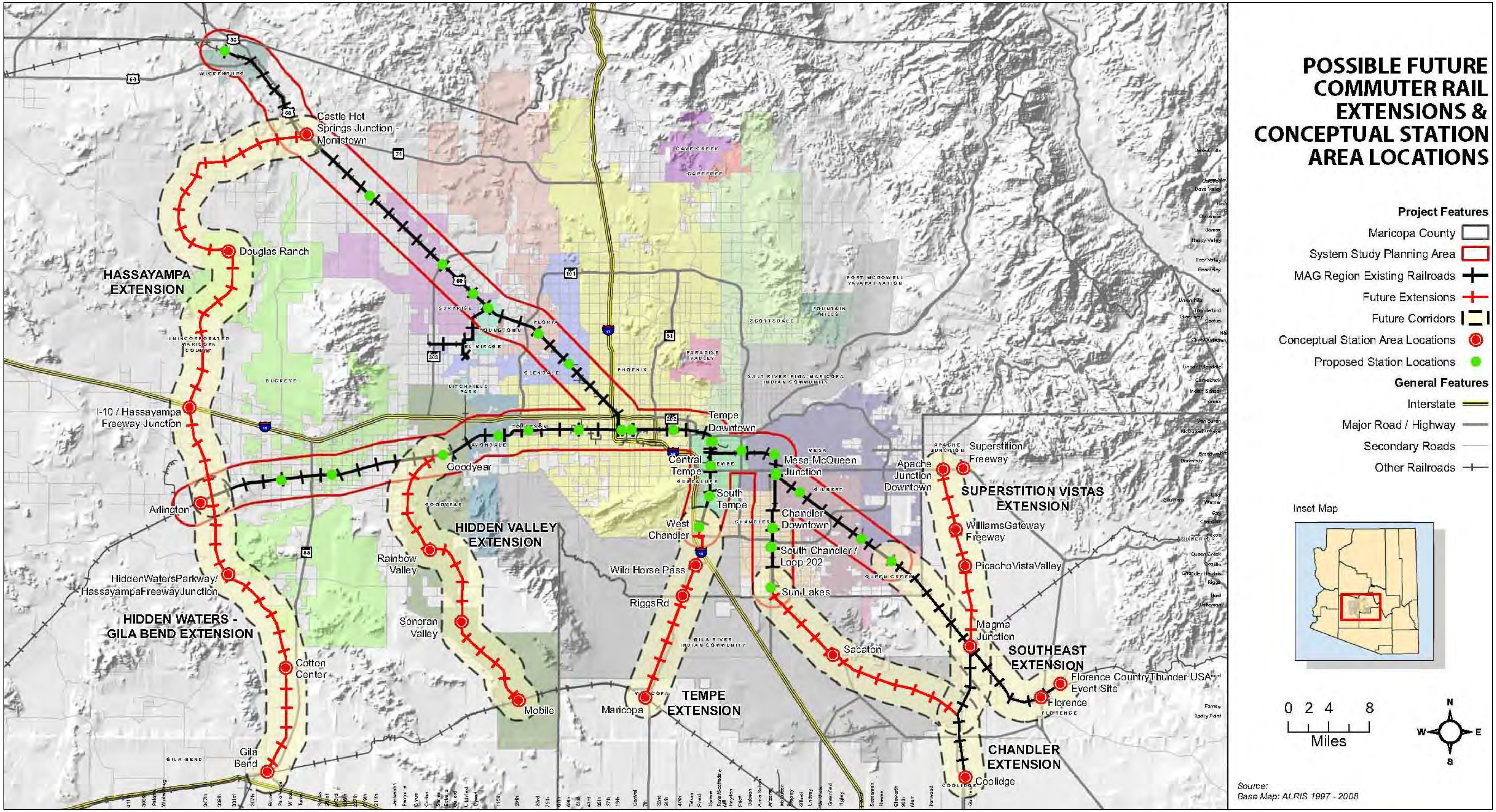
An analysis of these potential extension corridors will focus on high level demographic and land use projections as well as any pertinent information regarding the surrounding transportation infrastructure. For the purpose of this evaluation, all extension corridors should be viewed as generalized corridors, not as specific alignments. Future commuter rail

Chandler Branch: A potential future extension to Gila River Indian Community, Coolidge and Pinal County
Source: MAG.

service alignments shall be identified in future planning and design studies.

The complete analysis of these potential corridor extensions is provided in Appendix B: Evaluation of Potential System Study Commuter Rail Corridor Extensions.

Figure 2-22: Possible Future Commuter Rail Extensions and Conceptual Station Area Locations



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3.0 ALTERNATIVES DEVELOPMENT AND EVALUATION

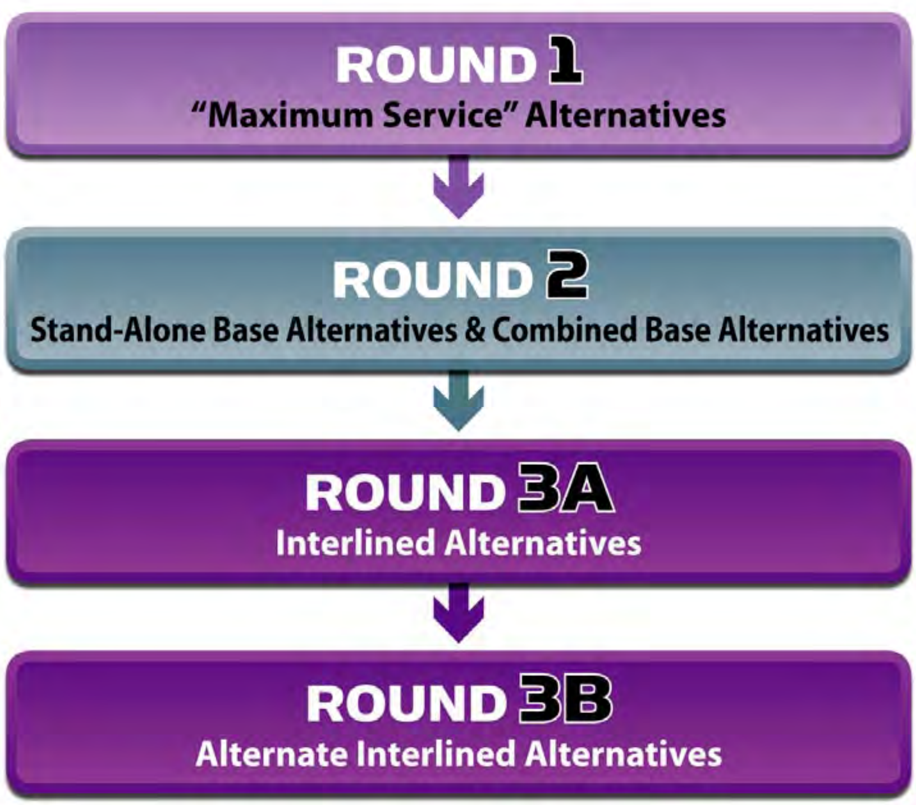
3.1 Introduction

This chapter describes the development and evaluation of MAG Commuter Rail System Study alternatives. It is organized as follows:

- Section 3.2 describes the development of alternatives and summarizes the recommendations of previous studies that led to the selection of the five potential commuter rail corridors under consideration in this System Study. This section also presents the assumptions that were incorporated into the development of each alternative, including ridership forecasting, cost estimates, recommended vehicle technology, and potential station target areas.

- Section 3.3 provides a description of alternatives, including routes, service frequencies, stations and travel time. It also describes the three-round ridership forecasting process used to develop and evaluate alternatives. The first round tested a set of Preliminary “Maximum Service” Alternatives (Round 1); the second round modeled a set of Stand-Alone Base Alternatives and Combined Base Alternatives (Round 2); and the third round modeled both Interlined Alternatives (Round 3A) and Alternate Interlined Alternatives (Round 3B).

Figure 3-1: Ridership Forecasting Process



- Section 3.4 presents commuter rail ridership forecasts for each round of alternatives. In addition to presenting ridership results, this section also compares boardings between alternatives and highlights significant findings.

- Section 3.5 presents the cost estimates for each alternative. It provides capital cost estimates, which include the cost to obtain right-of-way, construct the commuter rail tracks and stations, procure vehicles and make needed infrastructure improvements. This section also presents the operating and maintenance (O&M) costs, which include the annual cost to operate each alternative based on service plans.

- Section 3.6 presents the comparison factors for alternatives. It describes the set of factors used to characterize, compare and prioritize each alternative and describes the application of these criteria to the Round 2, Stand-Alone Base Alternatives, and Round 3A, Interlined Alternatives. Based on the results of the evaluation, this section provides a discussion of the major discriminators between alternatives and provides a relative ranking of each.

- Section 3.7 discusses the next steps in the MAG Commuter Rail System Study planning process.

3.2 Development of Alternatives

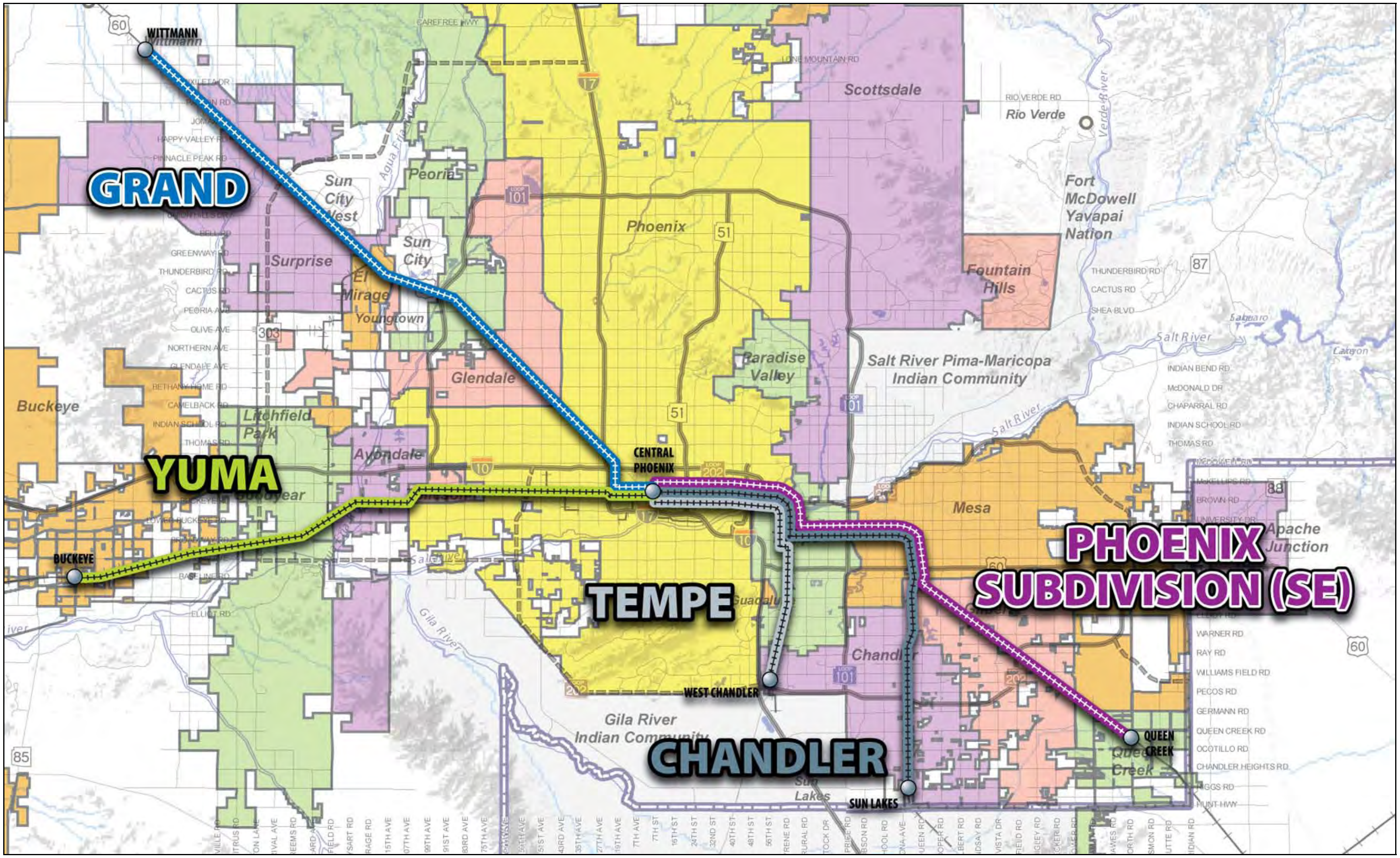
The development of alternatives built on the recommendations of the MAG Commuter Rail Strategic Plan. The Strategic Plan developed a commuter rail system concept that would radiate from downtown Phoenix to the west, northwest, and south/southeast. Using these five rail corridors, the Project Team developed System Study Alternatives with varying operating configurations described in Section 3.3.

As shown in Figure 3-2, each corridor would be oriented around existing freight rail lines including:

- Grand Avenue (Grand)Corridor (BNSF Railway Company – Grand Avenue)
- Yuma West (Yuma) Corridor (UPRR Mainline – Yuma West)
- Southeast (SE) Corridor (UPRR Mainline – Southeast)
- Tempe Corridor (UPRR Mainline – Tempe Industrial Lead)
- Chandler Corridor (UPRR Mainline – Chandler Branch)

Note that for the purposes of describing and evaluating alternatives in Chapters 3 and 4, the Grand Avenue Corridor will be referred to as the “Grand Corridor,” the Yuma West Corridor is referred to as the “Yuma Corridor,” and the Southeast Corridor is referred to as the “SE Corridor.”

Figure 3-2: MAG Commuter Rail System Study Corridors



Source: URS Corp., 2009.

3.2.1 Assumptions

In the development of alternatives, the Project Team applied a set of assumptions for ridership forecasting, cost estimates, vehicle technology, corridor extents, station locations and peer city comparisons. These assumptions are summarized below.

3.2.1.1 Ridership Forecasting

Ridership forecasting was performed using the MAG TransCAD travel demand model. This model was developed with a 2007 base year, an interim year of 2015, and a forecast year of 2030. The 2030 model was used for System Study ridership forecasting and incorporates improvements specified in the RTP 2007 Update, including approximately 57 miles of high capacity transit (such as LRT and bus rapid transit).

3.2.1.2 Cost Estimates

Cost estimates for the MAG System Study corridors were calculated based on a series of cost assumptions detailed in Appendix A: Methodology for Cost Estimating, and conceptual level drawings illustrated in Appendix D: Southeast, Tempe, and Chandler Corridor Commuter Rail Design Concepts. The costs are based on recent peer system costs or recent estimates derived from the commuter rail and freight rail industries. The costs are presented in 2009 US Dollars without an inflation factor and are summarized into Federal Transit Administration (FTA) standard categories using a typical FTA standard cost category summary sheet, as shown in Appendix A. Finally, the total corridor costs are inclusive of constructions costs, soft costs (including design and environmental review), and project contingencies.

3.2.1.3 Vehicle Technology

The Project Team evaluated Locomotive Hauled Coaches (LHC) and Diesel Multiple Unit (DMU) technologies to determine which type of commuter rail vehicles would be most appropriate for the MAG commuter rail system. At this time, an “off-the-shelf” DMU that would be appropriate for use in the Phoenix region is unavailable. Although both Siemens and a new manufacturer – US Railcar – have announced their intention to manufacture DMUs for the US market, it is uncertain when this technology will become available. Therefore, FRA-compliant LHCs are the assumed vehicle technology for all commuter rail alternatives under consideration. For a complete description of the vehicle technology evaluation, see Appendix F: Commuter Rail Vehicle Technology.

LHCs are powered by one diesel-electric locomotive engine and are configured for push-pull operation. In push-pull service, the locomotive pulls the train in one direction and pushes the train in the opposite direction. A cab car with operating controls is put on one end of the train and a locomotive at the other end. Trains of LHCs may range from two-car to 12-car consists. LHC commuter rail systems are currently in service in several US cities, a few of which include Seattle, Salt Lake City, and Dallas-Fort Worth.

Example of LHC vehicles in San Diego, California.

The seated capacity of each double-deck passenger car, typically used in LHC commuter rail operations, is approximately 140 passengers; therefore, a four-car train (three coaches and one cab control car) would seat approximately 560 passengers.

For a more detailed description of LHC features and vehicle procurement options, see Appendix F: Commuter Rail Vehicle Technology.

3.2.1.4 Corridor Extents

The Project Team determined that the Stand-Alone Base Alternatives under evaluation for this System Study would terminate in downtown Phoenix, thereby minimizing overlap to the extent possible. (For the three East Valley corridors, some overlap was unavoidable between downtown Phoenix and Tempe.)

To make comparisons among the corridors in the System Study, the west-end termini for both the Grand Avenue and Yuma West Corridors assume Phase B commuter rail service, which would be implemented between the years 2020 and 2030. In Phase B service, the Grand Avenue Corridor would terminate at Wittmann and the Yuma West Corridor would terminate at Buckeye. Phase C, or post-2030 service, for each of these corridors would extend commuter rail service further west, but these extensions are not assumed for the purposes of this Systems Study. For a more detailed description of corridor phasing and termini, see the Grand Avenue Corridor Development Plan and Yuma West Corridor Development Plan.

3.2.1.5 Stations

The Project Team conducted an evaluation of station target areas for each of the five commuter rail corridors under consideration in the System Study. Using the station locations identified in the 2003 MAG High Capacity Transit Study and those recommended by MAG staff, the Project Team characterized and assessed potential station target areas based on a set of evaluation criteria. These criteria included potential station boardings, demographic and employment projections, land use, connectivity with existing and planned transportation systems, and major activity centers. For the purposes of the evaluation, general station target areas are identified by major intersections along each commuter rail corridor. At this level of analysis, specific parcels are not identified for potential station locations.

For a detailed description of the station location evaluations, see Appendix B: Grand Avenue Corridor Station Target Area Evaluation of the Grand Avenue Corridor Development Plan, Appendix B: Conceptual Station Planning Technical Memorandum of the Yuma West Corridor Development Plan, and Appendix C: System Study Station Target Area Evaluation of this System Study. Based on the results of the station area evaluations, Table 3-1 contains the station target areas that were considered along each corridor:

Table 3-1: Station Target Areas for Each Corridor

Grand Corridor	
Station Target Area	**Distance between Station Target Areas**
Central Phoenix	-
State Capitol	1.0 miles
Downtown Glendale	8.8 miles
Downtown Peoria	4.0 miles
El Mirage/Youngtown/Sun City	5.5 miles
Downtown Surprise	2.4 miles
North Surprise	4.2 miles
Downtown Wittmann	9.9 miles
Total Distance	**35.8 miles**

Table 3-1: Station Target Areas for Each Corridor

Station Target Area	Distance between Station Target Areas
Yuma Corridor	
Station Target Area	**Distance between Station Target Areas**
Central Phoenix	-
State Capitol	1.1 miles
West Phoenix	4.2 miles
Downtown Tolleson	4.9 miles
Downtown Avondale	3.3 miles
Goodyear Airport	3.2 miles
Goodyear Estrella	4.2 miles
Buckeye-Liberty	3.1 miles
Downtown Buckeye	6.6 miles
Total Distance	**30.6 miles**
SE Corridor	
Station Target Area	**Distance between Station Target Areas**
Central Phoenix	-
Ballpark Arena - CBD	0.5 miles
Airport / 38th St	4.1 miles
Downtown Tempe	5.1 miles
Price/SR-101L PNR	4.2 miles
Downtown Mesa	3.5 miles
Mesa-McQueen Junction	2.0 miles
Downtown Gilbert	3.0 miles
Gateway-ASU Polytech	7.5 miles
Downtown Queen Creek	3.6 miles
Total Distance	**33.5 miles**
Tempe Corridor	
Station Target Area	**Distance between Station Target Areas**
Central Phoenix	-
Ballpark Arena - CBD	0.5 miles
Airport / 38th St	4.1 miles
Downtown Tempe	5.1 miles
Central Tempe	1.9 miles
South Tempe	3.1 miles
West Chandler	3.1 miles
Total Distance	**17.8 miles**
Chandler Corridor	
Station Target Area	**Distance between Station Target Areas**
Central Phoenix	-
Ballpark Arena - CBD	0.5 miles
Airport / 38th St	4.1 miles
Downtown Tempe	5.1 miles
Price/SR-101L PNR	4.2 miles
Downtown Mesa	3.5 miles
Mesa-McQueen Junction	2.0 miles
Downtown Chandler	5.6 miles
South Chandler	1.5 miles

Table 3-1: Station Target Areas for Each Corridor

Chandler Corridor	
Station Target Area	**Distance between Station Target Areas**
Sun Lakes	4.4 miles
Total Distance	**30.9 miles**

Source: URS Corp., 2009.

3.2.1.6 Peer City Comparisons

In order to gauge the relative ridership potential and cost-effectiveness of each of the alternatives, comparisons are made to peer city commuter rail systems currently in operation. Table 3-2 lists a number of commuter rail systems currently in operation and characteristics such as length and ridership.

Table 3-2: Peer City Commuter Rail Systems

Commuter Rail System	Start Year	Length (in route miles)	Trains Per Day (Weekday)	Daily Ridership (Weekday)
Metrolink, San Bernardino Line (Los Angeles-San Bernardino, CA)	1992	56	39	11,950
Metrolink, Ventura County Line (Los Angeles-Oxnard/Montalvo, CA)	1992	71	22	4,000
Coaster (San Diego-Oceanside, CA)	1995	41	22	6,000
Trinity Railway Express (TRE) (Dallas-Ft. Worth, TX)	1996	34	49	9,800
Altamont Commuter Express (ACE) (San Jose-Stockton, CA)	1998	86	6-8	3,700
Sounder, South Line (Seattle-Tacoma, WA)	2000	47	18	11,000
Sounder, North Line (Seattle-Everett, WA)	2003	35	8	1,500
Music City Star (Nashville-Lebanon, TN)	2006	32	11	1,000
New Mexico Rail Runner Express (Santa Fe-Albuquerque-Belen, NM)	2006	93	24	4,500
Front Runner (Salt Lake City-Ogden, UT)	2008	44	70	4,800

Source: MAG, 2009 -10.

Throughout the System Study, peer city commuter rail systems are used to compare boardings per revenue mile, capital cost per mile and annual O&M cost per passenger trip to the Study corridors.

The peer city commuter rail systems selected to compare daily boardings per revenue mile and annual O&M cost per passenger trip include the Sounder in Seattle, WA, the Coaster in San Diego, CA, the Metrolink in Los Angeles, CA, the Peninsula Corridor Joint Powers Board (PCJPB) Caltrain in the San Francisco Bay area, and the Altamont Commuter Express (ACE) between Stockton and San Jose, CA. These peer city systems were selected because they represent (1) commuter rail systems in the western United States and (2) their daily boardings per revenue mile and annual O&M cost per passenger trip have been recorded in the FTA's

National Transit Database (NTD). The NTD is the national database of statistics for the transit industry.

The peer city commuter rail systems selected to compare capital cost per mile include the Sounder in Seattle, WA, the Front Runner in Salt Lake City, Utah, the Northstar in Minneapolis, MN and the Westside Express in Portland, OR. These four systems were selected because they represent a handful of commuter rail systems that have been constructed relatively recently and therefore provide the closest approximation to what it would cost to build a new commuter rail system in the Phoenix region.

3.3 Description of Alternatives

The Project Team used a three-round process to develop and compare System Study alternatives. The first round tested a set of Preliminary "Maximum Service" Alternatives; the second round evaluated a set of Stand-Alone Base Alternatives and Combined Base Alternatives and the third round assessed Interlined and Alternate Interlined Alternatives.

The Alternatives were refined through each round of ridership forecasting model runs as described in Sections 3.3.1 through 3.3.4:

3.3.1 Round 1: Preliminary "Maximum Service" Alternatives

The first set of preliminary ridership forecasting model runs tested a set of "maximum service" alternatives as indicators of the maximum possible commuter rail service feasible within a specific corridor. Each preliminary alternative was developed with 15-minute peak and 30-minute off-peak headways. This level of service was selected as a "maximum" because that frequency is a reasonable limit for railroad operations with signal control. This level of service is not likely from an operations standpoint because very few commuter rail systems operate such an aggressive service level. In addition, such a high frequency schedule would not be practical if and when the individual corridors would be interlined with other corridors, (making the effective peak headways in overlapping segments unworkable). However, the Project Team tested these headways to understand the best performing corridors and stations at a high level of service. Table 3-3 lists the characteristics of the preliminary "maximum service" alternatives.

Table 3-3: Round 1 – Preliminary "Maximum Service" Alternatives

Preliminary "Maximum Service" Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
Grand	Service between Central Phoenix and West Wickenburg	56.4 miles	15 min.	30 min.	10	65 min.
Yuma	Service between Central Phoenix and Arlington	44.0 miles	15 min.	30 min.	10	61 min.
SE	Service between Central Phoenix and Downtown Queen Creek	33.5 miles	15 min.	30 min.	10	46 min.
Tempe	Service between Central Phoenix and West Chandler	17.8 miles	15 min.	30 min.	7	29 min.

Table 3-3: Round 1 – Preliminary "Maximum Service" Alternatives

Preliminary "Maximum Service" Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
Chandler	Service between Central Phoenix and Sun Lakes	30.9 miles	15 min.	30 min.	10	49 min.
3-Corridor: Grand-Yuma-SE	Service between Central Phoenix and West Wickenburg	56.4 miles	15 min.	30 min.	10	65 min.
	Service between Central Phoenix and Arlington	44.0 miles			10	61 min.
	Service between Central Phoenix and Downtown Queen Creek	33.5 miles			10	50 min.
5-Corridor: Grand-Yuma-SE-Tempe-Chandler	Service between Central Phoenix and West Wickenburg	56.4 miles	15 min.	30 min.	10	65 min.
	Service between Central Phoenix and Arlington	44.0 miles			10	61 min.
	Service between Central Phoenix and Downtown Queen Creek	33.5 miles			10	50 min.
	Service between Central Phoenix and West Chandler	17.8 miles			7	29 min.
	Service between Central Phoenix and Sun Lakes	30.9 miles			10	53 min.

Source: URS Corp., 2009.

The results of the maximum service tests helped the Project Team to understand the characteristics of the various alternatives, including peak vs. off-peak ridership characteristics and levels of passenger boardings at each station. The results of these preliminary model runs also informed the development of the next set of alternatives to be fully evaluated and prioritized.

3.3.2 Round 2: Stand-Alone Base Alternatives and Combined Base Alternatives

Based on the results of the preliminary ridership forecasting model runs, the Project Team refined the preliminary "maximum service" alternatives. The resulting Stand-Alone Base Alternatives had lower frequencies, with 30-minute peak and 60-minute off-peak headways, and shortened routes for the Grand and Yuma Corridors.

Base Alternatives included both stand-alone alternatives (1-Corridor Alternatives) and combined alternatives (3-Corridor and 4-Corridor Alternatives). As modeled, the Combined Base Alternatives would require transit patrons to transfer between corridors at the Central Phoenix station. Developing and evaluating the Combined Base Alternatives allowed the Project Team to assess how the commuter rail corridors would interact together and to evaluate the impact of a commuter rail system on system-wide LRT boardings. Table 3-4 lists the characteristics of the Stand-Alone Base and Combined Base Alternatives.

For a more detailed description of proposed service plans, see Appendix C: Grand Avenue Corridor Operations Plan of the Grand Avenue Corridor Development Plan, Appendix C: Yuma West Corridor Operations Plan of the Yuma West Corridor Development Plan, and Appendix G: System Study Operations Plan for service details related to the Tempe, Chandler, and Southeast Corridors.

Table 3-4: Round 2 – Stand-Alone Base and Combined Base Alternatives

Stand-Alone Base and Combined Base Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
Stand-Alone Base Alternatives						
Grand	Service between Central Phoenix and Downtown Wittmann*	35.8 miles	30 min.	60 min.	8	43 min.
Yuma	Service between Central Phoenix and Downtown Buckeye**	30.6 miles	30 min.	60 min.	9	47 min.
SE	Service between Central Phoenix and Downtown Queen Creek	33.5 miles	30 min.	60 min.	10	46 min.
Tempe	Service between Central Phoenix and West Chandler	17.8 miles	30 min.	60 min.	7	29 min.
Chandler	Service between Central Phoenix and Sun Lakes	30.9 miles	30 min.	60 min.	10	49 min.
3-Corridor Combined Base Alternatives						
Grand-Yuma-SE	Service between Central Phoenix and Downtown Wittmann	35.8 miles	30 min.	60 min.	8	42 min.
	Service between Central Phoenix and Downtown Buckeye	30.6 miles			9	47 min.
	Service between Central Phoenix and Downtown Queen Creek	33.5 miles			10	50 min.
4-Corridor Combined Base Alternatives						
Grand-Yuma-SE-Tempe	Service between Central Phoenix and Downtown Wittmann	35.8 miles	30 min.	60 min.	8	42 min.
	Service between Central Phoenix and Downtown Buckeye	30.6 miles			9	47 min.
	Service between Central Phoenix and Downtown Queen Creek	33.5 miles			10	50 min.
	Service between Central Phoenix and West Chandler	17.8 miles			7	29 min.
Grand-Yuma-SE-Chandler	Service between Central Phoenix and Downtown Wittmann	35.8 miles	30 min.	60 min.	8	42 min.
	Service between Central Phoenix and Downtown Buckeye	30.6 miles			9	47 min.
	Service between Central Phoenix and Downtown Queen Creek	33.5 miles			10	50 min.
	Service between Central Phoenix and Sun Lakes	30.9 miles			10	53 min.

* End-of-line shortened to downtown Wittmann. Downtown Wickenburg and West Wickenburg stations deferred to future years.
** End-of-line shortened to downtown Buckeye. Arlington station deferred to future years.
Source: URS Corp., 2009.

The results of the Stand-Alone Base and Combined Base Alternatives ridership forecasting helped the Project Team to understand the characteristics of the individual corridors and to determine how to pair up the corridors for interlined service.

3.3.3 Round 3A: Interlined Alternatives

The next set of alternatives created interlined corridors by connecting two or more corridors together into several series of continuous routes. These interlined routes were then combined into systems as 2-, 3-, or 4-Corridor Interlined Alternatives. While the Combined Base Alternatives would require a transfer in Central Phoenix, the Interlined Alternatives would not require a transfer. Instead, Interlined Alternatives would provide a one-seat ride between corridors. The rationale for developing Interlined Alternatives is that reducing the need to transfer would improve ridership, and combining corridors could help streamline operations.

Each Interlined Alternative was developed with 60-minute off-peak headways; and either 20-minute, 30-minute or 40-minute peak headways (alternative headways were needed in various portions of interlined routes primarily to keep headways at a manageable level in overlapping segments near Central Phoenix). Table 3-5 lists the characteristics of Interlined Alternatives.

Table 3-5: Round 3A – Interlined Alternatives

Interlined Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
2-Corridor Interlined Alternative						
Grand Interlined with SE	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	67.9 miles	30 min.	60 min.	16	89 min.
Yuma Interlined with SE	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	62.7 miles	30 min.	60 min.	17	93 min.
3-Corridor Interlined Alternative						
Grand Interlined With SE and Yuma Interlined With SE	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	67.9 miles	30 min.	60 min.	16	89 min.
	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	62.7 miles	60 min.	60 min.	17	93 min.
4-Corridor Interlined Alternatives						
Yuma Interlined with SE and Grand Interlined with Tempe	Service between Downtown Buckeye and Downtown Queen Creek with a stop in Central Phoenix	62.7 miles	20 min.	60 min.	17	93 min.
	Service between Downtown Wittmann and West Chandler with a stop in Central Phoenix	53.6 miles	20 min.	60 min.	13	72 min.
Grand Interlined with SE and Yuma	Service between Downtown Wittmann and Downtown Queen Creek with a stop in Central Phoenix	67.9 miles	20 min.	60 min.	16	89 min.

Table 3-5: Round 3A – Interlined Alternatives

Interlined Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
Interlined with Tempe	Service between Downtown Buckeye and West Chandler with a stop in Central Phoenix	48.4 miles	40 min.	60 min.	14	76 min.

Source: URS Corp., 2009.

3.3.4 Round 3B: Alternate Interlined Alternatives

The next set of alternatives created the same 3-Corridor and 4-Corridor Interlined Alternatives that had been developed in Round 2, but replaced the SE Corridor with the Chandler Corridor. The rationale for substituting the Chandler Corridor for the SE Corridor was to understand how an alternate East Valley corridor would impact forecasted ridership, should the SE Corridor be infeasible to implement due to freight activity or other railroad constraints.

As with Round 3A, each Interlined Alternative was developed with 60-minute off-peak headways; and either 20-minute or 40-minute peak headways. Table 3-6 lists the characteristics of Round 3B Interlined Alternatives.

Table 3-6: Round 3B – Interlined Alternatives

Interlined Alternatives	Description	Distance	Peak Service	Off-Peak Service	No. of Stations	Travel Time
3-Corridor Interlined Alternative						
Grand Interlined with Chandler and Yuma Interlined with Chandler	Service between Downtown Wittmann and Sun Lakes with a stop in Central Phoenix	64.9 miles	20 min.	60 min.	16	92 min.
Grand Interlined with Chandler and Yuma Interlined with Chandler	Service between Downtown Buckeye and Sun Lakes with a stop in Central Phoenix	59.7 miles	20 min.	60 min.	17	96 min.
4-Corridor Interlined Alternatives						
Yuma Interlined with Chandler and Grand Interlined with Tempe	Service between Downtown Buckeye and Sun Lakes with a stop in Central Phoenix	59.7 miles	20 min.	60 min.	17	96 min.
Yuma Interlined with Chandler and Grand Interlined with Tempe	Service between Downtown Wittmann and West Chandler with a stop in Central Phoenix	53.6 miles	20 min.	60 min.	13	72 min.
Grand Interlined with Chandler and Yuma Interlined with Tempe	Service between Downtown Wittmann and Sun Lakes with a stop in Central Phoenix	64.9 miles	20 min.	60 min.	16	92 min.
Grand Interlined with Chandler and Yuma Interlined with Tempe	Service between Downtown Buckeye and West Chandler with a stop in Central Phoenix	48.4 miles	40 min.	60 min.	14	76 min.

Source: URS Corp., 2009.

3.4 Ridership Forecasting Results

With each round of alternatives development, the Project Team used the ridership forecasting process described in Section 3.2.2.1 to assess the relative attractiveness of each corridor, to identify the lowest and highest performing stations, and to determine feasible system combinations.

3.4.1 Round 1: Preliminary "Maximum Service" Alternatives Ridership Forecasting Results

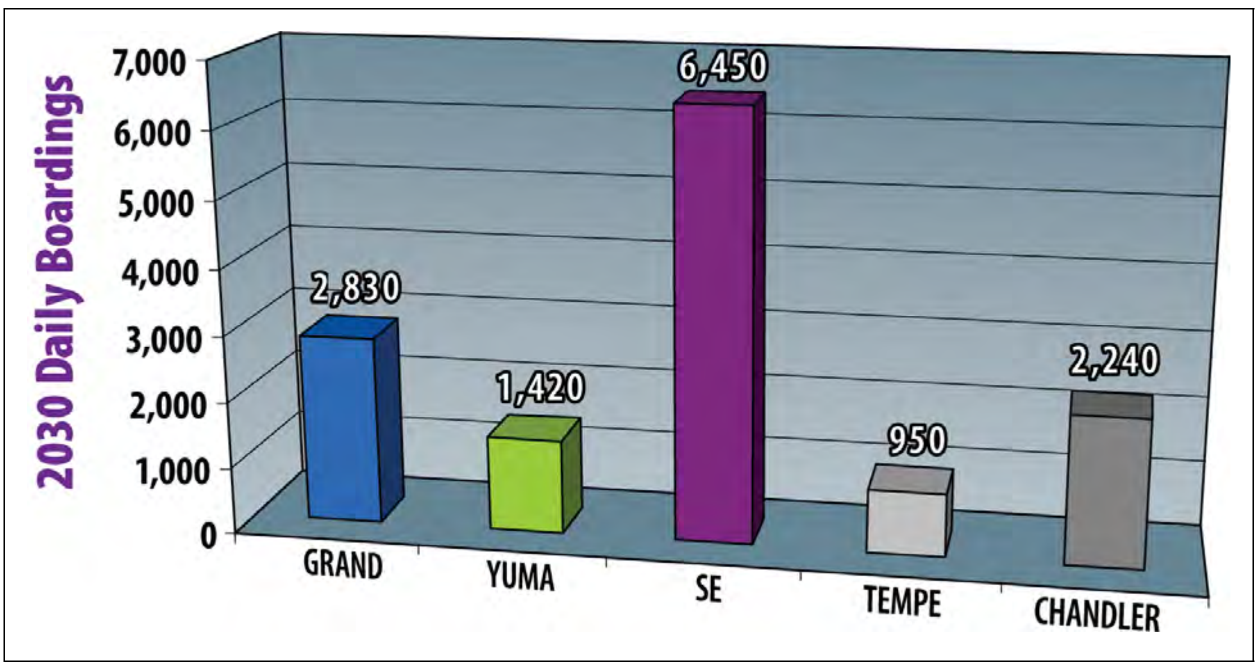
Round 1 ridership forecasting results indicated that two of the corridors – Grand and Yuma – included underperforming stations at or near the end-of-line of both corridors. Even with the frequent service modeled in Round 1, both the downtown Wickenburg and West Wickenburg stations on the Grand Corridor had fewer than 100 daily boardings, while the Arlington station on the Yuma Corridor had fewer than 50 daily boardings. Based on these results, the downtown Wickenburg and West Wickenburg stations along the Grand Corridor and the Arlington station along the Yuma Corridor were not included in the development of subsequent alternatives. For the purposes of the System Study, the Grand Corridor was shortened to Wittmann and the Yuma Corridor was shortened to Buckeye.

3.4.2 Round 2: Stand-Alone Base and Combined Base Alternatives Ridership Forecasting Results

3.4.2.1 Stand-Alone Base Alternatives

Ridership forecasting results for the Stand-Alone Base Alternatives in Round 2 indicated that the SE Corridor, with 6,450 daily boardings, would be the strongest individual corridor in the commuter rail system. The SE Corridor has 56 percent more boardings than the next strongest corridor, which is the Grand Corridor, with 2,830 daily boardings. As illustrated in Figure 3-3, the SE, Grand, and Chandler Corridors attract the most riders.

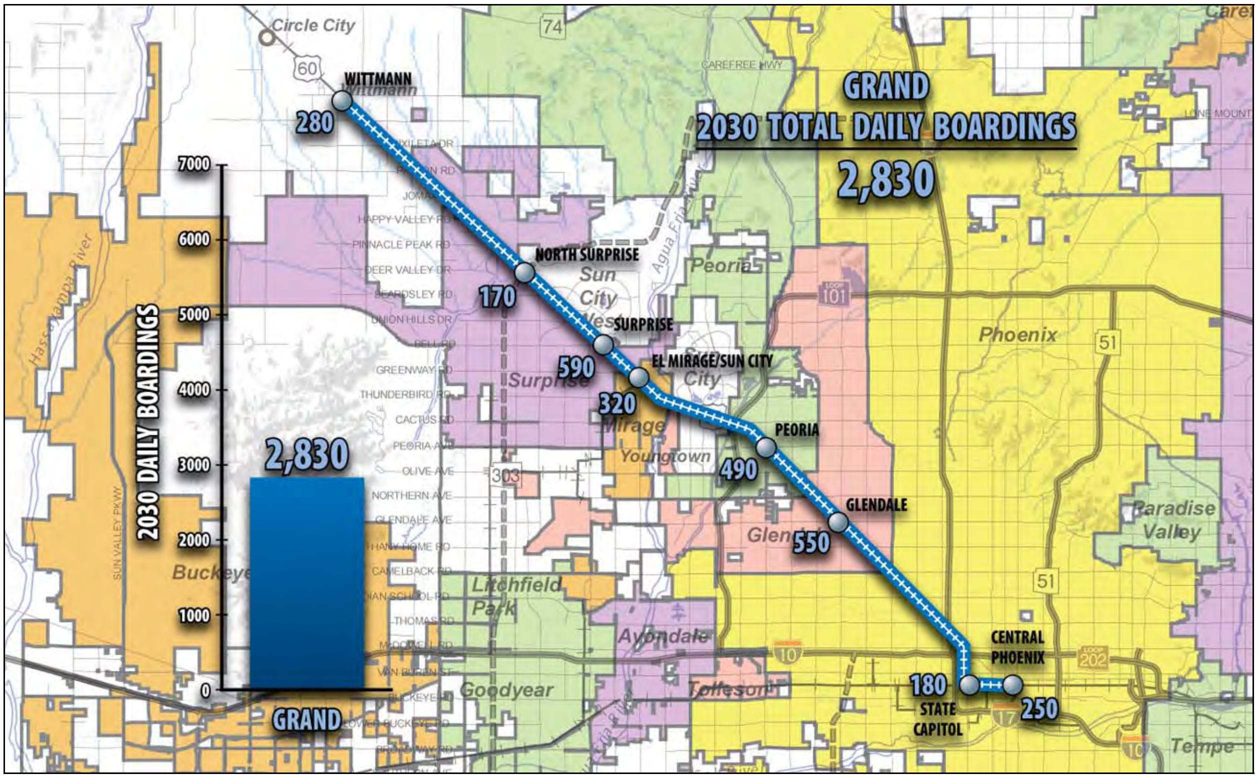
Figure 3-3: Stand-Alone Base Alternatives 2030 Total Daily Boardings



Source: URS Corp., 2009.

The following pages summarize the ridership forecasting results for each Stand-Alone Base Alternative.

Figure 3-4: Grand Corridor 2030 Total Daily Boardings



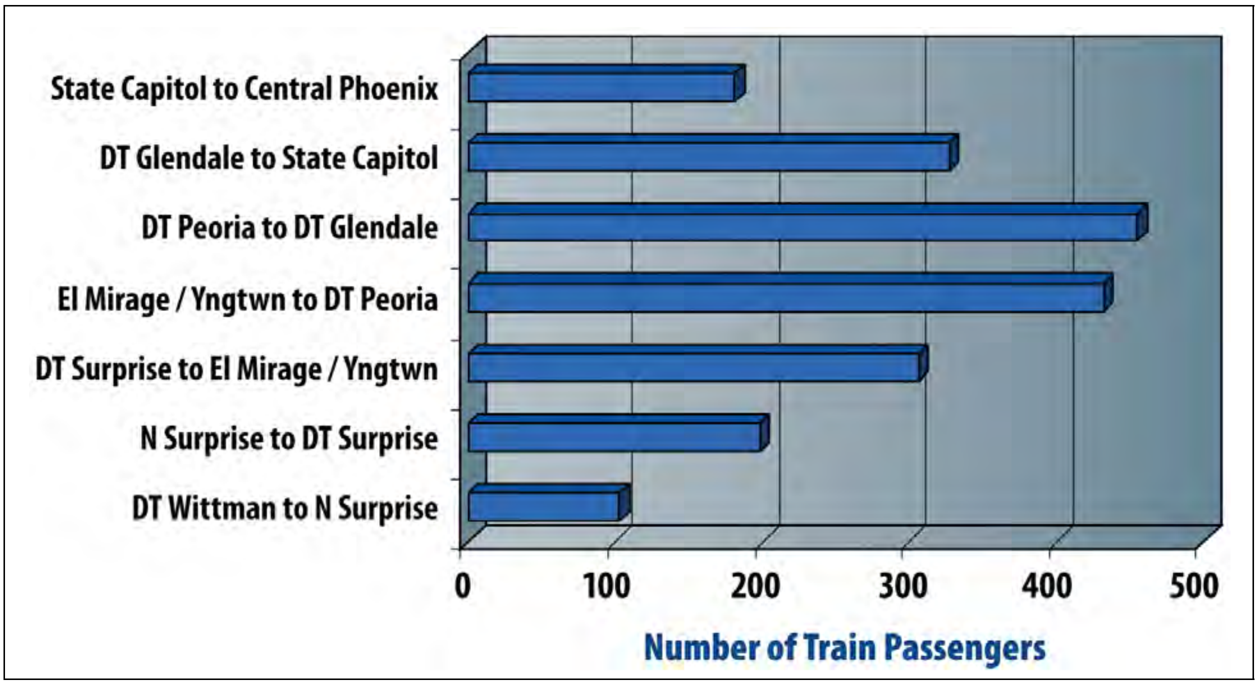
Source: URS Corp., 2009.

Findings: Overall, the Grand Corridor shows moderate ridership. The strongest boardings would be found throughout the middle of the corridor, between Glendale and downtown Surprise. The highest boardings along the corridor would be found at the two downtown stations located outside the Central Phoenix area: downtown Glendale (with 550 boardings) and downtown Surprise (with 590 boardings).

As shown in Figure 3-5, an analysis of AM peak period passenger loadings on inbound trains reveals that the number of passengers on the train is greatest between El Mirage and downtown Glendale. At each station between downtown Wittmann and downtown Peoria, more passengers are loading than are off-loading. Once the commuter rail train reaches the downtown Glendale station, this trend would reverse and more passengers would be off-loading than loading.

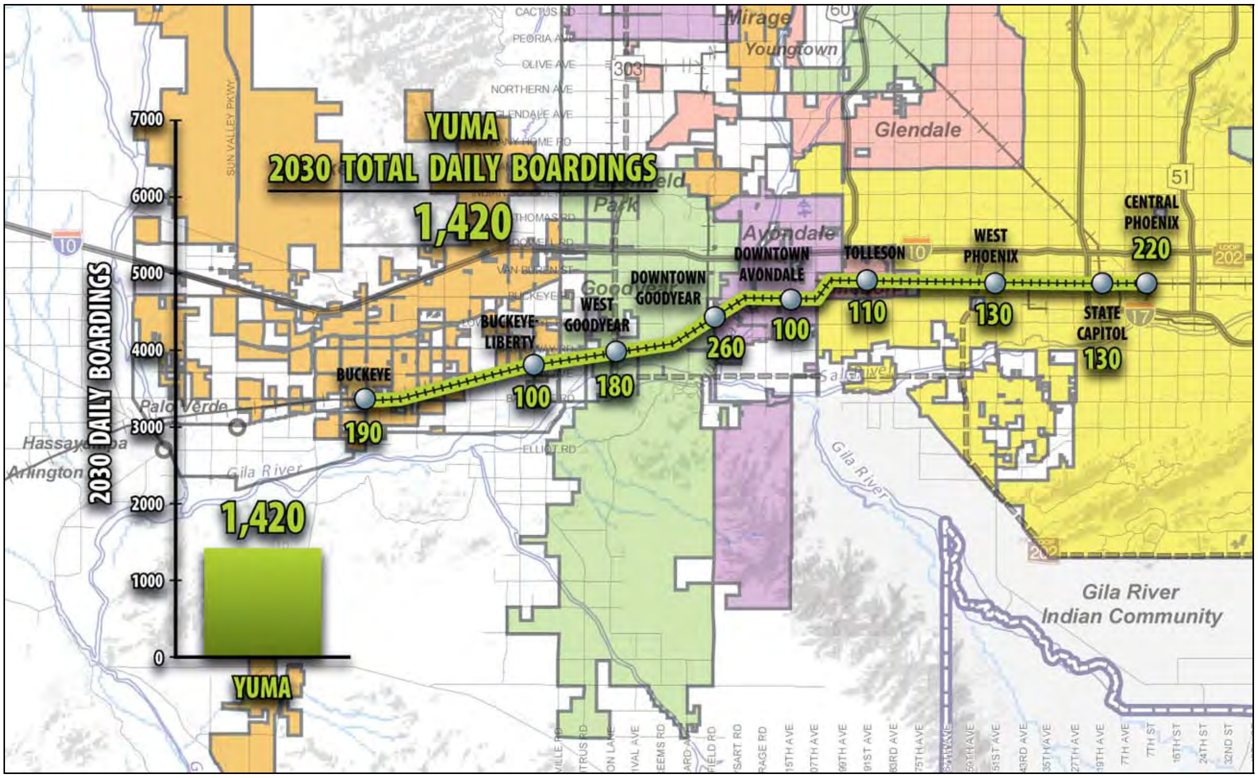
This analysis suggests that downtown Glendale, the State Capitol and Central Phoenix are major destinations along the corridor; and that Glendale is an employment center by 2030 that attracts significant numbers of off-loading riders in the AM peak period.

Figure 3-5: Grand Corridor 2030 A.M. Peak Period Passenger Loadings



Source: URS Corp., 2009.

Figure 3-6: Yuma Corridor 2030 Total Daily Boardings

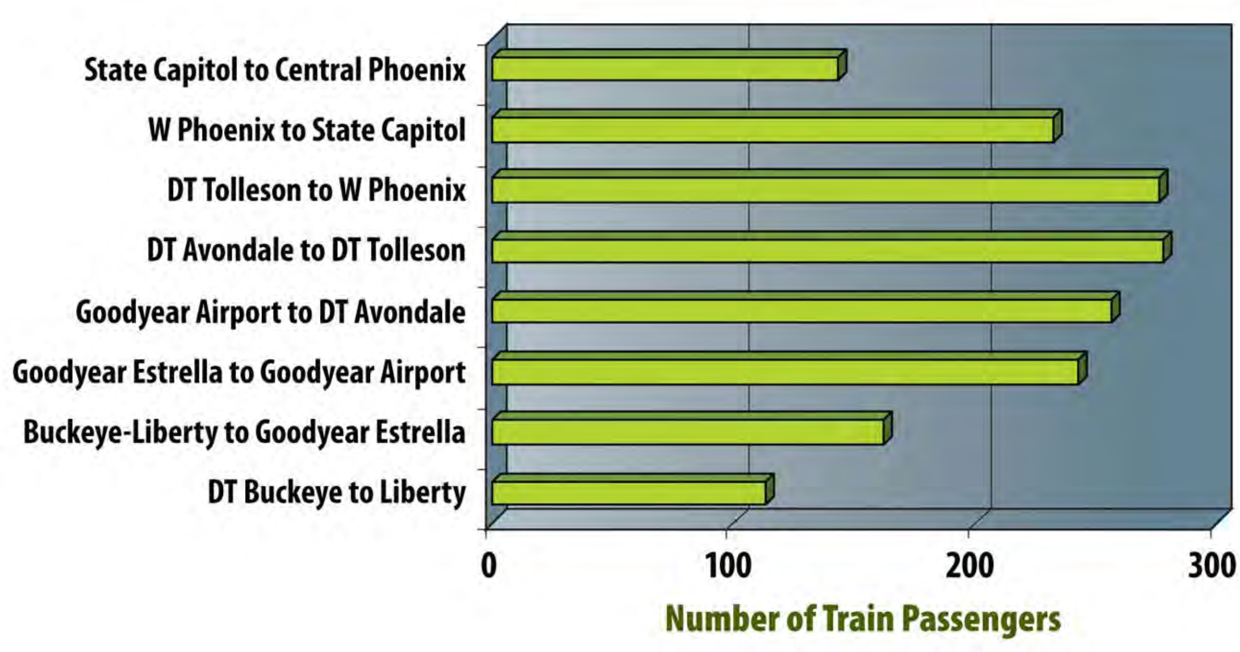


Source: URS Corp., 2009.

Findings: The Yuma Corridor has one of the lowest daily ridership forecasts of all the Stand-Alone Base Alternatives. The highest boardings along the corridor would be found at the Central Phoenix station (with 220 boardings) and Goodyear Airport station (with 260 boardings).

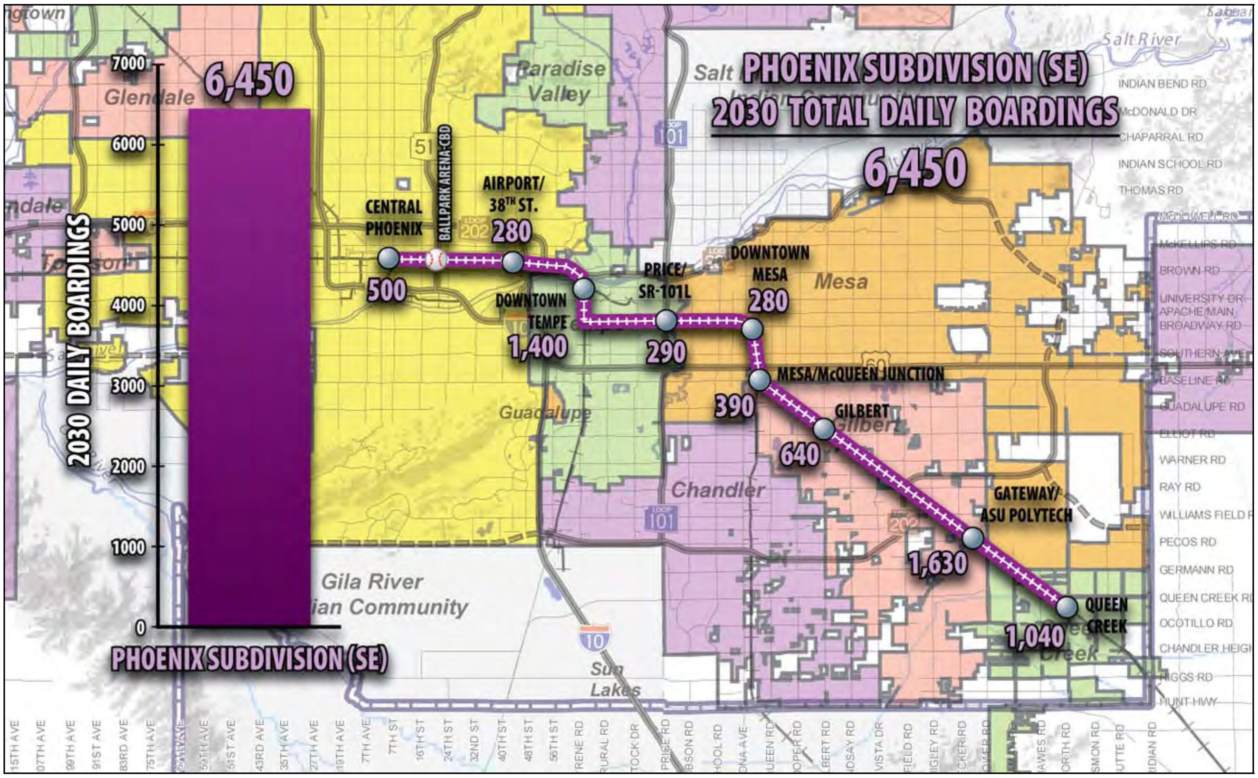
As shown in Figure 3-7, an analysis of AM peak period passenger loadings on inbound trains reveals that the number of passengers on the train is greatest between Goodyear Estrella and West Phoenix. At each station between Buckeye and downtown Tolleson, more passengers are loading than are off-loading. Once the commuter rail train reaches the West Phoenix station, this trend would reverse and more passengers would be off-loading than loading. This analysis suggests that West Phoenix, the State Capitol and Central Phoenix are major destinations along the corridor.

Figure 3-7: Yuma Corridor 2030 A.M. Peak Period Passenger Loadings



Source: URS Corp., 2009.

Figure 3-8: SE Corridor 2030 Total Daily Boardings

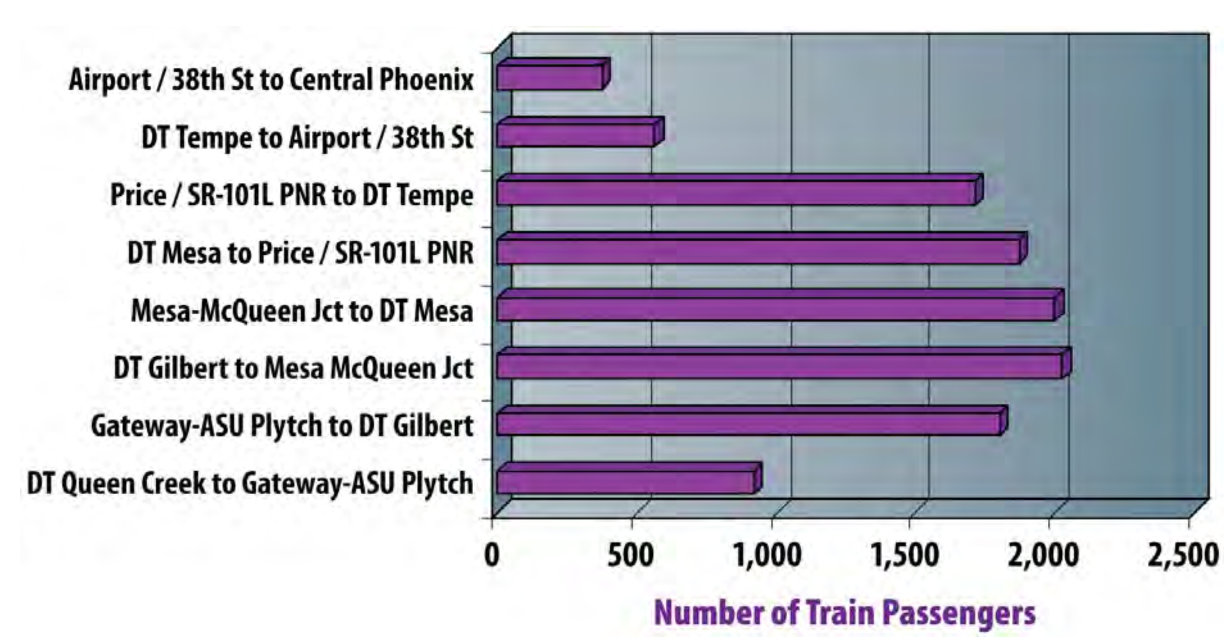


Source: URS Corp., 2009.

Findings: Overall, the SE Corridor is the strongest individual corridor in the system. Three stations along the corridor stand out as having the highest daily boardings, with 1,630 boardings at the Gateway/ASU Polytech station, 1,400 boardings at the downtown Tempe station and 1,040 boardings at the Queen Creek end-of-line station. A portion of the high number of potential passengers at the Queen Creek station is likely coming from the San Tan Valley area within Pinal County and the projected high number at the Gateway/ASU Polytech station is likely from a mix of the students attending the campus, travelers from the Phoenix-Mesa Gateway Airport and from residents living nearby.

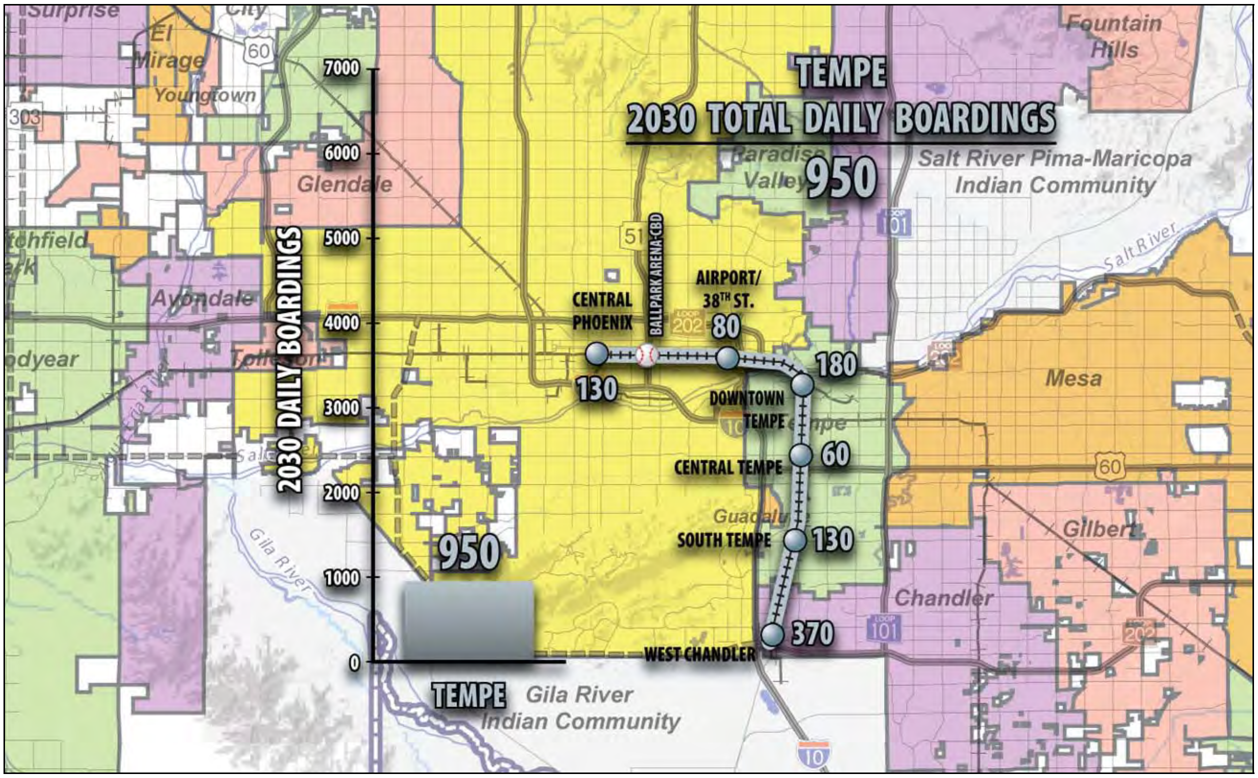
As shown in Figure 3-9, an analysis of AM peak period passenger loadings on inbound trains reveals that the number of passengers on the train is greatest between Gateway/ASU Polytech and downtown Tempe. At each station between Queen Creek and Gilbert, more passengers are loading than are off-loading. Once the commuter rail train reaches the Mesa/Queen Creek station, this trend reverses and more passengers are off-loading than loading. An important finding is that the number of passengers on the train is reduced by more than 50 percent after reaching downtown Tempe, indicating that Tempe is a significant destination for commuters along the corridor.

Figure 3-9: SE Corridor 2030 A.M. Peak Period Passenger Loadings



Source: URS Corp., 2009.

Figure 3-10: Tempe Corridor 2030 Total Daily Boardings

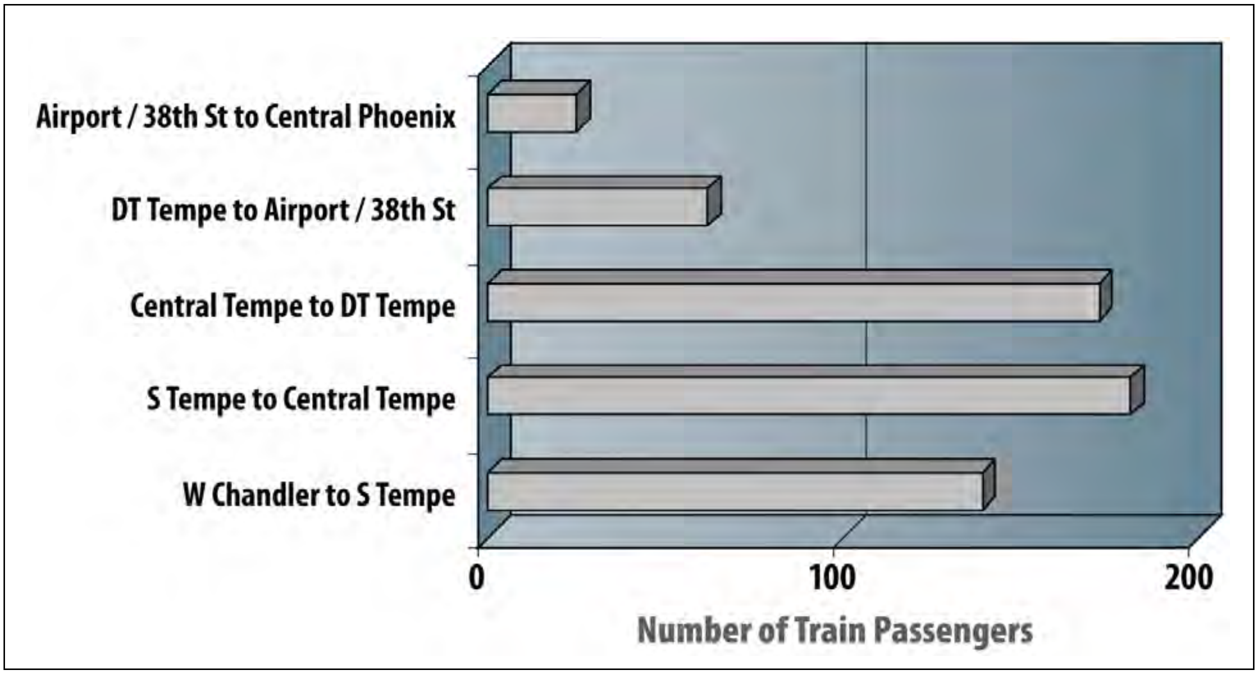


Source: URS Corp., 2009.

Findings: As the shortest corridor among the System Study corridors and with fewer than 1,000 daily boardings, the Tempe Corridor would have the lowest daily ridership of all the Stand-Alone Base Alternatives. With 370 daily boardings, the West Chandler end-of-line station has the highest boardings along the corridor and more than twice the number of boardings found at the next most productive station, which is downtown Tempe with 180 boardings.

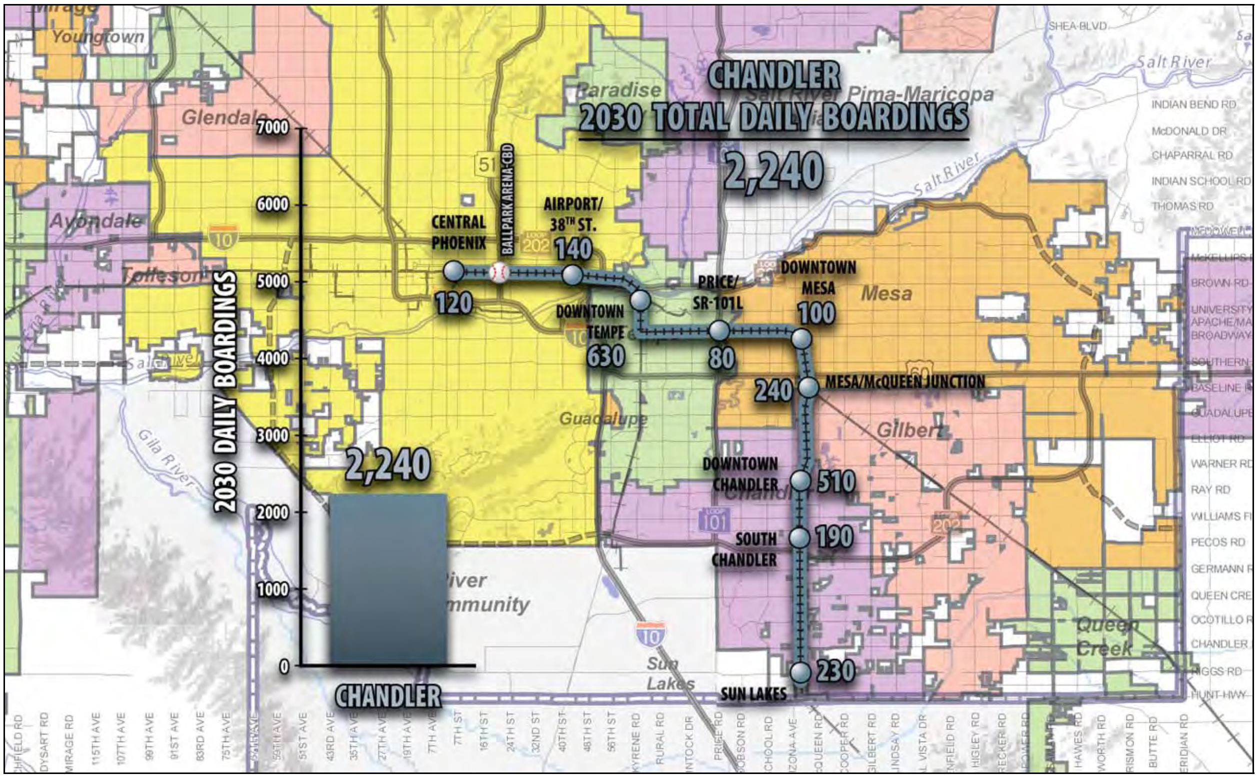
As shown in Figure 3-11, an analysis of AM peak period passenger loadings on inbound trains reveals that the number of passengers on the train is greatest between Chandler and downtown Tempe. Like the SE Corridor, passenger loadings on inbound trains reveal that the number of passengers on the train is reduced by more than 50 percent after reaching downtown Tempe, indicating that Tempe is a significant destination for commuters along the Tempe Corridor.

Figure 3-11: Tempe Corridor 2030 A.M. Peak Period Passenger Loadings



Source: URS Corp., 2009.

Figure 3-12: Chandler Corridor 2030 Total Daily Boardings

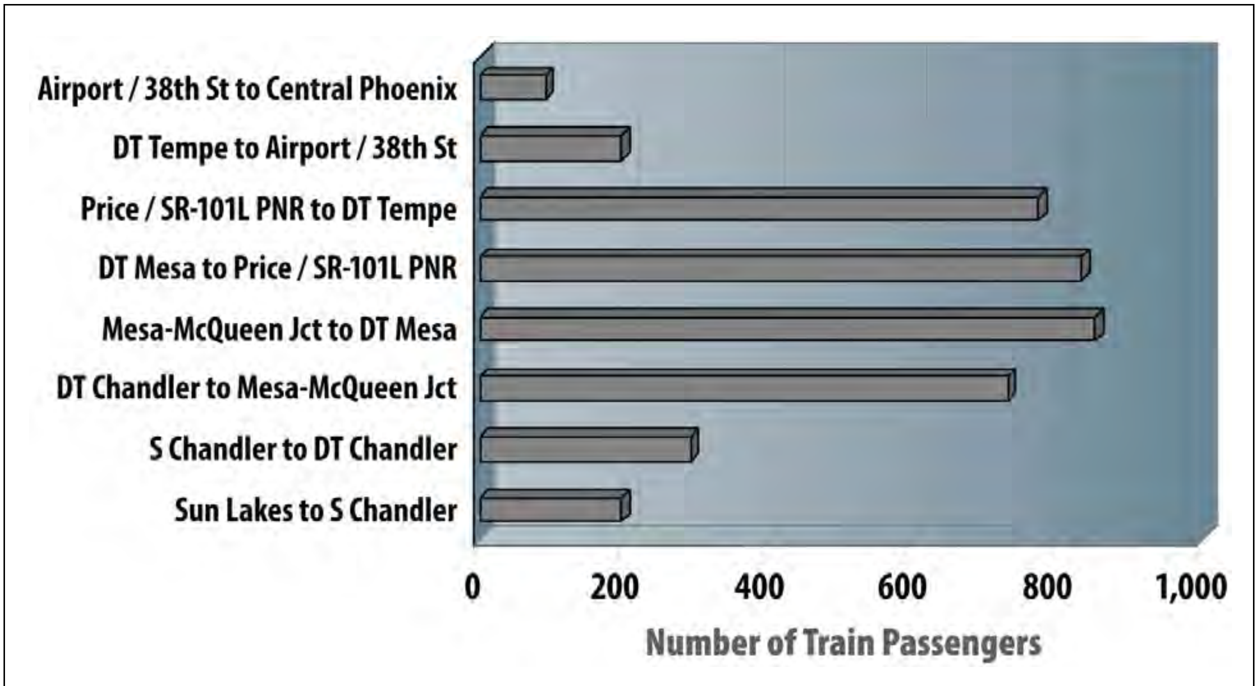


Source: URS Corp., 2009.

Findings: Among the East Valley corridors, the Chandler Corridor, with approximately 2,240 daily boardings, has less than a third of the boardings found along the SE Corridor but more than double the number of boardings found along the Tempe Corridor. The highest boardings along the Chandler Corridor are found at the downtown Tempe station, with 630 daily boardings, and the downtown Chandler station, with 510 daily boardings.

As shown in Figure 3-13, an analysis of AM peak period passenger loadings on inbound trains reveals that the number of passengers on the train is greatest between Chandler and downtown Tempe. Like the other East Valley corridors, the number of passengers on the train is reduced by more than 50 percent after the downtown Tempe station, indicating that Tempe is a significant destination for commuters along the corridor.

Figure 3-13: Chandler Corridor 2030 A.M. Peak Period Passenger Loadings

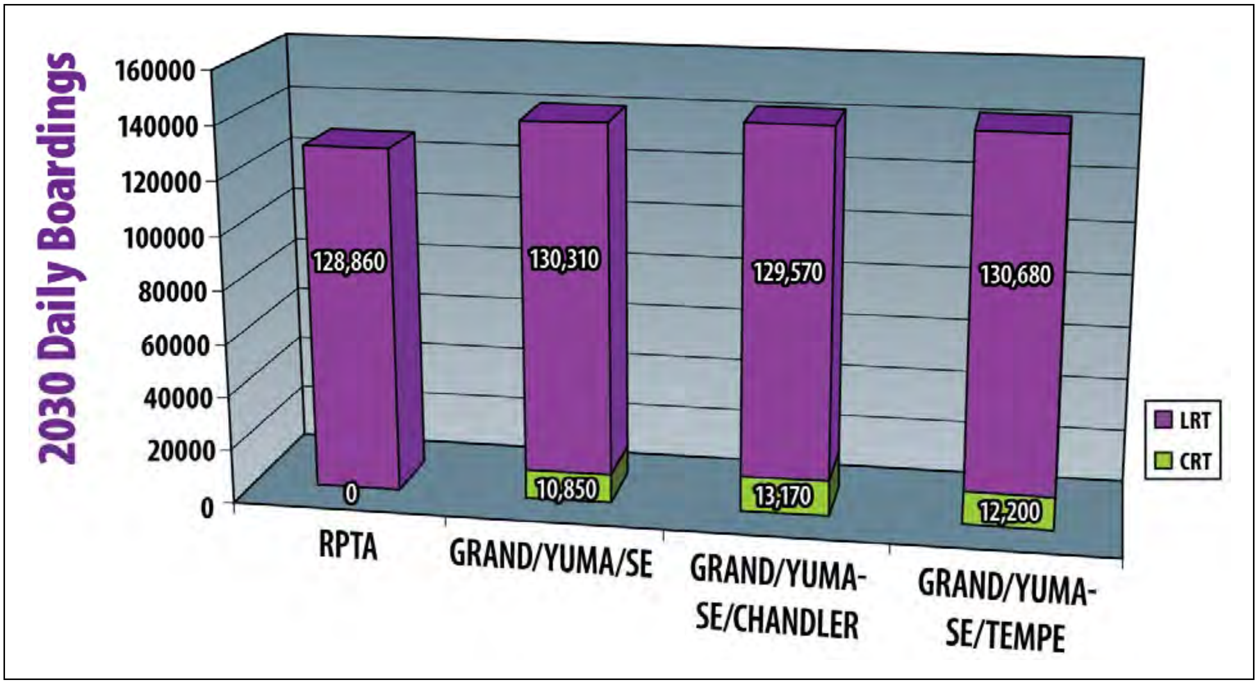


Source: URS Corp., 2009.

3.4.2.2 Combined Base Alternatives

Ridership forecasting for the Combined Base Alternatives was used to determine the impacts a multi-corridor commuter rail system would have on the overall Phoenix regional transit system, including the approximately 57 miles of high capacity transit included in the RTP 2007 Update. System wide, approximately 129,000 daily boardings are forecast on the planned high capacity transit system (including bus, BRT and LRT) in 2030. Results of the MAG System Study ridership forecasting indicated that with the implementation of a multi-corridor commuter rail system, LRT boardings would remain stable (within one percent of the RTP). See Figure 3-14.

Figure 3-14: Combined Base Alternatives 2030 Total Daily Boardings



Source: URS Corp., 2009.

Therefore, ridership forecasting indicates that implementing commuter rail would add transit riders to the high capacity transit system, rather than “stealing” riders from LRT. Commuter rail generally does not take riders away from an LRT system, because the two transit modes serve different markets. LRT generally serves shorter distance trips throughout the day, while commuter rail generally serves longer distance trips primarily during peak travel hours.

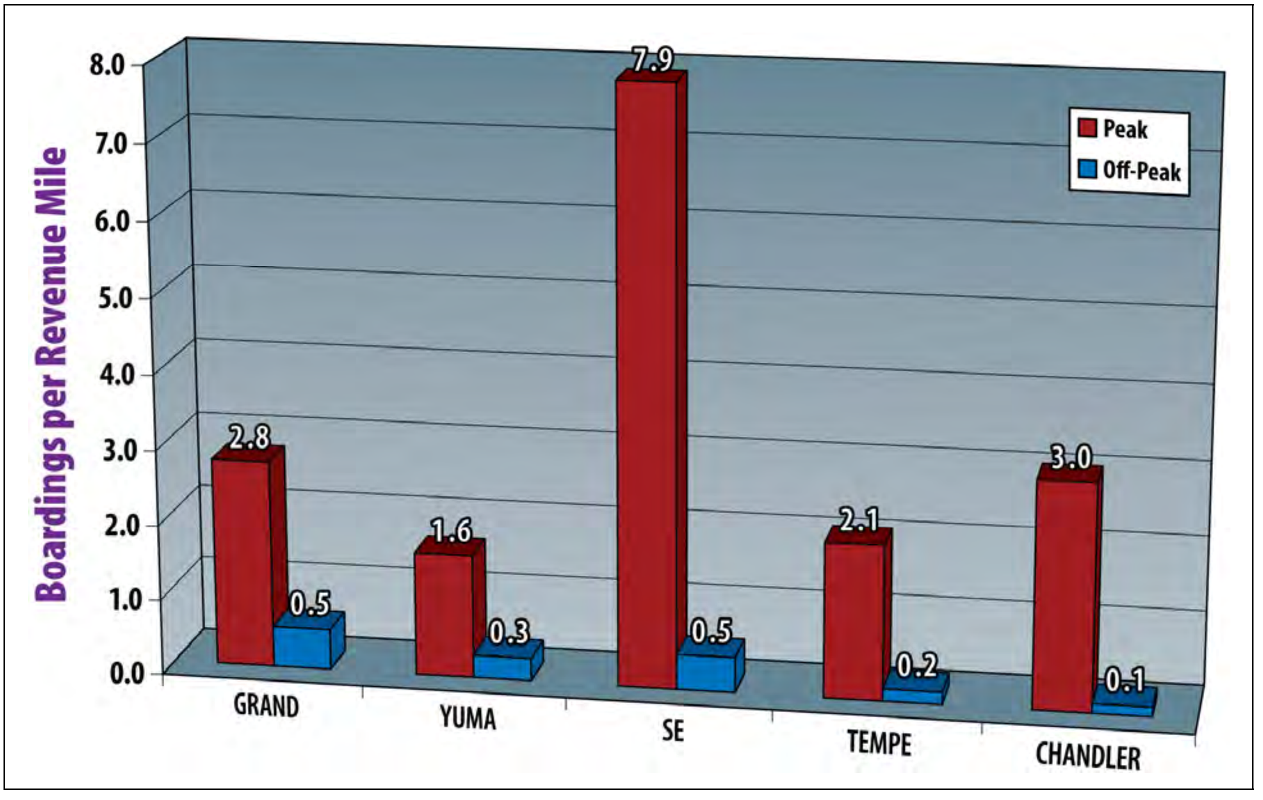
Ridership forecasting for the Combined Base Alternatives was also used to assess how the commuter rail corridors would interact together, thereby informing the composition of the Round 3A and 3B Alternatives. One of the most revealing findings was that when the Chandler and SE Corridors are combined, the two corridors would compete with each other for ridership and the Chandler Corridor would “steal” riders from the SE Corridor. Therefore, Round 3A Interlined Alternatives and Round 3B Alternate Interlined Alternatives do not include the SE and Chandler Corridors in combination with each other.

3.4.2.3 Additional Findings for Round 2 Alternatives

3.4.2.3.1 Peak vs. Off-Peak Boardings

Ridership forecasting results showed that all commuter rail corridors would experience heavy use during the peak hours. As shown in Figure 3-15, approximately 85 to 90 percent of commuter rail trips would occur in the peak period, while only 10 to 15 percent of commuter rail trips would occur in the off-peak period. Heavy peak period ridership is typical of most commuter rail systems, which generally offer frequent peak-period service and more limited service during off-peak periods.

Figure 3-15: Stand-Alone Base Alternatives 2030 Boardings per Revenue Mile



Source: URS Corp., 2009.

3.4.2.3.2 Special Events Ridership

Special events ridership has proven to be a substantial contributor to light rail ridership in the region, but it is difficult to quantify the impact on commuter rail ridership using available model information. The operations plans summarized in Section 3.3 indicate that special events service would occur in all phases. Special event venues in downtown Phoenix include but are not limited to the U.S. Airways Arena, Chase Field, the Dodge Theater, the Phoenix Convention Center, and Symphony Hall. Downtown Tempe is also a center for special events that attract attendees from throughout the region.

To assess the magnitude of the potential impact on ridership, special events were considered through a review of major events and their expected attendance in these two downtown areas. Downtown Phoenix is the home of two major sports teams, the Arizona Diamondbacks and the

Phoenix Suns. The Phoenix Civic Center hosts a number of large events throughout the year, such as the International Auto Show. First Fridays Artlink is a monthly event that continues to grow in popularity and attract people downtown. The annual attendance of these events in downtown Phoenix is estimated in Table 3-7.

Downtown Tempe hosts a number of large events that could be served in part by commuter rail. Arizona State University football games as well as the college bowl game draw large numbers of people from the entire Phoenix area. In addition, Tempe hosts a number of annual events including: the Tempe Arts Fest, New Year's Block Party, Tempe 4th of July Celebration, and the Tempe Music Fest. The estimated attendance for these events is shown in Table 3-7.

Table 3-7: Estimated Major Special Events Attendance

Special Event	Typical Annual Attendance
Downtown Phoenix	
Arizona Diamondbacks games	2,400,000
Phoenix Suns games	855,000
Phoenix Civic Center	1,000,000
First Fridays Artlink	300,000
Total for Downtown Phoenix	**4,555,000**
Downtown Tempe	
ASU football	400,000
College Bowl Game	50,000
Tempe Arts Fest	250,000
New Year's Block Party	100,000
Fourth of July	100,000
Tempe Music Fest	25,000
Total for Downtown Tempe	**925,000**

Source: URS Corp., 2009.

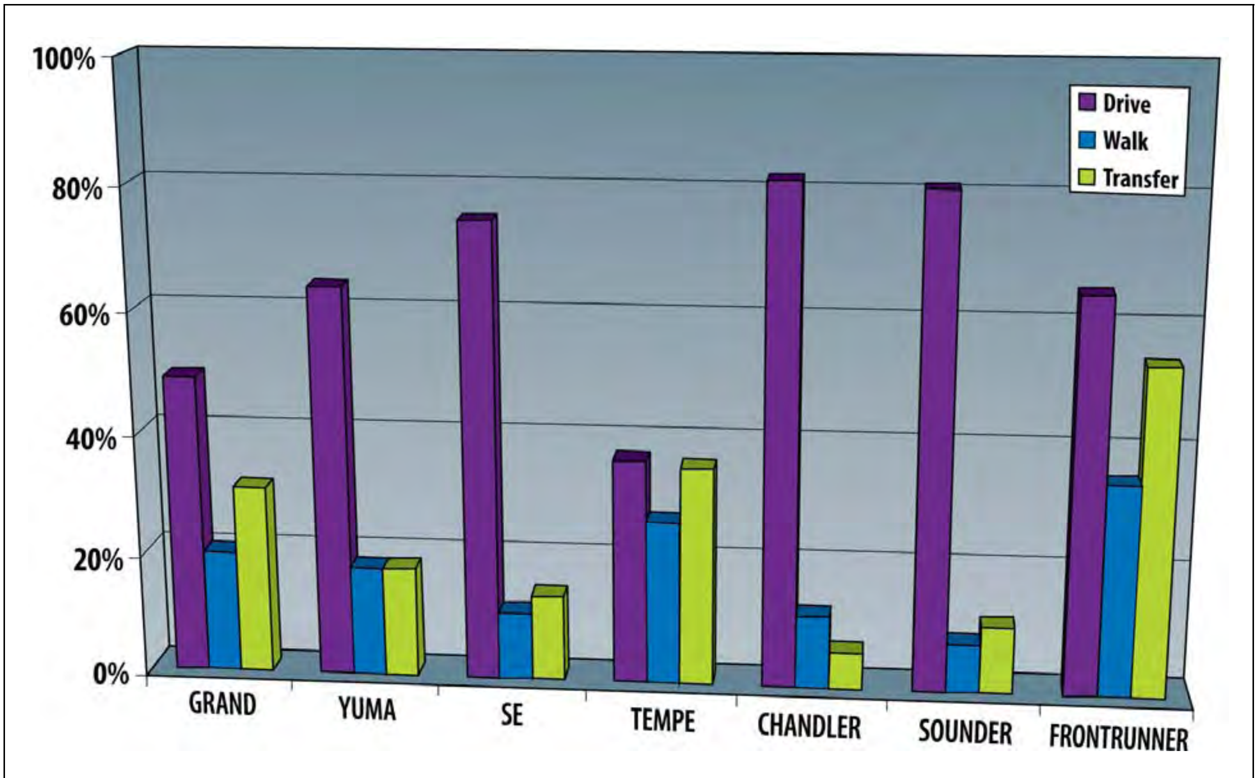
Both downtown Phoenix and Tempe host many other events, as well. However, the events listed above are some of the largest and are thus most likely to have a threshold of attendees high enough to benefit from and be attracted to commuter rail service.

Annual attendance to large special events in downtown Phoenix and Tempe is estimated at 5,480,000. Studies of other regions have found that transit may capture between 10 and 25 percent of special event trips. A conservative estimate of 10 percent of trips that would use some form of transit would equate to 548,000 trips annually (one-way).

3.4.2.3.3 Mode of Access

Mode of access refers to the way in which transit patrons access commuter rail by driving in automobiles, cycling, walking, or transferring from another form of transit, such as a bus or LRT. The "Drive" mode refers to transit riders that drive from their origin to the commuter rail station. The "Walk" mode refers to transit riders that walk from their point of origin to the station, without driving or taking a bus. The "Transfer" mode refers to transit riders that utilize bus or LRT prior to boarding at a commuter rail station. Figure 3-16 shows the mode of access for the Round 2 Stand-Alone Base Alternatives, along with mode of access for two comparable recent commuter rail systems, the Sounder commuter rail system in Seattle and the FrontRunner commuter rail system in Salt Lake City. The high percentage of "Drive" access is consistent with other commuter rail projects across the country.

Figure 3-16: Mode of Access by Commuter Rail Corridor*



Note: *For Sounder service, "Drive" access includes commuter rail riders who drive to and are dropped off at a commuter rail station. "Walk" access includes commuter rail riders who walk or bike to a commuter rail station. For FrontRunner service, "Transfer" includes both transferring from bus or LRT to a commuter rail station.

Source: URS Corp., 2009.

A review of the mode of access for each commuter rail corridor revealed that "Drive" access appears to be the dominant mode of access, while "Walk" and "Transfer" access are the lowest. The Tempe Corridor is the exception, which has an even distribution of "Drive", "Walk", and "Transfer" access. The Grand Corridor and Tempe Corridor have the highest "Transfer" access (greater than 20 percent) out of all five corridors, mainly due to the multiple bus and LRT connecting points along these lines. When comparing the mode of access to other peer cities, the Sounder service has a similar mode of access distribution to the SE and Chandler Corridors, while the FrontRunner service is similar to the Tempe Corridor with more "Transfer" access.

3.4.2.3.4 Ridership Forecasting Sensitivity Tests

The Project Team conducted four model sensitivity tests to verify ridership forecasting results for Round 2 Stand-Alone Base Alternatives and to assess how modifications to the model would impact ridership. For each sensitivity test, corridors that showed a ridership difference of 10 percent or greater compared to the base model corridor ridership were noted. (Changes of less than 10 percent are considered nominal and generally within normal model variation). The following sensitivity tests were conducted and results noted:

1. Removed selected RTP highway projects from the planned roadway network. These projects included construction of SR-801, SR-802, and portions of Loop 303 and improvements to I-17, and I-10. The Project Team sought to determine if commuters would opt to use commuter rail service if automobile mobility was limited along these highways without planned improvements.

   Result: In general, the impacts on travel time when planned highway projects are removed from the model do not result in substantial increases in projected commuter rail ridership. However, the SE corridor might see slightly higher commuter rail ridership (10 percent increase) if the SR-802 project is not constructed.

2. Increased the catchment area for drive access from eight to ten miles. The model limits the maximum number of miles a transit patron would drive to a commuter rail station to eight miles. The Project Team sought to determine if ridership would increase if the length commuters would consider driving to a station increased by two miles.

   Result: Changing the drive access assumption would not substantially influence ridership.

3. Changed the wait time for commuter rail riders from fifteen minutes to five minutes. Because commuter rail transit patrons generally plan their trips according to train schedules, a fifteen minute wait time assumed by the model is generally longer than most commuters would wait for a train at a station. The Project Team sought to determine if decreasing the wait time by ten minutes would increase ridership.

   Result: Changing the wait time yielded substantial increases in ridership for all corridors. Because wait times make up a relatively large component of the overall travel time for shorter trips, then those corridors with a predominance of shorter trip patterns – such as the Tempe Corridor – would be more likely to see a greater increase in ridership relative to corridors with longer trip patterns.

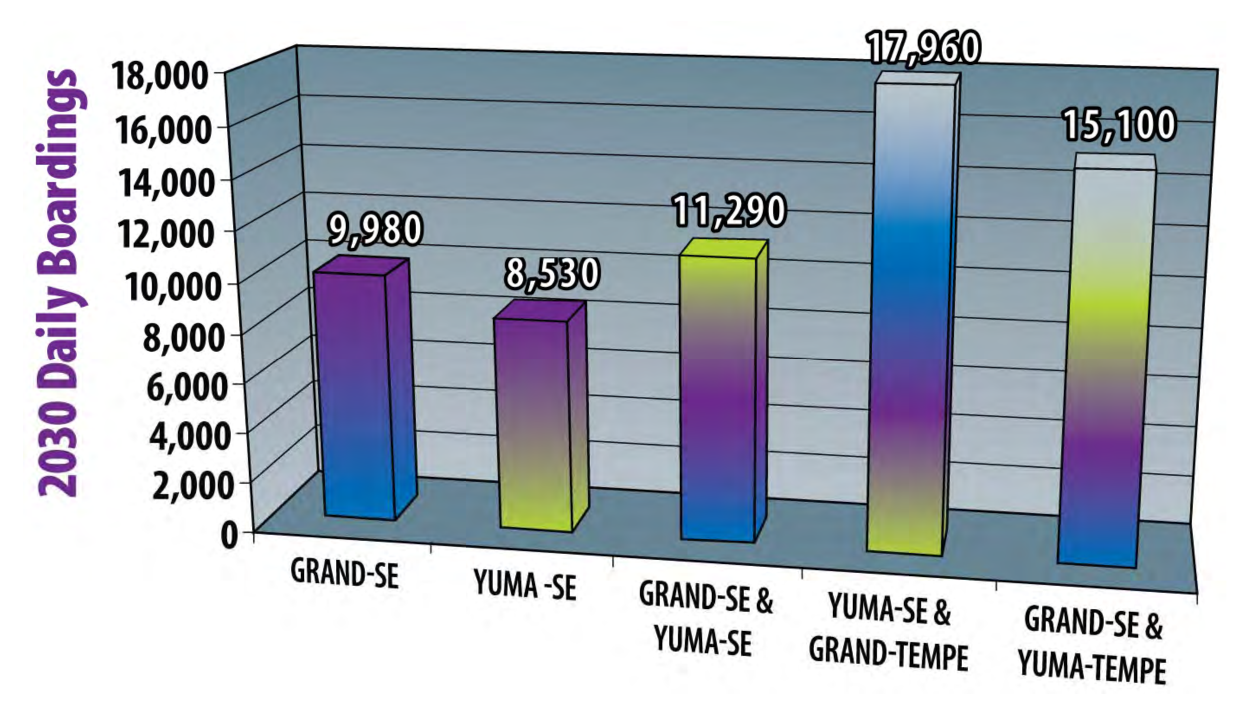
4. Changed the socioeconomic data from 2030 and to 2035 conditions. Initial ridership forecasts were based on year 2030 population/household and employment data. The Project Team sought to determine if ridership would increase using year 2035 demographic projections.

   Result: The Grand and Yuma Corridors would likely see a noticeable increase in ridership (17 percent and 19 percent increase respectively) between 2030 and 2035 if development occurs as predicted.

3.4.3 Round 3A: Interlined Alternatives Ridership Forecasting Results

Ridership forecasting results for the Interlined Alternatives ranged from 8,540 daily boardings with the interlining of the Yuma and SE Corridors to 17,940 daily boardings with the interlining of the Yuma and SE and Grand and Tempe Corridors. Figure 3-17 illustrates these ridership forecast results.

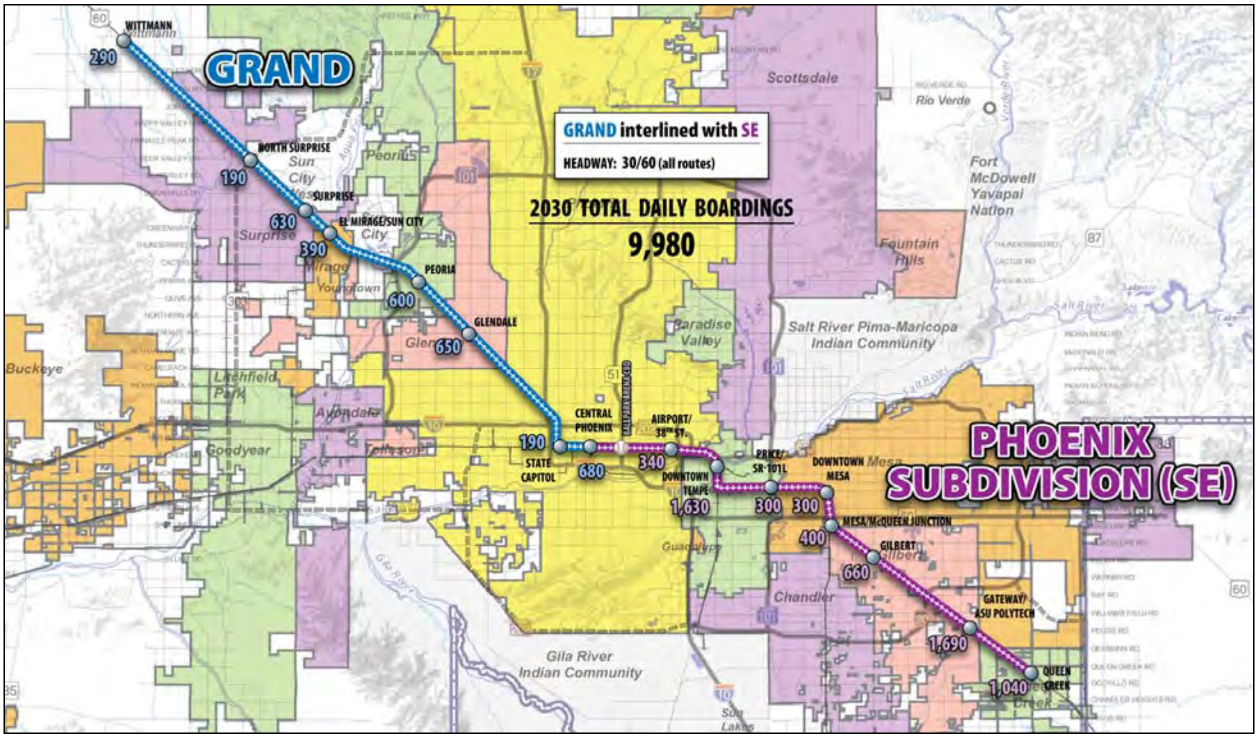
Figure 3-17: Interlined Alternatives 2030 Total Daily Boardings



Source: URS Corp., 2009.

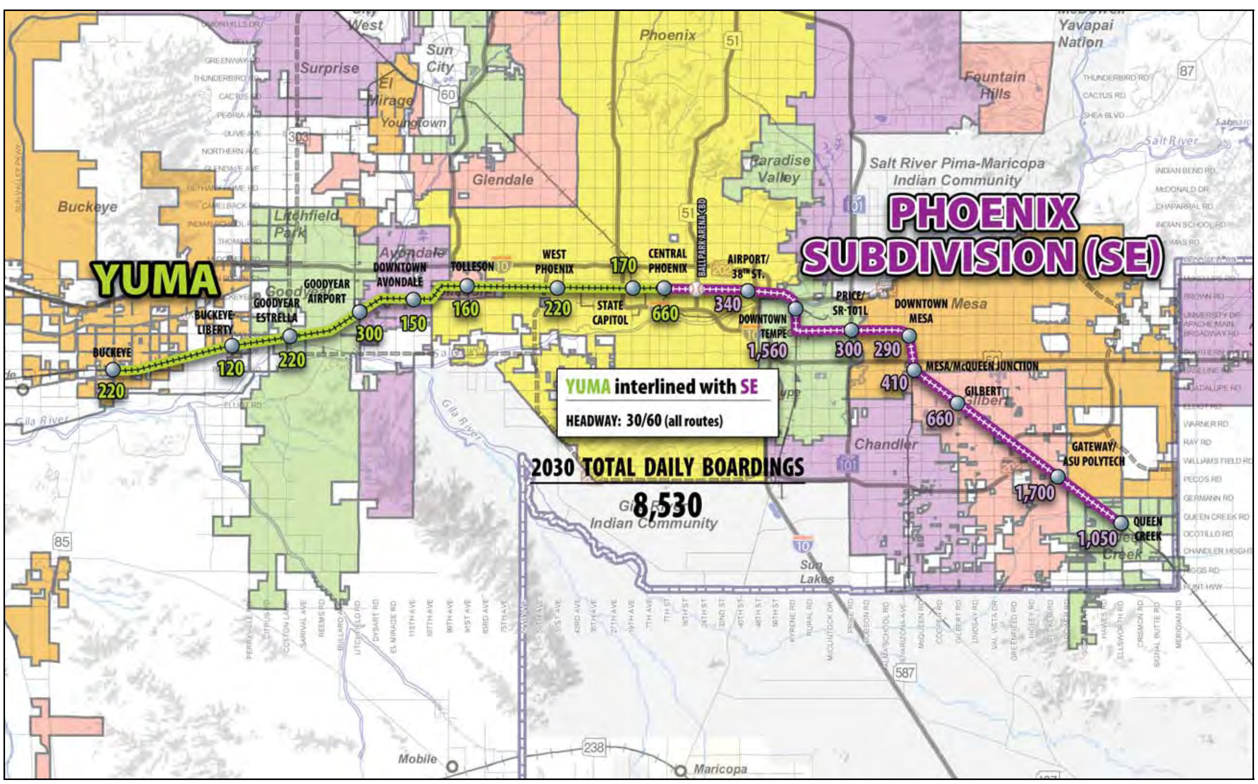
The following pages graphically illustrate the ridership forecasting results and findings for each Round 3A Interlined Alternative.

Figure 3-18: Grand Interlined with SE Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

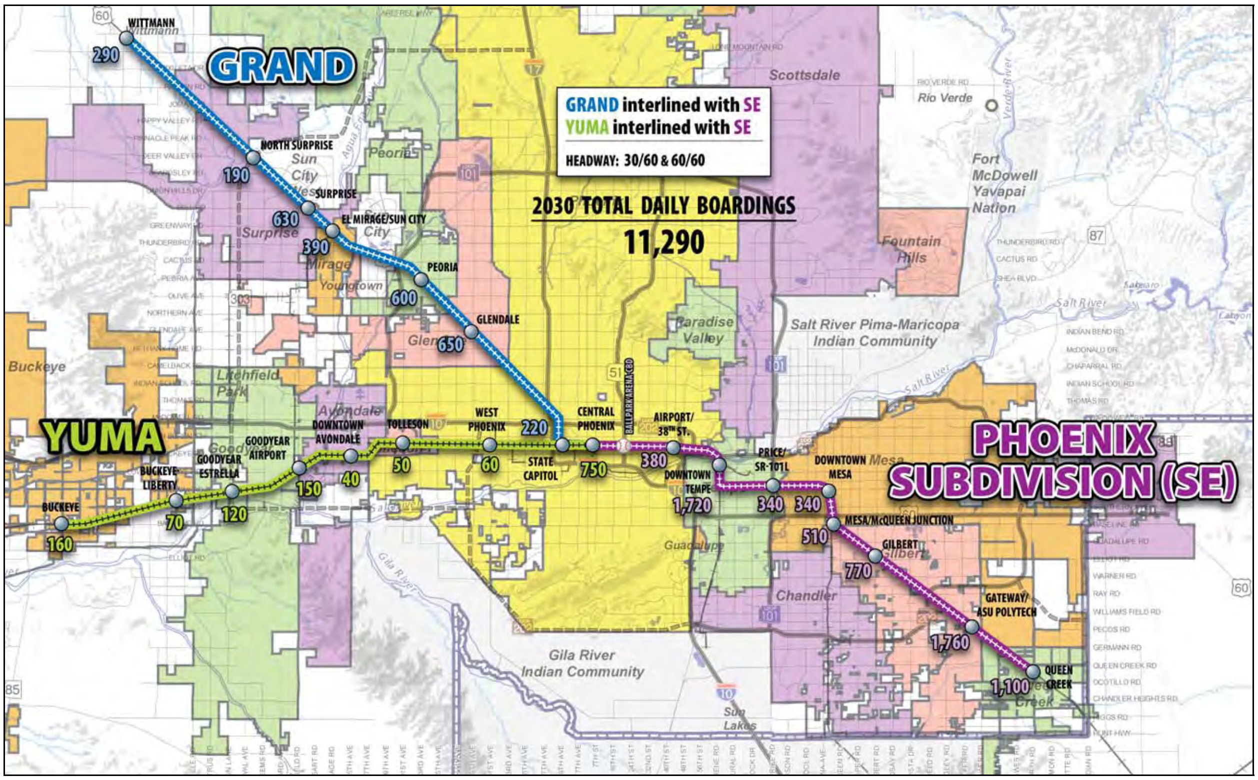
Figure 3-19: Yuma Interlined with SE Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

Findings: Ridership forecasting results for both of the 2-Corridor Alternatives indicate that interlining the Grand Corridor with the SE Corridor produces 1,450 more daily boardings in 2030 than interlining the Yuma Corridor with the SE Corridor. In both the 2-Corridor alternatives, the highest station boardings would be found at the downtown Tempe, Gateway ASU/Polytech and Queen Creek stations.

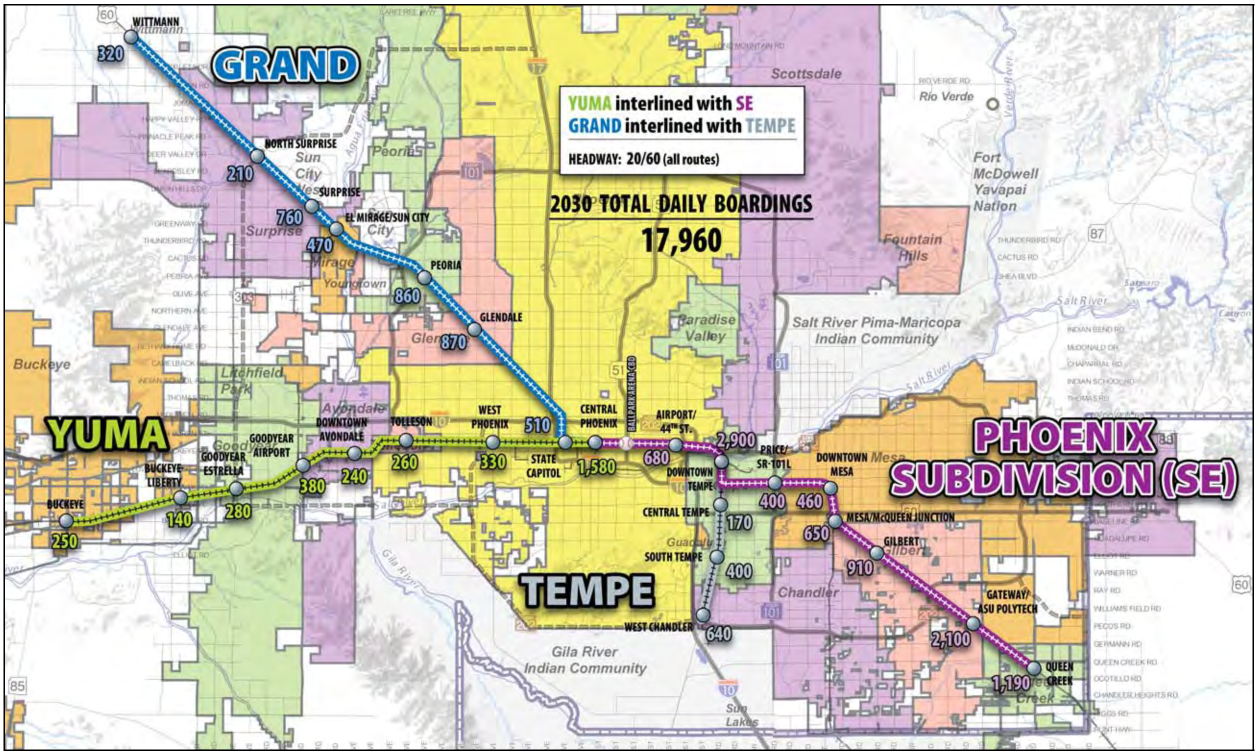
Figure 3-20: Grand Interlined with SE and Yuma Interlined with SE Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

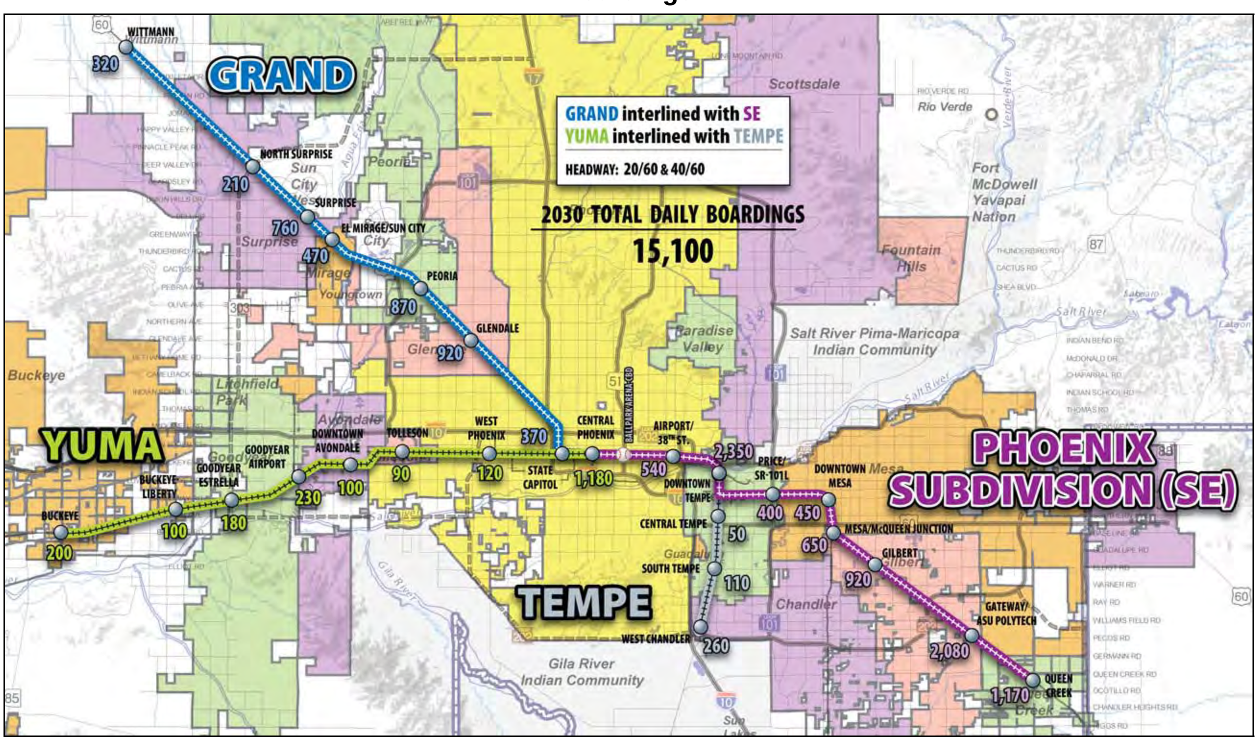
Findings: Ridership forecasting results for the single 3-Corridor Alternative indicate that interlining the Yuma and SE Corridors and the Grand and SE Corridors would produce just over 11,000 daily riders in 2030. As with the 2-Corridor alternatives, the highest station boardings would be found at the downtown Tempe, Gateway ASU/Polytech and Queen Creek stations.

Figure 3-21: Yuma Interlined with SE and Grand Interlined with Tempe Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

Figure 3-22: Grand Interlined with SE and Yuma Interlined with Tempe Corridor 2030 Total Daily Boardings



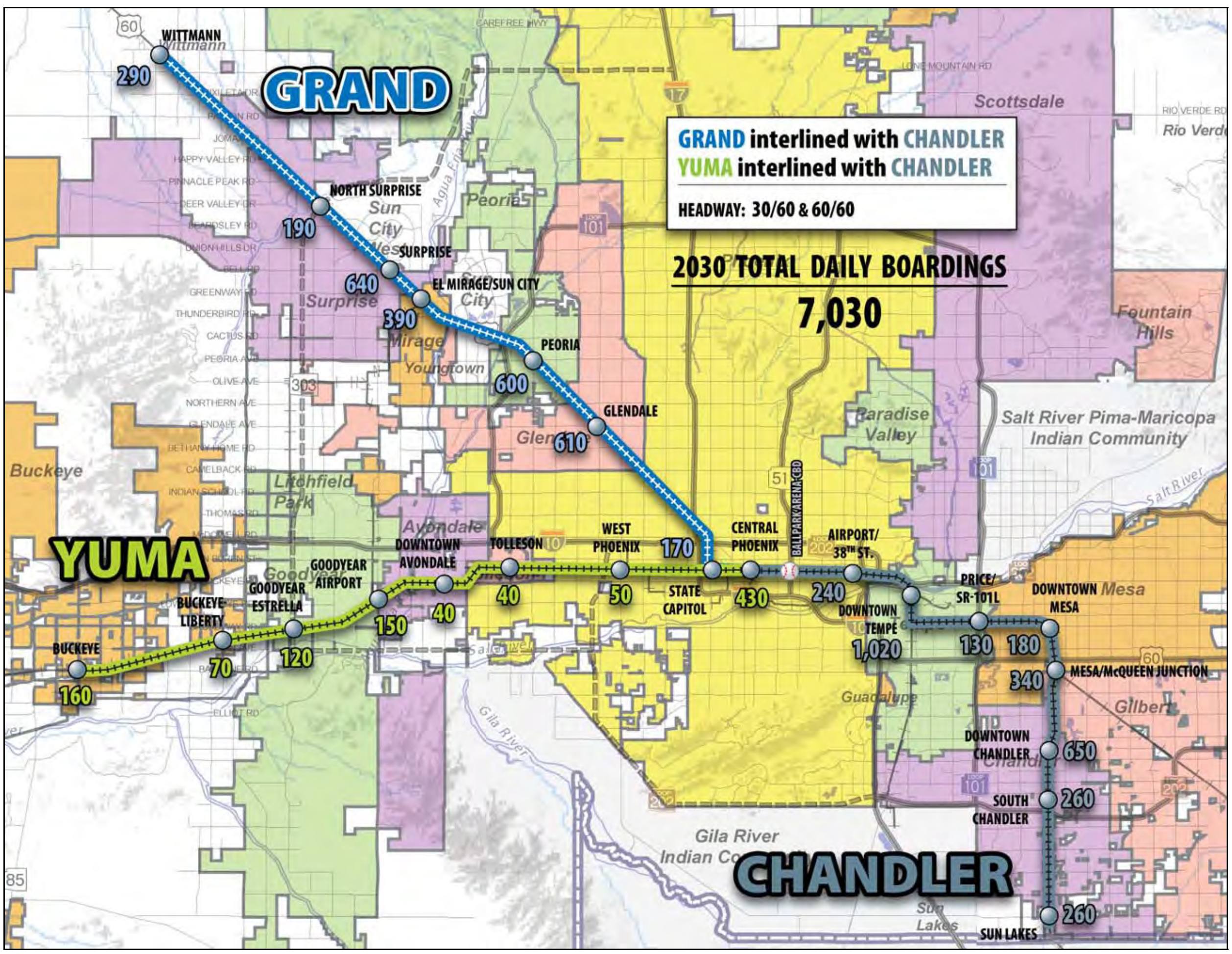
Source: URS Corp., 2009.

Findings: Ridership forecasting results for the two 4-Corridor Alternatives indicate that interlining the Yuma and SE Corridors and the Grand and Tempe Corridors would produce 2,860 more daily boardings in 2030 than interlining the Grand and SE Corridors and the Yuma and Tempe Corridors. As with the previous Interlined Alternatives, the highest station boardings would be found at the downtown Tempe, Gateway ASU/Polytech and Queen Creek stations; but Central Phoenix would see a substantial increase in boardings as well, with between 1,180 and 1,580 daily boardings.

3.4.4 Round 3B: Alternate Interlined Alternatives Ridership Forecasting Results

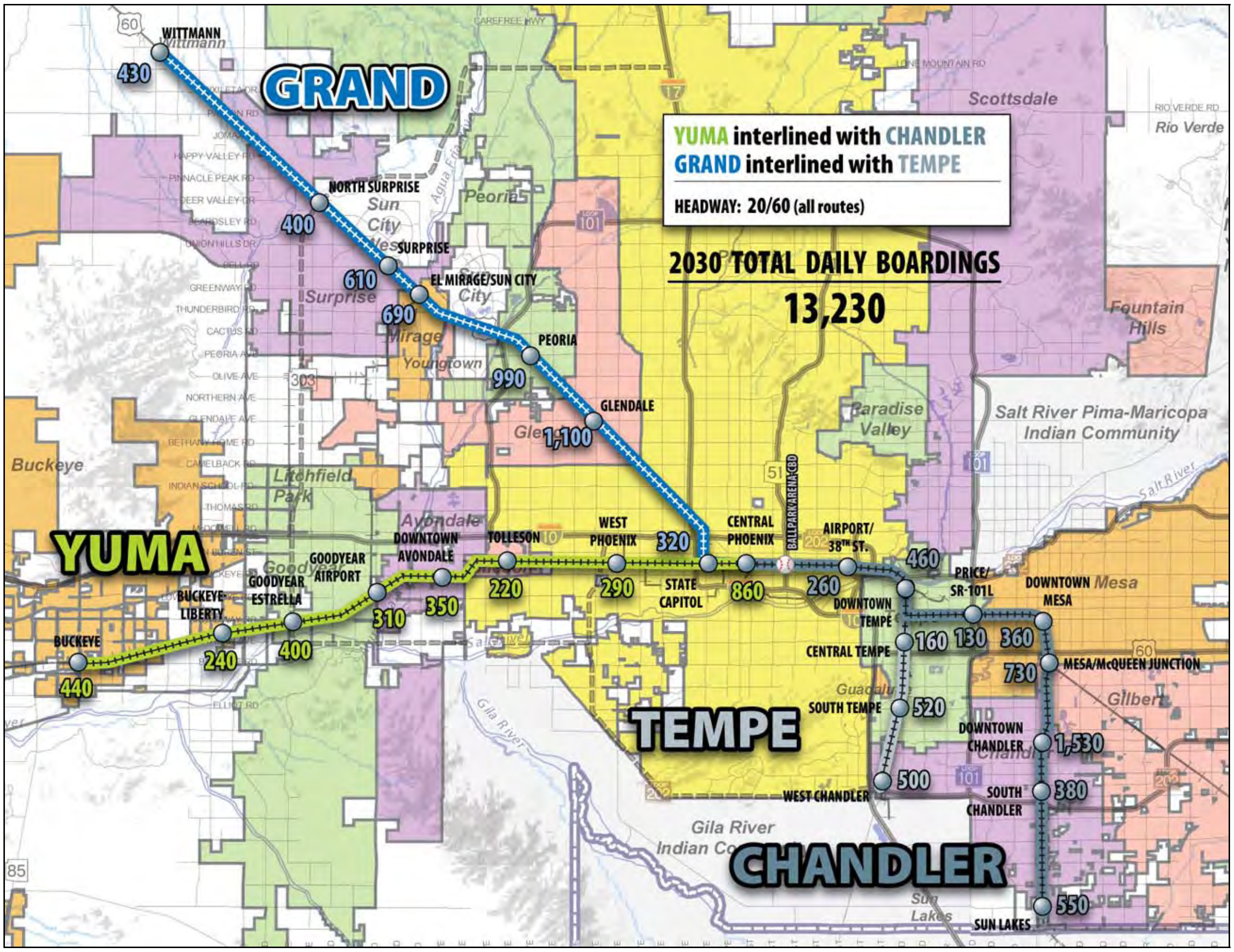
Ridership forecasting results for the Round 3B Alternate Interlined Alternatives, (which substituted the Chandler Corridor for the SE Corridor in these scenarios), ranged from 7,030 daily boardings with the interlining of the Chandler Corridor with both the Grand and Yuma Corridors to 13,230 daily boardings with the interlining of the Yuma Corridor with the Chandler Corrridor and the Grand Corridor with the Tempe Corridor. Figures 3-23 through 3-25 illustrate the ridership forecasting results for each Round 3B Alternate Interlined Alternative.

Figure 3-23: Grand Interlined with Chandler and Yuma Interlined with Chandler Corridor 2030 Total Daily Boardings



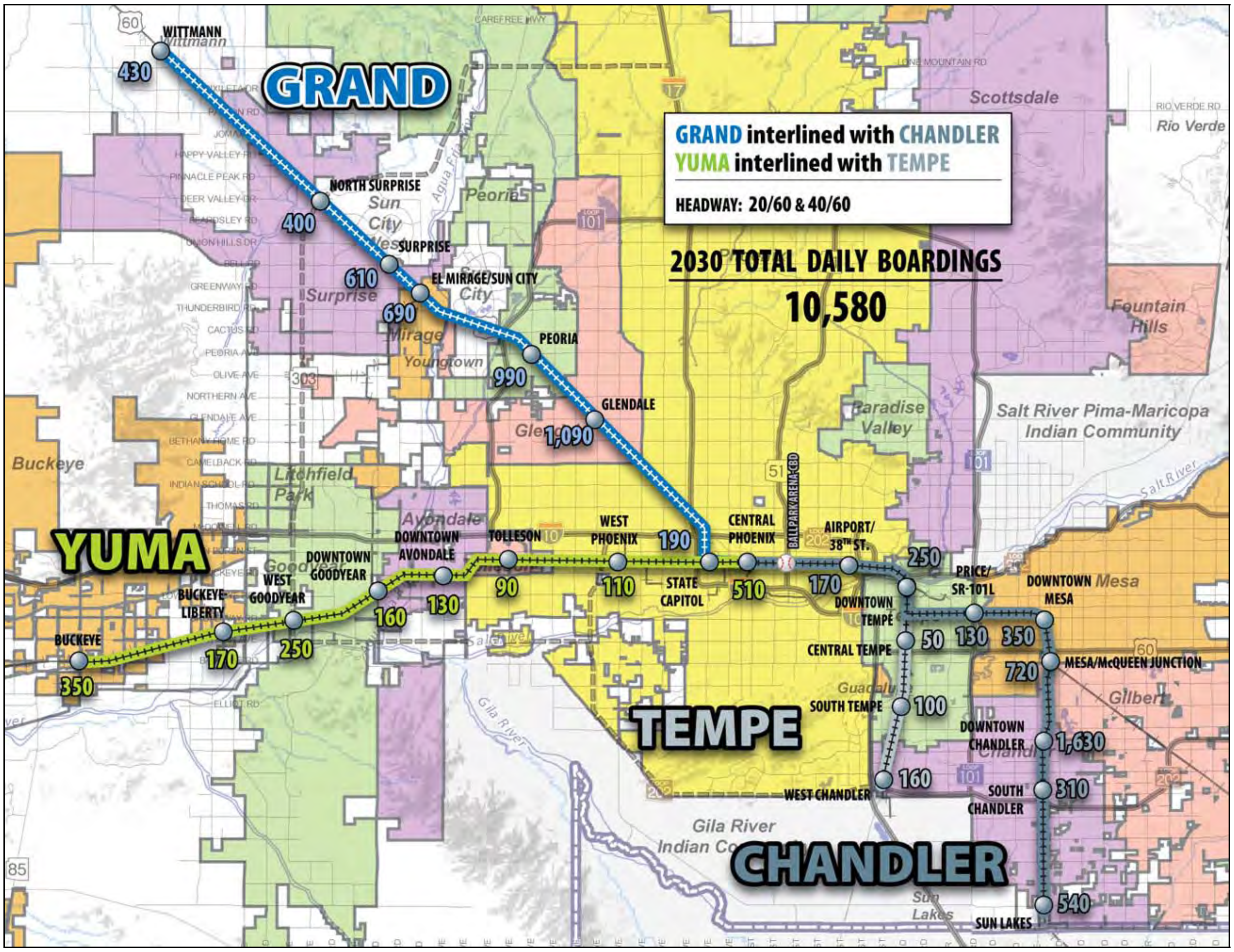
Source: URS Corp., 2009.

Figure 3-24: Yuma Interlined with Chandler and Grand Interlined with Tempe Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

Figure 3-25: Grand Interlined with Chandler and Yuma Interlined with Tempe Corridor 2030 Total Daily Boardings



Source: URS Corp., 2009.

Findings: Ridership forecasting results for the 3- and 4-Corridor Alternatives that substitute the Chandler Corridor for the SE Corridor do not produce strong ridership results, as will be discussed in greater detail in Section 3.6.4.

3.5 Cost Estimates

This section presents the cost estimates for each alternative. It provides capital cost estimates, which include the cost to obtain right-of-way, construct the commuter rail tracks and stations, procure vehicles and make needed infrastructure improvements. This section also presents the O&M costs, which include the annual cost to operate each alternative based on service plans.

3.5.1 Round 1: Preliminary "Maximum Service" Alternatives Cost Estimates

Cost estimates were not developed for these alternatives, as they were used to test a set of "maximum service" scenarios and to develop feasible operating characteristics for Round 2 Alternatives. Therefore, Round 1 Alternatives were not carried forward for further cost evaluation.

3.5.2 Round 2: Stand-Alone and Combined Base Alternatives Cost Estimates

For the Round 2 Alternatives, cost estimates were developed for the Stand-Alone Base Alternatives only. Combined Base Alternatives cost estimates were not produced because these alternatives were developed only to assess potential impacts of a commuter rail system on LRT and bus ridership and would not be carried forward for further cost evaluation. Table 3-8 presents the capital and annual O&M costs for each Round 2 Alternative.

Table 3-8: Round 2 Alternatives – Capital and O&M Costs

Base Alternative	Capital Cost*	Annual O&M Cost*
Grand	$599.6 million	$10.8 million
Yuma	$365.2 million	$11.9 million
SE	$476.6 million	$18.2 million
Tempe	$372.3 million	$4.6 million
Chandler	$448.7 million	$11.3 million

* Cost in 2009 US dollars.
Source: Gannett Fleming and URS Corp., 2009.

3.5.3 Round 3A: Interlined Alternatives Cost Estimates

Table 3-9 presents the capital and annual O&M costs for each Round 3A Alternative.

Table 3-9: Round 3A Alternatives – Capital and O&M Costs

Interlined Alternative	Capital Cost*	Annual O&M Cost*
2-Corridor Interlined Alternative		
Grand Interlined with SE	$1.1 B	$56.4 M
Yuma Interlined with SE	$834.4 M	$52.1 M
3-Corridor Interlined Alternative		
Grand Interlined with SE and Yuma Interlined with SE	$1.4 B	$98.2 M
4-Corridor Interlined Alternatives		
Yuma Interlined with SE and Grand Interlined with Tempe	$1.6 B	$104.5 M
Grand Interlined with SE and Yuma Interlined with Tempe	$1.6 B	$102.6 M

* Cost in 2009 US dollars.
Source: Gannett Fleming and URS Corp., 2009.

3.5.4 Round 3B: Alternate Interlined Alternatives Cost Estimates

Table 3-10 presents the capital and annual O&M costs for each Round 3B Alternative.

Table 3-10: Round 3A Alternatives – Capital and O&M Costs

Interlined Alternative	Capital Cost*	O&M Cost*
3-Corridor Interlined Alternative		
Grand Interlined with Chandler and Yuma Interlined with Chandler	$1.4 B	$97.5M
4-Corridor Interlined Alternatives		
Yuma Interlined with Chandler and Grand Interlined with Tempe	$1.5 B	$85.7M
Grand Interlined with Chandler and Yuma Interlined with Tempe	$1.5 B	$88.7M

* Cost in 2009 US dollars.
Source: Gannett Fleming and URS Corp., 2009.

3.6 Comparison of Alternatives

System Study Alternatives were fully evaluated with a set of evaluation criteria and measures in order to characterize, compare and prioritize each Stand-Alone Base Alternative (Round 2) and Interlined Alternative (Round 3A and 3B).

3.6.1 Evaluation Criteria

The process for evaluating commuter rail system corridors builds on previous work in the MAG Commuter Rail Strategic Plan that established the goals for commuter rail in the region and the MAG Regional Transit Framework Study that identified a method of evaluating and prioritizing transit corridors. Using the Commuter Rail Strategic Plan goals as a framework and the Regional Transit Framework Study categories of performance standards and indicators, the Project Team established a set of evaluation criteria by which to evaluate potential rail corridor alternatives. Each set of evaluation criteria seeks to answer the following questions:

- Primary Mode Choice: Will travelers choose to ride commuter rail transit based on **travel time savings**? Will there be sufficient **number of transit patrons** to support high levels of peak and off-peak service?

- Rider Perception Characteristics: Is the degree of **regional connectivity** and activity center connections provided by the commuter rail corridor enough to be deemed a **convenient** transit service?

- System/Policy Compatibility: Does the commuter rail corridor serve a concentration of **population and employment centers** such that **reductions in auto travel** and **improvements in air quality** are achieved?

- Cost-effectiveness: Does the investment in the rail corridor prove economical in terms of a number of **cost-effectiveness** measures? For the purposes of estimating capital and O&M costs, the Project Team used established FTA standards. Note that a more rigorous cost-benefit analysis would be required as corridor planning advances.

- Implementation/Constructability: What is the degree of ease or difficultly that might be expected to **construct and implement** the commuter rail corridor?

To answer these questions, each round of alternatives was evaluated based on a number of criteria, as shown in Table 3-11. While the Stand-Alone Base Alternatives (Round 2) were subjected to the complete list of evaluation criteria, the Interlined Alternatives (Round 3A) were primarily evaluated using measures of cost-effectiveness. Round 3B Alternate Interlined Alternatives, which substituted the Chandler Corridor for the SE Corridor, were compared to Round 3A Alternatives only on the basis of ridership forecasting results and were not subject to a comprehensive evaluation.

For a detailed description of each evaluation criteria and related measures, see Appendix H: System Study Corridor Evaluation Criteria.

Table 3-11: Application of System Study Comparison Factors

Categories	Factor	Round 2: Stand-Alone Alternatives	Round 3A: Interlined Alternatives
Primary Mode Choice	End-to-end travel time savings	X	
	Boardings per revenue mile	X	X
Rider Perception	Connections to activity centers	X	
System/Policy Compatibility	Land use compatibility	X	
	VMT reduction in corridor	X	
	VHT reduction in corridor	X	
Cost Effectiveness	Capital cost per mile	X	X
	Annual O&M cost per passenger trip	X	X
Implementation/ Constructability	Ease of implementation/ constructability	X	
	Compatibility with freight railroads	X	
	Benefit to adjacent or crossing highway infrastructure	X	

Source: URS Corp., 2009.

For each factor, an alternative was rated as High, Medium, or Low. A numeric score was assigned to each rating as follows: High = 4, Medium = 2, and Low = 0. The scores were added and the alternatives were ranked according to their total score.

3.6.2 Round 2 Alternatives Evaluation

Table 3-12 presents the results of the Round 2 Alternatives evaluation.

Table 3-12: Round 2 Alternatives

Criteria	Grand		Yuma		SE		Tempe		Chandler	
Primary Mode Choice										
Est. corridor end-to-end travel times savings (vs. SOV)	24 minutes	4	3 minutes	0	18 minutes	3	1 minute	0	0	0
Total daily ridership (boardings per revenue mile)	1.6	2	1.0	1	4.2	4	1.1	1	1.6	2
Rider Perception										
Direct connections to activity centers	High	4	High	4	High	4	High	4	High	4
System/Policy Compatibility										
Land use compatibility	Low - 3.1 persons/acre; 1.7 jobs/acre	0	Low - 3.5 persons/acre; 2.2 jobs/acre	0	High - 7.6 persons/acre; 6.4 jobs/acre	4	High - 7.4 persons/acre; 8.8 jobs/acre	4	Medium - 5.4 persons/acre; 4.8 jobs/acre	2
Impact on regional travel and air quality										
- VMT reduction in corridor	Slight decrease	2	Increase	0	Increase	0	Increase	0	Increase	0
- VHT reduction in corridor	Slight decrease	2	Increase	0	Increase	0	Slight decrease	2	Increase	0
Cost Effectiveness										
Capital cost per mile (millions)	$16.7	1	$11.8	4	$14.9	3	$20.7	0	$15.5	2
Annual O&M cost per passenger trip	$12.72	3	$27.93	0	$9.39	4	$16.14	2	$16.82	1
Implementation/Constructability										
Ease of implementation/ constructability	Low - Limited ROW in PHX, Glendale, and Alhambra; complex crossings in PHX and Glendale; Potential noise issues in residential areas.	0	Medium - ROW restricted in industrial areas; potential noise issues in residential areas	2	Medium - ROW restricted in some locations; major bridge over Salt River; potential noise issues in residential areas	2	Medium - ROW restricted in some locations; major bridge over Salt River; potential noise issues in residential areas; adequate ROW and minimal industrial spur tracks along branch tracks.	2	Medium - ROW restricted in some locations; major bridge over Salt River; potential noise issues in residential areas; adequate ROW and minimal industrial spur tracks along branch tracks.	2
Compatibility with freight railroads	Low - issues at Mobest Yard, Desert Lift and auto facility; though BNSF Railway Company is cooperative and encouraging	0	Medium - issues with Campo Yard and at industrial spur tracks; UPRR is less encouraging	2	Medium - issues with PHX Harrison St Yard and downtown Tempe; UPRR is less encouraging	2	Medium - issues with PHX Harrison St Yard and downtown Tempe; UPRR is less encouraging	2	Medium - issues with PHX Harrison St Yard and downtown Tempe; UPRR is less encouraging	2
Benefit to adjacent or crossing highway infrastructure	High - would provide improvements at complex crossings in Phoenix-Glendale segment	4	Medium - would provide constant warning at gated crossings	2	Medium - would provide constant warning at gated crossings	2	Medium - would provide constant warning at gated crossings	2	Medium - would provide constant warning at gated crossings	2
Totals		**22**		**15**		**28**		**19**		**17**
Ranking		**2nd**		**5th**		**1st**		**3rd**		**4th**

Source: URS Corp., 2009.

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3.6.2.1 Findings

The evaluation of Round 2 Alternatives revealed that the SE Corridor received the highest ranking, with a total of 28 points, and the Yuma Corridor received the lowest ranking, with a total of 15 points. Table 3-13 lists these results.

Table 3-13: Round 2 Alternative Rankings

Round 2 Alternative	Ranking
SE Corridor	1
Grand Corridor	2
Tempe Corridor	3
Chandler Corridor	4
Yuma Corridor	5

Source: URS Corp., 2009.

Primary discriminators among the alternatives included travel time savings, daily ridership, cost-effectiveness and implementation or constructability. The following is a summary of results related to these criteria.

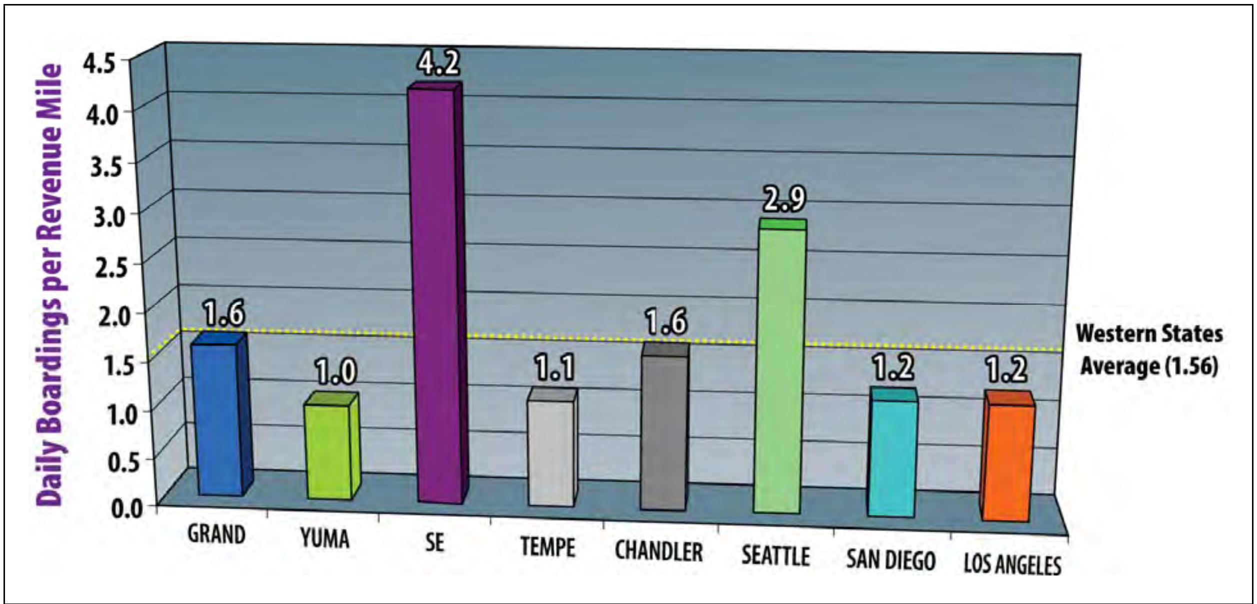
3.6.2.1.1 Travel Time Savings

The total travel time from one end of a commuter rail route to the terminal station should provide a time advantage over travel along parallel roadway corridors. The greater the time savings, the greater the passenger benefit and the more riders the system is likely to attract. An evaluation of travel time savings per corridor revealed that only two of the commuter rail corridors would offer any significant travel time savings. The Grand Corridor would save commuters an estimated 24 minutes between Wittmann and Central Phoenix, while the SE Corridor would save commuters an estimated 18 minutes between Queen Creek and Central Phoenix. It should be noted that these forecasted travel time savings would likely improve if roadway improvements in the RTP are not completed by 2030 or are removed due to funding shortfalls.

3.6.2.1.2 Total Daily Ridership Forecast

The measure of total daily riders per corridor revenue mile reflects the usefulness and attractiveness of the commuter rail corridor as a primary mode choice on a daily basis. According to the evaluation results, and as shown in Figure 3-26, with 4.2 daily boardings per revenue mile, the SE Corridor has between two and four times the number of boardings per revenue mile as all the other corridors evaluated. In addition, both the Grand and Chandler Corridor boardings per revenue mile are close to the average of 1.56 daily boardings per revenue mile for commuter rail systems in Western states[1]. The Yuma and Tempe Corridors are well below this average, with 1.0 and 1.1 daily boardings per revenue mile respectively.

Figure 3-26: Daily Boardings per Revenue Mile



Source: URS Corp., 2009, National Transit Database, Transit Profiles 2007.

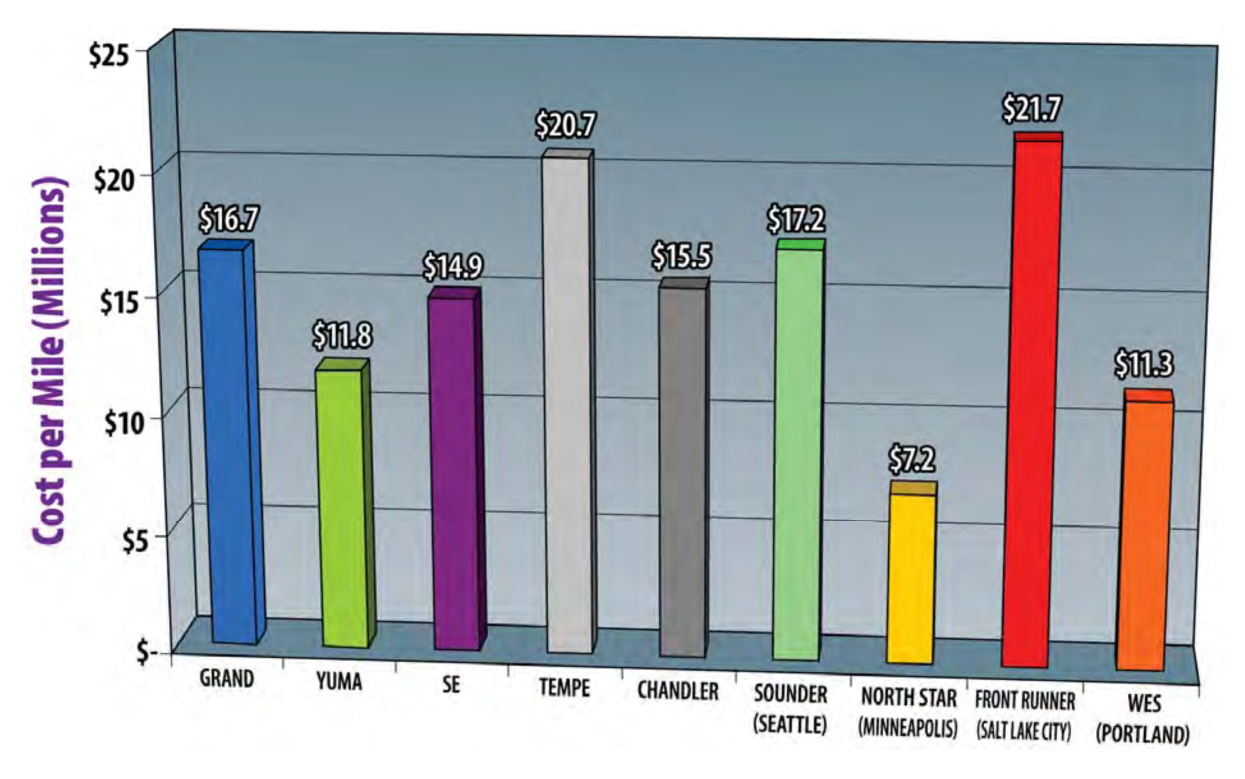
[1] National Transit Database, Transit Profiles 2007.

3.6.2.1.3 Cost Effectiveness

The estimated costs to build, operate and maintain a commuter rail corridor on a per mile basis is a strong indicator of the cost effectiveness of a corridor. With the exception of the Yuma Corridor, the cost per mile increases closer to downtown Phoenix due to more expensive infrastructure needs related to limited right-of-way and required infrastructure improvements.

Capital Cost per Mile: As shown in Figure 3-27, total capital cost per revenue mile ranges from approximately $12 million per mile for the Yuma Corridor to $21 million per mile for the Tempe Corridor.

Figure 3-27: Capital Cost per Mile*



* Cost in 2009 US dollars.
Source: URS Corp., 2009, National Transit Database, Transit Profiles 2007.

The primary variable on per-mile capital costs for commuter rail systems is the quality of existing track and infrastructure - including the track itself, the need for additional tracks and passing sidings to accommodate both commuter rail and freight rail traffic, and other features such as bridges, culverts, and other major capital items. For example, the Northstar system in Minnesota has a relatively low capital cost per mile because that system is using an existing high-quality double-track alignment. The FrontRunner system in Utah has a relatively high cost per mile because it was required to install a significant amount of new track.

Evaluation results indicate that all corridors, with the exception of the Yuma Corridor, would be more expensive to construct on a per mile basis than the peer city average of $14.4 million per mile. The following points highlight those factors that contribute to the variation in capital cost effectiveness between the corridors:

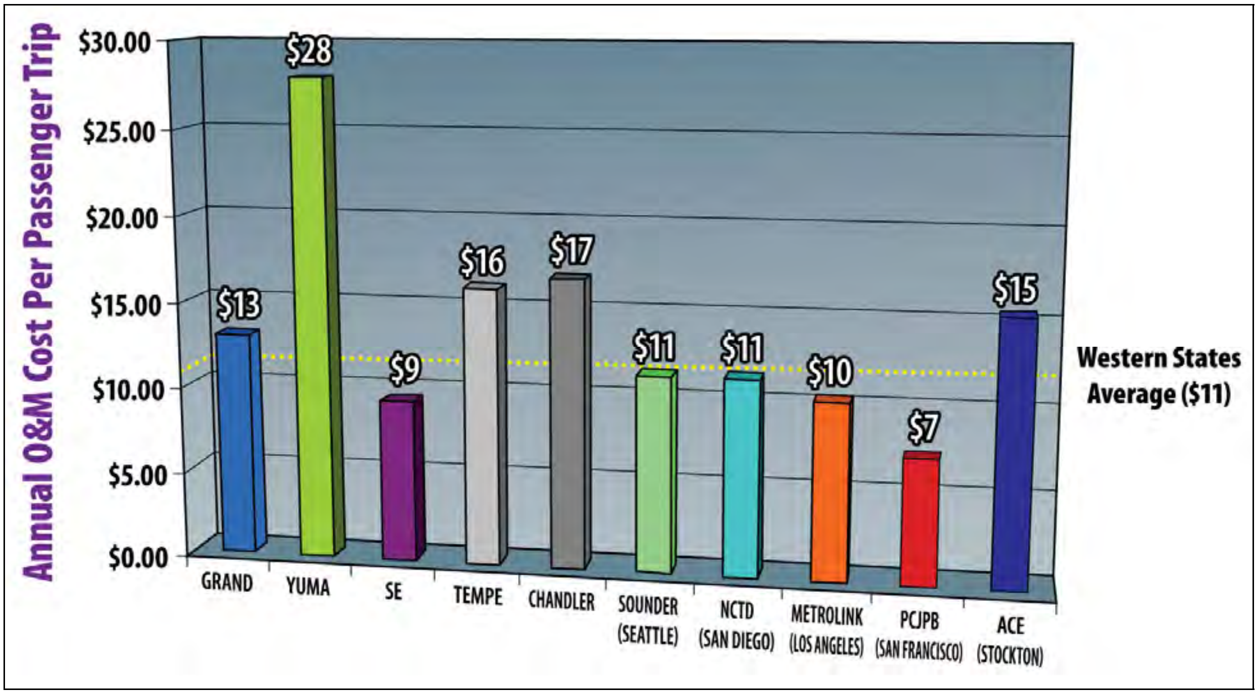
- The Yuma Corridor has the lowest capital cost per mile, at approximately $11.8 million per mile, because it requires relatively few infrastructure improvements as compared with the other corridors.

- The SE Corridor has the second lowest capital cost per mile, at approximately $14.9 million per mile. Like the other two East Valley corridors, the SE Corridor would require few infrastructure improvements outside Central Phoenix, where the costs associated with introducing commuter rail service through the Phoenix Harrison Street Yard are likely to be high. The Chandler Corridor is also comparable, at approximately $15.5 million per mile. At approximately $16.7 million per mile, the Grand Corridor is the second most expensive corridor on a capital cost per mile basis. Unlike the other corridors that require costly infrastructure upgrades primarily within Central Phoenix, the Grand Corridor would require infrastructure improvements along much of the length of the corridor. Most of these infrastructure improvements would be associated with improvements to at-grade crossings and issues with major freight facilities, such as the Mobest Yard, Desert Lift, and Auto Facility.

- At approximately $20.7 million per mile, the Tempe Corridor is the most expensive corridor on a capital cost per mile basis. On a per mile basis, the SE and Chandler Corridors can spread out the costs associated with the Phoenix Harrison Street Yard over more than 30 miles. Unlike the other East Valley corridors however, the Tempe Corridor, at just under 18 miles, is not long enough to spread out the costs of the infrastructure improvements required in Central Phoenix and therefore has a significantly higher capital cost per mile.

O&M Cost per Passenger Trip: The estimated cost to operate a commuter rail corridor on a per passenger trip basis is also a relevant indicator of cost effectiveness. Figure 3-28 illustrates the annual O&M cost per passenger trip for the five Stand-Alone Base Alternatives as well as peer city commuter rail systems. As shown in Figure 3-21, the annual O&M cost per passenger trip for the five corridors ranges from $9 per passenger trip for the SE Corridor to $28 per passenger trip for the Yuma Corridor. According the National Transit Database, Transit Profiles 2007, the average annual O&M cost per passenger trip for commuter rail systems in the Western states is approximately $11 per passenger trip. Therefore, only the SE Corridor falls below this average, while the Grand Corridor is close to this peer city average, with a cost of $13 per passenger trip.

Figure 3-28: Annual O&M Cost per Passenger Trip*



* Cost in 2009 US dollars.
Source: URS Corp., 2009, National Transit Database, Transit Profiles 2007.

The following points highlight those factors that contribute to the variation in O&M cost effectiveness between the corridors:

- While at $18.2 million per year to operate, the SE Corridor would have the most expensive annual O&M costs among the five system corridors; it also has the highest ridership forecasts (approximately 6,500 daily boardings). Therefore, the SE Corridor's strong ridership offset the relatively expensive O&M costs and results in the lowest O&M cost per passenger trip among the corridors at $9 per passenger trip.

- The Yuma Corridor has the second lowest ridership forecasts (approximately 1,420 daily boardings) and the second highest annual O&M cost behind the SE Corridor. Therefore, the annual O&M cost per passenger trip for the Yuma Corridor is approximately $28 per passenger trip, which is significantly greater than the other system corridors.

- The remaining three corridors – Grand, Tempe and Chandler Corridors – range between $13 and $17 for annual O&M cost per passenger trip.

Conclusions: The following observations highlight the major cost effectiveness discriminators between the Stand-Alone Base Alternatives:

- *Top Tier:* The SE Corridor is ranked highest in terms of cost effectiveness. At approximately $14.9 million per mile, the SE Corridor would have one of the lowest capital costs per mile. Given the relatively high ridership forecasts along this line, the SE Corridor would also have the lowest annual O&M cost per passenger trip at $9 per passenger trip, which is lower than the peer city average annual O&M cost per passenger trip.
- *Middle Tier:* The Grand, Yuma and Chandler Corridors are middle-tier performers from a cost effectiveness standpoint. At approximately $599.6 million to construct, the Grand Corridor would have the highest capital cost of all corridors. And, at approximately $16.7 million per mile, it would have the second highest capital cost per mile. Relatively high ridership on this corridor however, means that the annual O&M cost per passenger trip – $13 per passenger trip – is closer to the peer city average than all other corridors except the SE Corridor.

  While the Yuma Corridor is one of the longest lines, it would also have relatively low infrastructure requirements. Therefore, at approximately $11.8 million per mile, it would be the least expensive corridor to construct. However, at $28 per rider, the annual O&M cost per passenger trip for the Yuma Corridor would be significantly higher than all other corridors, primarily due to relatively low ridership forecasts.

  The Chandler Corridor also falls in the mid-range in terms of cost effectiveness, with approximately $15.5 million per mile to construct and an annual O&M cost per passenger trip of $17 per passenger trip.
- *Lower Tier:* The Tempe Corridor is the shortest line, but due to significant infrastructure requirements in Central Phoenix, would have the highest capital costs per mile, at approximately $20.7 million per mile. Annual O&M cost per passenger trip would be $16 per passenger trip, which like other corridors, is above the peer city average.

3.6.2.1.4 Implementation or Constructability

From an implementation standpoint, compatibility with railroad infrastructure may be an issue for all commuter rail corridors. Commuter rail service along the Grand Corridor may be the least compatible, as it would need to negotiate through several BNSF Railway Company facilities, including Mobest Yard, Desert Lift and Auto Facility. On the other hand, commuter rail service along the Yuma Corridor would need to negotiate through only one major facility, the Campo Yard. For the East Valley corridors, a major constraint may be negotiating service through the Phoenix Harrison Street Yard and its ancillary facilities located in downtown Phoenix.

While the Grand Avenue Corridor may have the most freight railroad facilities to contend with, it may also provide the greatest benefit to adjacent roadway infrastructure. Other corridors may be required to install constant warning devices at gated crossings, but the implementation of commuter rail service along Grand Avenue would likely require several new grade separations. These would likely be required to mitigate existing and projected safety and congestion problems.

3.6.3 Round 3A Alternatives Evaluation

Table 3-14 presents the results of the Round 3A Alternatives evaluation.

Table 3-14: Round 3A Alternatives

Criteria	Grand-SE		Yuma-SE		Grand-SE & Yuma-SE		Grand-SE & Yuma-Tempe		Yuma-SE & Grand-Tempe	
Primary Mode Choice										
Total daily ridership (boardings per revenue mile)	3.1	4	2.8	3	2.0	0	2.2	1	2.6	2
Cost Effectiveness										
Capital cost per mile (millions)	$15.7	1	$13.2	4	$14.4	3	$14.8	2	$14.8	2
Annual O&M cost per passenger trip	$18.84	4	$20.36	2	$28.99	0	$22.65	1	$19.39	3
Totals		**9**		**9**		**3**		**4**		**7**
Ranking		**1st (tied)**		**1st (tied)**		**4th**		**3rd**		**2nd**

Source: URS Corp., 2009.

3.6.3.1 Findings

The evaluation of Round 3A Alternatives revealed that the interlining of the Yuma and SE Corridors and the interlining of the Grand and SE Corridors received the highest ranking, with a total of nine points, and the interlining of both the Grand and Yuma Corridors with the SE Corridor received the lowest ranking, with a total of three points. Table 3-15 lists these results.

Table 3-15: Round 3A Alternative Rankings

Round 3A Alternative	Ranking
Yuma-SE	1 (tied)
Grand-SE	1 (tied)
Yuma-SE & Grand-Tempe	2
Grand-SE & Yuma-Tempe	3
Grand-SE & Yuma-SE	4

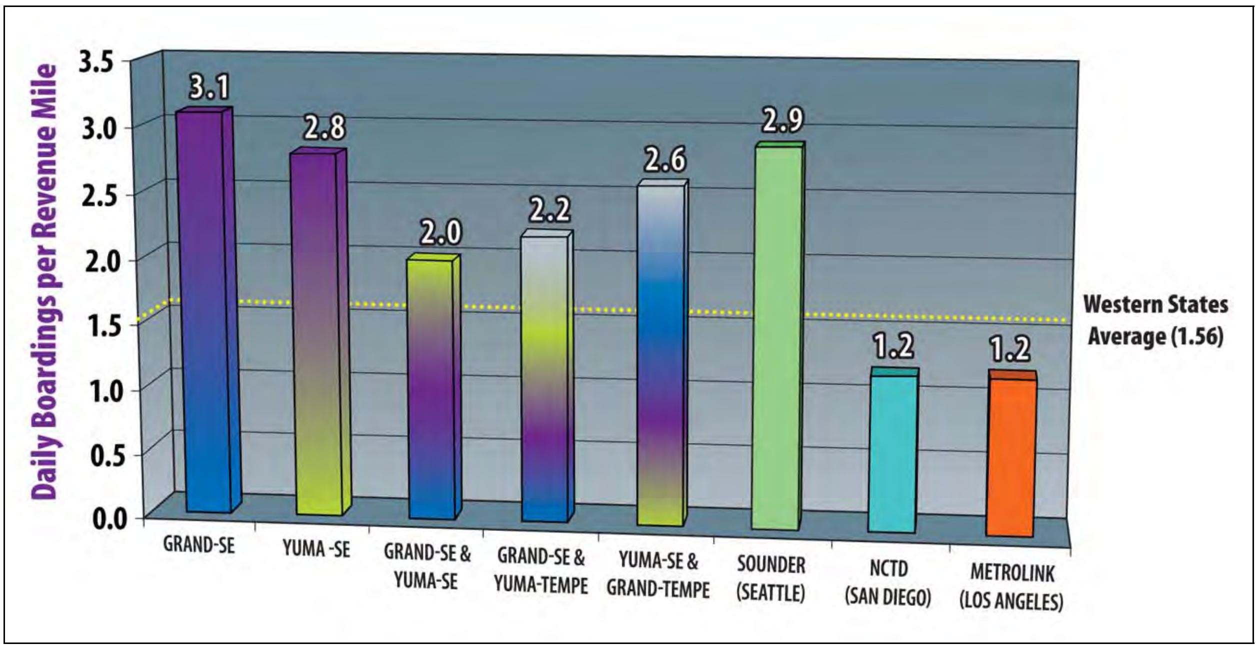
Source: URS Corp., 2009.

Primary discriminators among the alternatives related to ridership forecasts and cost effectiveness measures, including capital cost per mile and annual O&M cost per passenger trip. The following pages are a summary of results related to these criteria.

3.6.3.1.1 Total Daily Ridership Forecast

The measure of total daily riders per revenue mile for regional Interlined Alternatives reflects the attractiveness and productivity of the commuter rail system as a primary mode choice on a daily basis. Ranging from 2.0 to 3.1 boardings per revenue mile, the overall productivity of all the Interlined Alternatives, as shown in Figure 3-29, is higher than the Western states commuter rail system average of 1.56 boardings per revenue mile. Daily ridership forecasts are greatest when the most productive East Valley and West Valley Corridors – Grand and SE – are combined to achieve 4.2 daily boardings per revenue mile. And, with the exception of the SE Corridor, (which would have 4.2 daily boardings per revenue mile as a Stand-Alone Base Alternative), each Interlined Corridor increases the overall commuter rail system productivity.

Figure 3-29: Interlined Daily Boardings per Revenue Mile 2030

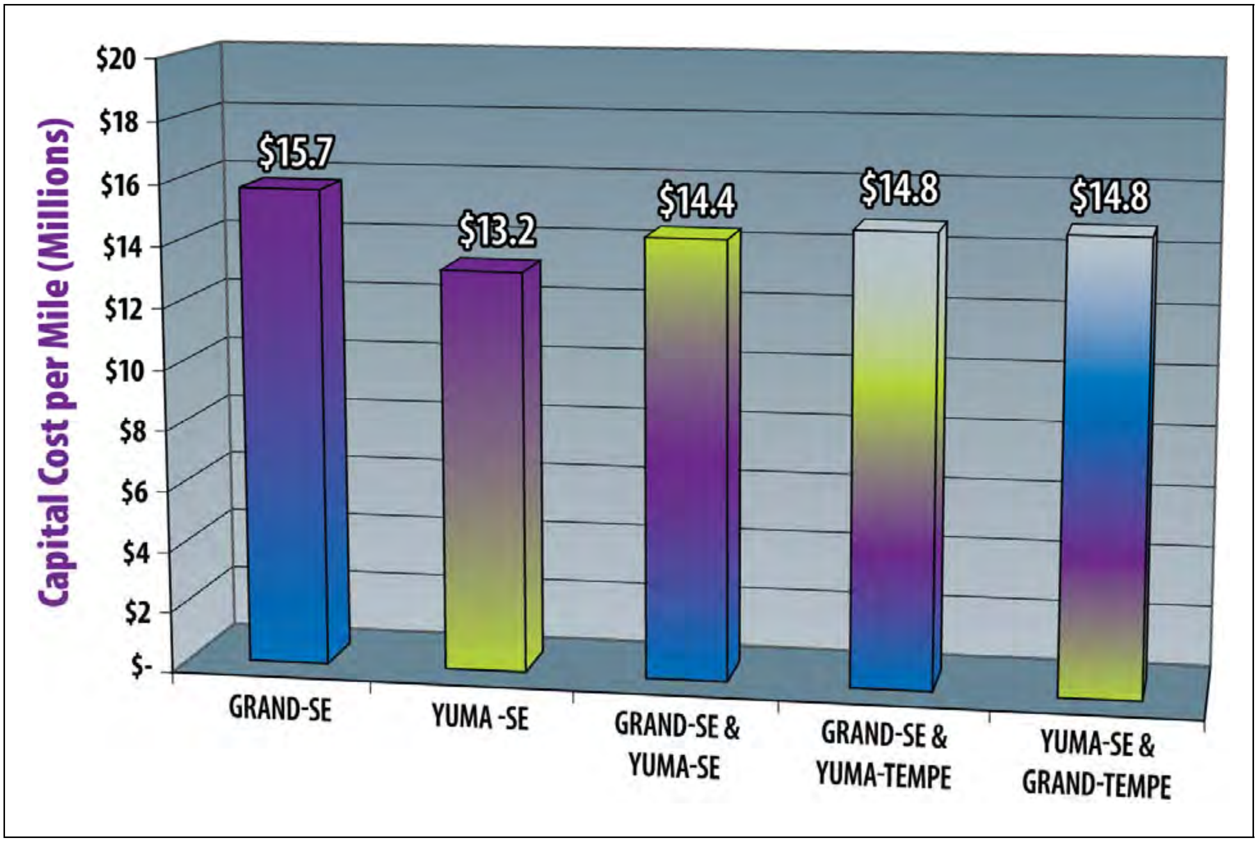


Source: URS Corp., 2009, National Transit Database, Transit Profiles 2007.

3.6.3.1.2 Capital Cost per Mile

As shown in Figure 3-30, total capital cost per mile ranges from approximately $13.2 million per mile when the Yuma and SE Corridors are interlined to $15.7 million per mile with the interlining of the Grand and SE Corridors. The interlining of the Yuma and SE Corridors is the least expensive Interlined Alternative on a per mile basis because, unlike the other Interlined Alternatives, it does not include the costly rail infrastructure upgrades required in Central Phoenix. Conversely, the interlining of the Grand and SE Corridors is the most expensive on a per mile basis because it is the only Interlined Alternative that does not include the less-costly Yuma Corridor.

Figure 3-30: Interlined Corridor Total Capital Cost per Mile*

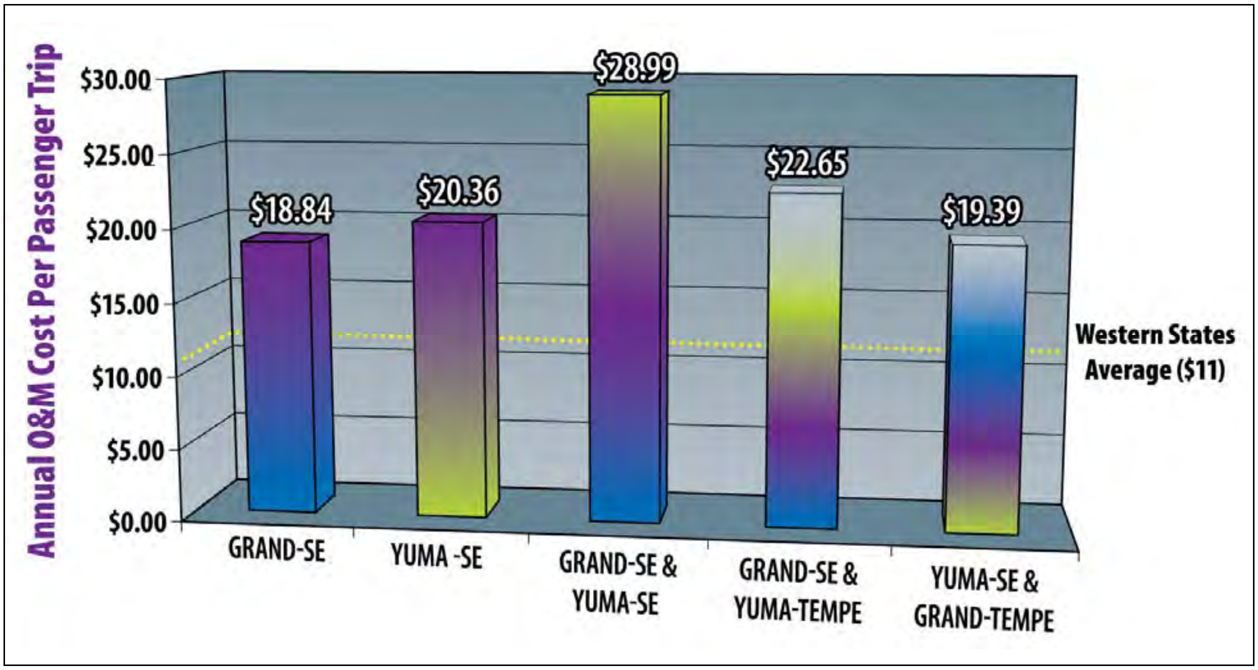


* Cost in 2009 US dollars.
Source: URS Corp., 2009.

3.6.3.1.3 O&M Cost per Passenger Trip

The estimated cost to operate a commuter rail corridor on a per passenger trip basis is also a relevant indicator of cost effectiveness. As shown in Figure 3-31, the annual O&M cost per passenger trip for the five Interlined Alternatives ranges from approximately $19 per passenger trip for the interlining of the Grand and SE Corridors to approximately $29 per passenger trip for the interlining of the SE Corridor with both the Grand and Yuma Corridors. In general, any Interlined Alternative that includes the Yuma Corridor tends to have an elevated cost per passenger trip due to the Yuma Corridor's relatively low ridership. According the National Transit Database, Transit Profiles 2007, the average annual O&M cost per passenger trip for commuter rail systems in the Western states is approximately $11 per passenger trip. Therefore, all Interlined Alternatives are well above this average.

Figure 3-31: Interlined Annual O&M Cost per Passenger Trip*



* Cost in 2009 US dollars.
Source: URS Corp., 2009.

3.6.4 Round 3B Alternatives Evaluation

In Round 3B, the Chandler Corridor was substituted for the SE Corridor in the 3-Corridor and 4-Corridor Alternatives. For each Interlined Alternative, substituting the Chandler Corridor for the SE Corridor would result in significantly fewer daily boardings in 2030. As shown in Table 3-16, boardings along the Chandler Corridor would range from 62 percent to 74 percent of those estimated for the SE Corridor. Therefore, Round 3A Interlined Alternatives will not be carried forward for further consideration.

Table 3-16: Round 3A and 3B Interlined Alternatives – Comparison

Round 3A and 3B Interlined Alternatives	Daily Boardings with SE in the Interlined Alternative	Daily Boardings with Chandler (CH) in the Interlined Alternative	Chandler as a Percentage of SE Boardings
Grand+[SE or CH] / Yuma+[SE or CH]	11,290	7,030	62%
Yuma+[SE or CH] / Yuma+Tempe	15,100	10,580	70%
Grand+[SE or CH] / Grand+Tempe	17,960	13,320	74%

Source: URS Corp., 2009.

3.6.5 Potential Future Extensions Ridership Potential

As a component of the System Study, the Project Team assessed the viability of potential future extensions to the five System Study corridors under consideration. To assess Year 2035 ridership potential, the potential ridership for the extensions was estimated by coding the routes into the MAG model and running it with 2035 socioeconomic data. The results for all extensions are summarized in Table 3-17.

Table 3-17: 2035 Commuter Rail Extensions

Corridor	Distance	No. of Stations	2035 Estimated Ridership
Low Ridership Potential			
Hidden Waters	32 miles	4	10
Hassayampa	52 miles	4	30
Tempe Extension	18 miles	4	180
Moderate Ridership Potential			
Hidden Valley	31 miles	4	490
Chandler Extension	29 miles	3	570
High Ridership Potential			
Superstition Vistas - to Coolidge	33 miles	6	900
Superstition Vistas - to Florence	32 miles	5	1,010
SE Extension	24 miles	4	1,420

Source: URS Corp., 2009.

Post 2030 ridership potential for each of the corridor extensions was determined by using the latest available (2007) MAG future land use data. For each extension corridor, total projected households with eight miles and employment within a half mile of station target areas were correlated with ridership potential. In order to normalize values for comparison between the extension corridors, the Project Team calculated households per mile and employment per station target area. Table 3-18 presents the results of this analysis.

Table 3-18: Post-2035 Commuter Rail Extensions

Corridor	Households per Mile (8 mile buffer)	Employment per Station (1/2 mile buffer)
Low Ridership Potential		
Hidden Waters	6,700	2,500
Moderate Ridership Potential		
Hassayampa	19,100	3,400
Hidden Valley	24,900	3,300
High Ridership Potential		
Superstition Vistas - to Coolidge	38,800	13,500
Superstition Vistas - to Florence	35,200	15,900
SE Extension	39,400	1,400
Tempe Extension	38,700	1,800
Chandler Extension	29,800	11,600

Source: URS Corp., 2009.

Based on expected development patterns, extensions to each of the East Valley corridors and both Superstition Vistas corridors would have high ridership potential.

3.7 Next Steps

The next steps in the development and evaluation of System Study alternatives will be to recommend prioritization of corridors and phasing options based on the findings of this chapter.

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4.0 RECOMMENDATIONS AND IMPLEMENTATION STRATEGY

4.1 Introduction

This chapter presents decisions to be made and steps to be taken to further the planning and preparation for implementation of commuter rail in the MAG region. The chapter includes the following sections:

- Section 4.2 summarizes the findings of Chapter 3 related to the performance and cost-effectiveness the System Study corridors relative to other commuter rail systems currently in operation throughout the U.S. It concludes with a recommendation to pursue the implementation strategies described in the subsequent sections of this chapter.

- Section 4.3 provides System Study corridor phasing recommendations and scenarios, including recommended start-up service and phased corridor implementation to reach full build-out of the regional commuter rail system.

- Section 4.4 discusses the opportunities and constraints associated with integrating commuter rail transit with other transit modes throughout the region, particularly at key transit hubs within and outside downtown Phoenix. It also discusses options for integrating commuter rail with proposed intercity rail passenger service between Phoenix and Tucson.

- Section 4.5 provides an overview of commuter rail layover and maintenance facility needs and illustrates potential locations for each type of facility within the System Study planning area.

- Section 4.6 describes several models for operating commuter rail, including Sale or Capacity Rights agreements with the railroads.

- Section 4.7 discusses options for governance and evaluates the suitability of these options for this region.

- Section 4.8 provides options and strategies for funding.

- Section 4.9 delineates the near-term and subsequent steps towards implementing commuter rail in the region.

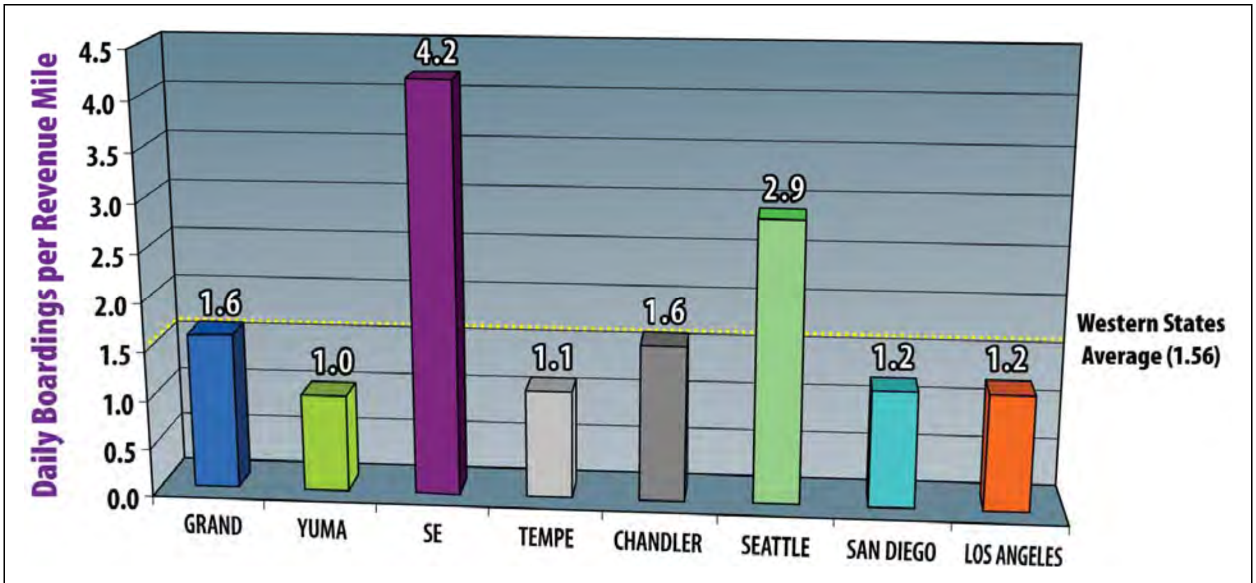
4.2 Summary of Performance and Cost-Effectiveness

The detailed analysis presented in Chapters 3 found that both the performance and cost-effectiveness of several corridors within the proposed MAG regional commuter rail system are comparable to commuter rail systems currently in operation in peer cities, as described below.

4.2.1 Peer City Comparison: Ridership

With nearly 6,500 daily riders forecast for 2030, the Southeast (SE) Corridor would have approximately 4.2 daily boardings per revenue mile. As shown in Figure 4-1, this forecasted ridership is between two and four times the number of boardings per revenue mile as all the other corridors evaluated and well above the average of 1.56 daily boardings per revenue mile for commuter rail systems in Western states. The Grand Avenue and Chandler Corridors are more comparable to the peer city average as they both are forecasted to have 1.6 daily boardings per revenue mile in 2030.

Figure 4-1: Peer City Daily Boardings per Revenue Mile Comparison



Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

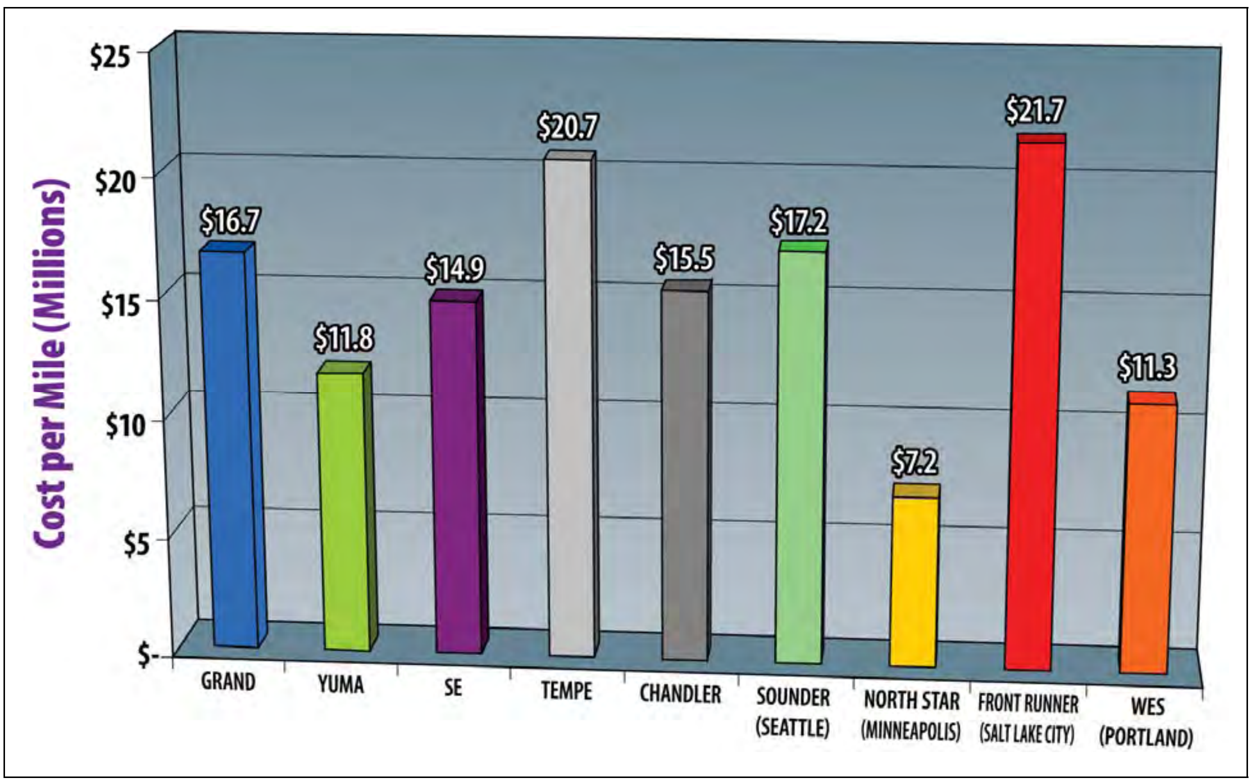
4.2.2 Peer City Comparison: Capital Costs

As shown in Figure 4-2, total capital cost per mile ranges from approximately $12 million per mile for the Yuma West Corridor to $21 million per mile for the Tempe Corridor. Overall, the cost to build any of the five corridors would be comparable to other systems and within the range of what most industry experts would consider reasonable.

As previously noted, the primary variable on per-mile capital costs for commuter rail systems is the quality of existing track and infrastructure and improvements needed to accommodate both commuter rail and freight rail traffic. For example, the North Star Commuter Rail system in Minneapolis is the least expensive of the peer city systems because that system is using an existing high-quality double-track alignment. The FrontRunner system in Utah has a relatively high cost per mile because it was required to install a significant amount of new track.

Implementation of the Yuma West Corridor would require relatively few costly infrastructure improvements as compared with the other corridors. Implementation of the Tempe Corridor however, would require substantial and costly infrastructure improvements in Central Phoenix. These improvements are common to the Tempe, Chandler, and Southeast Corridors, but because it is a relatively short length of just under 18 miles, the Tempe Corridor has a significantly higher capital cost per mile than the other East Valley Corridors that are over 30 miles in length.

Figure 4-2: Capital Cost per Mile*



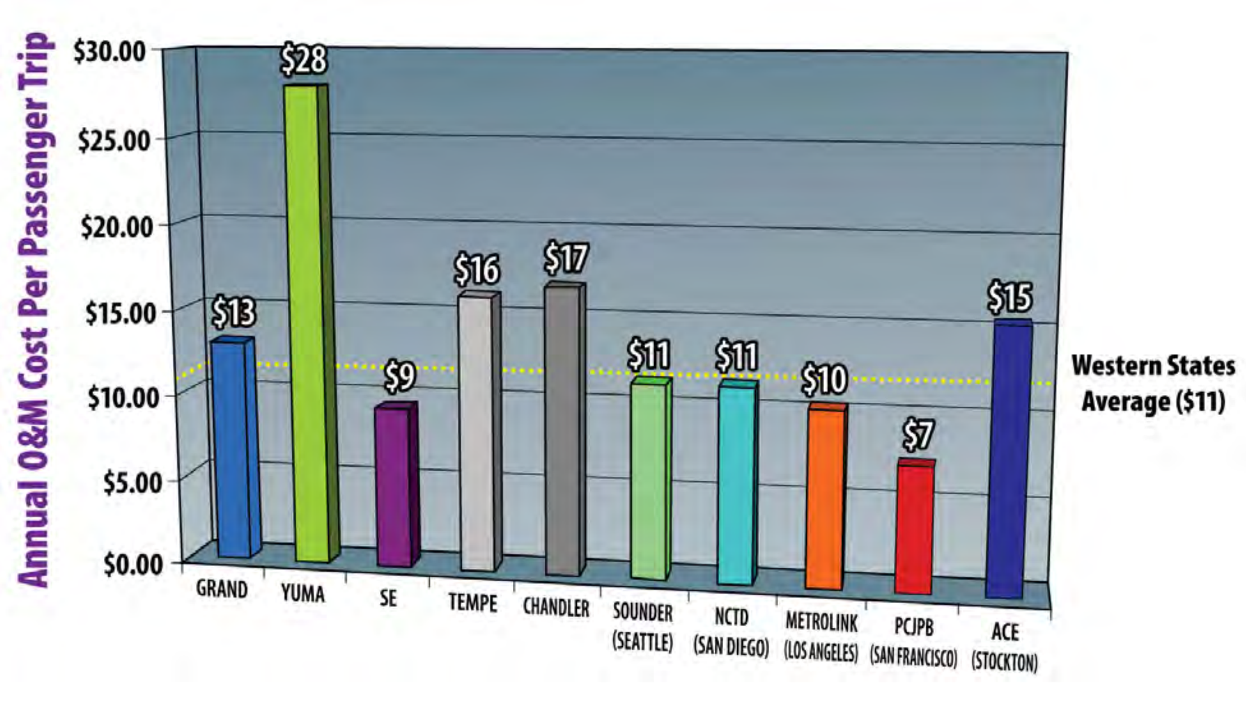
* Cost in 2009 US dollars.
Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

4.2.3 Peer City Comparison: O&M Costs

According the National Transit Database, Transit Profiles 2007, the average annual O&M cost per passenger trip for commuter rail systems in the Western states is approximately $11 per passenger trip. Therefore, only the SE Corridor falls below this average, while the Grand Avenue Corridor is close to this peer city average, with a cost of $13 per passenger trip. Strong ridership forecasted for the SE would result in the lowest O&M cost per passenger trip among the corridors at $9 per passenger trip, which is $2 below the Western states average. On the other hand, due to low ridership forecasts, the O&M costs for the Yuma West Corridor would be more than double that of the peer city average.

It should be noted that these annual O&M costs would likely be reduced by the recovery of farebox revenue. The farebox recovery is the percent of commuter rail O&M costs paid for by passenger fares. According to National Transit Database, the national average farebox recovery for commuter rail systems was 37 percent in 2007.

Figure 4-3: Annual O&M Cost per Passenger Trip*



* Cost in 2009 US dollars.
Source: URS Corp., 2009; National Transit Database, Transit Profiles 2007.

4.2.4 Findings

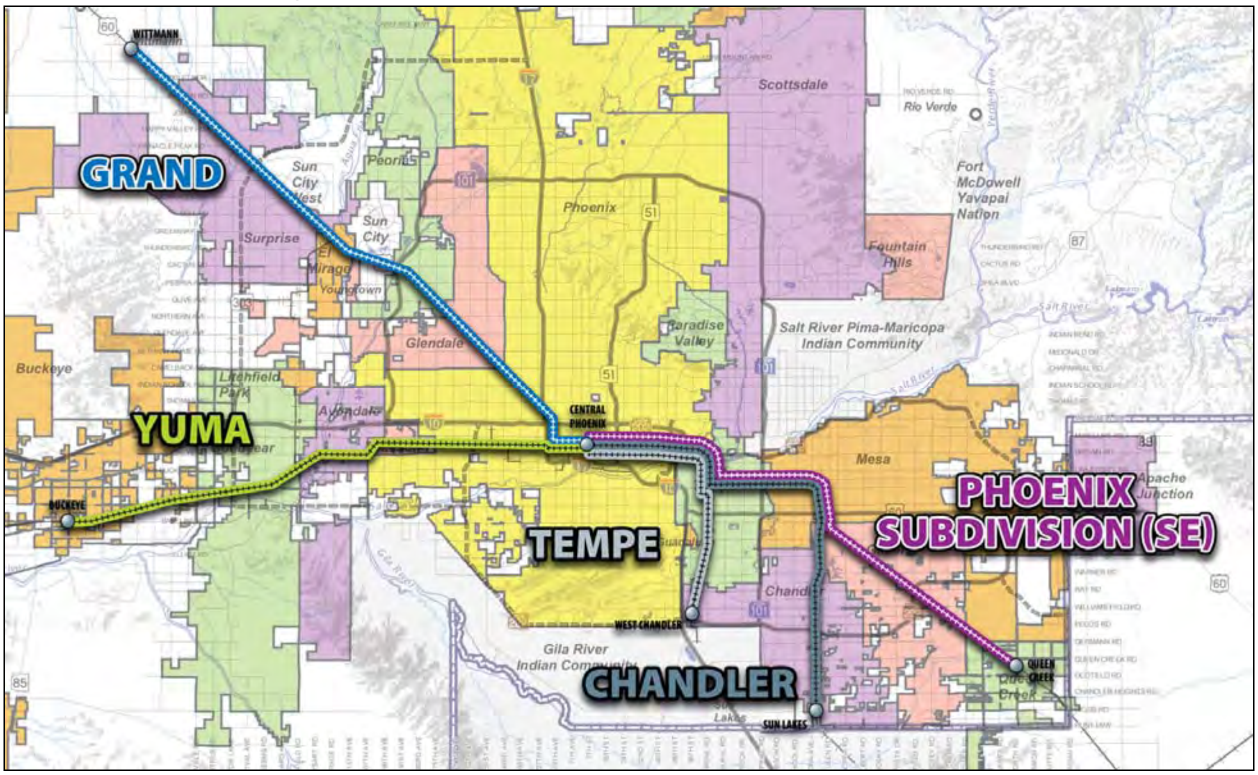
The ridership estimates and costs associated with the five potential commuter rail corridors within the System Study are generally comparable to other systems and within the range of what most industry experts would consider reasonable, with a few exceptions as previously noted. It has also has been shown that interlining corridors increases overall ridership over single stand-alone corridors. Therefore, at this stage of advanced planning, there is no single corridor that should be eliminated from future consideration. And, as design of the commuter rail corridors progresses, ridership forecasts and cost estimates will continue to be refined and updated.

Based on these findings, the Project Team recommends that MAG and partnering agencies continue to advance the design of all System Study corridors and pursue the phasing options and implementation steps for each of the five corridors as outlined in the following sections.

4.3 Corridor Phasing Recommendations and Scenarios

The categorizing of alternatives by tiers helps to prioritize corridors for implementation of the full commuter rail system as shown in Figure 4-4. Assuming limited financial resources are available for full system build-out of all commuter rail corridors concurrently, a phased implementation approach would be used. This approach is much like the phased implementation of Phoenix's 57-mile light rail system, which began with the construction of the 20-mile minimum operating segment or "starter line" and has successfully demonstrated the need for additional high capacity transit as a viable and competitive mobility choice in the region.

Figure 4-4: MAG Commuter Rail System Study Corridors



Source: URS Corp., 2009.

The following sections describe Project Team recommendations for the sequencing of corridor implementation to achieve full system build-out based on the alternatives evaluation and ranking.

4.3.1 Stand-Alone Alternatives Ranking

The findings of the alternatives evaluation, detailed in Chapter 3, revealed three distinct tiers of Study System alternatives – top, middle and lower – based on their performance relative to a set of evaluation factors. The factors that proved to be major discriminators included ridership, travel time savings, cost effectiveness, and implementation/constructability. Table 4-1 is a summary of Stand-Alone Alternatives rankings and discriminators.

Table 4-1: Stand-Alone Alternatives Ranking

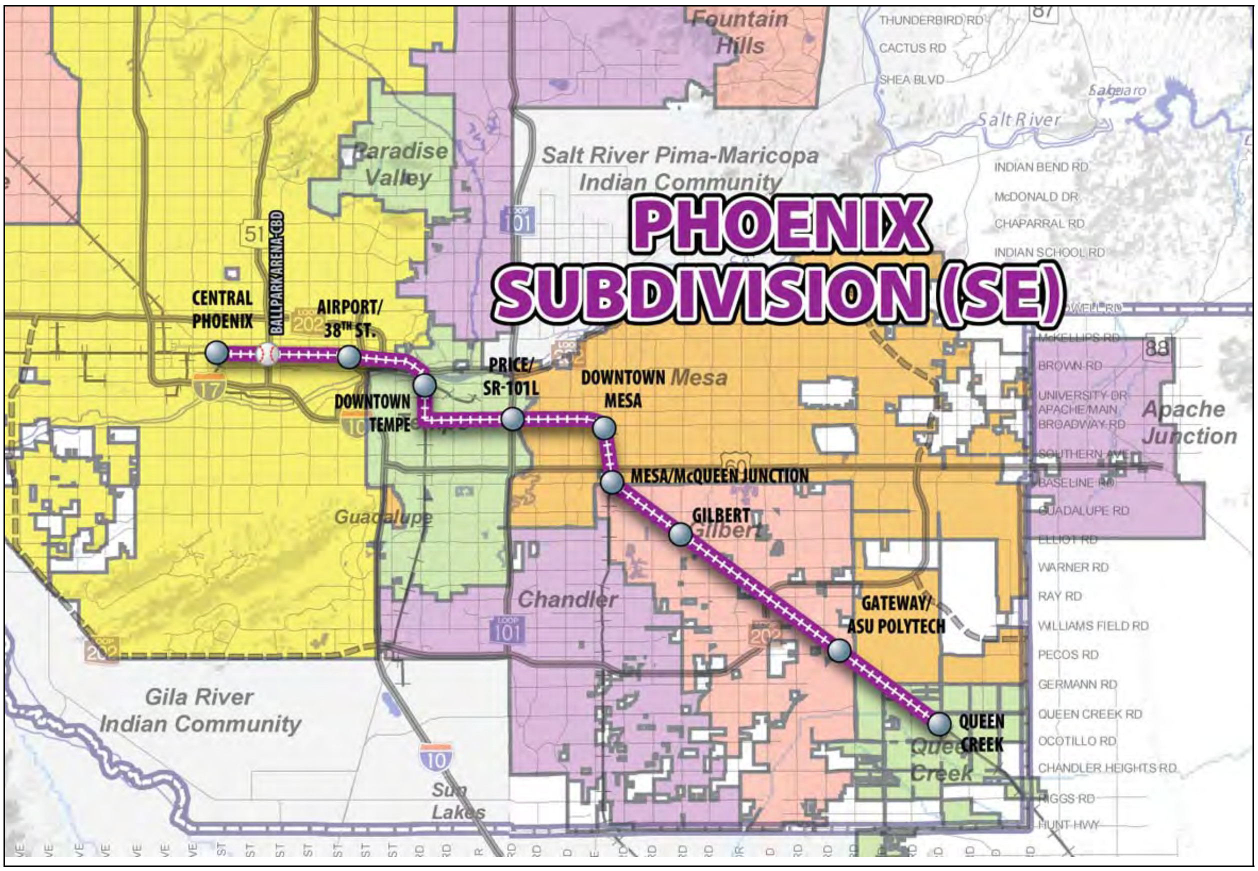
Stand-Alone Corridor	Ranking	Major Discriminators
SE	Top Tier	• 2 to 4 times the number of boardings per revenue mile as all other corridors • 18 minute end-to-end travel time savings* • Second lowest capital cost per mile • Lowest O&M cost per passenger trip
Grand Avenue	Middle Tier	• Boardings per revenue mile are close to Western states average • 24 minute end-to-end travel time savings* • Moderate capital cost per mile • Second lowest O&M cost per passenger trip
Tempe & Chandler	Middle Tier	• Low to moderate boardings per mile • High O&M cost per passenger trip • Moderate to high capital cost per mile
Yuma West	Lower Tier	• Lowest capital cost per mile due to relatively few infrastructure improvements, but lowest boardings per revenue mile • Minimal travel time savings • Highest O&M cost per passenger trip

* Compared to travel time for single-occupancy vehicle.
Source: URS Corp., 2009.

4.3.2 Recommendation for First Segment of Commuter Rail System

The ranking of alternatives helps to determine the priority in which each corridor should be implemented for build-out of the full regional commuter rail system. Based on the Stand-Alone Alternatives ranking, the Project Team recommends the following:

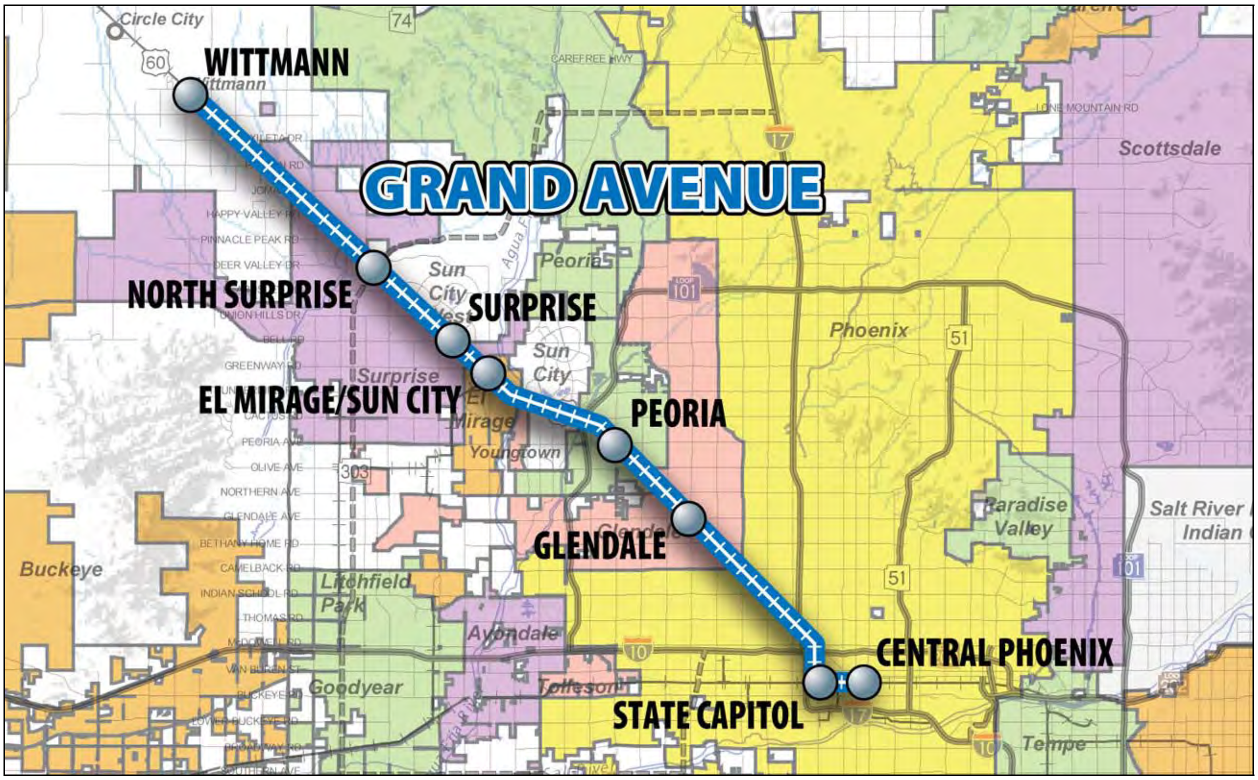
Start-Up Service Scenario 1: Build the SE Corridor.
The SE Corridor offers the highest ridership by a significant margin, offers substantial travel time savings, and is cost-effective.



Source: URS Corp., 2009.

While the SE Corridor ranking far exceeded those of the other corridors, if use of all or a portion of the UPRR right-of-way is a fatal flaw due to costs and/or agreements to get through rail yards in Central Phoenix, then alternative options for the first segment of the regional commuter rail system should be considered. Alternative start-up service scenarios include the following:

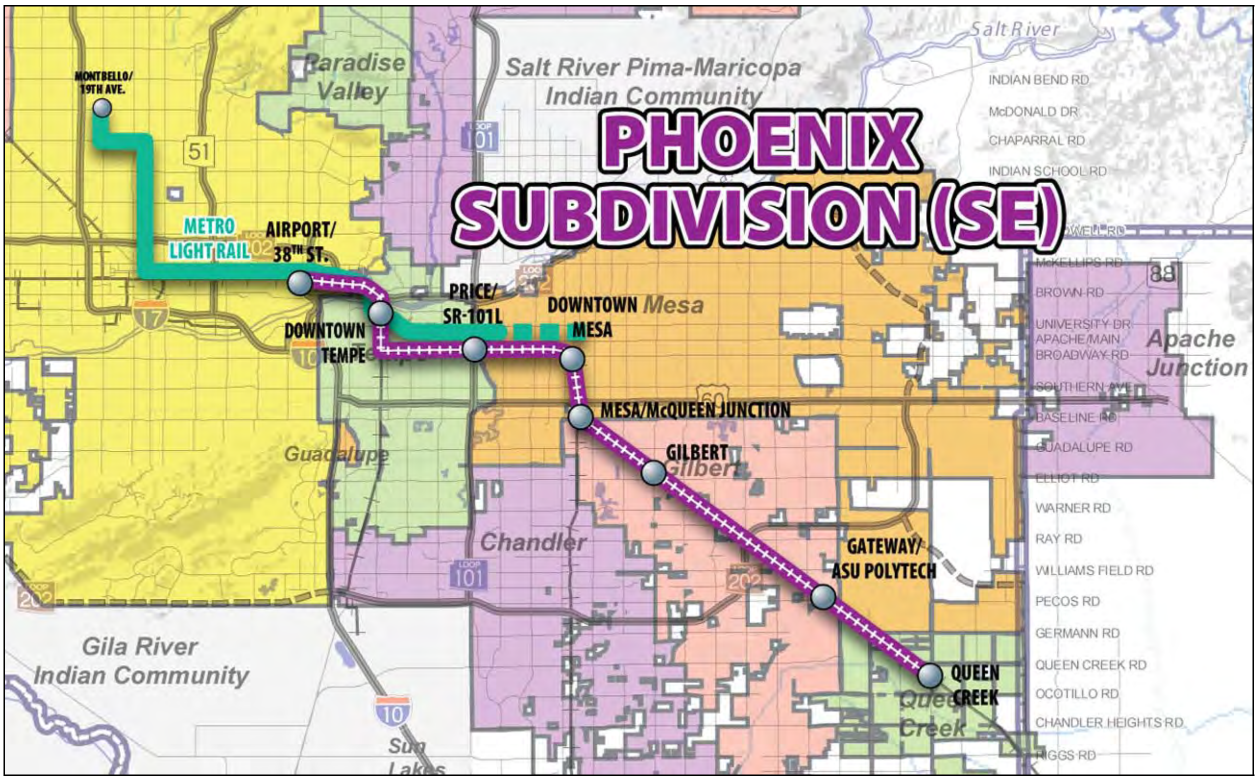
Start-Up Service Scenario 1A: Build the Grand Avenue Corridor.
The Grand Avenue Corridor offers ridership that is on par with other commuter rail systems in operation throughout the Western US, offers substantial travel time savings, and is moderately cost-effective. Implementation of commuter rail may result in the relocation of some freight facilities, consistent with BNSF Railway Company long-range plans.



Source: URS Corp., 2009.

Start-Up Service Scenario 1B: Build SE Corridor segment between Queen Creek and downtown Mesa/downtown Tempe/Airport & 38th St.

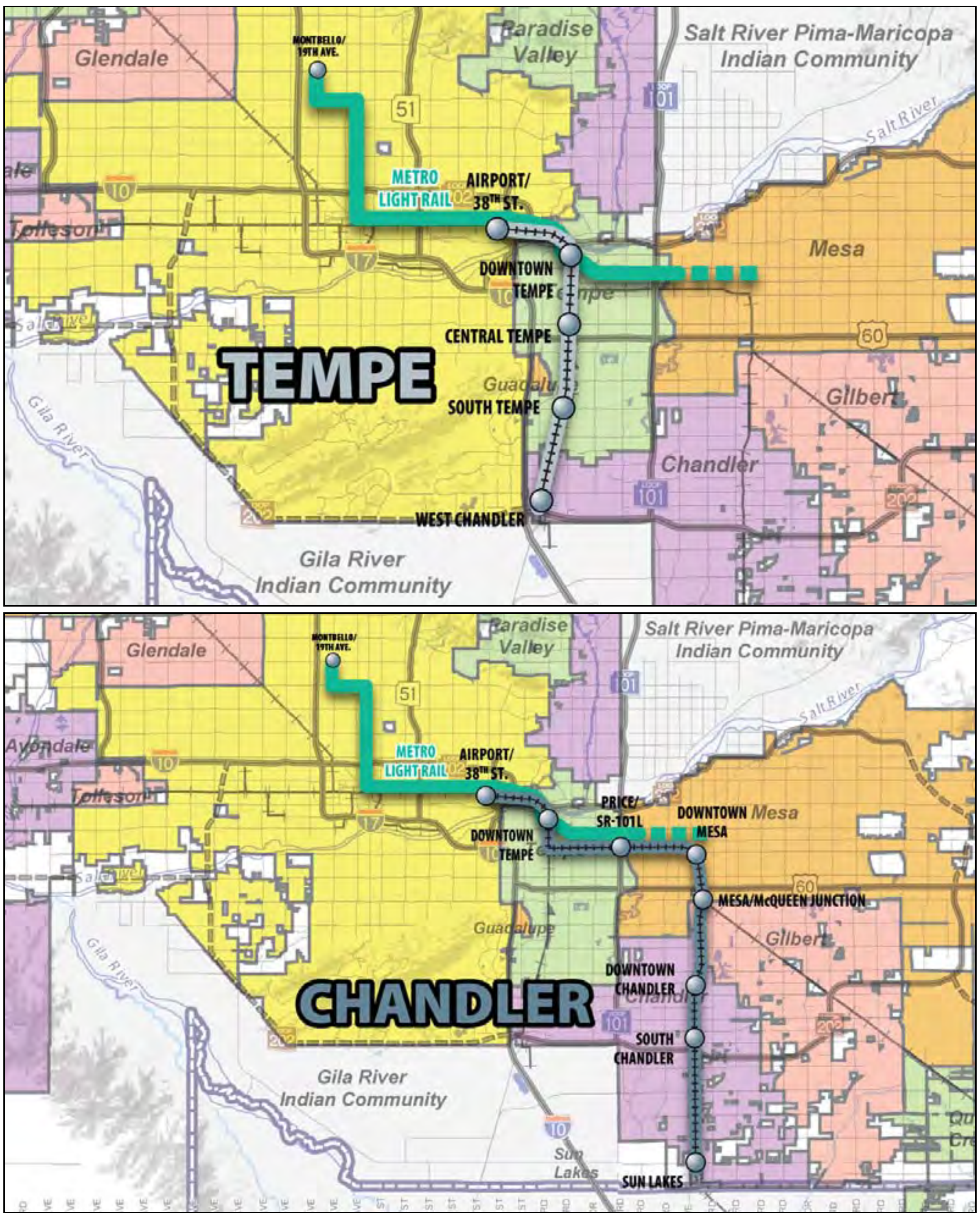
This scenario would require a transfer to LRT either in downtown Mesa, downtown Tempe, or the vicinity of the airport. Ridership forecasting shows large origin-destination traffic in Tempe and the airport is generally considered an emerging employment hub. A future LRT station in downtown Mesa may also provide a possible connection to commuter rail. (Details regarding potential transit connections in the Sky Harbor Airport area are provided in Section 4.4.2.3). Either one of these options would improve mobility in the East Valley while avoiding some of the more challenging operational and right-of-way constraints in downtown Phoenix. However, Scenario 1B would require a forced transfer for many riders, which would increase travel times and decrease overall ridership.



Source: URS Corp., 2009.

Start-Up Service Scenario 1C: **Build Tempe Corridor segment between West Chandler and downtown Tempe/Airport & 38th St.**
- or -
Build Chandler Corridor segment between Sun Lakes and downtown Mesa/downtown Tempe/Airport & 38th St.

Like Scenario 1B, this scenario would require a transfer to LRT either in downtown Mesa (for the Chandler Corridor), downtown Tempe, or the vicinity of the airport. While ridership on these corridors is not as strong as on the SE Corridor, if (1) right-of-way constraints limit use of the SE Corridor, or (2) inter-city rail plans suggest these corridors are suitable for passenger service between Phoenix and Tucson, then Tempe or Chandler may become higher priority commuter rail corridors.



Source: URS Corp., 2009.

4.3.3 Interlined Alternatives Ranking

Like the Stand-Alone Alternatives ranking, the findings of the Interlined Alternatives evaluation revealed three distinct tiers of Study System alternatives – top, middle and lower tier. The factors that proved to be major discriminators included ridership and cost effectiveness. Table 4-2 is a summary of Interlined Alternatives rankings and discriminators.

Table 4-2: Interlined Alternatives Ranking

Interlined Corridors	Ranking	Major Discriminators
Grand-SE	Top Tier	• Highest boardings per mile • High capital cost per mile • Lowest O&M cost per passenger trip
Yuma-SE	Top Tier	• Moderate boardings per mile • Lowest capital cost per mile • Moderate O&M cost per passenger trip
Grand-SE & Yuma-Tempe and Yuma-SE & Grand-Tempe	Middle Tier	• Low to moderate boardings per mile • Moderate capital cost per mile • Moderate O&M cost per passenger trip
Grand-SE & Yuma-SE	Lower Tier	• Lowest boardings per mile • Moderate capital cost per mile • Highest O&M cost per passenger trip

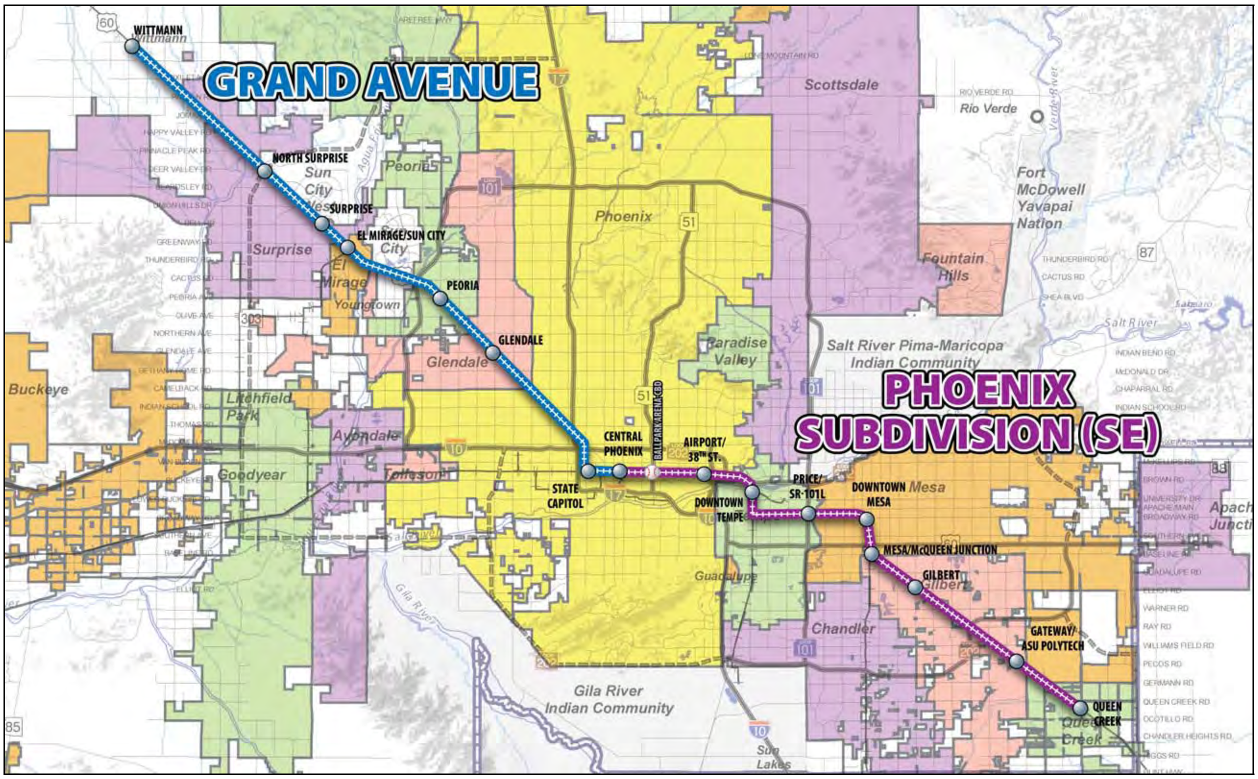
Source: URS Corp., 2009.

4.3.4 Recommendation for Second Segment of Commuter Rail System

The ranking of Interlined Alternatives helps to determine which combination of corridors would be most effective and should therefore be considered first for interlining with the start-up corridor. If, as in Scenario 1A, the SE Corridor is built first, then the Project Team recommends the following:

Interlined Service Scenario 1: Build the Grand Avenue Corridor (interline with the SE Corridor).

Ridership is greatest when the most productive East Valley and West Valley Corridors – Grand Avenue and SE – are combined.

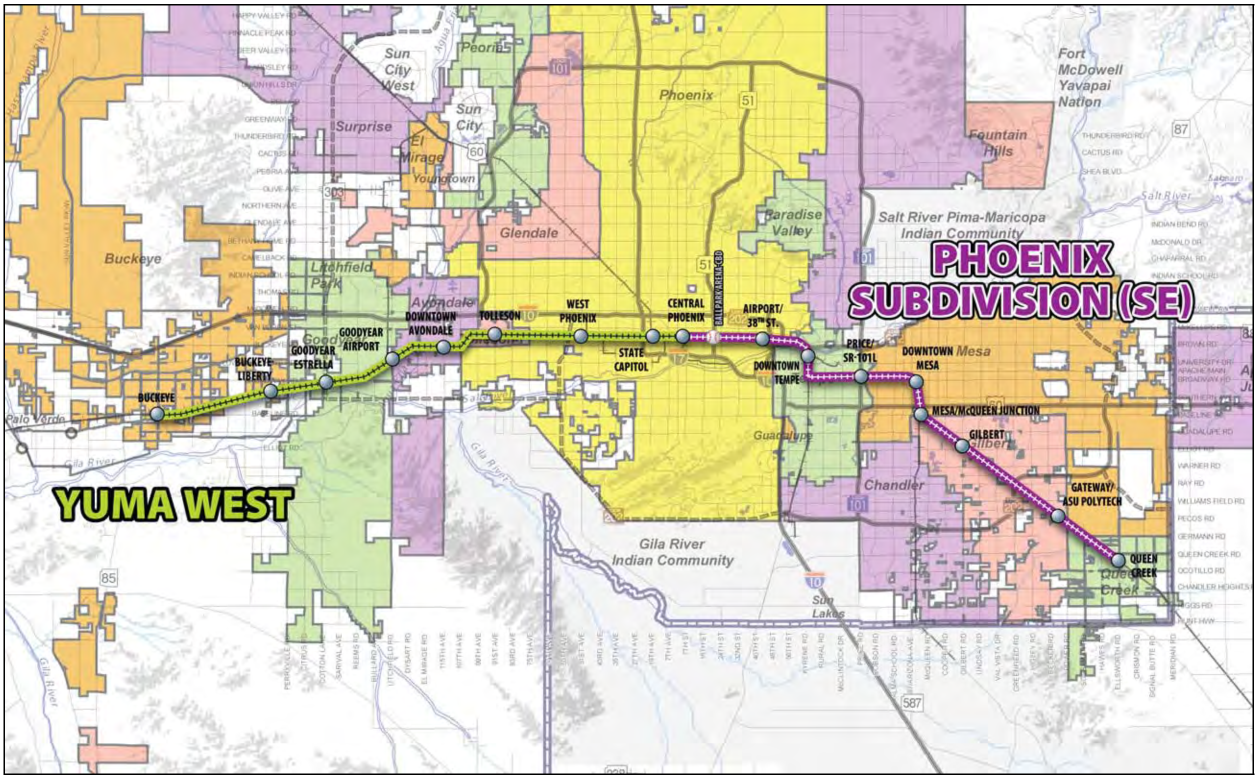


Source: URS Corp., 2009.

The implementation of the Grand Avenue Corridor as the second corridor in the commuter rail system would produce ridership that is two times greater than the average found in commuter rail system in operation throughout the western US.

Interlined Service Scenario 2: Build the Yuma West Corridor (interline with the SE Corridor).

The combination of Yuma with the SE Corridor results in the lowest capital cost per mile of any interlined combination. This integrated alignment also has good overall ridership and the second-highest boardings per revenue mile of any combination.



Source: URS Corp., 2009.

4.3.5 Recommendation for Remaining Segments of Commuter Rail System

Phased implementation of the remainder of the corridors will be highly dependent on a number of factors. The alternatives evaluation revealed no single outstanding performer among the Tempe, Chandler, and Yuma Corridors. Therefore, considerations for future phasing to achieve build-out of the regional commuter rail system will include such factors as:

- Development patterns;
- Changes in travel demand;
- Community support;
- Potential funding sources (as described in more detail in Section 4.8); and
- Potential integration with Phoenix/Tucson intercity rail (as described in more detail in Section 4.4.3).

4.3.5.1 Improvements to Low Performing Corridors

While ridership forecasts for the Tempe, Chandler and Yuma Corridors indicate these commuter rail routes would be low performers, steps can be taken to potentially improve the ridership potential along these alignments. From the commuter rail operations side, increasing the number of stations and headways may boost ridership, but would also have travel time and cost implications that would need to be more thoroughly investigated. In terms of local planning, jurisdictions can ensure their land use policies focus development within the transit corridors, and particularly around the station target areas themselves. Local agencies can also pursue more robust local bus or circulator services to provide efficient transit connections.

4.4 Integration with other Transit Modes

The analysis of ridership forecasting affirmed that the commuter rail system would be more productive when connections with other transit modes are maximized. The strongest station areas typically are characterized by high levels of connectivity with bus and light rail systems as well as activity/employment centers. The approach to station planning in this study was generalized, in that large areas were identified as targets to site a commuter rail station. Further study would be required to plan for the functionality of these areas as regional transit centers that would serve key destinations and maximize intermodal connections that strengthen the overall productivity of the transit system.

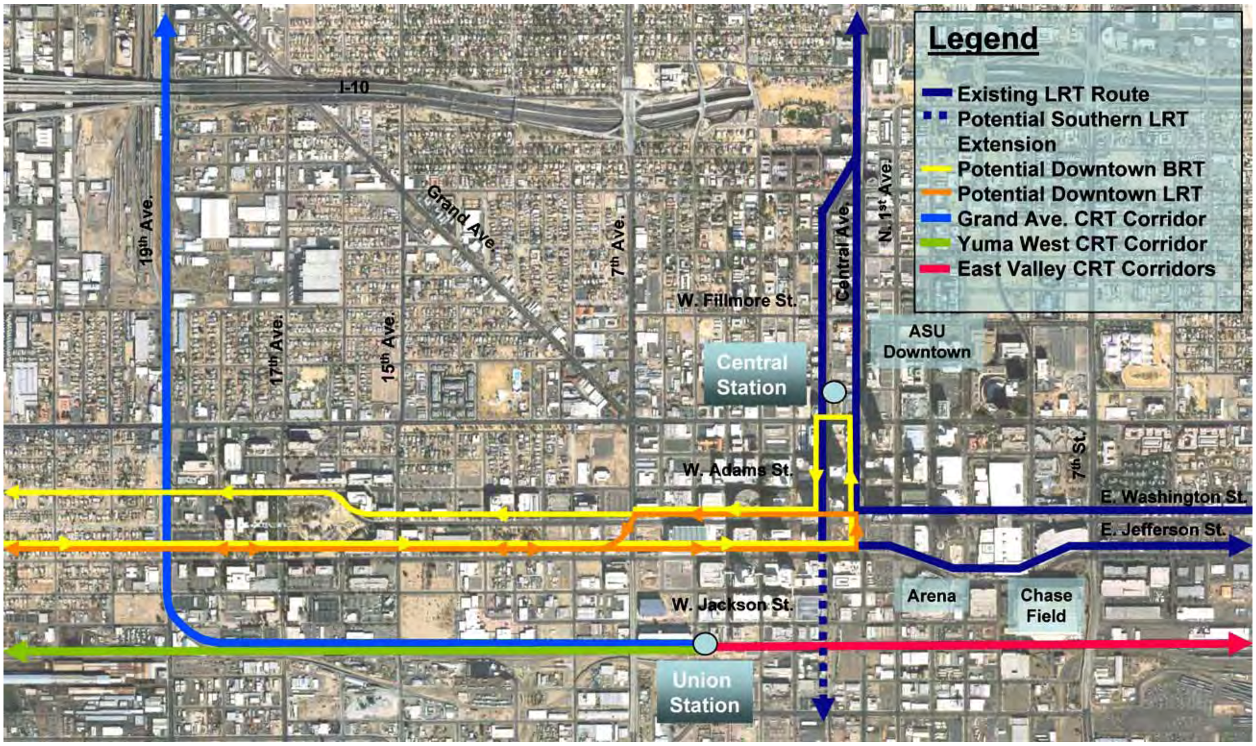
The remainder of this section describes major transit hubs within the region that could provide these intermodal centers and highlights potential opportunities and constraints that were identified through the System Study process. Overall, future coordination among the transit operators and local jurisdictions could enhance opportunities for intermodal connections.

4.4.1 Transit Connections within Downtown Phoenix

The existing rail line through downtown Phoenix is located slightly south of the main employment hub, near Harrison Street. Options for specific station locations in this area are associated with various constraints. Union Station provides excellent support for train maintenance facilities, but the station itself is currently privately owned and may not be available for public use. A special events station location may be appropriate adjacent to Chase Field or U.S. Airways Arena, but right-of-way would need to be acquired.

Existing light rail and a planned high-capacity transit corridor are located on Jefferson Street, less than a quarter-mile away from the commuter rail line. Bus routes running south of Jefferson Street operate on Central Avenue, and a conceptual high-capacity transit corridor to connect with the Jefferson Street line and serve south-central Phoenix is programmed for future study. Central Station, a hub for all transit, is located about a quarter-mile to the north of Harrison Street on Van Buren Street and Central Avenue. The DASH, a downtown circulator bus, operates on weekdays and could be rerouted to more directly serve commuter rail riders. Figure 4-5 illustrates the many types of transit modes and activity centers existing or planned for the downtown area.

Figure 4-5: Existing and Planned Transit Modes in Downtown Phoenix



Source: METRO, 2010.

Downtown Phoenix is unusual in that it includes two distinct employment hubs: the area in proximity to Central Avenue, and the state government complex approximately three quarters of a mile to the west. The State Capitol area demonstrated consistently strong ridership potential. The UPRR and BNSF Railway Company rail lines cross the State Capitol area at slightly different locations. The BNSF Railway Company corridor provides an opportunity to interconnect with future high-capacity transit (the potential Phoenix West extension) at a key destination point at 19th Avenue and Jefferson Street. An objective of future evaluation may be to ensure that other commuter rail corridors can readily access the State Capitol area, and that studies for multiple modes are appropriately coordinated to ensure the most efficient connections.

Coordination with the railroads is likely to result in the identification of additional opportunities and constraints in this area. Right-of-way is constrained through downtown Phoenix, and assembly of new right-of-way from multiple owners would be challenging. In addition, both railroads consider this segment to be part of major routes where commercial freight traffic must be maintained at certain levels. The complexity of freight operations at Harrison Yard may limit options for passenger service.

The high density of transit service and attractiveness of downtown Phoenix for employment and special events makes it a good candidate for further study to ensure efficient interconnections and coordinated planning for a future system. In addition, the City of Phoenix has been actively planning to enhance and expand the pedestrian-oriented character of this area, and the integration of land use and transit planning is one strategy to meet this objective.

There is also a relationship between downtown parking policies, cost, and availability and transit use. Currently, parking costs are relatively low for a major metropolitan area and policies exist to promote the availability of parking. Some cities, such as Portland, Oregon, have taken steps to limit parking availability and raise rates to provide incentives to choose other modes.

4.4.2 Transit Connections outside Downtown Phoenix

The Phoenix metropolitan area is polycentric, with multiple high-density employment areas. Ridership forecasting suggests that destinations outside of the traditional city center of downtown Phoenix may be equal or greater attractions to riders in the region. These destinations include downtown Tempe, downtown Glendale, and the Sky Harbor Airport area, which serves not only airport travelers but an emerging employment area.

4.4.2.1 Downtown Tempe Transit Connections

The downtown Tempe station area consistently showed stronger ridership potential than downtown Phoenix, and appears to be a major destination particularly for East Valley residents. Downtown Tempe also offers a dense network of transit, a pedestrian-oriented area, and large special event venues as well as the main campus for Arizona State University. The physical distance between the existing UPRR rail line and existing light rail and primary bus routes is less than a half-mile. Downtown Tempe serves as a focal point for light rail, bus, and circulator service, providing opportunities to strengthen those connections. However, this area may present physical constraints to achieving these connections, with limited additional right-of-way or vacant land available. These transit connections would require further study.

4.4.2.2 Downtown Glendale Transit Connections

The downtown Glendale station area was forecast to have the strongest ridership along the Grand Avenue Corridor. This is likely due to the concentration of population and employment as well as extensive transit connections. Planning is ongoing in Glendale to promote the pedestrian-oriented character of downtown, including enhancements along the Grand Avenue corridor. Additional evaluation of this station area could serve to maximize multimodal transit connections and support local planning efforts.

4.4.2.3 Sky Harbor Airport Area Transit Connections

This area, between 36th and 44th Streets in Phoenix, is an emerging focal point. Within this approximately half-mile-long area, the opportunity exists to connect commuter rail with light rail and bus transit as well as the planned Sky Train people mover system that will serve the airport. This area is characterized by travelers going to Sky Harbor Airport, airport employees, Gateway Community College, and a growing employment center particularly up 44th Street. Additional evaluation to improve circulation within this area could address multimodal transit connections and bring together the multiple agencies planning for mobility in the area.

4.4.3 Connectivity with Inter-City Rail

The potential integration of a regional commuter rail system with intercity rail and a larger statewide rail system as envisioned in the Arizona Department of Transportation (ADOT) Statewide Rail Framework Study will be an important consideration as MAG moves forward with the planning and design of the System Study corridors. The on-going Statewide Rail Framework Study is charged with formulating a rail development program to promote a sustainable multimodal transportation system that addresses rail transportation needs across the State of Arizona. The Study includes the identification of several passenger and freight rail improvements statewide, including the Phoenix/Tucson Intercity Rail Project, which would be a precursor to future high-speed rail service between Phoenix and Tucson.

Several of the Phoenix to Tucson intercity passenger rail corridors currently under consideration would operate along UPRR right-of-way alignments also under consideration in this System Study. These corridors include the Tempe, Chandler and Southeast Corridors. Table 4-3 describes the intercity rail conceptual corridors as well as the East Valley commuter rail corridors each would possibly use.

Table 4-3: Conceptual Phoenix/Tucson Intercity Rail Corridors

Intercity Rail Corridor Alignment	Description
Maricopa SR 347 to UPRR	Utilizes the Tempe Corridor to SR 347
Tempe Branch – I-10	Utilizes the Tempe Corridor connecting to I-10
Chandler Branch – I-10	Utilizes the Chandler Corridor connecting to I-10
Chandler Branch – PHX Subdivision	Utilizes the Chandler Corridor to SR 87 through Coolidge
PHX Subdivision – I-10	Utilizes the Southeast Corridor through Coolidge
North-South Corridor	Utilizes the Southeast Corridor to Florence connecting to I-10
SR 79	Utilizes the Southeast Corridor to Florence to SR 79
Superstition – Coolidge	Utilizes the Chandler Corridor to SR 87 through Coolidge

Source: BQAZ, 2009.

Given the potential to investigate joint-use corridors as well shared operations between intercity passenger rail and regional commuter rail service, continued coordination between ADOT, MAG and other local and regional entities will be necessary.

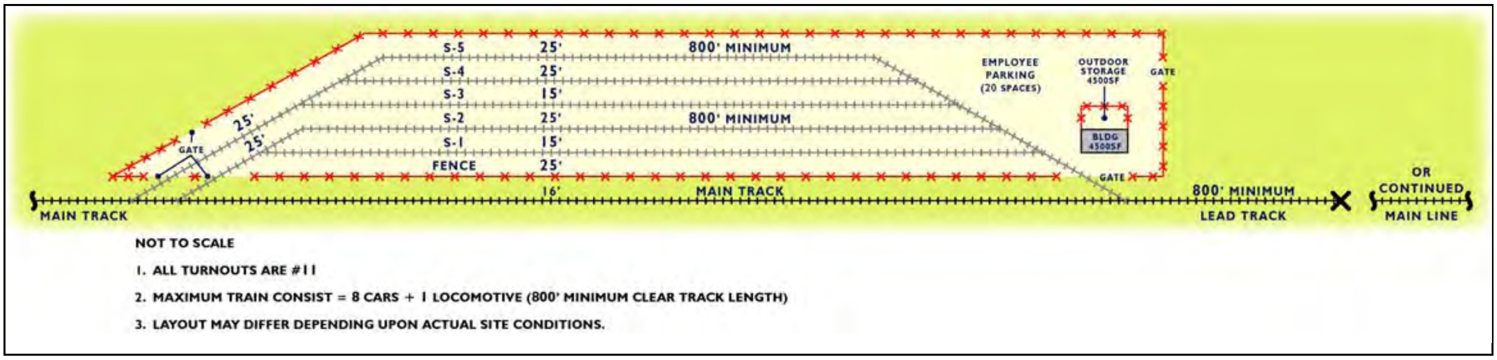
4.5 Siting of Layover and Maintenance Facilities

Commuter rail layover and maintenance facilities would be needed to support the commuter rail operations in the MAG region. Advance planning for these facilities is important, as the space needs and locational requirements may limit where they can be sited. For a complete description of layover and maintenance facility functions and requirements, see Appendix I: Commuter Rail Maintenance Facility Description and Evaluation. The following subsections provide an overview of each type of facility and potential locations within the System Study planning area.

4.5.1 Layover Facility

Layover facilities (or tracks) serve the primary purpose of vehicle storage and minor vehicle cleaning and inspection. Even when a train storage and maintenance facility is provided on-line, layover facilities need to also be provided at the opposite end, or ends, of the corridor. Some trains are kept at the storage and maintenance facility and some are kept at the layover facility in order to allow trains to begin or end the service day from each end of the system. This allows equal service to be operated in both directions much sooner than if all of the trains had to start or end from one end of a corridor. The layover facility should be located near the terminal station, or stations, at the end of the line in order to minimize the travel distance between the station and the layover facility. Figure 4-6 depicts a typical layover facility site plan.

Figure 4-6: Typical Layover/Trail Track Facility

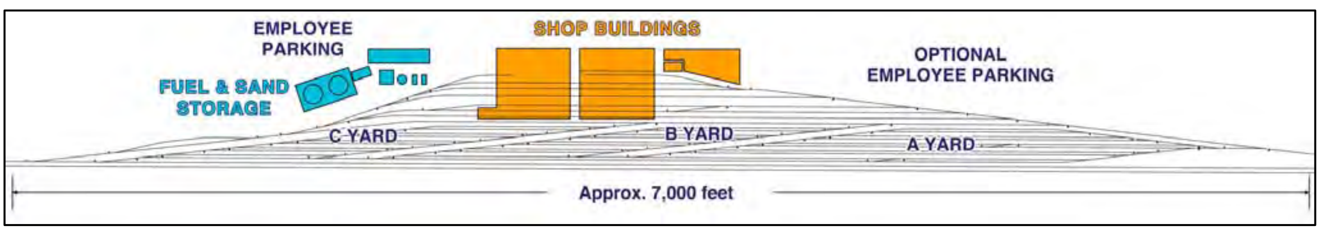


Source: URS Corp., 2009.

4.5.2 Maintenance Facility

Commuter rail maintenance facilities are the facilities used to repair, maintain, clean, fuel, and store commuter rail vehicles that serve a commuter rail line or system. In addition, control center rail operations and maintenance-of-way (MOW) facilities are necessary and are often components of larger maintenance facilities. MOW includes facilities required to maintain the track, stations, signaling, bridges, at-grade crossings and other fixed facilities along a given passenger rail corridor. The commuter rail maintenance facility would accommodate train operations and maintenance functions that involve daily, routine activities that are of short duration. A maintenance facility could either be provided on the corridor or be performed at a local BNSF Railway Company or UPRR facility, even if the heavy repair functions are contracted to an outside vendor. Locating the maintenance facility on-line precludes the need to constantly move vehicles to and from an off-line facility for basic, routine inspection, servicing, and maintenance. Figure 4-7 depicts a typical commuter rail maintenance facility site plan.

Figure 4-7: Typical CRMF Site Layout

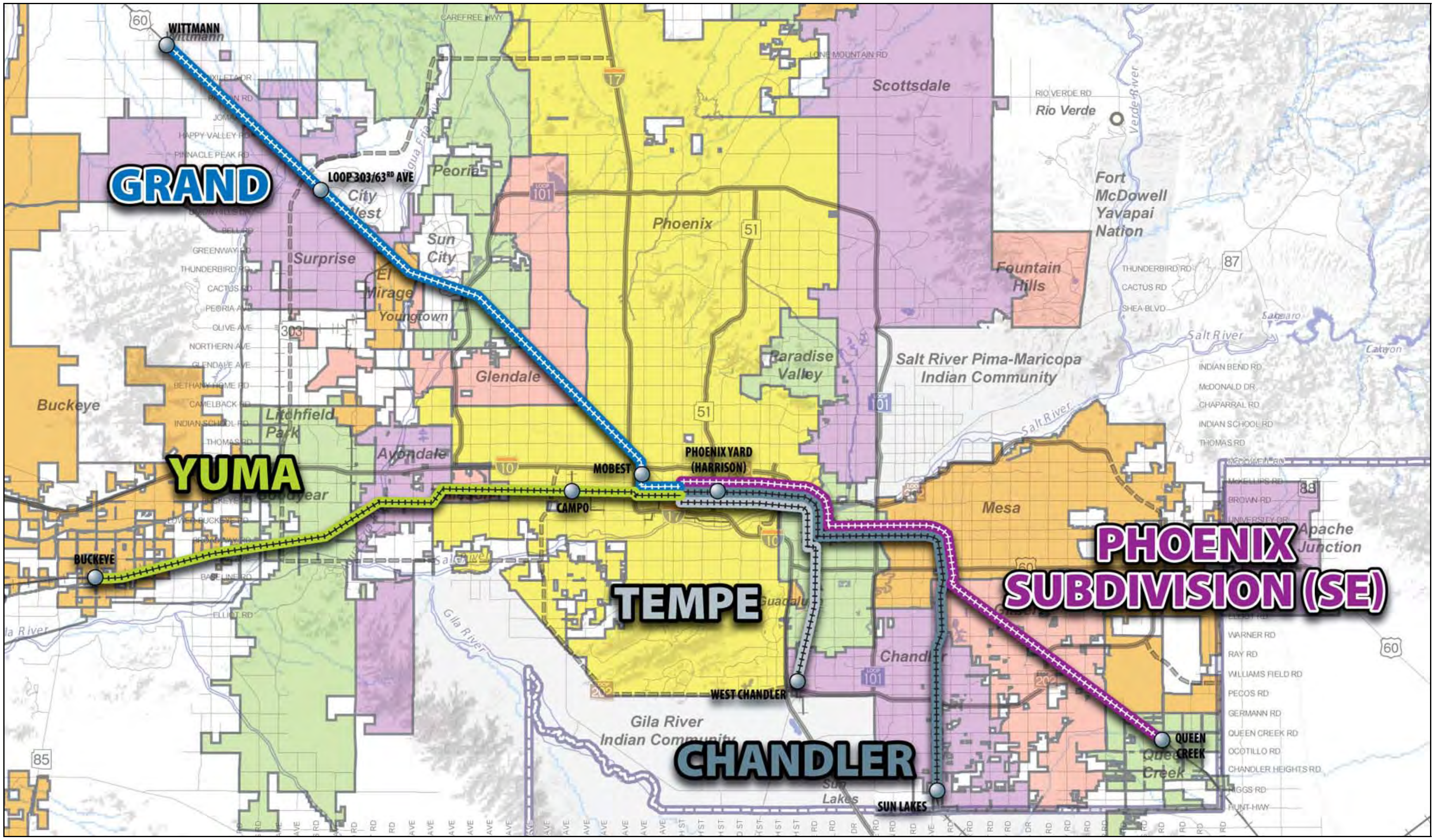


Source: URS Corp., 2009.

In addition to a maintenance facility that accommodates daily maintenance, a facility would also be needed to accommodate heavy maintenance that involves extensive, long-duration work on locomotives and cars. Heavy maintenance work would be contracted to the UPRR, BNSF Railway Company, or to an outside vendor until such time as it becomes economical to do such work in the maintenance facility.

Potential maintenance and/or layover facility locations are shown in Figure 4-8.

Figure 4-8: Potential Maintenance and/or Layover Facility Locations



Source: URS Corp., 2009.

4.6 Operations Models

As envisioned, commuter rail service in the MAG region would share right-of-way currently owned by the UPRR and BNSF Railway Company, preferably utilizing the same track. To enable this, a rail access agreement of some type would be required. Railroad access agreements fall into two broad categories: Sale Agreements and Capacity Rights Agreements. A more detailed discussion of these types of agreements is provided in the Maricopa Association of Governments (MAG) Commuter Rail Strategic Plan (2008). These agreements are assessed in this section for suitability for implementing commuter rail service in the five System Study commuter rail corridors. In addition, Section 4.6.3 identifies options for operating commuter rail service, which may be contracted with the railroads or another party.

4.6.1 Capacity Rights Agreement

Capacity Rights Agreements may be a real estate interest such as a lease or easement, or a contractual or license right. The purchaser is not acquiring the line, but rather is only acquiring the right to operate a specified number of trains. Unless conditions change, a Capacity Rights Agreement is expected to be the likely avenue for implementing commuter rail service along any of the System Study corridors.

Two key elements of these agreements that need to be negotiated are (1) level of service and how passenger and freight service are timed to operate concurrently, and (2) capacity improvements. Chapter 3 provides a schedule for conceptual operations that may provide a starting point for these negotiations. Actual schedules will be influenced by both the projected ridership and the level and type of freight service on the corridor. With regard to capacity improvements, parties will need to show funding commitments and agree on the timing and nature of the improvements necessary to accommodate the level of service.

Because the railroads still owns the line, most capacity improvements would be designed and constructed by the railroads, or by contractors working for the railroads. In most instances, existing railroad labor agreements require that railroad employees actually construct the improvements that tie into an existing railroad facility. Normally the agreement with the railroad contains cost estimates for all the capacity improvements, with the commuter rail agency responsible for any increases over the estimate.

Under a Capacity Rights Agreement, a railroad would continue to maintain and dispatch the rail line. The standard of maintenance required for the speed and ride quality necessary for good passenger rail service is higher than that required for freight service. Accordingly, the agreement would detail the standard of maintenance required and set the cost paid for maintenance, or establish the method, or formula for allocating ongoing maintenance costs. Because the railroad use of the rail line may still be significant, these allocation formulas more evenly split maintenance costs than in sale agreements, where railroad use is less significant.

The agreement would also establish the process to be followed for identifying future capital projects. These future capital projects include capacity improvements requested by either party to the agreement, as well as capital maintenance projects such as major tie replacement and rail relay programs. The allocation formula or method of allocating these capital replacement costs is weighted to emphasize the more demanding operating requirements of passenger rail systems.

Under this scenario, dispatch of the line would remain with the railroad. Dispatch protocol (what train has priority) and compensation for dispatch services are negotiated between the agency and the railroad. All of these considerations for operations and maintenance may influence the preliminary cost estimates provided in Chapter 3.

4.6.2 Sale Agreements

Generally, a railroad would only enter into a Sale Agreement when the rail line involved is a light or moderate density (density refers to the number of trains operating on the corridor) branch line or a light density secondary main line that does not figure prominently in the railroad's current or future operations. Under a Sale Agreement the purchaser would assume greater upfront costs and liabilities, as sales costs may reach or exceed a million dollars per mile and the purchaser assumes responsibility for any environmental or other issues associated with the right-of-way. However, the owner would have greater control over timing and levels of service, dispatch, and the timing and nature of improvements.

A Sale Agreement generally will not transfer mineral or rail freight rights; the railroad will normally retain the right and obligation to serve rail freight customers on the corridor. The right and obligation to provide freight service is regulated by the Surface Transportation Board, formerly the Interstate Commerce Commission. This retained right is usually styled as a "common carrier easement," and gives the railroad a real estate, contractual, and regulatory right and obligation to continue providing rail freight service. This common carrier obligation could transfer to the new owner, but few, if any, public entities want to be burdened with the obligations and regulatory entanglements of freight rail responsibilities. The common carrier responsibilities may, however, be transferred at closing, or soon thereafter to a third party operator.

For any of the System Study corridors to be considered as a branch that could be eligible for a Sale Agreement, the UPRR or BNSF Railway Company would likely have determined that (1) there are no major customers along the line; or (2) service on the line is not expected to increase dramatically in significance in the future. Should any of the System Study corridors be considered by the UPRR or BNSF Railway Company to be candidates for a Sale Agreement in the future, the additional costs and liabilities may still make this an untenable option for a regional commuter rail agency.

However, if a statewide rail authority is identified as the appropriate governance structure for commuter rail in the region, there may be more justification for assuming greater responsibilities associated with owning the line(s). Ownership of rail lines by a statewide rail authority would require the appropriate resources needed to manage the wider array of responsibilities attendant to owning such a resource. New responsibilities would include acquiring experienced staffing, meeting federal regulations, purchasing and maintaining rolling stock and providing other necessary facilities. Potential governance options are discussed in more detail in Section 4.7.

4.6.3 Contracting Operations

A significant option for the operation of commuter rail service would be to contract with a private operator. Operations could be contracted to an independent contractor, such as Amtrak or a private contractor like Herzog, which operates several commuter rail systems throughout the U.S., including the New Mexico Railrunner and the San Diego Coaster. An owner railroad – the BNSF Railway Company or UPRR – could also operate passenger rail service under the terms of a Capacity Rights or other agreement. Currently, the BNSF Railway Company operates passenger service for three commuter rail systems, including the Metra Chicago-Aurora Line in Illinois, the Sounder in Seattle and the Northstar in Minnesota.

Another option is to contract with a short line or other qualified operating entity to operate passenger service as a third party. A short line railroad is an independent company that operates shorter rail lines, typically under 100 miles. Short line and contract operators generally have lower labor, overhead, and regulatory costs than larger Class I railroads and can operate shorter lines profitably. A short line railroad or contract operating company may be contracted to operate passenger service under either a Sale or Capacity Rights Agreement.

4.6.4 Summary of Potential Agreements to Operate Commuter Rail

Further coordination with the UPRR and BNSF Railway Company is critical to determining the appropriate approach to contractual relationships to operate commuter rail. The railroads' projections of future freight activity along the corridors would need to be integrated into the overall agreement. Table 4-4 provides a summary of the pros and cons of each type of railroad agreement for operating commuter rail.

Table 4-4: Summary of Considerations for Passenger Rail Agency when Entering into Agreements to Operate Commuter Rail

Agreement	Potential Advantages	Potential Disadvantages
Capacity Rights Agreement	• Usually lower initial costs (compared to Sale Agreement). • May contract with railroads to operate passenger service.	• Passenger rail agency has less control over the line, which makes increasing service or changing schedules more difficult. • Railroads would continue to maintain and dispatch the lines, which limits control over train priority by passenger rail agency. • Need to identify additional agreements to dispatch the line for commuter rail. • Difficult and complex to negotiate compensation for capacity rights, infrastructure, maintenance. • Railroads have the ability to shut down negotiations.
Sale Agreement	• More flexibility to operate service (although freight service likely would still continue) and schedule infrastructure improvements. • Greater capacity to exercise control along the corridor with dispatch and maintenance. • Freight common carrier service likely would remain with the railroad.	• Greater upfront costs to purchase. • Purchaser assumes environmental and other liabilities associated with the right-of-way. • Limited segments of the rail line would be considered eligible for sale by the railroad; most likely sales would not be considered where there is high freight traffic, or where existing customers or future development options might be compromised. • Need to identify additional agreements to dispatch the line and operate service, although these could be addressed in the Sale Agreement.
Contract to Operate Passenger Rail to Third Party	• Operations would be run by qualified, experienced rail operator. • Short lines or qualified contract operators typically have reduced overhead and can operate shorter lines profitably. • Railroads may prefer third party operator agreements.	• Need to identify additional agreements to dispatch the line. • May require coordination between short line or other parties if different entities are operating passenger and freight on the line.

Source: URS Corp., 2009.

4.7 Governance Options

One of the most significant issues to be resolved for the implementation of commuter rail in the MAG region is the question of who would be the responsible party for managing, designing, constructing and operating the system. A commuter rail system typically goes farther and cuts across more jurisdictional boundaries than most other types of transit service.

In the MAG region, this means that the commuter rail service area will expand beyond the political boundaries of existing local transit service areas and potentially beyond the boundaries of the MAG region itself into northern Pinal County. Implementation of a commuter rail system will likely require a governance structure that reflects the financial, political, and representational patterns of the areas served by commuter rail.

The following subsections describe potential governance models for consideration. It is important to note that additional legal analysis is necessary to determine the application of governance options in the State of Arizona.

4.7.1 Regional Transit Authority/District (Multi-Modal)

Regional transit authorities or districts are usually characterized by appointed boards, with representation closely aligned with area political subdivisions, and the authority to impose voter-approved taxes to balance financial resources with service demands. In many of the mature transit systems throughout the country, a regional transit authority will manage and operate several types of transit services, such as light rail, commuter rail, bus, streetcar, etc.

4.7.2 Regional Rail Authority/District (Single-Purpose)

A new regional transit authority or district could conceptually be a single provider of commuter rail service with its own board and planning, design, construction and operations functions. A new regional authority can be formed in one of two ways: (1) by a legislative statute at the state level that defines and grants authority to a district; or (2) by a direct popular vote of the electorate in which voters opt-in to form a regional transit district. Like a regional transit authority responsible for multi-modal services, a single-purpose regional rail authority is also usually characterized by an appointed board with representation closely aligned with area political subdivisions, and ideally has the authority to impose voter-approved taxes for balancing financial resources with service demands.

4.7.3 Joint Powers Authority

A Joint Powers Authority (JPA) is a common governance model for commuter rail transit operations. A JPA is an institution permitted under the laws of some states whereby two or more public authorities can operate collectively. A JPA is distinct from the member authorities and has separate operating boards of directors that can be given any of the powers inherent in all of the participating agencies. Unlike a new transit district, which would have its own source of funding as a taxing entity, a JPA relies on funding through its constituent members. A JPA can have legal standing at the state level or can be a partnership entered into between its constituent members via intergovernmental agreements at the local or regional level.

The rationale for forming JPAs to govern commuter rail systems varies. In some cases, a JPA is formed during the planning and design phases of commuter rail, while in other cases a JPA is formed to take over governance from another agency, such as a state Department of Transportation.

4.7.4 Division of State Department of Transportation

The provision of regional transportation services by state agencies is more common in small states with one dominant metropolitan area. Both Boston, Massachusetts and Baltimore, Maryland are examples of commuter rail systems that are planned and operated by a state Department of Transportation.

4.7.5 Division of Metropolitan Planning Organization

While Metropolitan Planning Organizations (MPOs) generally play a significant role in the planning for regional commuter rail service, they are usually not the entity responsible for the governance and administration of commuter rail service. One exception to this is New Mexico's recently opened Rail Runner Express; the Mid-Region Council of Governments is the lead agency for implementation of this service. Within the MAG region and part of Pinal County, MAG has initiated the preliminary planning of commuter rail service.

4.7.6 Examples of Governance Models in Other Regions

Generally, the institutional arrangements for regional or commuter rail service throughout the country range from state-run regional rail operations to large single-purpose regional rail authorities that extend service into multiple political jurisdictions, to regional transit authorities that are responsible for multimodal services, to sub-regional agreements between cities to contribute to the management of a rail service in a common corridor.

There are several new commuter rail systems currently in operation or being considered across the country. From these networks there is a wealth of information and experience on which to draw for the analysis of possible governance structures.

The more mature systems are significantly larger in size than the newer ones, primarily because they have built ridership as the region has grown around them. Each has been a catalyst for successful service in corridors or in the region. Ridership has followed, growing steadily as the train became a preferred commuter option for local residents. In many of these locations, commuter rail was added after the regional urban form and transportation network had already been established. This has required close coordination among regional and local jurisdictions, the railroads, private businesses, and residents in order to be successful. Regional agencies such as the MPO or the transit agency have often taken the lead in initiating this coordination.

Table 4-5 illustrates the array of institutional arrangements that characterize typical commuter rail governance structures throughout the U.S.

Table 4-5: Existing Governance Models

Governance Structure	Governing Authority/District	Commuter Rail Service Description
Regional Transit Authority/District (Multi-Modal)	Sound Transit District, Washington	Sounder between Seattle and Everett and Seattle and Tacoma
	Tri-County Metropolitan District, Oregon	Westside Express Service (WES) between Wilsonville, Tualatin, Tigard and Beaverton
Regional Rail Authority/District (Single-Purpose)	Sonoma-Marin Area Rail Transit, California	Planned commuter rail between Cloverdale in Sonoma County and the San Francisco-bound ferry terminal in Larkspur, Marin County.
Joint Powers Authority	Peninsula Corridor Joint Powers Board, California	Caltrain between San Francisco, San Jose, and Gilroy
	South Florida Regional Transit Authority, Florida	Tri-Rail between Miami, Fort Lauderdale and West Palm Beach
	Virginia Railway Express, Virginia	Virginia Railway Express (VRE) between northern Virginia suburbs and Alexandria, Crystal City and downtown Washington, D.C.
Division of State Department of Transportation	Maryland Transit Administration, Maryland	Maryland Area Regional Commuter (MARC) between Maryland and Union Station in Washington, D. C., operating along three rail
Division of Metropolitan Planning Organization	New Mexico Mid-Region Council of Governments, New Mexico	Rail Runner Express between Albuquerque, Santa Fe, and Belen

Source: URS Corp., 2009.

4.7.7 Key Considerations for Governance Models

Based on a review of existing commuter rail system governance structures listed above, it is clear that the new systems have many different governance structures, as do the established systems. There is no one appropriate structure for governing a commuter rail system.

However, based on the decisions regarding governance made in the most recent commuter rail projects, two key factors are likely to determine the success of a new governance structure. These factors include the ability of the institutional arrangement to (1) balance local control with the need for regional system performance; and (2) provide stable funding opportunities. With these factors in mind, a set of typical responsibilities for the entity that manages the system has been developed as follows:

- Provide a seamless transportation service;
- Raise funds from a variety of sources including: fares, local/state/federal transit or rail programs, private developers, etc.;
- Coordinate with other transit providers regarding schedules, public information and integrated fare systems;
- Participate in priority-setting in RTP process;
- Facilitate growth of the network and provide transit options in off-peak periods;
- Develop long-range plans for system development;

- Coordinate with the private freight railways;
- Manage operations (often through contracts with private operators); and
- Build ridership by encouraging development at stations.

These responsibilities require the close working relationship among existing transit operators and the cities served by the network.

4.7.8 Potential Governance Structures in the MAG Region

The existing structure of transit service providers in the Phoenix metropolitan region is a complex mix of historical operations such as the City of Phoenix transit system, the Regional Public Transportation Authority or RPTA (commonly known as Valley Metro) and Valley Metro Rail Inc. (METRO), a nonprofit, public corporation charged with the design, construction, and operation of the Valley's light rail system. Defining appropriate governance structures for a commuter rail system would depend upon opportunities that arise for cooperation and use of railroad right-of-way. This could be for one commuter rail project or a series of projects. Each agency would have to participate in the process to define the appropriate structure.

The options for an appropriate institutional structure for regional commuter rail, based on both the national experience and the local situation, are summarized below.

Regional Transit Authority/District (Multi-Modal): Should MAG consider this model in the implementation of commuter rail, it would likely entail a restructuring of RPTA, which was authorized in 1985 by the State Legislature.

Regional Rail Authority/District (Single-Purpose): A newly formed regional rail authority with the sole purpose of implementing commuter rail in the region would likely involve membership by Maricopa County, and potentially Pinal County if service is expanded. This new authority would be similar to METRO. The more commuter rail lines that are developed and operated, the more this alternative makes sense. If only one or two lines develop, the efficiency of one authority is not as great. The clearest benefit of one single-purpose entity would be the focus and efficiency. Modifications to the organizational features of METRO could also be made to include a commuter rail system.

Joint Powers Authority: In the MAG region, a JPA would be formed by aggregating authorities from constituent districts. For example, METRO could enter into an agreement with the cities to be served by commuter rail to form a JPA responsible for the design, construction and operation of commuter rail service. The mission of METRO could be expanded, building upon the existing staff resources that are currently focused on light rail services. In this case, each of the constituent districts would be responsible for providing project funding, rather than funding coming from a single taxing authority, as is the case with a regional district. Depending on the structure of the JPA, individual jurisdictions may tax their constituents or rely on annual appropriations. Another option may be for those jurisdictions that would be served by commuter rail, but are not currently within the boundaries of RPTA or participants on the METRO Board to form one or more regional transit districts that could enter into a JPA with RPTA or METRO for the purposes of implementing commuter rail. This governance model is the most flexible, as it can be formed to fit whatever combined structure makes the most sense locally. However, a JPA would not generate any new taxing authority, may lack focus, and would likely need a strong leader to identify and further a common vision among the member entities.

Division of State Department of Transportation: While this model is primarily found in smaller states with a single metropolitan area, it may have an application in the MAG region, particularly in conjunction with a state-sponsored intercity rail connection between Tucson and Phoenix and a statewide passenger rail system. ADOT is currently finalizing a Statewide Rail Framework Study in which it is considering the establishment of a state rail organization that would be empowered to negotiate with railroads for a unified statewide passenger rail system. Further, determining the responsible agency for regional or statewide rail operation, governance, and oversight is a key implementation element of the ADOT study.

Division of Metropolitan Planning Organization: This governance model would require expanding the charter of MAG to include the operation of commuter rail. This expansion would likely require a change in state law and the creation of an operational division of MAG. Another consideration is that commuter rail service could extend to jurisdictions or regional governments in northern Pinal County, which is not part of the MAG region.

Table 4-6 summarizes the potential advantages and disadvantages of theses governance structures.

Table 4-6: Potential Governance Structures

Governance Structure Option	Potential Advantages	Potential Disadvantages
Regional Transit Authority/District (Multi-Modal)	• One transit service provider would create greater efficiencies and coordination between all transit modes to help ensure integrated regional system.	• May lack focus; if RPTA's role is expanded to include commuter rail, as it has typically focused on bus and paratransit services. • May be cumbersome political process to expand taxing authority to outlying areas (could create an issue of taxing equity), particularly if services are expanded to Pinal County. • Would present a learning curve for RPTA to manage a rail program.
Regional Rail Authority/District (Single-Purpose)	• Single focus on commuter rail, rather than competition for resources being distributed among transit modes, may help ensure success. • With creation of new taxing district, all funding partners would be equally represented from the outset. • Could be added to METRO organizational responsibilities.	• Would require close coordination with METRO and RPTA to ensure integrated regional transit system. • Adds another entity to the mix. • If formed by popular vote, would be unable to serve jurisdictions which do not vote to join, leaving gaps in representation/service. • Cost and start-up time to form new authority may be greater.
Joint Powers Authority	• Would provide maximum flexibility in the formation and responsibilities of a governing body. • Does not require legislative authority. • If METRO mission is expanded,	• May result in potential overlapping responsibilities among or within representative entities. • Each participating entity would be required to secure its own funding source through annual appropriations or voter-approved taxes, which may result in less-stable funding.

Table 4-6: Potential Governance Structures

Governance Structure Option	Potential Advantages	Potential Disadvantages
	JPA will benefit from similar rail expertise with LRT.	• May start "turf war" between entities if a new JPA is formed. • Would present a learning curve as LRT and commuter rail are "different animals," and serve different markets.
Division of State Department of Transportation	• A state agency could apply for funding from federal programs that a local entity may not be able to obtain. • Could empower single railroad negotiator and greater coordination for unified statewide passenger rail service.	• ADOT has not traditionally been an operator of systems, and there could be an institutional learning curve. • May rely primarily on state legislative appropriations. • May bring into question equity between regions of the state. • Increases state influence over local/regional decisions.
Division of Metropolitan Planning Organization	• MAG could continue its role as lead implementation agency and pass-through funding entity.	• Could require continued/greater collaboration and coordination among existing transit authorities. • Northern Pinal County is part of Central Arizona Association of Governments, or CAAG, (not within MAG region). Unless limited to commuter rail operations, Pinal County jurisdictions would be involved in other modal planning for the region. This may add confusion within the MAG and CAAG transportation planning processes. • Would require expansion of MAG charter. • MPOs typically don't have an operations mindset. Would require establishment of new operational division within MAG.

Source: URS Corp., 2009.

4.8 Funding Options

The initial step to develop a funding implementation strategy is to gauge possible or probable funding options from governments at the federal, state and local levels. The policy positions of the involved agencies and possible implementation responsibilities should be thoroughly considered, as should those of other local entities included in the project area. Ultimately, the critical financial issue at the local level is the annual requirement for local funds to meet capital, operating, and maintenance costs.

Table 4-7 lists the federal, state, local and private funding sources and their relative viability for use in the System Study corridors. Each funding source is described in more detail Sections 4.8.1 through 4.8.4.

Table 4-7: Federal, State, Local and Private Funding Sources

Federal Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Federal Transit Administration Section 5307	Supports transportation capital costs including preventive maintenance	Low. The MAG region's allocation is currently programmed to support a host of other transit projects; future funds could be allocated to commuter rail. This is an annual programming allocated by formula; if and when commuter rail is added to the region, its data would enter into the formula calculation.
Federal Transit Administration Section 5309 New Starts	Supports transportation capital	Moderate. The application of Section 5309 is feasible, but the New Starts alternatives analysis planning requirements will require a significant evaluation and time. However, New Starts regulations have been relaxed recently and additional funding will likely be provided nationwide in the next authorization bill.
Federal Railroad Administration Section 130	Supports transportation capital uses only, primarily for the use of improving grade crossings.	Low. The State's allocation of Section 130 funding is relatively small and may likely only support a portion of a safety improvement project.
Congestion Mitigation and Air Quality (CMAQ) Funds	Supports transportation capital uses only	Low. A commuter rail project application will contend with many other capital projects in the MAG region.
Surface Transportation Program (STP) Funds	Supports transportation capital uses only	Low. A commuter rail project application will contend with many other capital projects in the MAG region.
Federal Railroad Administration High Speed and Passenger Rail Program	Supports transportation capital uses only.	Low. May only address some intercity components of commuter rail or related rail projects.

State Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Highway User Revenue Fund (HURF)	Supports transportation capital uses only	Low. Funding is driven by fuel taxes and vehicle license taxes, which may not be sustainable sources in the future. In order to use HURF, State statute changes would be required.
Vehicle License Tax (VLT)	Supports transportation capital and/or operations	Low. The MAG region's allocation is currently programmed. The revenue generated from the tax may not be a sustainable source of funding in the future.
Statewide Transportation Acceleration Needs (STAN) Account	Supports transportation capital and/or operations	Low. The STAN account was a potential source of transit funding in the recent past, however it is not considered to be a reliable funding source in the future.
New Dedicated Statewide Transportation Funding (e.g. statewide tax)	Supports transportation capital and/or operations	Low. Unclear if new tax would be considered viable in the future.

Table 4-7: Federal, State, Local and Private Funding Sources

Local or Regional Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Maricopa County Transportation Excise Tax (Sales Tax)	Supports capital and/or operations	Moderate. Although the revenue generated from the current tax (Proposition 400) is programmed, future propositions are expected to occur.
Vehicle Miles Travelled (VMT) Tax	Supports capital and/or operations	Moderate. Typically used for roadway maintenance. Commonly unpopular with voters because of perceived invasion of privacy. Would be considered to be a more consistent funding alternative to a gas tax.
Payroll Tax	Potentially support capital and/or operations.	Low. Existing state, and potentially federal, tax codes must be modified to support these uses.
Motor Vehicle Sales Tax	Potentially support capital and/or operations.	Low. The MAG region's allocation programmed. The revenue generated from the tax may not be a sustainable source of funding in the future.
Vehicle Rental Tax	Supports capital and/or operations	Low. Special uses for the surcharges collected for this tax will require County, and possibly State, law modification for the purpose of commuter rail.
Local Gas Tax	Potentially supports capital and/or operations	Low. The MAG region's allocation is currently programmed. The revenue generated from the tax may not be a sustainable source of funding in the future. State tax codes will likely require modification to authorize uses.
Vehicle License Tax by District	Supports capital and/or operations	Moderate. The VLT by district concept would require significant political support since it has not been implemented. State and/or County tax codes will likely require modification to authorize districts and uses.

Private Funding		
Fund Source	**Capital and/or Operations**	**Viability**
Public Value Capture: Benefits Assessment Districts	Potentially support capital and/or operating uses.	Low. Setting up the finance mechanism for such a public investment will require State and County statute or code modification.
Public Value Capture: Tax Increment Financing	Potentially support capital and/or operating uses.	Low. The authorization of such a mechanism will require political support and State law modification.
Public-Private Partnerships	Potentially support capital and/or operating uses.	Moderate. ADOT is investigating new PPP opportunities. This approach is being used sparingly in other cities given uncertain nature of financial markets, but may be more viable in the future.

Source: URS Corp., 2009.

4.8.1 Federal Funds

While federal funds for commuter rail projects are fairly limited, there are several potential sources of funding for both capital and operating costs. The future spending levels for these federal programs are primarily subject to federal transportation legislation, or the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The SAFETEA-LU authorizes federal surface transportation programs for highways, highway safety, and transit for a period of five years. This program expired in September 2009 and is in the process of being reauthorized by Congress at the time of this writing. Funding authorized by SAFETEA-LU includes both formula and grant monies to be used at the discretion of states and MPOs, and earmarked funds for particular projects.

It is anticipated that new legislation will be completed later in 2010. The new Administration has given indications that it will boost transit funding and ease previous restrictions on qualifying for federal funding for transit such as that embodied in the New Starts program. In addition, Congressional leaders in charge of the authorization effort also have indicated support for additional transit funding. While it is unknown exactly the shape the new legislation will take, many in the transit industry are optimistic that additional federal resources will be available for new transit projects around the country as a means to promote job development and economic growth and to assist with mobility needs.

According to the MAG RTP, a total of $6.3 billion is anticipated from federal funding programs for the construction of transportation projects in the MAG region between FY 2008 and FY 2028. These forecasted funds have been committed to specific projects and do not include commuter rail projects. Since the passage of the Intermodal Surface Transportation Efficiency Act of 1991, the US Department of Transportation has permitted wide state discretion in assigning portions of "conventional" highway funds to the flexible funding pool, thus widening the funds potentially available for transit projects. The use of these funds for purposes of commuter rail could decrease funding for future light rail transit and bus projects, as well as street and highway projects. However, as mentioned above, higher federal allocations than anticipated in the RTP may provide opportunities to utilize federal funds for commuter rail. The MAG region should continue its planning efforts with the intent of moving quickly to take advantage of any new funding opportunities that might be available through New Starts or other federal transit funding programs.

4.8.1.1 FTA Section 5307 Funds

The Federal Transit Administration (FTA) 5307 Urbanized Area Formula Program makes federal resources available to urbanized areas for transit capital and operating assistance in urbanized areas. Funding is apportioned on the basis of legislative formulas. For areas with populations of 200,000 and more, like the MAG region, the formula would be based on a combination of fixed guideway revenue vehicle miles, and fixed guideway route miles as well as population and population density.

This funding source is expected to generate $1.9 billion for transit development in the MAG Region from FY 2008 through FY 2028.

4.8.1.2 FTA Section 5309 New Starts Funds

The FTA 5309 New Starts Program is the federal government’s primary financial resource for supporting locally planned, implemented, and operated major transit capital investments. Transit 5309 funds are available for the capital costs associated with New Starts commuter rail projects through discretionary grants from the FTA. New Starts funds are limited and the program is extremely competitive, with the national demand for funding far exceeding the supply of funds available. While this federal program can fund up to 80 percent of the capital cost of a project, the average New Starts project receives about 50 percent of its funding from the New Starts program.

These funds are granted at the discretion of the FTA and projects applying for New Starts funds must follow a very stringent planning and project development process. New Starts project evaluations and ratings are based on a number of criteria including the local financial commitment, project mobility improvements, environmental benefits, cost effectiveness, and transit supportive land use patterns.

Over the planning horizon, it is estimated that $1.7 billion in 5309 funds for bus and rail transit projects will be made available to the MAG Region from the FTA, during FY 2008 through FY 2028. The total does not include the $587 million in 5309 funds for the 20-mile light rail starter segment, which has already been committed to the region.

4.8.1.3 Congestion Mitigation and Air Quality Funds

Congestion Mitigation and Air Quality (CMAQ) funds are available through the FHWA and FTA for projects that improve air quality in areas that do not meet clean air standards, otherwise known as nonattainment areas. Projects may include a wide variety of highway, transit and alternate mode projects that assist nonattainment areas in complying with the National Ambient Air Quality Standards. While these funds are allocated to the State, Arizona’s funds have been dedicated entirely to the MAG region, due to the high congestion levels and major air quality issues in the Phoenix area.

MAG CMAQ funds are projected to generate $1.3 billion from FY 2008 through FY 2028. Approximately $465 million has been allocated to transit projects in the RTP.

4.8.1.4 Surface Transportation Program Funds

The Surface Transportation Program (STP) provides flexible funding that may be used by states and localities for a broad range of surface transportation capital needs, including highway, transit or street projects. STP funds are the most flexible federal transportation funds and the federal share is generally 80 percent of the project cost. The MAG RTP currently allocates the region’s share of these funds to primarily street and highway projects.

During the period from FY 2008 through FY 2028, it is estimated that $1.4 billion will be available from STP funds. This amount includes $34.1 million per year that has been allocated through FY 2015 to retire debt related to the completion of the Proposition 300 program, initiated in 1985.

4.8.1.5 Federal Railroad Administration Section 130 Funds

Federal Railroad Administration (FRA) funding may be available to improve at-grade railroad crossings to support safe automobile and commuter/freight rail travel within the corridor. The FRA 130 Program’s intent is to eliminate hazards at public highway-railroad grade crossings. In fiscal year 2008, $220 million was allocated nationwide under SAFETEA-LU authorization. It is undetermined at this time the allocation Arizona can expect, however authorization of the federal transportation bill is expected to provide a similar amount to the states.

The FRA has designated ADOT to award funding for the Section 130 program. Grade crossing safety improvement projects are evaluated by ADOT on behalf of FRA. In the interest of public safety, grade separations, safety equipment or other components may be eligible costs within an infrastructure improvement adjacent or intersecting the state highway system.

4.8.1.6 Federal Railroad Administration High-Speed Intercity Passenger Rail Funds

The High-Speed Intercity Passenger Rail (HSIPR) program is designed to invest federal funding via competitive grants in an efficient High-Speed/Intercity Passenger Rail network. Congress established the framework for this program through the passage of three key pieces of legislation: the FY 2008 and FY 2009 DOT Appropriations Acts, the Passenger Rail Investment and Improvement Act of 2008 (PRIIA) and the American Recovery and Reinvestment Act of 2009 (ARRA). The first round of grants is anticipated to be released in early-2010. The MAG region should continue to coordinate with state-wide rail planning efforts to pursue the opportunity for commuter rail service to be included as one component of a larger high-speed intercity rail program.

4.8.2 State Funds

State funding sources for commuter rail could come from a variety of potential sources as described below.

4.8.2.1 Arizona Highway Users Revenue Fund

ADOT is funded through two primary sources including the Highway Users Revenue Fund (HURF) and federal transportation funds. The HURF is an allocation and programming accounting framework funded with motor fuel excise taxes, truck fees, vehicle registration fees and taxes, and other miscellaneous charges and fees. These funds represent the primary source of revenues available to the ADOT for highway construction and improvements and other expenses. HURF funds are allocated through a number of statewide, regional, and local programs. The MAG Region receives annual funding from ADOT in the form of ADOT 15 percent funds, which are allocated from the HURF. In addition, a 37 percent share of ADOT Discretionary Funds is targeted to the MAG Region.

According to the Arizona constitution, HURF funds can only be used on highways and streets. Therefore, in order to use HURF funds for commuter rail projects, the Arizona Constitution would need to be changed to allow use of these funds for transit projects. Gas taxes, which are included in the HURF fund in Arizona, are used to completely fund transit systems in other states such as Rhode Island, South Carolina, and Tennessee.

4.8.2.2 Statewide Transportation Acceleration Needs Account

In 2006 the State Legislature established the Statewide Transportation Acceleration Needs (STAN) account as a separate account within the State Highway Fund (SHF) to provide a new vehicle for directed and accelerated funding of key transportation improvements. The State Transportation Board uses funds in the STAN Account of the SHF to pay for certain costs for the construction or reconstruction of freeways, state highways, bridges, and interchanges that are in a RTP or the long-range statewide transportation plan. The STAN account was a potential source of transit funding in the recent past, however it is not considered to be a reliable funding source in the future.

The STAN account would not be considered as a source of revenue for future commuter rail except in conjunction with highway improvements that may be directly related to the project(s).

4.8.2.3 Potential New State Funding Sources

New state funding streams could include general fund appropriations for commuter rail as well as funding and/or acquisition of railroad right-of-way as part of a comprehensive state-wide rail program. ADOT also is expected to continue to play an important part in commuter rail implementation throughout, both because of its expertise and interest in innovative transit strategies and because of the possibility of state funding for both capital, and operations and maintenance.

The State of Arizona may appropriate funds for commuter rail service from its general fund. These funds may be made up of revenues from a number of sources including state sales taxes, property taxes and income taxes. In addition, the state could dedicate new funds to a comprehensive statewide rail system that unifies commuter rail and intercity rail. One component of the on-going Statewide Rail Framework Study is the construction of intercity rail in the Sun Corridor Megapolitan that would build on the MAG commuter rail systems. Like many other state DOTs around the nation, ADOT could also pursue the acquisition of lines from private railroad companies such as BSNF and UPRR as 'vital state intermodal corridors.'

4.8.3 Regional and Local Funds

Local transportation funding mechanisms can include any tax or fee presently authorized for local use (e.g., sales tax, property tax, service fees, fines and forfeitures, etc.). In practice, only the sales tax is currently employed as an exclusive transportation funding vehicle, such as the existing Maricopa County's half-cent sales tax program authorized by Proposition 400, described below.

4.8.3.1 Maricopa County Transportation Excise Tax

The major funding source for the RTP is the half-cent sales tax for transportation that was approved through Proposition 400. On November 2, 2004, the voters of Maricopa County passed Proposition 400, which authorized the continuation of the existing half-cent sales tax for transportation in the region (also known as the Maricopa County Transportation Excise Tax). This action provides a 20-year extension of the half-cent sales tax through calendar year 2025 to implement projects and programs identified in the MAG RTP. The results of the Proposition 400 vote in Maricopa County dedicated approximately one-third of the half-cent sales tax at the regional level to mass transit. The current MAG RTP reflects this significant increase in transportation funding, with expanded transit plans and programs. The use of transit funds must be separately accounted for based on allocations to: (1) light rail transit, (2) capital costs for other transit, and (3) operation and maintenance costs for other transit.

House Bill 2456 addresses the allocation of revenues from the collection of sales tax monies among the eligible transportation modes funded through Proposition 400. The legislation creates three "firewalls", which prohibit the transfer of half-cent funding allocations from one transportation mode to another. Therefore, this tax is unlikely to be available for commuter rail implementation, as the funds are committed to transit projects identified in the RTP.

4.8.3.2 Potential New Local/Regional Funding Sources

Most likely, commuter rail funding would be included in a future regional ballot proposition that is based on specific planned corridors that may emerge from this and other studies. Throughout the United States, sales taxes are the most common source of funding for local and regional transit services. As was the case in 2004, Maricopa County has the authority to place an initiative on the ballot for voters to authorize a sales tax specifically for transportation purposes.

A potential sales tax program to specifically to fund commuter rail however, should consider the jurisdictional boundaries of the commuter rail system and the likely beneficiaries in the region.

Additional or alternative local taxes, with voter approval, could include one or a combination of the following revenue streams:

- **Payroll tax.** In Portland, Oregon, TriMet receives its operating revenue from 0.63 percent payroll and self-employment taxes that are collected and administered by the State Department of Revenue. In 2003, the State Legislature provided TriMet with the authority to increase the tax rate over ten years to help pay for new transit service throughout the region. The rate increases annually by 1/100 of a percent. In 2008, receipts from payroll taxes totaled approximately $214 million.
- **Vehicle rental tax.** In Pittsburgh, Pennsylvania, Allegheny County has enacted a $2 rental car fee to help support regional transit services provided by Port Authority Transit Services.
- **Local gas tax.** In South Florida, each county served by the South Florida Regional Transit Authority is required to dedicate $2.67 million to the authority annually. This funding may come from each county's share of the ninth-cent fuel tax, the local option fuel tax, or any other source of local gas taxes or other nonfederal funds available to the counties.
- **Vehicle license tax or registration fee.** In Seattle, Washington, the "car tab tax" is a motor vehicle excise tax collected by the Washington State Department of Licensing as part of vehicle license renewals in the Sound Transit District. The voter-approved 0.3 percent motor vehicle excise tax is one funding source for the construction and operation of the regional mass transit system. In 2008, receipts from the vehicle excise tax totaled approximately $68.6 million. Another example of a vehicle registration fee to fund transit can be found in South Florida. The Florida State Legislature has authorized the levy of an annual $2 vehicle registration or renewal tax for the counties served by the South Florida Regional Transit Authority.
- **Vehicle Miles Traveled (VMT) tax.** A VMT tax would charge motorists a fee based on the number of miles driven rather than on fuel consumption, which is becoming a declining source of transportation revenues as vehicles become more fuel efficient. A VMT tax would require the installation of an onboard tracking device in vehicles to identify the locations where vehicles travel. While the idea of a VMT tax is increasingly being discussed among elected officials, it does not currently have widespread political support primarily due to privacy concerns.
- Other examples of local funding approaches include property taxes, resident impact fees, driver's license fees, and hotel occupancy taxes.

4.8.3.3 Alternative Funding Strategies

Early identification and assembly of potential project sponsors is a critical factor in evaluating dedicated funding options for commuter rail in the MAG region. Early discussion with key Congressional, state, and local legislators and officials would also be helpful to gain support for the project.

4.8.3.4 Public Value Capture

Current federal, state and local funds that have traditionally been used for transportation projects in Maricopa County have been dedicated to the implementation of the 20-year transit program identified in the RTP as defined through the Transportation Improvement Program.

Due to the considerable cost involved in implementing a regional commuter rail system, the region will need to look at other funding mechanisms such as value capture.

Value capture mechanisms are used to indirectly capture some of the economic benefits derived by the private sector from the development and operation of a transit corridor. Building near a transit stop is not only good for the transit system; it is good for property owners and interested developers. Residential and commercial projects near transit typically appreciate in value more rapidly than other projects. As demand for scarce properties near transit stops increases, this trend will continue. As a result, development near transit stops increases tax revenues. As the value of property near transit appreciates, property taxes collected by local governments also increase.

Value capture techniques used throughout the United States include:

Benefits Assessment Districts – assessment charges imposed on property owners in a designated area, based on the specific benefits to those properties, as generated by the transit facilities. An example of this technique is Portland, Oregon's Transit Revitalization Investment District (TRID). The TRID model is able to calculate job creation, housing development and income results for each district. The revenues above a certain amount from property taxes, business license fees, system development charges and other revenues within the boundaries of a TRID district are used to pay for bonds that fund transit improvements, subsidize operating costs and other public benefits such as housing within the TRID district. The revenue sources and amounts from each can vary from TRID district to district. TRID has been used by Portland, Oregon to fund their streetcar system. Arizona state law does not authorize the use of Benefits Assessment Districts for commuter rail capital projects. These districts have not previously been used in Arizona for transit purposes, but could be further investigated as a public value capture mechanism.

Tax Increment Financing – incremental property tax receipts (above a pre-determined base) which can be attributed to infrastructure improvements, such as transit facilities. These incremental receipts will typically be captured through a redevelopment agency (which could dedicate some of its own tax increment funds for transit facilities in a designated redevelopment area), or through the establishment of infrastructure financing districts. Arizona currently does not have a state law authorizing the use of Tax Increment Financing.

4.8.4 Public-Private Partnerships

Increasingly, transportation agencies are turning to the private sector to improve the efficiency of designing and building major transit projects and to help meet the financial demands of projects. Considered to be an innovative financing mechanism, a public-private partnership is described by FTA as a contract wherein a single private entity, typically a consortium of private companies, is responsible and financially liable for performing all or a significant number of functions in connection with a project. Advantages to forming a public-private partnership can include cost savings, cost predictability, additional expertise from the private sector with regard to finance, reduced project completion time, and greater private sector investment. Additionally, a public agency could potentially spread the cost of a project over a greater period of time. FTA has invested in several projects designed to promote private-sector investment in transit. Through the PPP Pilot Program (Penta-P), FTA is currently exploring how private sector funding could be integrated into the New Starts program.

Disadvantages of public private partnerships may include the disincentive for private companies to assume risk for design, construction, financing, and even operations and maintenance. Other challenges may include the establishment of long-term contracts, procurement that may be too long and costly, the use of more expensive private sector capital, and perceived loss of public sector control.

Types of Public-Private Partnerships may include:

- Design/Build – private sector designs and builds but public entity operates and maintains
- Design/Build/Maintain – private sector designs, builds, and maintains system but public entity operates
- Design/Build/Operate – private sector designs, builds, and operates over a specified period of time while public entity gets title to system
- Design/Build/Operate/Maintain – private sector builds and operates over a specified period; at end of period, operations and maintenance revert to public entity
- Design/Build/Operate/Maintain/Finance – private entity does it all under a long-term agreement; at end of agreement, operations and maintenance conducted by public entity

An example of a successful Public-Private Partnership project is the New Jersey Riverline, a Design/Build/Operate/Maintain-type partnership, which is an LRT system operating 34 miles and serves 17 communities. The service was procured outside of the FTA process and financing was not required.

4.8.5 Summary of Funding Approaches in Other Cities

Peer cities and regions that have implemented commuter rail systems have used a variety of funding sources and mechanisms. Table 4-8 provides a summary of peer city approaches to funding. Recently developed commuter rail systems are built with a combination of federal funding, state budget commitments, and local tax monies. The Rail Runner in New Mexico is an anomaly, in that state and local sources funded the capital costs of commuter rail (exclusive of federal funding, although CMAQ funding contributes to operating costs), and thus the system was built more quickly than other recent commuter rail systems. Colorado's FasTracks and Minnesota's Northstar are continually evaluating public-private partnerships for future projects; this approach may also be a viable contributor to funding sources in Arizona.

Table 4-8: Comparison of Commuter Rail Facilities and Transit Funding

State: County	Operating Authority	Commuter Rail Facility	Key Funding Sources (inclusive of all transit services provided by operating authority)
Colorado: Denver	Regional Transportation District (RTD)	FasTracks	Dedicated Regional Sales Tax; Federal Funding (Section 5309 New Starts program); Private Contributions
Utah: Weber, Davis, and Salt Lake	Utah Transit Authority	FrontRunner	Dedicated Local Sales Tax; Federal Funding (Section 5309 New Starts program)
Texas: Tarrant and Dallas	The Fort Worth Transportation Authority (The T)/Dallas Area Rapid Transit	Trinity Railway Express	Dedicated Local Sales Tax; Federal Funding (CMAQ)
California: San Diego	San Diego Metropolitan Transit System	The San Diego Coast Express Rail (COASTER)	Dedicated Local Sales Tax
New Mexico: Valencia, Bernalillo, and Sandoval	Rio Metro	Rail Runner	Funded by the State of New Mexico; Federal Funding (CMAQ), Dedicated Local Sales Tax.
Minnesota: Anoka, Benton, Hennepin, and Sherburne	Minnesota Department of Transportation (MnDOT) and the Northstar Corridor Development Authority	Northstar	Various dedicated funding for counties in Minnesota (only 17% of Northstar construction costs from local governments/transit agencies); State Funding; Federal Funding (Section 5309 New Starts program).

Source: MAG, 2008; URS, 2009.

4.9 Implementation Steps

4.9.1 Near-Term Implementation Steps (2010-2015)

This section outlines the near-term (within the next five years) implementation steps to advance this System Study. MAG's Commuter Rail Strategic Plan (2008) lays out key implementation steps. This section builds upon those concepts by applying them to the System Study corridors based on the stakeholder input and more detailed operations planning that has occurred through this planning process.

Periodic Ridership Forecasting Updates. MAG continually updates socioeconomic data assumptions for the region; therefore, it is recommended to re-run the MAG model approximately twice a year with the latest socioeconomic data to generate updated commuter rail boardings estimates. These estimates should be incorporated into the corridor prioritization and implementation process.

Coordination with the Railroads. Further coordination with the BNSF Railway Company and UPRR is critical to understanding the feasibility of sharing the corridor, and defining train schedules, operational constraints, and needed capacity improvements. To enable this coordination, the following key efforts should be completed:

- **Establish state-level point of contact and communication protocols**. UPRR has indicated a preference to work through one point of contact on issues pertaining to its rail lines in Arizona. In addition to commuter rail, ADOT has been engaged in intercity rail planning between Tucson and the Phoenix metropolitan area and a Statewide Rail Framework Study, both of which have involved UPRR and BNSF Railway Company. ADOT has been identified as a logical point of contact going forward through their participation in the Project Management Team reviewing the commuter rail planning process. Communication protocols should be established to facilitate continuing stakeholder input and awareness of efforts to further rail planning efforts with both the UPRR and BNSF Railway Company.

- **Develop partnership to investigate options in accordance with an MOU.** A conceptual framework for a Memorandum of Understanding (MOU) with the railroads is attached as Appendix G: Conceptual Memorandum of Understanding. This MOU would address key points of negotiation such as determining compensation, capacity improvements, and level of service (see Appendix G as well as MAG Commuter Rail Strategic Plan). It is expected that resolution of these issues will require further modeling and investigation by the railroads based on the conceptual operating plan outlined in this System Study as well as ongoing discussions. For the UPRR, BNSF Railway Company, and other parties to commit the resources and efforts required to make substantive progress on these, it is likely that a funding commitment to furthering commuter rail must first be identified and be demonstrated.
- **Passage of enabling legislation relative to liability and indemnification**. Careful review of Arizona state law must be conducted to determine if legislation is required to facilitate passenger rail operations in freight rail corridors similar to legislation passed in Minnesota, Virginia, New Mexico, and Colorado. Progress on this issue may facilitate more effective coordination with the railroads, as this would be an important issue to the UPRR and BNSF Railway Company.
- **Advance the design and operating concepts.** This System Study, along with the Grand Avenue Corridor Development Plan and the Yuma West Corridor Development Plan, provides plan drawings which may be further developed in coordination with the UPRR and BNSF Railway Company. The railroads likely will opt to conduct their own modeling and assessment of the infrastructure improvements that would be required. This information would be used to form the basis for any long-term agreement with the UPRR and BNSF Railway Company.

Coordination of Infrastructure Improvements with the Railroads, ADOT and Local Jurisdictions. The implementation of commuter rail service in the MAG region will require close coordination with the UPRR, BNSF Railway Company, ADOT and local jurisdictions. Specifically, the BNSF Railway Company is planning a number of freight rail infrastructure improvements that would reduce freight activity into downtown Phoenix and thereby free up space on the rail mainline for commuter rail in the Grand Avenue Corridor. Similarly, ADOT and local jurisdictions are planning for extensive roadway upgrades throughout the region that may improve the viability and safety of System Study corridors for both freight and passenger rail service.

Identify Funding Commitments. To advance commuter rail it is critical to define new revenue streams that would be dedicated to development and ongoing operation of the commuter rail system. As previously discussed, a phased approach and cost-sharing agreements may segment or defer expenditures.

A cost-sharing approach among the entities may facilitate the use of different funding sources for the capital costs of commuter rail implementation. An example of a cost-sharing approach is outlined in Table 4-9.

Table 4-9: Potential Cost-Sharing Approach to Commuter Rail Implementation

	Potential Cost-Sharing Partners			
	Commuter Rail Authority or JPA	Local Jurisdictions	ADOT	UPRR and/or BNSF Railway Company
Potential areas of responsibility	• Overall responsibility for the construction of the system. • Overall responsibility for coordination with UPRR and BNSF Railway Company on maintaining freight service during and after construction.	• Partner on development of station areas • Partner on improvements in at-grade crossings that increase public safety.	• Partner on improvements in at-grade crossings that increase public safety. • Partner on utility relocation or other efforts that may be coordinated with programmed road improvements.	• Implementation of positive train control may predate commuter rail (Although not necessarily cost-sharing, these independent efforts may reduce overall cost estimates.) • Partner on development of sidings, bridges, and improvements in at-grade crossings that also benefit freight service.

Source: URS Corp., 2009.

Initiate process for Federal funding. The process for FTA New Starts funding requires completion of Alternatives Analysis and NEPA compliance. Local match funding should be evaluated prior to initiating this process with FTA.

Develop and Implement Governance Plan. Options for governance of a commuter rail system are described in Section 4.7. The most likely approaches that are suitable for the region include:

- A new Commuter Rail Authority
- Designation of an existing agency as the Commuter Rail Authority (RPTA, METRO, MAG, ADOT)
- Establishment of a new Joint Powers Authority (JPA) with a provision for representation appropriate to the corridor or system to be implemented. One potential example of a regional JPA would be through the formation of a multi-county Megapolitan Planning Council.

Preserve Future Options. Planning studies may identify and preserve rights-of-way in developing and underdeveloped areas for multimodal transportation corridors to include roadway and rail transit. The System Study corridors are assumed to occur within the existing railroad right-of-way and thus right-of-way acquisition requirements have not been identified for the implementation of the corridors. However, preliminary analysis of potential extensions of a commuter rail system was conducted as part of the MAG Commuter Rail System Study. Right-of-way preservation of future extensions may reduce the costs for growing a future regional system.

Local Planning Efforts. A successful commuter rail system will require a collaboration of all participants – primarily the local governments as the development regulator and financial partner, the transit agency as the transit infrastructure builder, and the UPRR and BNSF Railway Company as the railroad right-of-way owners. Prior to securing project financing, local governments within the corridor can take steps to lay the foundation for commuter rail implementation. The following is a list of such actions:

- Partner with the UPRR, BNSF Railway Company, and ADOT to upgrade existing at-grade railroad crossings along System Study corridors.
- Control regulatory actions within station areas, including the planning, zoning, and development permitting process, to facilitate the development of commuter rail stations.
- Use other implementation tools such as infrastructure construction (for example, streets and utilities), land purchase and assembly, and creation of urban design guidelines to facilitate transit-supportive development.

Table 4-10 summarizes the near-term implementation steps, including the step, potential responsible parties, and timeframe.

Table 4-10: Summary of Near-Term Implementation Steps

Item	Responsible Party	Partners	Timeframe
Periodic Ridership Forecasting Updates	MAG	Local jurisdictions	Ongoing
Coordination with UPRR and BNSF Railway Company - Maintain points of contact and communication protocols - Develop partnership to investigate options - Advance design and operating concepts	ADOT MAG UPRR BNSF Railway Company	Local jurisdictions METRO RPTA	Ongoing
Address Enabling Legislation (Liability and Indemnification)	ADOT (as a statewide issue)	MAG UPRR	2010-2013
Identify Funding Commitments	MAG ADOT Legislature	Local jurisdictions	2010-2015
Initiate process for federal funding	MAG	Local jurisdictions	Following identification of local funding commitments
Develop and Implement Governance Plan	MAG ADOT	METRO RPTA Local jurisdictions	Following identification of local funding commitments
Preserve Future Options	Commuter Rail Authority or JPA	Local jurisdictions UPRR BNSF Railway Company	Ongoing

Table 4-10: Summary of Near-Term Implementation Steps

Item	Responsible Party	Partners	Timeframe
		MAG CAAG ADOT	
Local Planning Efforts	Local jurisdictions	MAG ADOT	Ongoing

Source: URS Corp., 2009.

4.9.2 Longer-Term Implementation Steps

The identification of funding commitments and determination of the appropriate governance structure for commuter rail, which are likely to influence each other, will set the stage for moving into the next level of investment in commuter rail within the MAG region. With progress on these key steps, the region will be in a position to move forward on other recommendations from the Strategic Plan, as described below.

Formalize partnership with the railroads. Following the development of a public/ private Memorandum of Understanding with the UPRR and BNSF Railway Company, detailed agreements must be negotiated to define funding and the parameters to implement commuter rail facilities and services that will mutually benefit the public and private sector interests.

Secure Funding Sources. Secure sources of funding including federal, state, regional and local public funding, as well as private sector participation. Federal funds should be obtained following the completion of the NEPA process, FTA New Starts requirements and the identification of local funding commitments.

Design, construct, and operate initial commuter rail system. The implementation of the system would be contingent upon the realization of a partnership agreement with the UPRR and BNSF Railway Company and funding commitments.

Continue planning to develop seamless transportation system and meet regional sustainability goals. As the commuter rail system develops and expands, regional planning must occur to ensure efficient systems and intermodal connections.

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