Maricopa Association of Governments

HASSAYAMPA VALLEY RAIL CORRIDORS
COST ANALYSIS UPDATE

Prepared for
MARICOPA ASSOCIATION of GOVERNMENTS

FINAL REPORT
OCTOBER 2013

Prepared by
Kimley-Horn and Associates, Inc.

Hassayampa Valley Rail Corridors Cost Analysis Update

FINAL REPORT

Task Order No. C-02-444-C-E-04
October 28, 2013

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EXECUTIVE SUMMARY

The purpose of the Hassayampa Valley Rail Corridors Cost Analysis Update is to develop planning-level financial assumptions and an estimate of probable cost for new conceptual freight railroad lines in the far western area of Maricopa County (**Figure E1**). The study area extends from Gila Bend in the south, to Morristown in the north. The study area is more than 60 miles long, 30 miles wide, and encompasses more than 1,500 square miles. Major natural features within the study area include the Gila River, Hassayampa River, White Tanks Mountains, and Vulture Mountains. Major transportation features within the study area include Interstate 10 (I-10), Interstate 8 (I-8), the proposed Interstate 11 (I-11), State Route (SR) 85, US Highway 60 (US 60), Union Pacific Railroad (UPRR) Gila Mainline, and the BNSF Railway Phoenix Subdivision. The study are includes portions of the Town of Gila Bend, Town of Buckeye, and City of Surprise.

The new rail corridors would extend connect the Union Pacific Railroad Gila Subdivision Mainline in Gila Bend (top photo)to the BNSF Railway Phoenix Subdivision at Morristown/Castle Hot Springs (bottom photo).

The concept for new rail corridors in western Maricopa County originated with the Maricopa Association of Governments (MAG) Hassayampa Valley Transportation Framework Study, completed in 2007. A number of studies completed by MAG and the Arizona Department of Transportation since 2007 have also carried this recommendation forward. The purpose of the new rail corridors is to:

- Promote economic development by linking future economic activity centers and supporting future population and employment growth.
- Promote a diversified economic base in western Maricopa County.
- Facilitate improved rail connectivity to Phoenix and to northern and southern Arizona.

A north-south connection would link the BNSF Railway/Grand Avenue and UPRR corridors. The new rail corridor would connect future major classification yards of the BNSF (near Surprise) and UPRR (near Buckeye), thus allowing interchange traffic to occur outside the Phoenix metropolitan area, as well as provide access to both Class I railroads in Arizona with any potential future new railroad links to Mexico. The Wellton Branch line west of Arlington, Arizona has been out of service for freight since 1997 (shown in **Figure E1)**. This requires freight trains entering the Phoenix area from the west (Los Angeles) to make an unnecessary, extra-miles-detour between Yuma, Picacho Junction (Eloy), Coolidge, and the East Valley to reach Phoenix and the West Valley. This detour adds over 130 miles to the trip, and adds several hours of travel time. The new rail corridors would enable trains to connect directly from the UPRR Gila Mainline to the BNSF, improving rail efficiency, saving time, and avoiding the congested Phoenix rail corridors. The Hassayampa Rail Corridors would serve as a faster, more convenient route for freight rail traffic that would bypass downtown Phoenix, connecting northern and southern Arizona. The rail

corridors would provide opportunities to create public/private partnerships for implementation of new corridors.

Conceptual corridors were developed and are separated into three segments. These are illustrated in **Figure E2.**

Segment No. 1: Morristown to Buckeye

Segment No. 1 would link the communities of Buckeye/Arlington (south of I-10) and Morristown/Castle Hot Springs. The line would connect the existing UPRR Wellton Line at Buckeye/Arlington with the BNSF Phoenix Subdivision at Morristown/Castle Hot Springs (southeast of Wickenburg), near the US 60 overpass at Gates Road (BNSF Castle Hot Springs siding). Key features of the corridor include the Vulture Mountains, Toyota Proving Grounds, the Hassayampa River, and I-10.

Segment No. 2: Buckeye/Arlington to Gila Bend

Segment No. 2 would link the communities of Buckeye/Arlington and Gila Bend connecting the existing UPRR Wellton Line at Buckeye/Arlington with the UPRR Gila Mainline in Gila Bend near the Gila Bend Municipal Airport. The potential rail line would provide an alternative connection between the UPRR mainline to Yuma and the Los Angeles coastal ports and the MAG Region, by providing a more direct link through Gila Bend. Two alternatives are proposed for Segment 2.

Segment No. 2A: This alternative roughly follows Old Highway 80, extending from the UPRR Wellton Line near Arlington to the intersection with the UPRR Sunset Route/Gila Mainline east of the Gila Bend Municipal Airport.

Segment No. 2B: This utilizes the Wellton Branch Line from Palo Verde to the junction with SR 85. At SR 85, a new rail facility would roughly follow SR 85 to Gila Bend and a junction with the UPRR Sunset Route/Gila Subdivision Mainline.

Planning-level Estimate of Probable Cost

Planning-level estimate of probable costs for each segment are summarized in **Table E1.** The corridors are projected to cost up to $2.3 Billion (2013) or up to $3.5 Billion in 2033. **Table E2** summarizes the cost per mile for the new corridors.

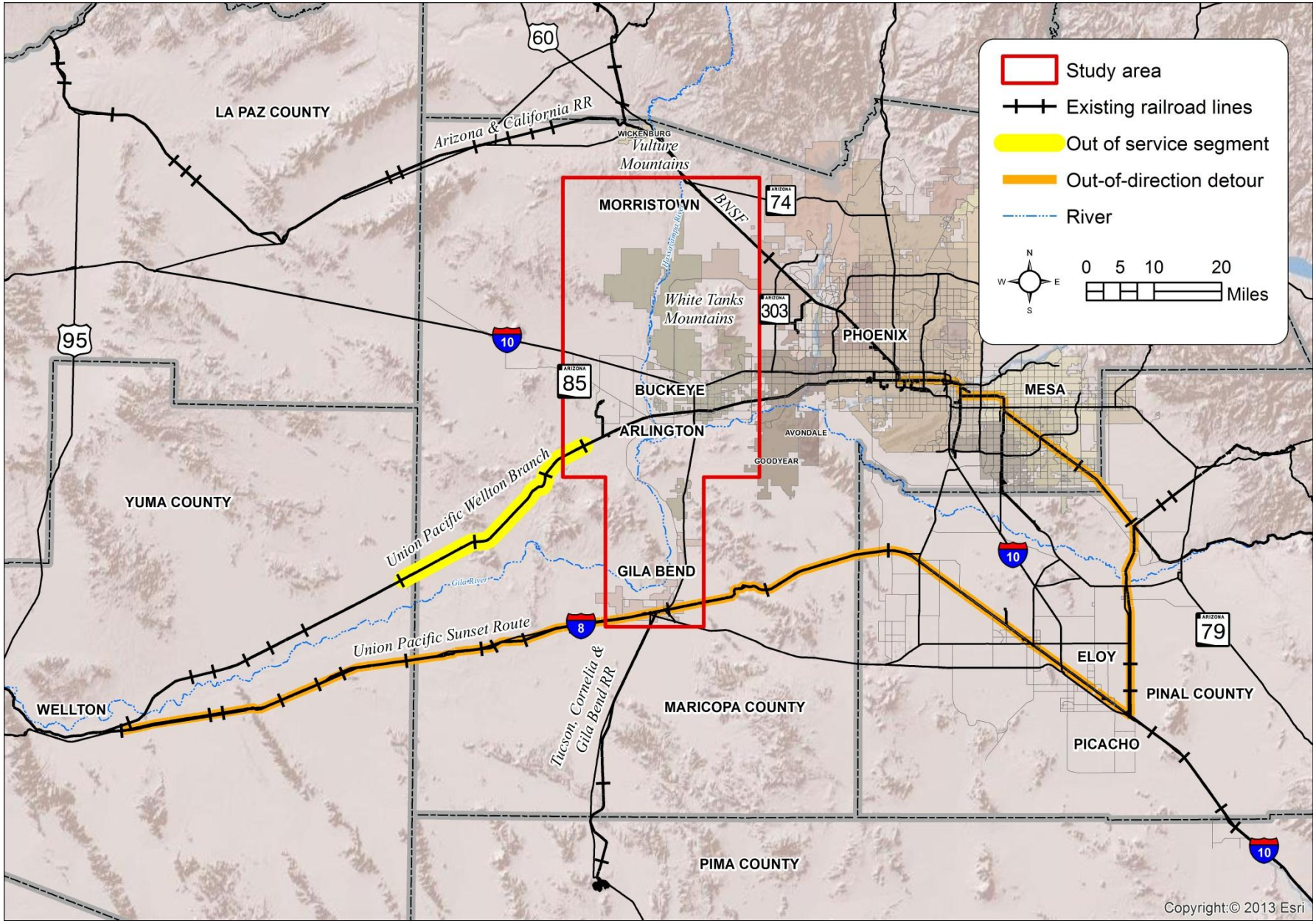


Figure E1. Study Area

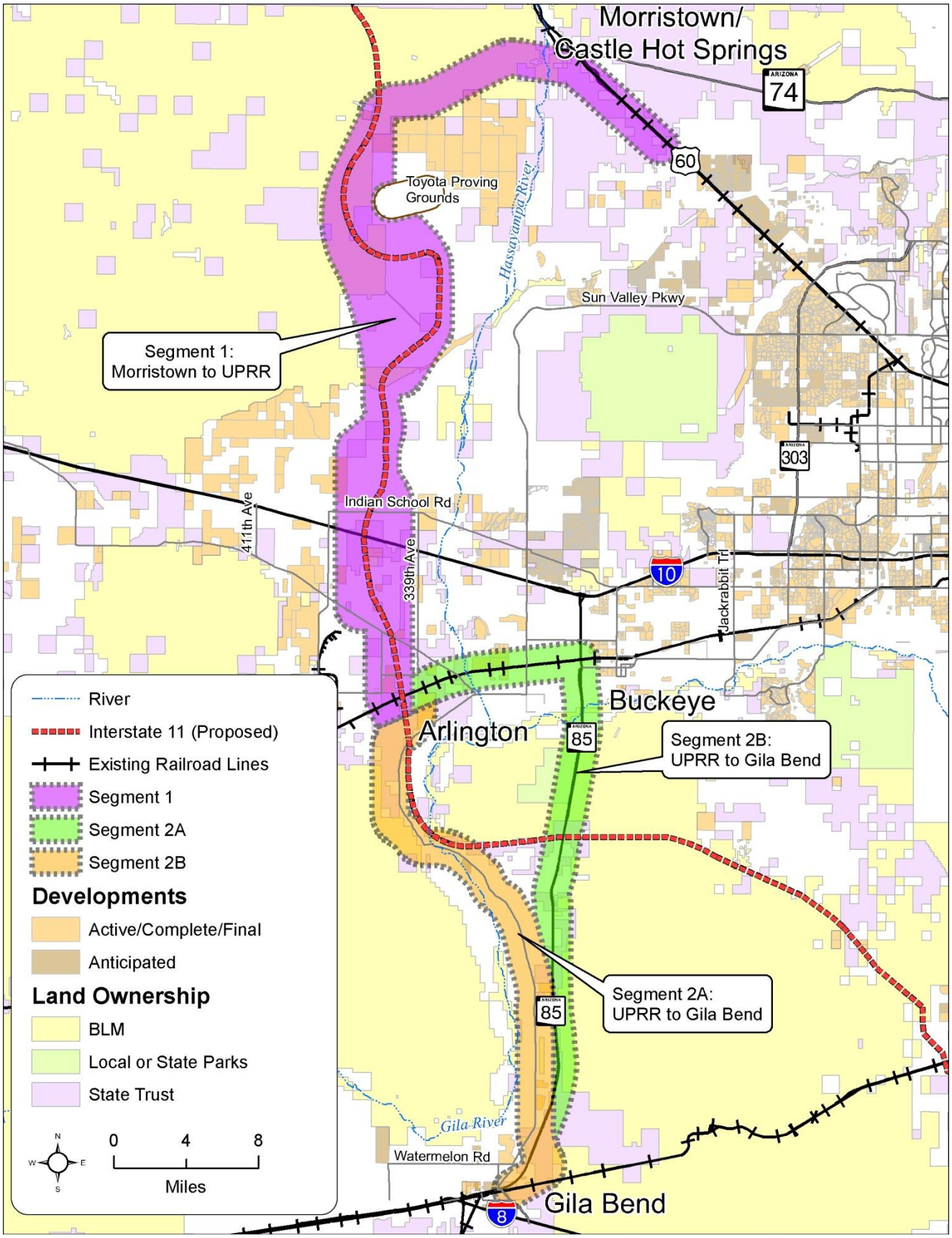


Figure E2. Rail Corridors Segment Alternatives

Table E1. Summary of Segment Alternatives Estimate of Probable Cost: Total Costs

Corridor	Corridor Improvements	Crossing Improvements	Right of Way	Maintenance of Way (per year)	Engineering and Planning Costs	10% Contingency	Corridor Total Cost (2013$)	Corridor Total Cost (2033$)
Segment No. 1 - Hassayampa	$630,000,000	$210,000,000	$6,000,000	$470,000	$350,000,000	$119,600,000	$1,315,600,000	$1,993,604,000
Segment No. 2A - Hidden Water-Gila Bend via Old Highway 80	$350,000,000	$180,000,000	$4,000,000	$300,000	$220,000,000	$75,400,000	$829,400,000	$1,256,837,000
Segment No. 2B - Hidden Water-Gila Bend via SR 85	$420,000,000	$220,000,000	$4,000,000	$300,000	$270,000,000	$91,400,000	$1,005,400,000	$1,523,540,000
Planning-Level Estimate of Probable Cost						Segments 1 and 2A	**$2,145,000,000**	**$3,250,441,000**
						Segments 1 and 2B	**$2,321,000,000**	**$3,517,144,000**

Table E1. Summary of Segment Alternatives Estimate of Probable Cost: Cost per Mile

Corridor	Total Length	Total Cost / Mile (2013 $)	Total Cost / Mile (2033 $)
Segment No. 1 - Hassayampa	47.35	$27,785,000	$42,104,000
Segment No. 2A - Hidden Water-Gila Bend via Old Highway 80	30.49	$27,204,000	$41,224,000
Segment No. 2B - Hidden Water-Gila Bend via SR 85	41.74 (30.1 miles of new track)	$24,088,000	$36,501,000

1.0 Project Introduction

The purpose of the Hassayampa Valley Rail Corridors Cost Analysis Update is to develop planning-level financial assumptions and an estimate of probable cost for new conceptual freight railroad lines in the far western area of Maricopa County (refer to **Figure 1).** This study documents a planning-level estimate of probable cost for the railroad lines through best practice research and application of railroad industry per mile/unit construction costs.

1.1 Study Area

The study area is shown in **Figure 1.** The study area is in western Maricopa County, Arizona, and extends from Gila Bend in the south, to Morristown in the north. The study area is more than 60 miles long, 30 miles wide, and encompasses more than 1,500 square miles.

Major natural features within the study area include the Gila River, Hassayampa River, White Tanks Mountains, and Vulture Mountains. Major transportation features within the study area include Interstate 10, Interstate 8 (I-8), the proposed Interstate 11 (I-11), State Route (SR) 85, US Highway 60 (US 60), Union Pacific Railroad (UPRR) Gila Mainline, and the BNSF Railway Phoenix Subdivision. The study are includes portions of the Town of Gila Bend, Town of Buckeye, and City of Surprise.

1.2 Background and Purpose of New Rail Corridors

The concept for new rail corridors in western Maricopa County originated with the Maricopa Association of Governments (MAG) Hassayampa Valley Transportation Framework Study, [1] completed in 2007. A number of studies completed by MAG and the Arizona Department of Transportation since 2007 have also carried this recommendation forward.

The purpose of the new rail corridors is to:

- **Promote economic development by linking future economic activity centers and supporting future population and employment growth.** The CANAMEX Corridor is a designated set of highways connecting Canada, Mexico, and the states of Arizona, Nevada, Utah, Idaho, and Montana. The CANAMEX corridor was established under the North American Free Trade Agreement (NAFTA) to facilitate freight transportation, encourage trade, increase tourism, and promote economic activity. In addition to a freeway, the corridor is also proposed for use by railroads, pipelines, and fiber optic telecommunications infrastructure. UPRR owns a rail line connecting Phoenix, Arizona and Nogales, Sonora, Mexico; however, there is no existing direct railroad line connecting Las Vegas, Nevada and Phoenix, Arizona. The proposed Hassayampa Rail Corridors would provide a critical linkage between the existing UPRR (at Gila Bend, Arizona) and the BNSF Railway at Morristown/Castle Hot Springs, Arizona, facilitating economic development along the CANAMEX corridor.
- **Promote a diversified economic base in western Maricopa County.** The MAG Hassayampa Valley Transportation Framework Study projected nearly 1,000,000 residents will call Western Maricopa County home by the year 2030, and over 2,000,000 by the year 2050. A new rail corridor would support a diversified economic base and employment opportunities within the region.
- **Facilitate improved rail connectivity to Phoenix and to northern and southern Arizona.** The proposed rail corridor would improve railway connectivity west of Phoenix. A north-south connection

[1] MAG Hassayampa Valley Transportation Framework Study, 2007

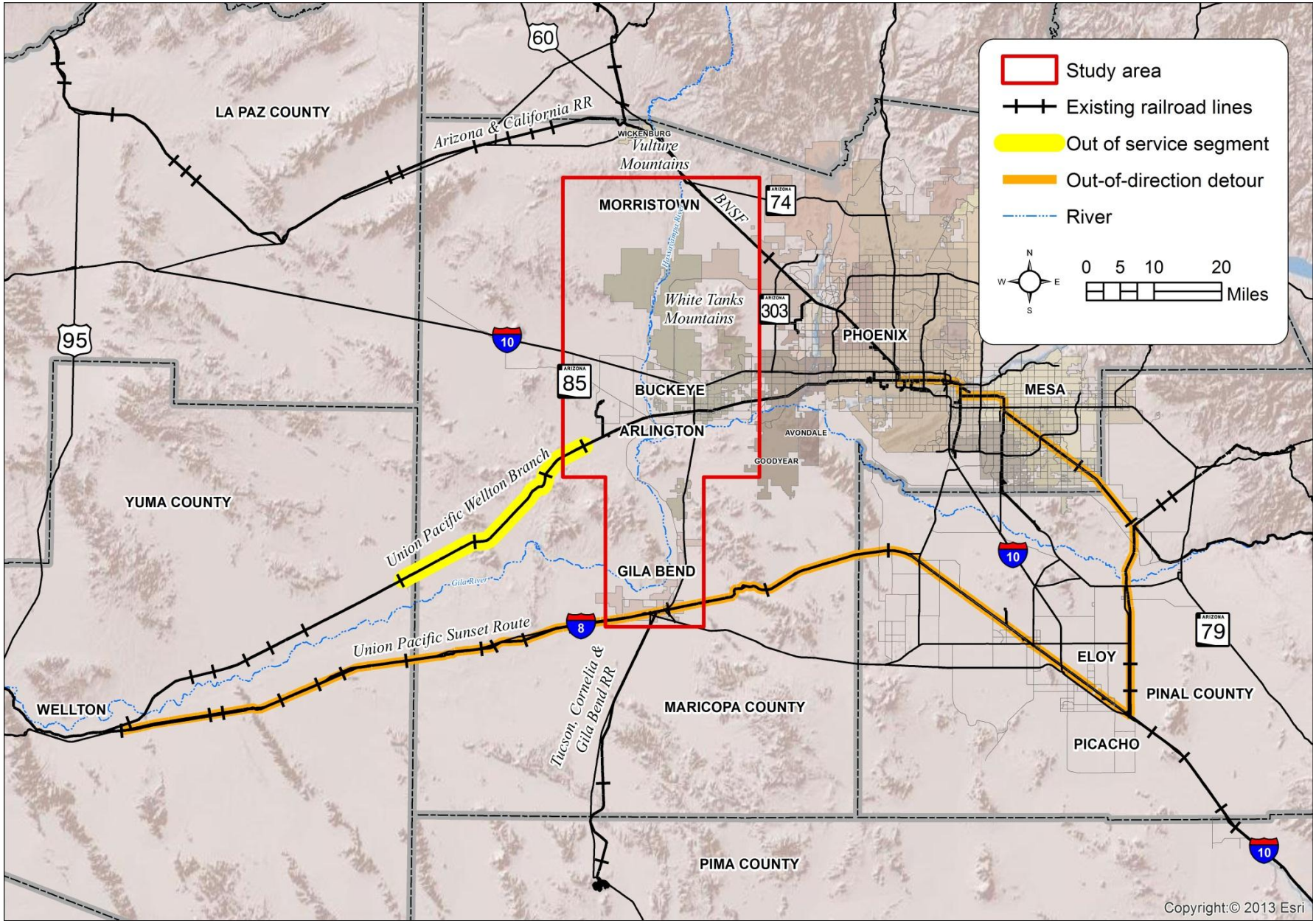


Figure 1. Study Area

would link the BNSF Railway/Grand Avenue and UPRR corridors. The new rail corridor would connect future major classification yards of the BNSF (near Surprise) and UPRR (near Buckeye), thus allowing interchange traffic to occur outside the Phoenix metropolitan area, as well as provide access to both Class I[2] railroads in Arizona with any potential future new railroad links to Mexico. The Wellton Branch line west of Arlington, Arizona has been out of service for freight since 1997 (refer to **Figure 1).** This requires freight trains entering the Phoenix area from the west (Los Angeles) to make an unnecessary, extra-miles-detour between Yuma, Picacho Junction (Eloy), Coolidge, and the East Valley to reach Phoenix and the West Valley. This detour adds over 130 miles to the trip, and adds several hours of travel time. The new rail corridors would enable trains to connect directly from the UPRR Gila Mainline to the BNSF, improving rail efficiency, saving time, and avoiding the congested Phoenix rail corridors. The Hassayampa Rail Corridors would serve as a faster, more convenient route for freight rail traffic that would bypass downtown Phoenix, connecting northern and southern Arizona. The rail corridors would provide opportunities to create public/private partnerships for implementation of new corridors.

1.3 Final Report Contents

Working Paper No. 1 – Summary of Existing Conditions within the Hassayampa Valley/Hidden Waters Parkway Corridors includes the following activities:

- Literature review of previously completed plans and studies.
- Documentation of observations based on a field inspection conducted of the corridor.
- Introduced candidate corridors for a new conventional freight line in the study area.

Working Paper No. 2 – Corridor Options and Capital Assumptions includes the following activities:

- Develop a list of required corridor and crossing cost elements such as type of active grade crossings, grade separated crossings, bridges, culverts/canals, switches, and utilities.
- Depiction of assumed corridor cross-section for cost estimating purposes.
- Development of corridor development options.
- Estimate of cost element quantities for each corridor option.
- Derivation of planning-level cost for each corridor.

This Final Report represents a compendium of Working Papers No. 1 and No. 2. The study and Final Report does not:

- Update any regional socioeconomic, census, ridership, or freight volume data for the MAG Region.
- Address the Class I railroads' necessity for Sovereign Immunity for liability/indemnity, as that will be addressed later with legislative research should the region/state seek funding for commuter rail or intercity passenger rail.
- Provide an Environmental Impact Statement (EIS) or Environmental Assessment (EA).

[2] The Surface Transportation Board defines Class I railroads as any large freight railroad company having annual carrier operating revenues of $250 million or more after adjusting for inflation using a Railroad Freight Price Index developed by the Bureau of Labor Statistics.

- Provide capital or operating funding for implementation of the study findings.

2.0 Summary of Previous Studies

A number of previously completed studies have addressed rail service or infrastructure within the study area (**Table 1)**. Relevant information from each of these studies is summarized in the following sections.

Table 1. Existing Studies Inventory

ID	Document Name	Sponsor Agency	Author	Date
1	MAG I-10 Hassayampa Valley Roadway Study	MAG	DMJM Harris/AECOM	2007
2	MAG Interstates 8 and 10 Hidden Valley Transportation Framework Study	MAG	AECOM	2009
3	MAG Commuter Rail System Study (Yuma West and Grand Avenue Corridor Plans)	MAG	URS	2010
4	ADOT State of Arizona Railroad Inventory and Assessment	ADOT	R.L. Banks & Associates, Inc.	2007
5	ADOT Statewide Rail Framework Study	ADOT	AECOM	2010
6	Arizona State Rail Plan	ADOT	AECOM	2010
7	ADOT Wellton Branch Railroad Rehabilitation Study	ADOT	URS	Ongoing
8	ADOT Passenger Rail Corridor Study, Tucson to Phoenix	ADOT	ADOT Multimodal Planning Division	Ongoing
9	MCDOT Hidden Waters Parkway Corridor Feasibility Study – Watermelon Road to Interstate 10	Maricopa County Department of Transportation (MCDOT)	Kimley-Horn and Associates, Inc.	2011
10	Gila Bend General Plan	Town of Gila Bend	HDR, Inc.	2006
11	Town of Buckeye 2007 General Plan Update	Town of Buckeye	Partners for Strategic Action	2008
12	Town of Surprise Draft General Plan 2035	City of Surprise	-	2013
13	I-11 and Intermountain West Corridor Study	Nevada Department of Transportation (NDOT) and ADOT	-	Ongoing

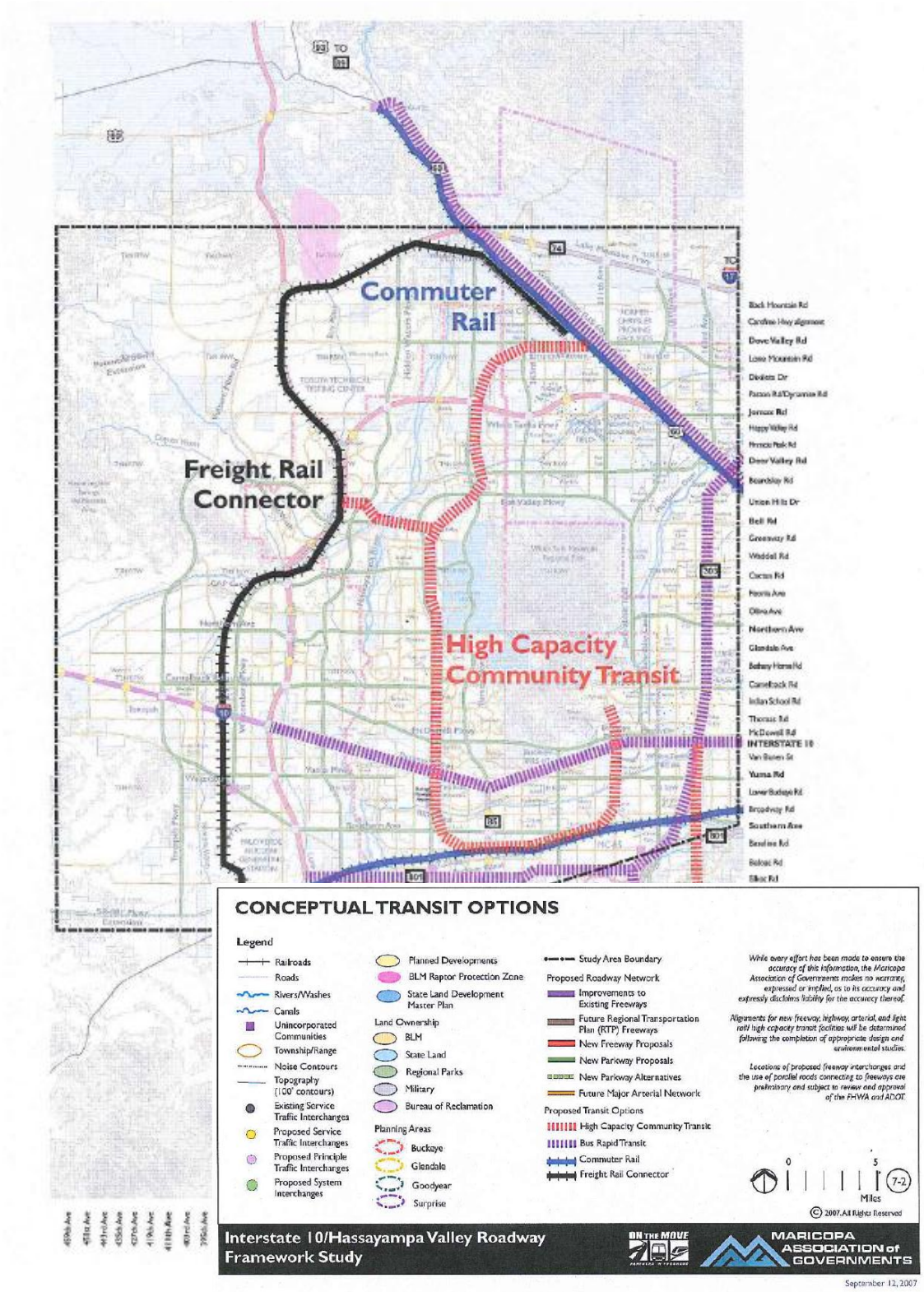
1. MAG I-10 Hassayampa Valley Roadway Study

ID	Document Name	Sponsor Agency	Author	Date
1	MAG I-10 Hassayampa Valley Roadway Study	MAG	DMJM Harris/AECOM	2007

The MAG Hassayampa Valley Roadway Framework Study initiated transportation planning in a 1,400-square-mile area extending from SR 303L on the east, the 459th Avenue section line on the west, SR 74 on the north, and the Gila River on the south. This area is anticipated to experience significant growth in coming decades. The study notes that as of September 2007, over 100 entitlements have been granted for master planned communities and other developments in the area, primarily in the Town of Buckeye, City of Surprise, and unincorporated areas of Maricopa County.

Study recommendations show a possible conventional rail (freight and possibly passenger) line connecting the BNSF near Morristown with the UPRR near Palo Verde Nuclear Generating Station, as depicted in **Figure 2.** This rail line would directly link new classification and internal yards proposed by the two railroads. Such a

route would enable the BNSF and UPRR to interchange freight while bypassing the congested central Phoenix area.



Source: MAG Hassayampa Valley Framework Study

Figure 2. MAG Hassayampa Valley Framework Study

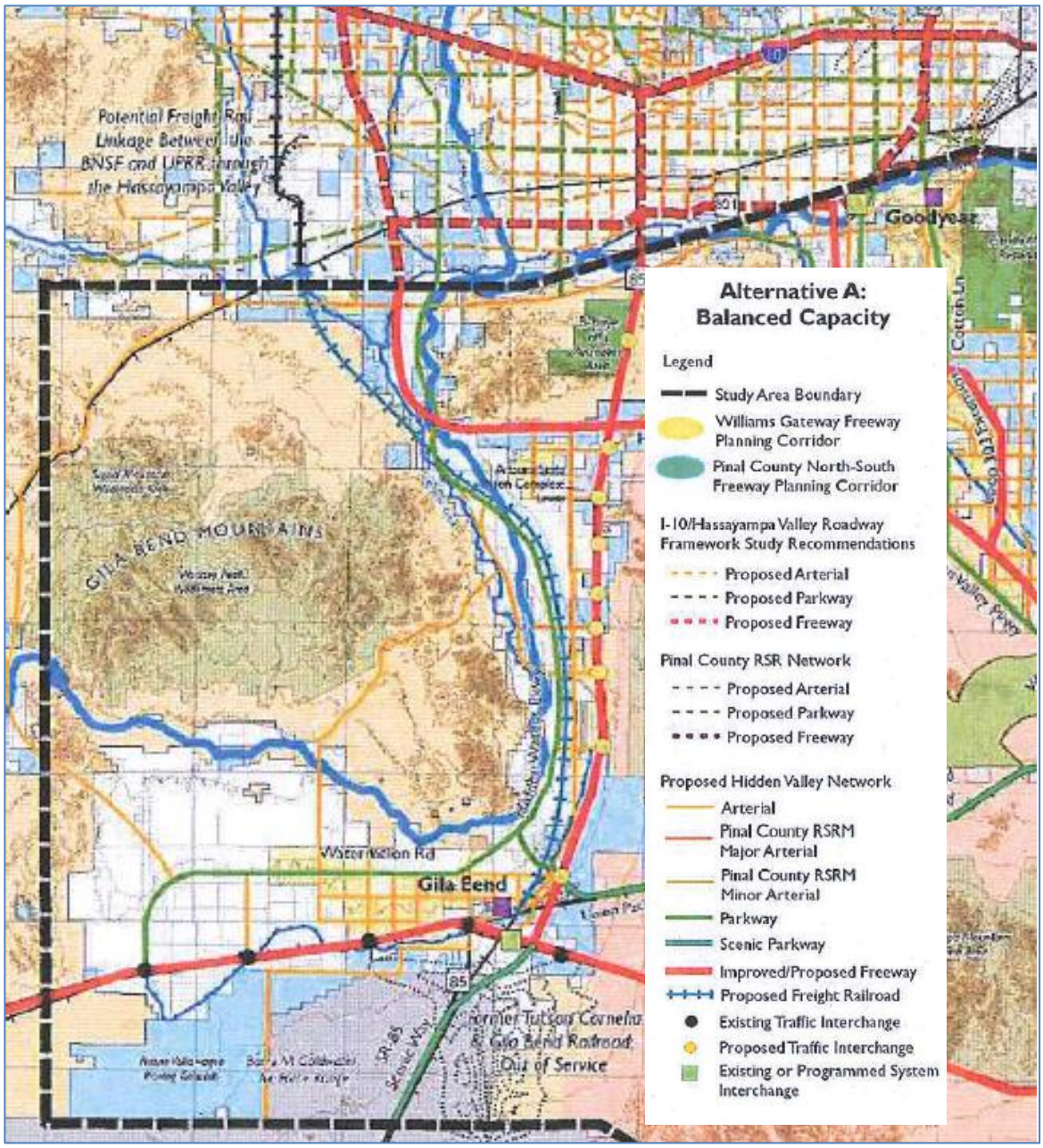
2. MAG Interstates 8 and 10 Hidden Valley Transportation Framework Study

ID	Document Name	Sponsor Agency	Author	Date
2	MAG Interstates 8 and 10 Hidden Valley Transportation Framework Study	MAG	AECOM	2009

The Interstates 8 and 10 Hidden Valley Framework Study initiated transportation planning in the rapidly growing area of 3,000 square miles in western Maricopa and northern Pinal counties. The boundaries were generally the Gila River on the north, I-8 on the south, Overfield Road on the east, and 459th Avenue in Maricopa County on the west. The study developed a conceptual framework for freeways, parkways, arterials, and public transit through the study area. The study also specified future corridors in which right-of-way (ROW) should be preserved now.

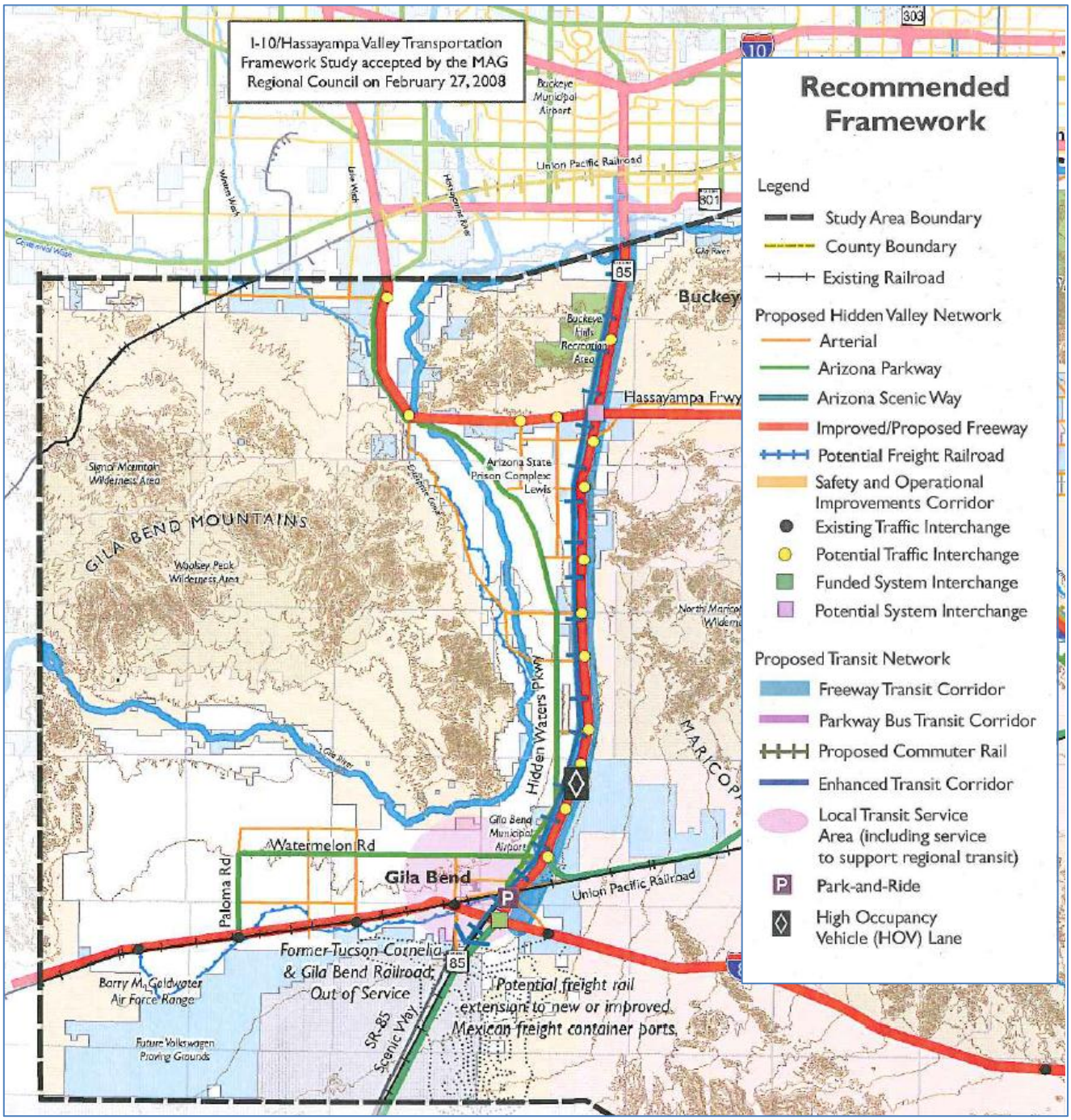
The study includes a recommendation for a new freight corridor. Alternative A (**Figure 3**) illustrated the corridor roughly following Old US Highway 80. However, the final recommended alternative (**Figure 4**) shows the rail line running parallel to SR 85 between I-8 and I-10. The rail line would connect the UPRR Wellton Branch near Buckeye to the Union Pacific Sunset Route/Gila Subdivision main line at Gila Bend. The study states the rail line recommendation was moved to closely follow SR 85 to consolidate ROW needs.

The Hidden Valley Transportation Framework Study Alternative A rail alignment represents a continuation of the recommended rail alignment from the MAG Hassayampa Valley Transportation Framework Study rail alignment, extending from the existing UPRR line near the Palo Verde Nuclear Generation Station (along the Wintersburg Parkway alignment), and then generally following Old Highway 80 to Gila Bend. The Hidden Valley Transportation Framework Study recommended alternative rail alignment (**Figure 4**) follows SR 85. Reasons cited for recommending the SR 85 alignment include consolidation of ROW needs and minimizing impacts to adjacent land uses.



Source: MAG I-8 to I-10 Hidden Valley Transportation Framework Study

Figure 3. MAG Hidden Valley Framework Study, Alternative A



Source: MAG I-8 to I-10 Hidden Valley Transportation Framework Study

Figure 4. MAG Hidden Valley Framework Study, Recommended Alternative

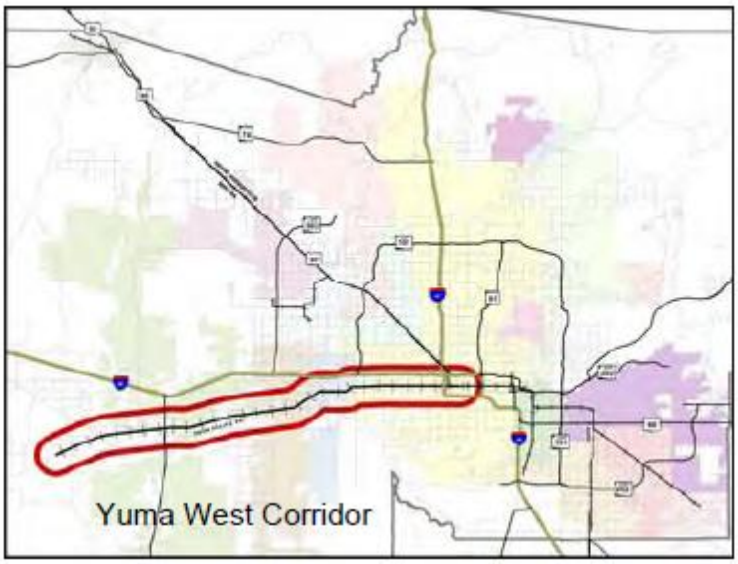
3. MAG Commuter Rail System Study

ID	Document Name	Sponsor Agency	Author	Date
3	MAG Commuter Rail System Study (Yuma West and Grand Avenue Corridor Plans)	MAG	URS	2010

The MAG Commuter Rail System Study defines a network of commuter rail corridors and the necessary elements to implement a regional commuter rail system. The study builds on previous local and regional planning work to consider the feasibility of operating commuter rail service on existing freight rail lines. Considered corridors include the Grand Avenue Corridor (BNSF) and the Yuma West Corridor (UPRR). A summary of these corridors is below.

Yuma West Corridor

The Yuma West Corridor is defined by a two-mile radius surrounding 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. Through freight train movement on the Wellton Branch ended in 1997.



Source: MAG Commuter Rail System Study

Figure 5. Yuma West Corridor

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 miles-per-hour (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 per day. UPRR 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.

UPRR 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. Railroad infrastructure improvements would allow for enhanced freight service as well as facilitate needed improvements should potential commuter rail service be implemented. By 2011, a new Hickman Farms facility was built at Palo Verde Yard in Buckeye and UPRR installed new signals, rail, ties, and ballast on the line between Phoenix and Buckeye/Arlington.

Grand Avenue Corridor

The 54-mile Grand Avenue Corridor has been defined by a two-mile radius surrounding the BNSF line between Union Station in downtown Phoenix and the Town of Wickenburg within Maricopa County. The corridor is located adjacent to and runs parallel along Grand Avenue/US 60. The cities, towns, and unincorporated areas of Maricopa County that fall within this corridor include Phoenix, Glendale, Peoria, Youngtown, El Mirage, Surprise, and Wickenburg. The Grand Avenue Corridor is primarily an un-signalized single track with sidings located throughout to allow trains to pass as necessary.

Source: MAG Commuter Rail System Study

Figure 6. Grand Avenue Corridor

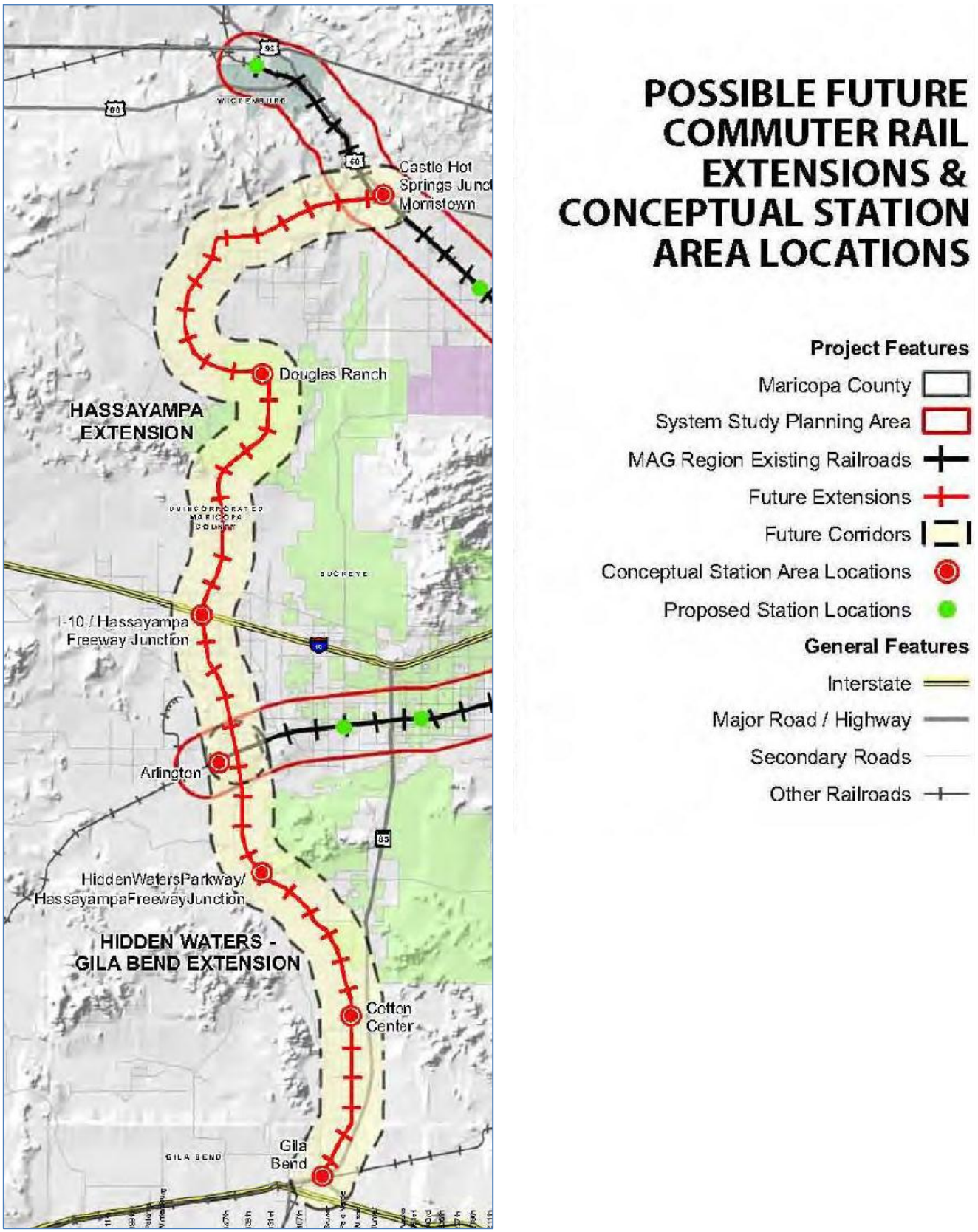
In an effort to expand capacity and reduce the number of trains accessing the downtown area, BNSF is exploring options to build additional facilities northwest of the downtown Phoenix area (in the community of Wittman, City of Surprise). Some of the activity currently conducted in the Mobest Yard (MP 191.6) and Desert Lift Intermodal Facility (MP 186.8) 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 is also looking at the possibility of adding and upgrading existing siding throughout the corridor, which includes 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.

Future Extensions

As part of the MAG Commuter Rail System Study, service areas beyond the current limits of the existing railroad network were also evaluated. **Figure 7** illustrates potential corridor extensions to commuter rail corridors:

- 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 Waters Parkway-Gila Bend Extension: A conceptual commuter rail service study area between the end-of-line along the Yuma West Corridor and Gila Bend.

The proposed future commuter rail extensions show some deviation from the MAG Hassayampa Valley Transportation Framework Study, the Hidden Valley Transportation Framework Study Alternative A, and the Hidden Valley Transportation Framework Study recommended alignment for the rail line.



Source: MAG Commuter Rail System Study

Figure 7. Possible Future Commuter Rail Extensions

The Hassayampa Extension alignment is a blend of the Hassayampa Valley Transportation Framework Study and the Hidden Valley Transportation Framework Study Alternative A. The northern part of the Hassayampa Valley Extension between US 60 and Wintersburg Parkway matches the Hassayampa Transportation Framework Study rail alignment, but the center part of the Commuter Rail Study Future Extension continues along the Hassayampa Freeway/I-11 instead of following Wintersburg Parkway. The southern part transitions to the Hidden Waters Parkway alignment like the Hidden Valley Parkway Alternative A, just at a point farther east than Alternative A because it has been following I-11 instead of Wintersburg Parkway. The Commuter Rail extension is located along Hidden Waters Parkway.

4. State of Arizona Railroad Inventory and Assessment

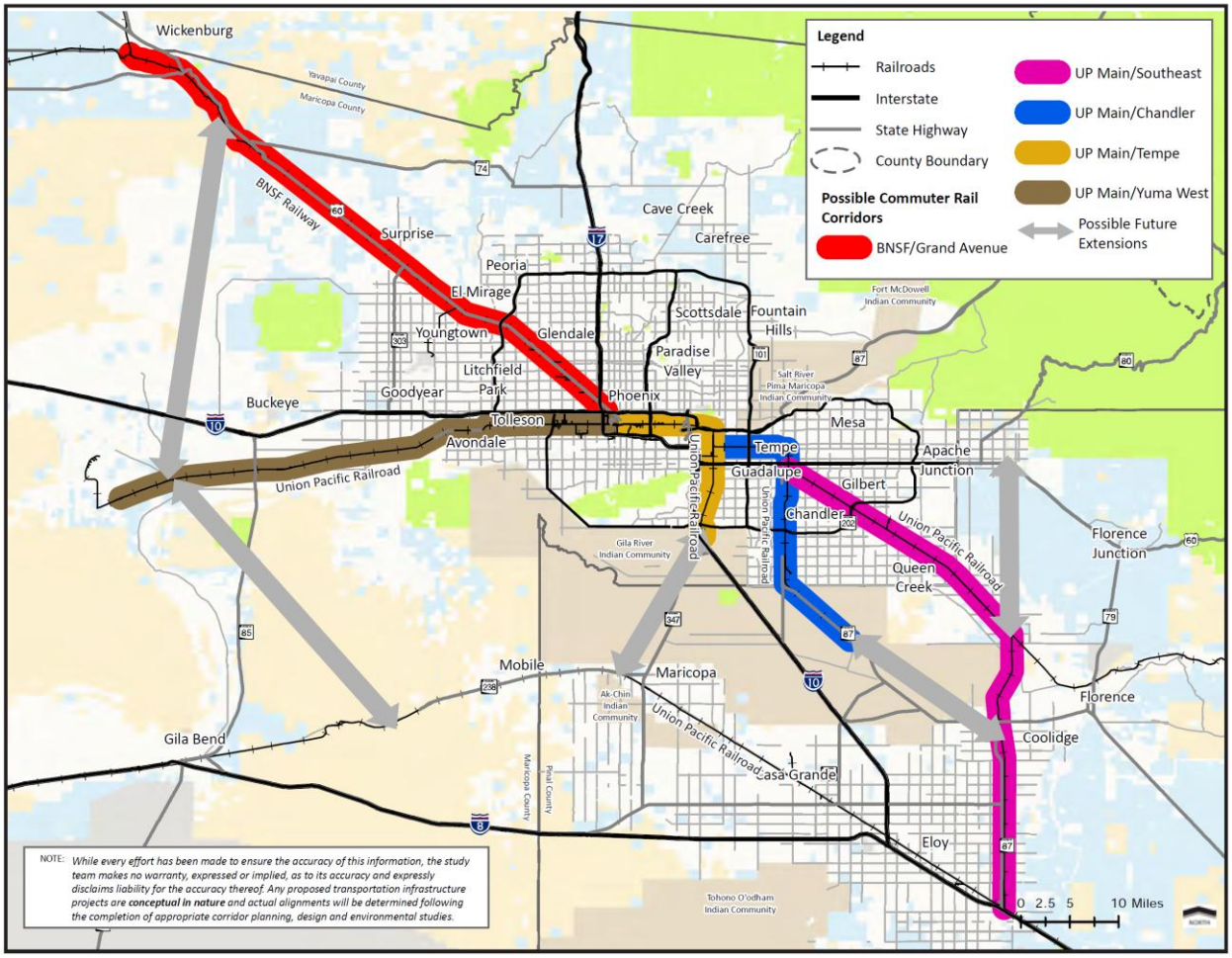
ID	Document Name	Sponsor Agency	Author	Date
4	ADOT State of Arizona Railroad Inventory and Assessment	ADOT	R.L. Banks & Associates, Inc.	2007

This report served as an update to the inventory documented in the 2000 Arizona State Rail Plan. It documents Arizona's rail network, Class I Railroad needs and plans, as well as ROW preservation strategies. The document does not mention the need for a new rail corridor in the Hassayampa Valley, nor connecting Gila Bend to Buckeye.

5. ADOT Statewide Rail Framework Study

ID	Document Name	Sponsor Agency	Author	Date
5	ADOT Statewide Rail Framework Study	ADOT	AECOM	2010

The ADOT Statewide Rail Framework Study was a continuation of the bqAZ (Building a Quality Arizona) program initiated by ADOT. A series of Regional Framework Studies were key inputs into the Statewide Transportation Planning Framework. The Rail Framework Plan recommends development of a new rail freight/passenger rail corridor in the greater Hassayampa Valley. The Framework states that a new rail corridor between the UPRR Sunset Route/Gila Subdivision mainline, and a future UPRR Buckeye yard could provide an alternative route for Amtrak to access the Phoenix metropolitan area, instead of rehabilitating the Wellton Branch. The rail corridor could also serve as a possible future extension of commuter rail service (**Figure 8**).



Source: ADOT Statewide Rail Framework Study

Figure 8. Possible MAG Commuter Rail Corridors

6. ADOT State Rail Plan

ID	Document Name	Sponsor Agency	Author	Date
6	Arizona State Rail Plan	ADOT	AECOM	2010

The Arizona State Rail Plan (ASRP) presents a series of issues and opportunities relative to the future of rail development in Arizona, including a series of implementation directions and a discussion on funding options. The ASRP serves to identify the current rail system, determine infrastructure needs, and to enable rail projects to be included in the State's long-range planning processes. The principle purpose is to convey the magnitude of rail needs in the State and set forth a policy framework through which strategic actions can be taken to realize the full potential of passenger and freight rail transportation.

Source: Arizona State Rail Plan

Figure 9. ADOT State Rail Plan, Hassayampa Valley Rail Corridor

The ASRP states that new railroad corridors may need to be constructed to accommodate changes in travel patterns, take advantage of new economic development opportunities, and improve safety system-wide. The ASRP identifies a potential action item to establish several new rail corridors which are determined to be feasible. The ASRP describes the Hassayampa Valley rail corridor as a new north-south railroad line connecting the UPRR and BNSF to provide opportunities for commuter and intercity rail.

The ASRP includes the following description for the Hassayampa Valley Rail Corridor (**Figure 9**):

> This corridor could start at the BNSF Phoenix Subdivision (aka The Peavine) line near Morristown, running south along the proposed Hassayampa Freeway to the UPRR Wellton Branch, and continuing south parallel to the proposed Hidden Waters Parkway to Gila Bend, where it would connect to the UPRR Sunset Route/Gila Subdivision mainline. This corridor is very conceptual and requires additional study to determine an alignment. North of the Gila River, this corridor is planned in conjunction with a new freeway corridor, running through or near several proposed master planned communities. The land south of the Gila River is environmentally sensitive, and positioning a new rail line along an existing roadway (e.g., SR 85) might be the least intrusive alternative.
>
> Current master planned communities such as Douglas Ranch and Belmont in the Hassayampa Valley are already designating land adjacent to this multimodal transportation corridor (rail and highway) for

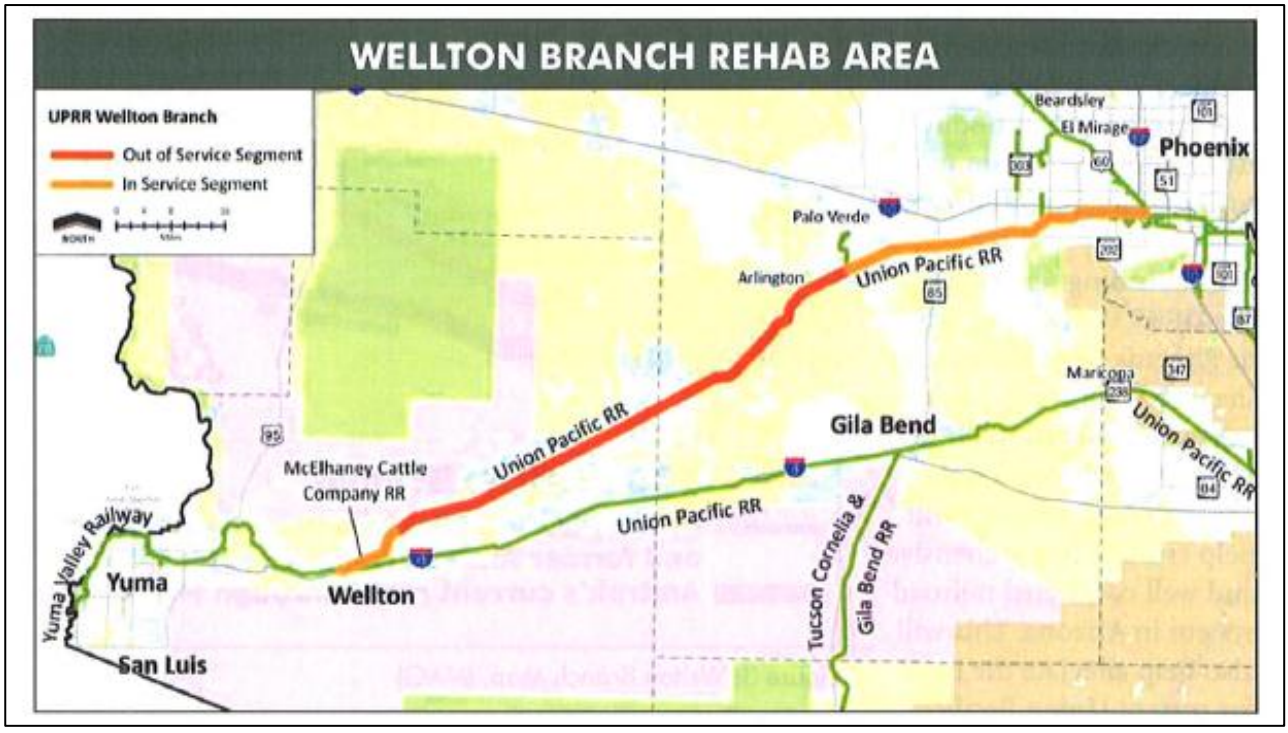
industrial and major employment uses.

The new rail corridor could provide a transit spine through the Hassayampa Valley, linking future economic activity centers and supporting future population and employment growth. A north-south connection would link the proposed MAG commuter rail routes on the BNSF/Grand Avenue and UPRR/Yuma West corridors, allowing commuters in the Hassayampa Valley to gain access to central Phoenix. Additionally, the new rail corridor would connect the many future major classification yards of the BNSF (near Surprise) and UPRR (near Buckeye), thus allowing interchange traffic to occur outside the Phoenix metropolitan area, as well as providing access to both Class I railroads in Arizona with any potential future new railroad links to Mexico.

7. ADOT Wellton Branch Railroad Rehabilitation Study

ID	Document Name	Sponsor Agency	Author	Date
7	ADOT Wellton Branch Railroad Rehabilitation Study	Arizona Department of Transportation	URS	Ongoing

The Wellton Branch is a segment of the UPRR Phoenix Subdivision through west central Arizona (**Figure 10**). A 45-mile segment of the Wellton Branch between Phoenix and Buckeye/Arlington has significant industrial development along its ROW and is currently in service. Approximately 80 miles of track is out of service between the communities of Arlington, and Roll, Arizona. This segment is currently used for railroad car storage. The entire line requires rehabilitation to become active. Amtrak service previously utilized the Wellton Branch until June 1996 after which all Phoenix-bound traffic was rerouted through Picacho Junction, Casa Grande, Maricopa, Gila Bend, and Wellton.



Source: ADOT Wellton Branch Rehabilitation Study

Figure 10. UPRR Wellton Branch Study Segments

The purpose of the ADOT Wellton Branch Railroad Rehabilitation Study is to evaluate the cost to rehabilitate and activate the line. The purpose of the reactivation would be to provide direct benefits to facilitate CANAMEX corridor trade and potential Amtrak service to Phoenix. Reestablishing service on the UPRR Wellton Branch to Phoenix from the west to the UPRR Sunset Route/Gila Subdivision mainline would help create a well-connected railroad system in Arizona and also help to alleviate the need for current UPRR freight trains from having to make the unnecessary, 130-extra-miles-detour between Yuma, Picacho Junction/Eloy, Coolidge, and the East Valley to reach Phoenix and the West Valley.

8. ADOT Passenger Rail Corridor Study, Tucson to Phoenix

ID	Document Name	Sponsor Agency	Author	Date
8	ADOT Passenger Rail Corridor Study, Tucson to Phoenix	ADOT	ADOT Multimodal Planning Division	Ongoing

The ADOT Passenger Rail Corridor Study; Tucson to Phoenix is an ongoing study evaluating alternatives to establish passenger rail service between Tucson and Phoenix. Preliminary alternatives include six rail alternatives and a dedicated bus rapid transit system alternative. Some of the alternatives utilize existing corridors of both ADOT and UPRR, while others use proposed future corridors.

In June 2013, the three final alternatives were announced (**Figure 11**). These include the Green Alternative, which would run along I-10 between Phoenix and Tucson; the Orange Alternative, which would serve the East Valley and share part of its alignment with the planned North-South Freeway Corridor; and the Yellow Alternative, also serving the East Valley but sharing ROW with UPRR. All three alternatives would run along I-10 south of Eloy into Tucson. In addition, all of the alternatives share a common corridor extending to the west valley consistent with the MAG Commuter Rail System Study (Summarized document No. 3). The study is anticipated to be completed in 2014.

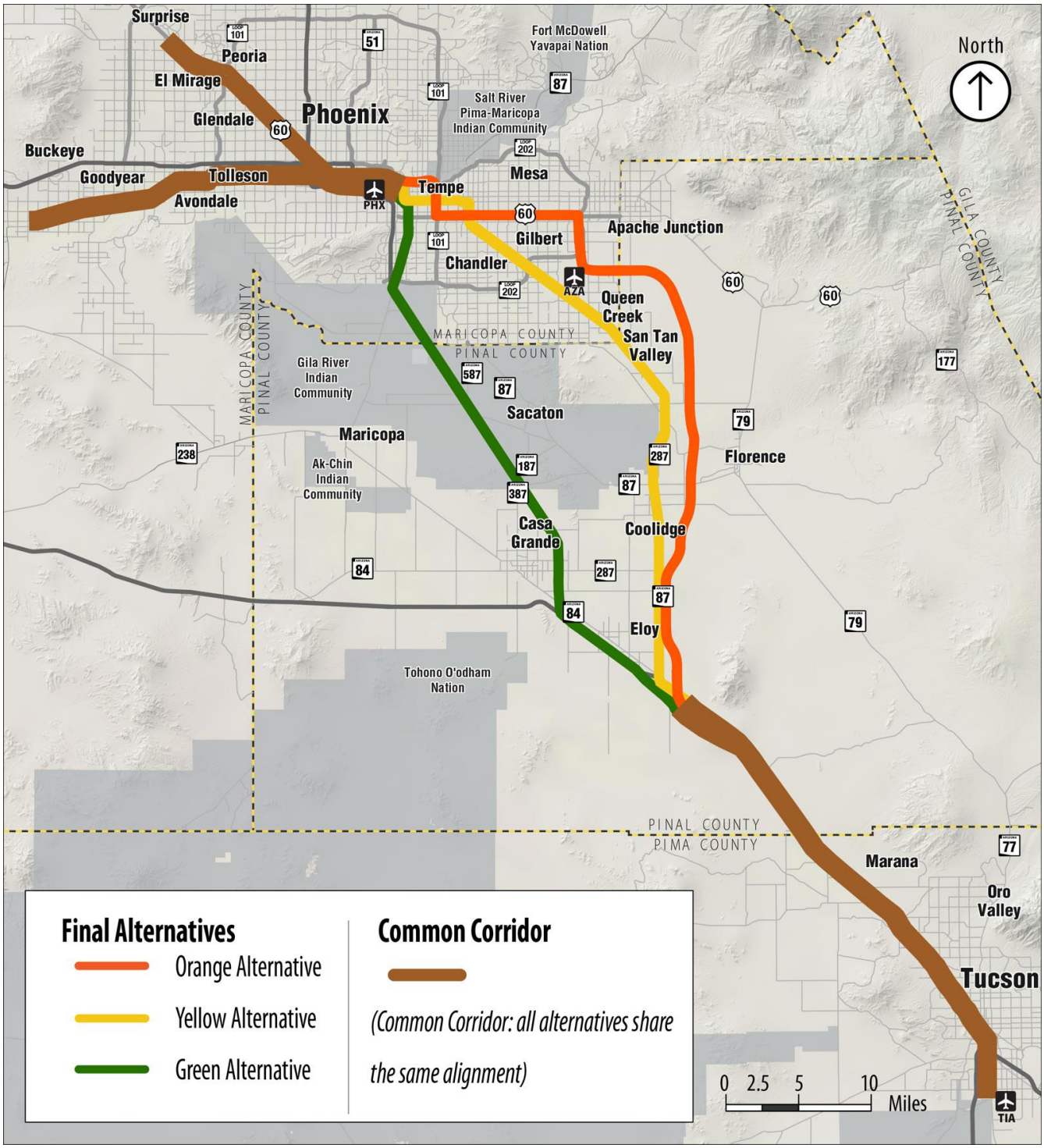


Figure 11. Passenger Rail Corridor Study, Tucson to Phoenix, Final Alternatives

9. MCDOT Hidden Waters Parkway Corridor Feasibility Study – Watermelon Road to Interstate 10

ID	Document Name	Sponsor Agency	Author	Date
9	MCDOT Hidden Waters Parkway Corridor Feasibility Study – Watermelon Road to Interstate 10	MCDOT	Kimley-Horn and Associates, Inc.	2011

The Hidden Waters Parkway Corridor Feasibility Study – Watermelon Road to Interstate 10, is one in series of long-range transportation planning studies conducted by Maricopa Department of Transportation (MCDOT) to evaluate future parkways identified in the MAG transportation framework studies.

The study area for the Hidden Valley Parkway Feasibility Corridor Study extends from Watermelon Road in Gila Bend to the I-10/339th Avenue interchange. The study area is approximately 39 miles in length and generally covers a two-mile wide corridor centered on the north-south segment of Old U.S. Highway 80 and on 339th Avenue. The study area is shown in **Figure 12.**

The study defined and assessed the project study area for potential opportunities and constraints for alternative corridor alignments. For alternatives development and evaluation purposes, the study area was divided into two separate segments; one south of the Old US 80 Bridge over the Gila River and one north of the Old US 80 Bridge over the Gila River.

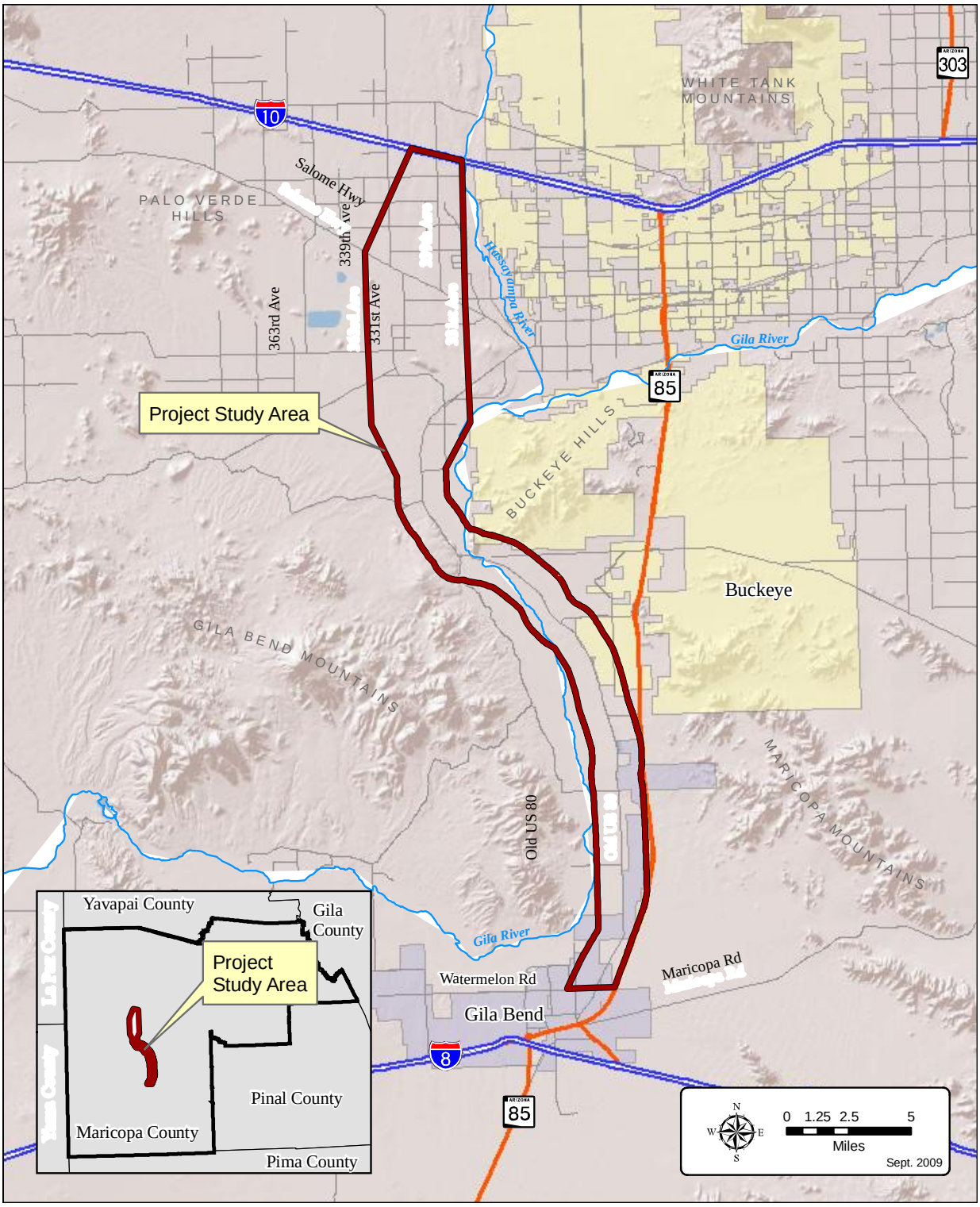
Conceptual alternatives were developed and a subjective, qualitative assessment was performed on all conceptual alternatives. Recommended candidate alternatives were:

- Southern segment: Alternative C generally following the existing Old US 80 alignment.
- Northern segment: Alternative D following the 351st Avenue alignment on the south and transitions to the 339th Avenue alignment on the north.

The preferred alternatives for the southern and northern segments of the Hidden Waters Parkway are respectively shown in **Figure 13** and **Figure 14**.

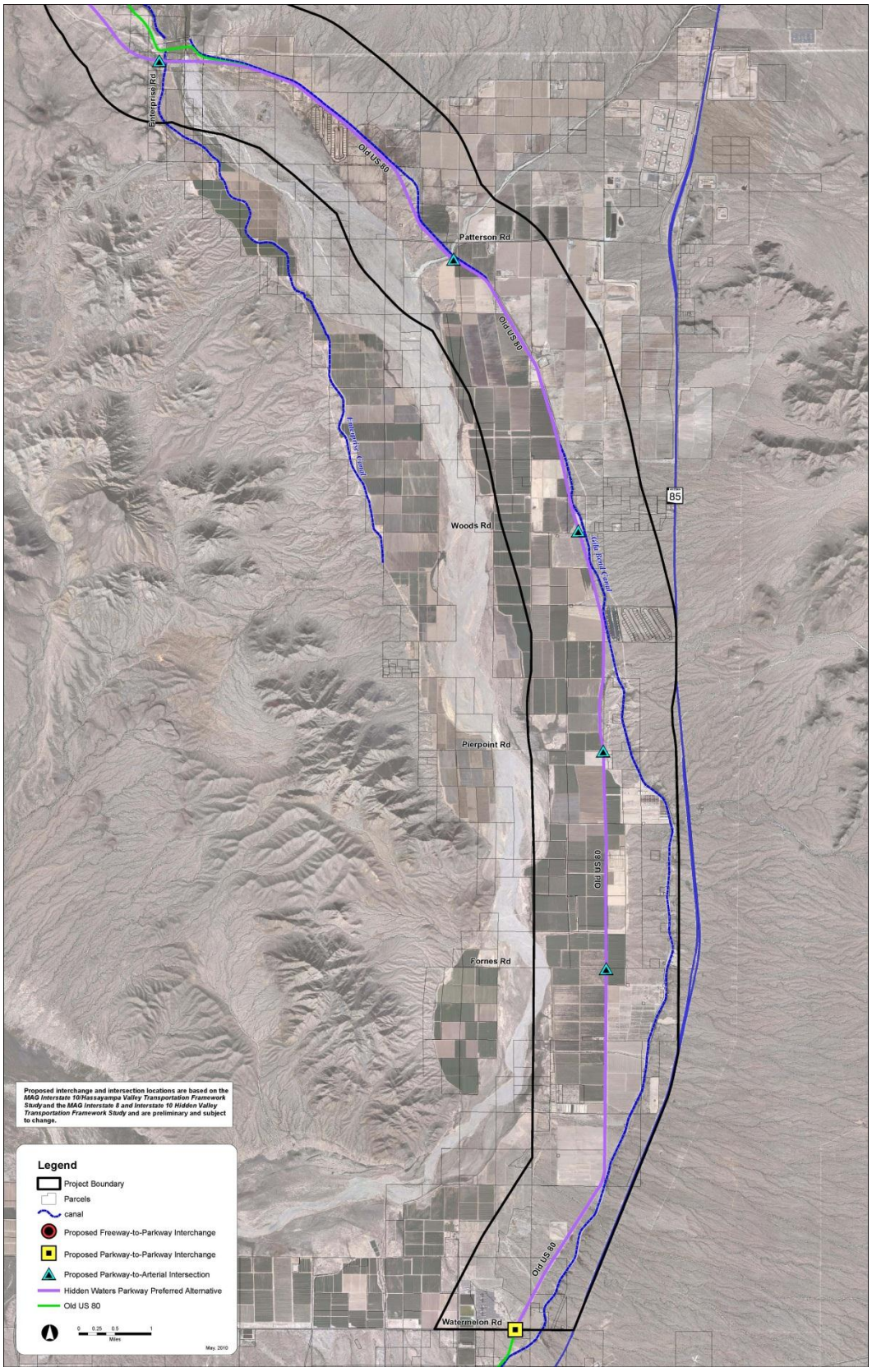
Potential impacts of the new corridors that would require mitigation include:

- Impacts to drainage features to mitigate flooding, erosion, and sedimentation.
- Impacts to existing development including low-density farm houses and agricultural buildings along Old US 80 and improvements in the Spring Mountain Ski Ranch. Much of the area is owned by the Arizona State Land Department.
- Impacts to wildlife habitat and natural wildlife movement corridors could benefit from alternative wildlife crossing structures.
- Impacts to cultural or archaeological areas south and east of the Old US 80 Bridge. It is likely that any major new corridors outside the existing Old US 80 ROW limits would have a negative impact on these cultural and archaeological resources.
- Impacts to utilities including 69kV power lines, agricultural wells, irrigation canals, and the Gila Bend Canal in close proximity to Old US 80.



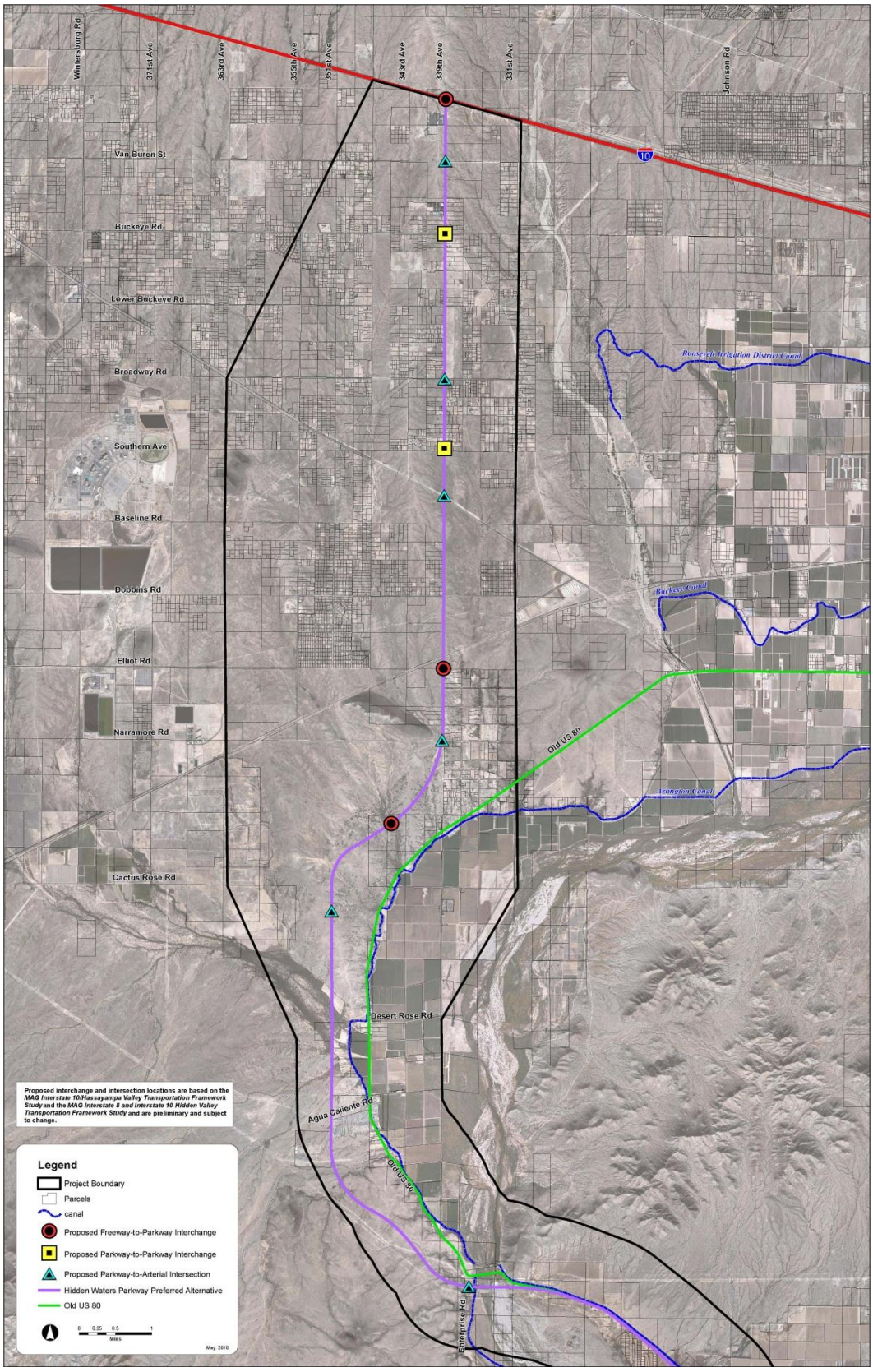
Source: MCDOT Hidden Waters Corridor Feasibility Study

Figure 12. MCDOT Hidden Waters Corridor Feasibility Study



Source: MCDOT Hidden Waters Corridor Feasibility Study

Figure 13. MCDOT Hidden Waters Corridor Feasibility Study, Southern Corridor Preferred Alternative



Source: MCDOT Hidden Waters Corridor Feasibility Study

Figure 14. MCDOT Hidden Waters Corridor Feasibility Study, Northern Corridor Preferred Alternative

10. Town of Gila Bend General Plan

ID	Document Name	Sponsor Agency	Author	Date
10	Gila Bend General Plan	Town of Gila Bend	HDR, Inc.	2006

The Gila Bend General Plan was approved in November, 2006. Rail related goals and objectives in the Land Use Element include:

Goal 8: Actively promote quality industries and business which will contribute to investment and development in the Town.

Objective: Work with the UPRR to establish rail access in Gila Bend.

Policy: Contract to have an economic market analysis prepared which identifies the potential for developing industrial properties with rail access in Gila Bend.
Policy: Work with UPRR to allow rail access in Gila Bend.

The ongoing Gila Bend Small Area Transportation Study will be updating the circulation portion of the General Plan.

11. Town of Buckeye General Plan Update

ID	Document Name	Sponsor Agency	Author	Date
11	Town of Buckeye 2007 General Plan Update	Town of Buckeye	Partners for Strategic Action	2008

The Town of Buckeye General Plan Update has the following rail-related strategies:

- The Plan states that although rail freight can be a tool of economic development, the implementation of rail service must be carefully considered. The Plan states that care should be taken to ensure that new employment associated with rail are high-quality jobs and associated land uses are compatible with quality of life concerns.
- The Plan states that air quality and safety are two significant issues of which the Town is keenly aware. The Plan encourages early and continued conversations with UPRR regarding the use of the latest locomotive technology to reduce air particulates (e.g., PM-10) and installation of grade separated crossings at arterials and parkways.
- The Plan recommends that the Town work with City of Surprise to mitigate any impacts of noise and air pollution that would be generated from planned new BNSF rail facilities in the City of Surprise.
- The Plan discusses potential new rail facilities to connect the BNSF and UPRR lines to facilitate freight movement. The Plan states that inasmuch as the Town supports a multimodal approach to transportation, both freight and commuter rail would be given serious consideration as part of the development process.

12. City of Surprise General Plan 2035

ID	Document Name	Sponsor Agency	Author	Date
12	City of Surprise Draft General Plan 2035	City of Surprise	City of Surprise	2013

The City of Surprise General Plan 2035 is in draft form and has been approved by City Council. It will be presented to voters in November 2013. The plan includes the following rail-related goals and policies:

Goal 2: Access and Alternatives – Provide attractive and convenient public transit services to, from, and within Surprise.

Policy 3. Work with all appropriate agencies and interests to support the implementation of commuter rail service in the BNSF Railway corridor adjacent to US 60/Grand Avenue.

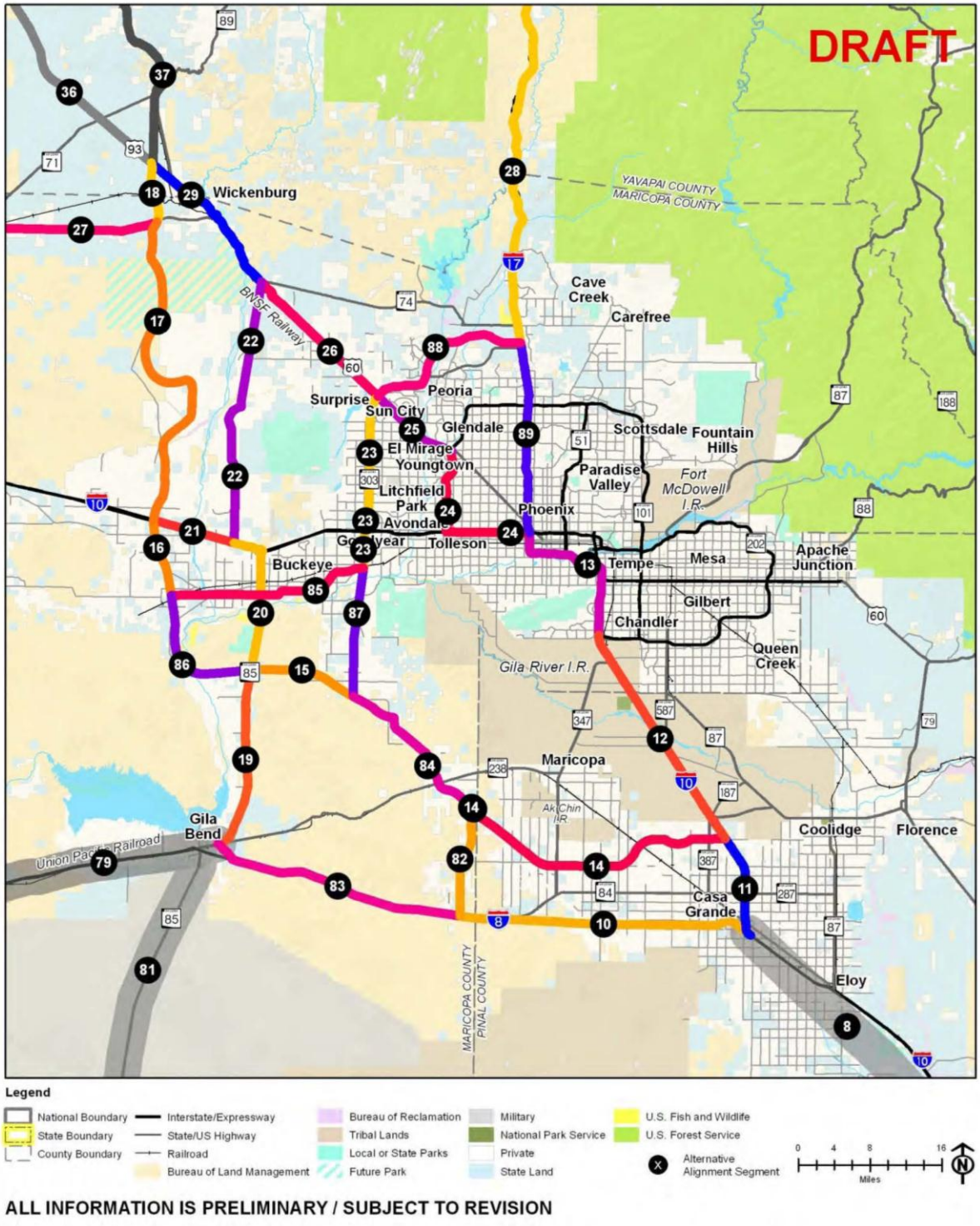
13. I-11 and Intermountain West Corridor Study

ID	Document Name	Sponsor Agency	Author	Date
13	I-11 and Intermountain West Corridor Study	NDOT and ADOT	-	Ongoing (2013)

ADOT and the Nevada Department of Transportation (NDOT) are collaborating on the I-11 and Intermountain West Corridor Study for a possible high priority interstate link between Phoenix and Las Vegas (the I-11 portion), and a high-level visioning for potentially extending the corridor north to Canada and south to Mexico. The study is planned to be completed in July 2014. Input from focus group meetings held in early 2013 regarding rail freight included:

- The development of more manufacturing facilities adjacent to and within the Corridor will help to justify the inclusion of freight rail.
- Multimodal considerations should be emphasized within this Corridor, especially passenger and freight rail even if rail alternatives have significant geographic constraints (including between the Hoover Dam and Kingman). If near-shoring in Mexico expands as predicted, a rail connection to Las Vegas and other points north would be important.
- There is a need to secure sufficient ROW now to include rail and other components in the Corridor—despite the geographic or political challenges that exist now.

The \I-11 and Intermountain West Corridor Study developed a set of alternatives for Priority Section #1: Phoenix Metropolitan Area (**Figure 15**). Priority Section #1 includes the greater metropolitan Phoenix area, extending from the northwest at Wickenburg to the southeast near Casa Grande. One of the alternatives proposed (Alternative G) bypasses the core of the Phoenix metropolitan area to the west and south using the proposed Hassayampa Freeway and I-10.



Source: Interstate 11 and Intermountain West Corridor Study, Draft Candidate Corridor Alternatives for Level 1 Screening, Figure 11 – Alignment Alternatives for Priority Section # 1: Phoenix Metropolitan Area (Draft, September 12, 2013)

Figure 15. Interstate 11 and Intermountain West Corridor Study, Draft Candidate Corridor Alternatives

3.0 Summary of Field Review Observations

On May 15, 2013, the Project Management Team conducted a windshield field review of the study area. The purpose of the field review was to gain a first-hand look at the study area to inform corridor alternatives development. The Project Management Team identified issues and opportunities associated with a potential rail corridor. The following are notes and images from the field review.

Field Review Stop No. 1 – SR 85 and Gila Bend, Arizona

A. SR 85, Southbound at Milepost 131.

SR 85 (Photo A) between Buckeye, Arizona and Gila Bend, Arizona has undergone several improvements over the past few years in preparation for a fully access controlled highway between Gila Bend and Buckeye. Improvements include a fully divided highway with two lanes in each direction. Improvements have been constructed to accommodate freeway ramps. SR 85 was identified as a potential rail corridor in the I-8/I-10 Hidden Valley Transportation Framework Study. The purpose of utilizing SR 85 is to consolidate ROW requirements for a new rail corridor.

B. Out-of-service Tucson, Cornelia & Gila Bend Railroad sidings (view to west) in Gila Bend, Arizona. The UPRR Sunset Route/Gila Subdivision mainline is at the far right.

Within the Town of Gila Bend there are numerous out-of-service sidings associated with the out-of-service Tucson, Cornelia & Gila Bend to Ajo, Arizona Railroad. The lines are viewable from Martin Avenue south of Pima Street in Gila Bend (Photo B).

C. Gila Bend Airport (view to the north from Maricopa Road/SR 238 and the UPRR Sunset Route/Gila Subdivision mainline)

D. UPRR Sunset Route/Gila Subdivision mainline in Gila Bend near the Gila Bend Airport, viewing west from Maricopa Road (SR 238)

The conceptual new rail corridors could connect to the UPRR Sunset Route/Gila Subdivision mainline east of Gila Bend in the vicinity of the Gila Bend Airport (Photo C and D), establishing a multimodal hub. A potential concept for this connection was developed by MAG. The potential concept is included in the **Appendix A.**

Field Review Stop No. 2 – Old Highway 80

Old Highway 80 between Gila Bend and Arlington was identified as a potential rail corridor in early versions of the I-8/I-10 Hidden Valley Transportation Framework Study. The I-8/I-10 Hidden Valley Transportation Framework Study subsequently ultimately recommended that the rail corridor follow SR 85 to consolidate ROW needs. A rail corridor along Old Highway 80 was also shown in both the MAG Commuter Rail System Study (Yuma West and Grand Avenue Corridor Plans) as a future extension as well as in the Arizona State Rail Plan.

Old Highway 80 primarily serves agriculture facilities (Photo E). A new freight rail corridor could potentially serve existing Hidden Valley agribusiness with transportation of fertilizer, chemicals, and refrigerated perishables.

E. Old Highway 80 between Gila Bend and Arlington

Much of the corridor is undeveloped desert lands (Photo F).

F. View of Old Highway 80 corridor

The Gila Bend Canal runs roughly parallel to Old Highway 80 (Photo G).

G. Gila Bend Canal

H. 500-kV Transmission lines along Old Highway 80

Sections of Old Highway 80 have multiple utilities including 500-kV lines that originate at the Gila Bend Power Generating Station (Photo H).

I. Gillespie Dam Bridge on Old Highway 80

River crossings of the Gila River represent one of the more significant challenges to a rail corridor through this area. The historic Gillespie Dam Bridge over the Gila River (Photos I and J) is joined by the Hassayampa River a few miles upstream.

J. Gillespie Dam Bridge (view facing East)

K. Old Highway 80, east of the Gillespie Dam Bridge

As Old Highway 80 departs the Gillespie Bridge, it encounters sections of steeper grade (Photo K). A proposed railroad corridor would need to account for this steep grade to ensure a maximum acceptable grade of 1%.

There may be opportunities to weave a rail corridor through gaps in the mountain ridges (Photo L) located west of Old Highway 80.

.

L. Mountain rides south and west of the Gillespie Dame Bridge, west of Old Highway 80

Field Review Stop No. 3 – Wellton Branch Line near Arlington and Palo Verde

M. Wellton Branch Line crossing on Palo Verde Road in Buckeye, viewing north

Old Highway 80 continues through the agricultural communities of Arlington and Palo Verde. The potential rail corridor would depart to the west of Old Highway 80 before entering Arlington and Palo Verde. The rail corridor would cross the existing UPRR Wellton Branch line (Photos M and N). The rail corridor could connect to the proposed UPRR West Valley/Palo Verde switching yard via a resuscitated Wellton Branch Line and serve nearby agricultural and industrial facilities such as Hickman Farms.

N. Wellton Branch Line crossing on Palo Verde Road in Buckeye, viewing west

Field Review Stop No. 4 – I-10 to Central Arizona Project Canal

Upon leaving the Palo Verde and Arlington area, the corridor would head west of 355th Avenue and extend north to cross I-10 and continue approximately north to Aguila Road. The rail corridor identified in the Hassayampa Valley Transportation Framework Study is located about three to four miles west of 355th Avenue in areas without accessible roads. The rail corridor would cross the Central Arizona Project (CAP) canal at approximately Aguila Road (Photo O).

O. Central Arizona Project Canal at Aguila Road

Field Review Stop No. 5 – Hassayampa Valley from CAP Canal to Morristown

From the CAP Canal, the potential corridor would continue to the northwest along Vulture Mine Road (Photo P), passing west of the Toyota Proving Grounds and then north of Whispering Ranch to avoid the hills and mountains near Wickenburg. This area is characterized by steep topography and wide flood plains.

The potential rail corridor would connect to the BNSF Phoenix Subdivision near US 60/Grand Avenue in Morristown at Gates Road and Castle Hot Springs Road (Photos Q and R).

P. Historic Vulture Mine along Vulture Mine Road

Q. BNSF Phoenix Subdivision at Gates Road in Morristown/Castle Hot Springs siding

R. Gates Road in Morristown/Castle Hot Springs siding

4.0 Conceptual Rail Corridors

This chapter presents conceptual corridors for the proposed new rail facilities. Conceptual corridors were developed based on the information presented in the literature review, field observations, and analysis of existing geographical constrains and opportunities. Conceptual rail corridors are separated into three segments, and are depicted in **Figure 16** through **Figure 21.**

Rail corridor segments are:

- Segment 1: Morristown to Buckeye
- Segment 2A: Buckeye/Arlington to Gila Bend Via Old Highway 80
- Segment 2B: Buckeye/Arlington to Gila Bend Via Wellton Branch Line and SR 85

4.1 Segment No. 1: Morristown to Buckeye

Segment No. 1 (**Figure 16)** would link the communities of Buckeye/Arlington (south of I-10) and Morristown/Castle Hot Springs. The line would connect the existing UPRR Wellton Line at Buckeye/Arlington with the BNSF Phoenix Subdivision at Morristown/Castle Hot Springs (southeast of Wickenburg), near the US 60 overpass at Gates Road (BNSF Castle Hot Springs siding). Key features of the corridor include the Vulture Mountains, Toyota Proving Grounds, the Hassayampa River, and I-10.

4.2 Segment No. 2: Buckeye/Arlington to Gila Bend

Segment No. 2 would link the communities of Buckeye/Arlington and Gila Bend connecting the existing UPRR Wellton Line at Buckeye/Arlington with the UPRR Gila Mainline in Gila Bend near the Gila Bend Municipal Airport. The potential rail line would provide an alternative connection between the UPRR mainline to Yuma and the Los Angeles coastal ports and the MAG Region, by providing a more direct link through Gila Bend.

Two alignment alternatives exist for this segment:

- Segment No. 2A: This alternative roughly follows Old Highway 80 and the preferred alignment of the MCDOT Hidden Waters Parkway Feasibility Study, extending from the UPRR Wellton Line near Arlington to the intersection with the UPRR Sunset Route/Gila Mainline east of the Gila Bend Municipal Airport.
- Segment No. 2B: This utilizes the Wellton Branch Line from Palo Verde to the junction with SR 85. At SR 85, a new rail facility would roughly follow SR 85 to Gila Bend and a junction with the UPRR Sunset Route/Gila Subdivision Mainline.

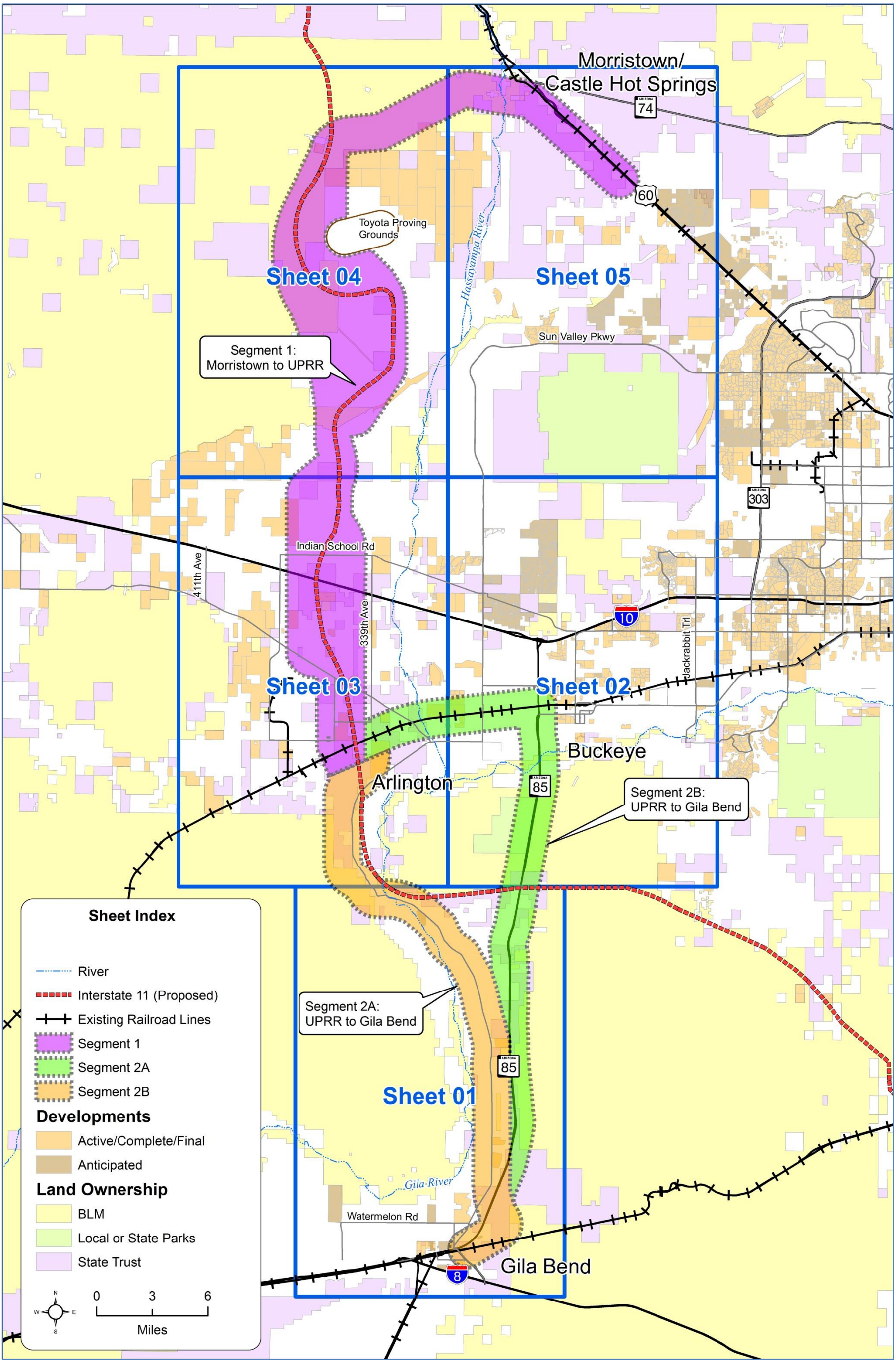


Figure 16. Corridors Alternatives

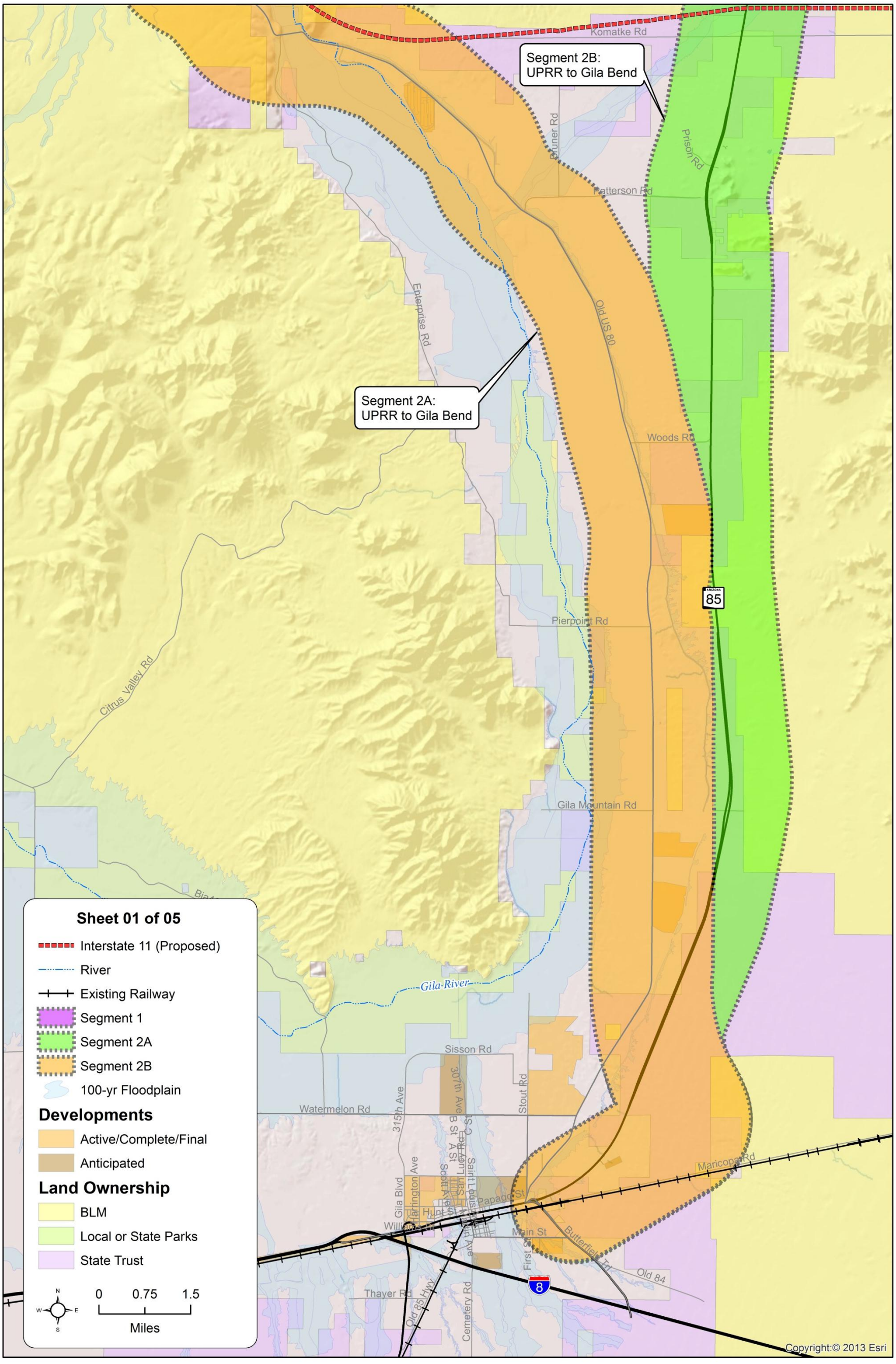


Figure 17. Corridors Alternatives, Sheet 1 of 5

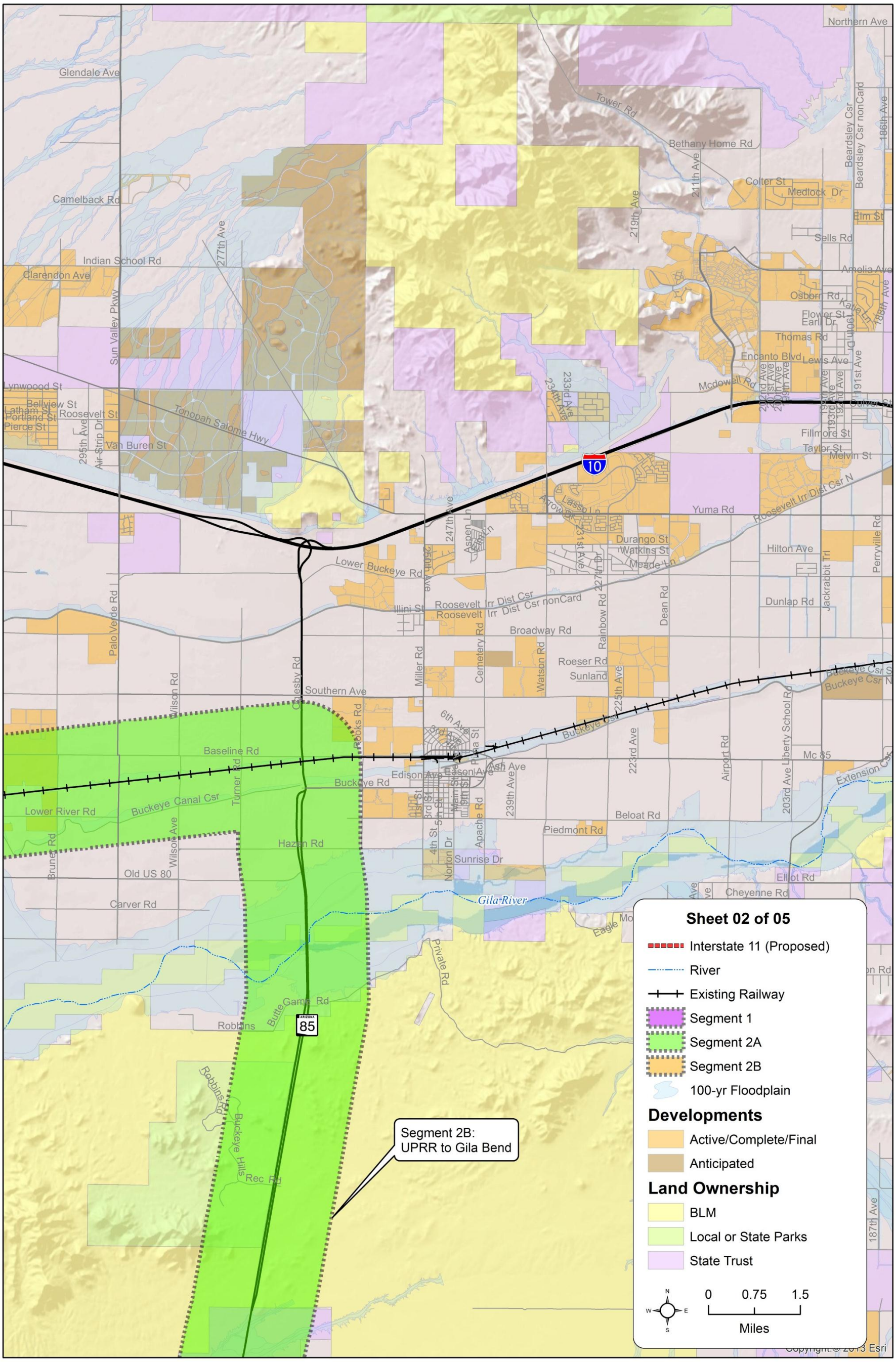


Figure 18. Corridors Alternatives, Sheet 2 of 5

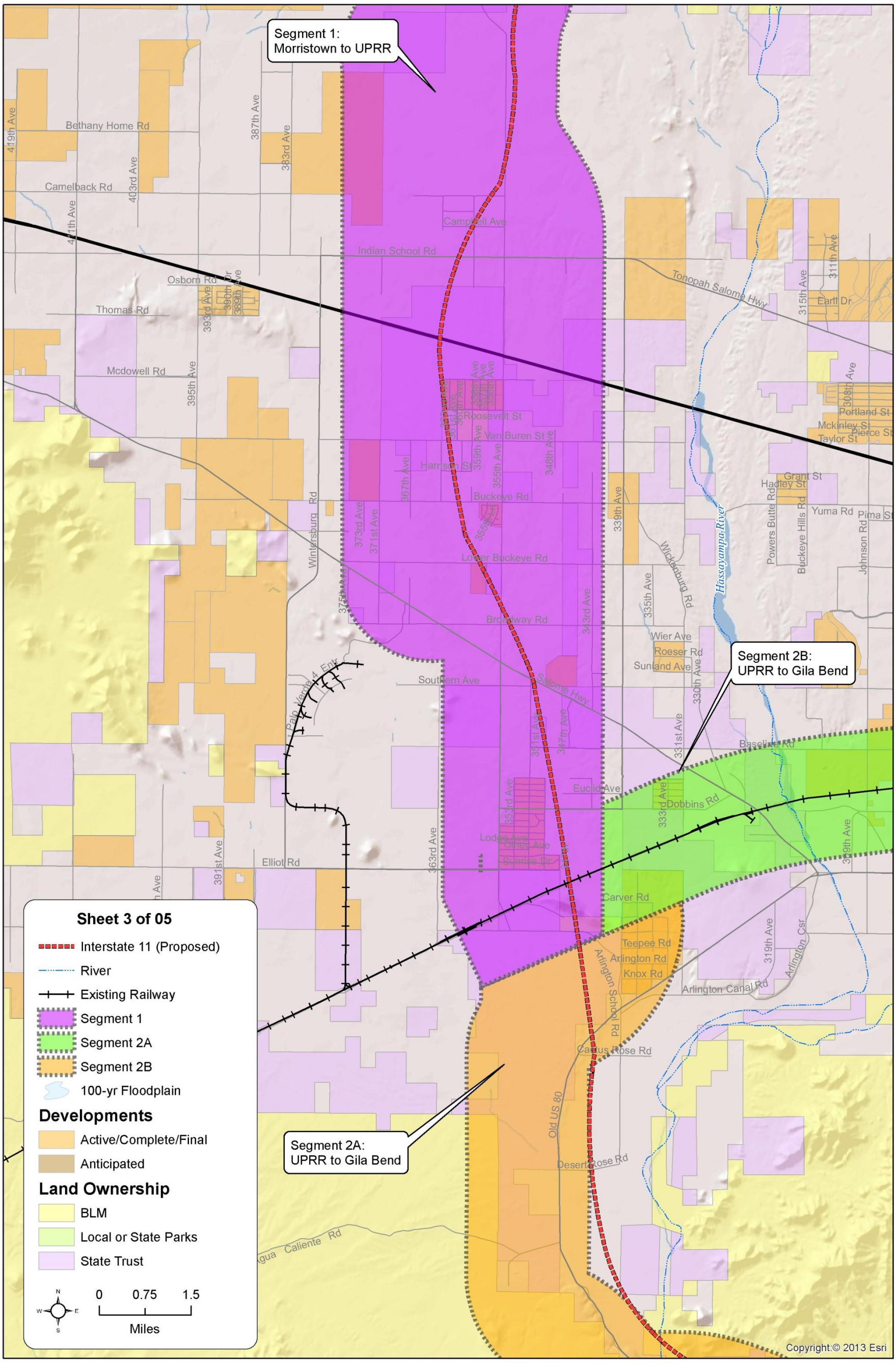


Figure 19. Corridors Alternatives, Sheet 3 of 5

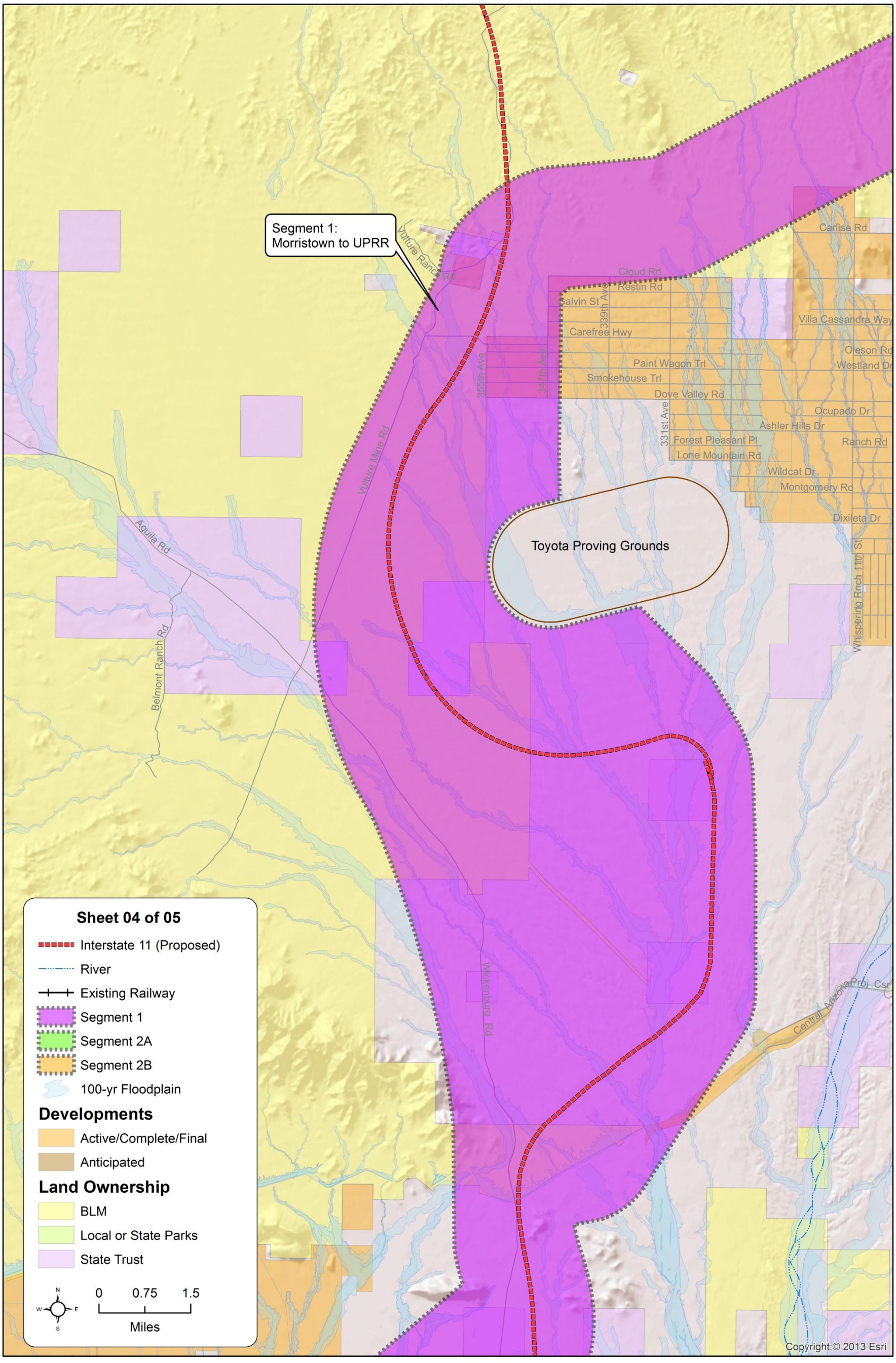


Figure 20. Corridors Alternatives, Sheet 4 of 5

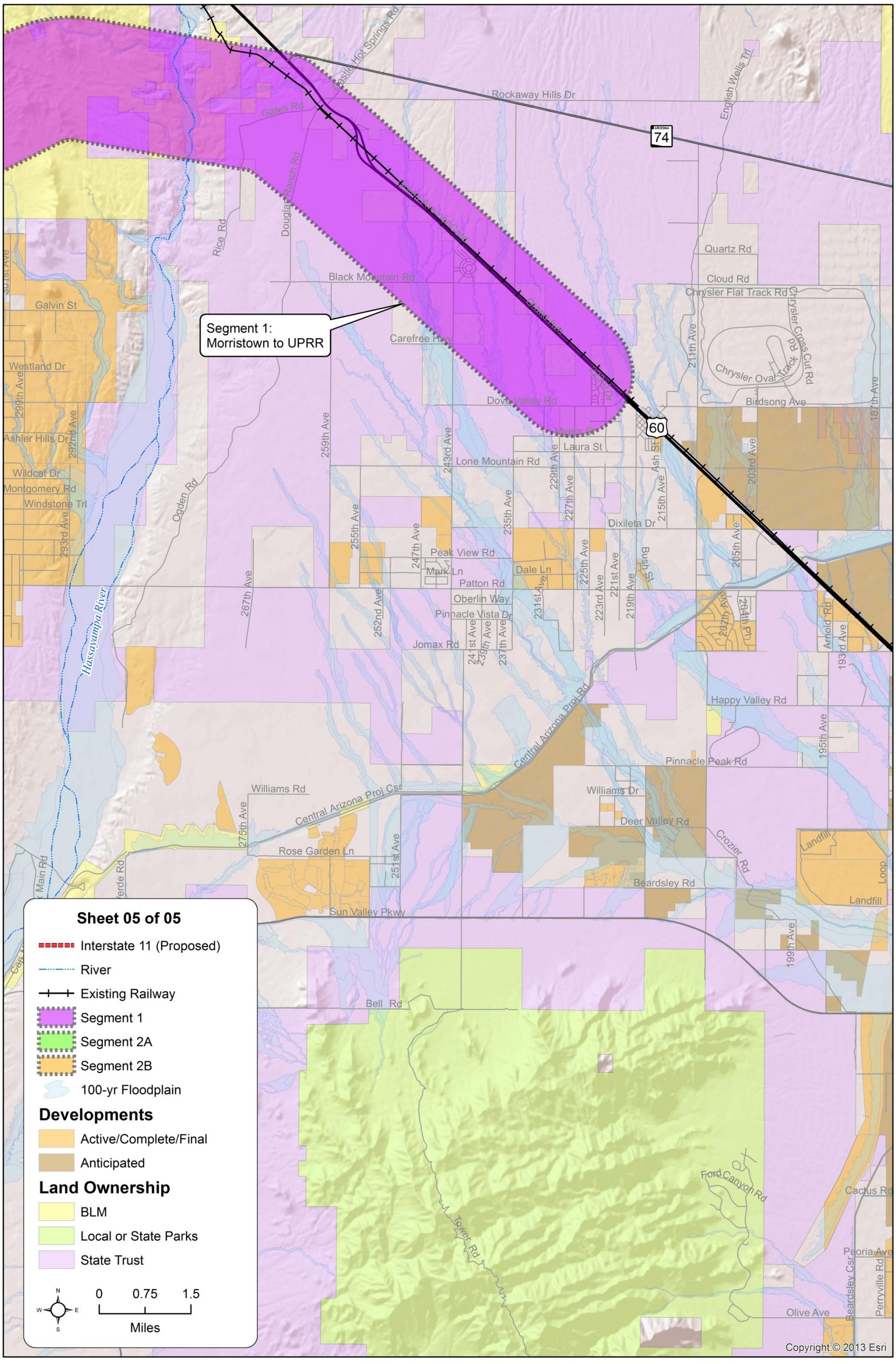


Figure 21. Corridors Alternatives, Sheet 5 of 5

5.0 Rail Corridor Elements and Unit Costs

Based on best practice research and railroad industry per mile/unit costs, Chapter 5 presents potential rail corridor elements. The elements were developed based on a review of mapping, aerial photographs, and similar studies.

Rail elements are separated into two categories: 1) corridor improvements, and 2) crossing improvements. Planning-level unit costs are developed for each rail corridor element.

Cost information is based on the Wellton Branch Rehabilitation Study [3], Oregon Rail Study[4], and the State of Arizona Rail Safety & Security Resource Guide[5].

The unit costs serve as the basis for developing planning-level costs for each rail corridor segment. Planning-level costs are presented in Chapter 6.

5.1 Contingency Costs

For the purposes of the included preliminary cost estimate, contingencies were assumed based on the current level of design, potential for design changes, and presently unknown field conditions. First, for each line item or major cost category included for each track segment—segments 1, 2A, and 2B—an allocated contingency of 20% was added due to the level of design at this point in conceptual design of the track alignments. There is significant potential for the quantities to change as the design progresses, thus this contingency was included within the cost for each item. Second, a 15% contingency was included in the total "Planning/Engineering" associated with the rail design and construction. These costs include tasks such as engineering and design, construction administration, permit fees, etc. As with the hard quantities, there is potential for these costs to change. Not only might the percentages of the total cost assumed change, but depending on the scope of the final alignment and schedule of design or construction, these "Soft Cost" totals can increase.

Finally, due to the scope, size, and overall variability in obstacles such as ROW constraints and costs, project duration and schedule, potential changes in the corridors and alignments, the current lack of geotechnical, utility, survey data, etc., a 10% overall contingency was assumed for the overall preliminary estimated cost of each rail segment. Not only does this contingency allow for variability in construction items, but also allows for some variation in inflation given the assumed build out year of 2033.

5.2 Federal Railroad Administration (FRA) Rail Class Standards

For informational purposes, a summary of FRA Rail Class Standards is provided in **Table 2.** The rail corridors are proposed to be designed as Class III, IV, or V facilities.

[3] Wellton Branch Railroad Rehabilitation Study, Arizona Department of Transportation, 2013

[4] Oregon Rail Study, Appendix G: Eugene to Ashland Intercity Passenger Rail Assessment, 2010

[5] State of Arizona Rail Safety and Security Resource Guide, November 2007

Table 2. FRA, Rail Class Standards

Track Type	Max. Allowable Speed (mph)		Speed limit without block signal systems		Track Gauge Requirements		Track Inspection Requirements		Elevation	Positive Train Control	
	Freight Rail	*Passenger Rail*	*Freight Rail*	*Passenger Rail*	*Min.*	*Max.*	*Main Track and Sidings*	*Other - Non-Main Track and Sidings*	*Max. Elev. Of Outside Rail (in.)*	*Freight (main lines)*	*Intercity Passenger (main lines)*
Excepted	10	n/a	10	n/a	n/a	4' 10-1/4"	Weekly, at least 3 calendar days b/t	Weekly, at least 3 calendar days b/t	n/a	n/a	n/a
Class 1	10	15	10	15	4' 8"	4' 10"	Weekly, at least 3 calendar days b/t	Weekly, at least 3 calendar days b/t	8"	Y[2]	Y
Class 2	25	30	25	30	4' 8"	4' 9-3/4"	Weekly, at least 3 calendar days b/t	Weekly, at least 3 calendar days b/t	8"	Y	Y
Class 3	40	60	40	*59*	4' 8"	4' 9-3/4"	Weekly, at least 3 calendar days b/t	Weekly, at least 3 calendar days b/t	7"	Y	Y
Class 4	60	80[1]	*49*	*59*	4' 8"	4' 9-1/2"	Twice Weekly, at least 1 calendar day b/t	Twice Weekly, at least 1 calendar day b/t	7"	Y	Y
Class 5	80[1]	90[1]	*49*	*59*	4' 8"	4' 9-1/2"	Twice Weekly, at least 1 calendar day b/t	Twice Weekly, at least 1 calendar day b/t	7"	Y	Y

Note:
1. Trains without an automatic cab signal, automatic train stop, or automatic train control system may not exceed 79 mph.
2. PTC required for Class 1 main lines carrying 5 million or more gross tons annually that handle any poisonous-inhalation-hazardous (PIH) materials.

5.3 Corridor Cost Elements

A list of corridor cost elements is presented in **Table 3**. References and cost estimating assumptions are also noted.

Track mile costs include all appropriate track costs from the top of the subgrade. This includes continuously welded 136 lb. rail, concrete ties, fasteners, ballast, subballast, geotextile, and service road. Upgraded track includes continuously welded 136 lb. rail (per yard), concrete ties, and fasteners. For the purposes of this study, it is assumed that an FRA compliant Quiet Zone would be in effect for the entire corridor.

Sidings are assumed to be 1.5 miles in length every four miles based on *The Design of Railway Location: A Study of the Physical and Economic Conditions That Control the Location of Railways in Order That Their Operation May Be at Maximum Safety and Efficiency* by Clement Clarence Williams. All turnouts are assumed to be #20 turnouts on timber ties.

Table 3. Corridor Cost Elements

Item No.	Description	Unit	Unit Cost	Assumptions and Notes	References
1	Main Track - New (On New ROW)	MI	$2,500,000	136# CWR, conc. ties, ballast, subballast, service road	Oregon Rail Study Appendix G
2	Main Track - Upgrades	MI	$1,600,000	136# CWR, conc. ties	Wellton Branch Cost Analysis Alt #3
3	Second Main Track	MI	$2,500,000	136# CWR, conc. ties, ballast, subballast	Oregon Rail Study Appendix G
4	Sidings	MI	$2,500,000	136# CWR, conc. ties, ballast, subballast	Oregon Rail Study Appendix G
5	Turnouts/Switches New #20 TO	EA	$188,000	136# wood ties	Wellton Branch Cost Analysis Alt #3
6	Diamond Crossing New	EA	$300,000	-	-
7	Bridges Steel Ballast Deck	LF	$8,000	estimate total bridge length for each corridor	Wellton Branch Cost Analysis Alt #3
8	Culverts, Concrete pipes 36"	LF	$250.00	estimate total culvert length for each corridor	Wellton Branch Cost Analysis Alt #3
9	Canals (Railroad Steel Ballast Deck Bridge)	EA	$8,000	estimate total bridge length for each corridor	Wellton Branch Cost Analysis Alt #3
10	Signalization System (signals and communication)	MI	$2,000,000	-	Oregon Rail Study Appendix G
11	Utilities (Allowance 5% of Construction cost)	Allowance of 5% of construction costs	-	-	-
12	Earthwork	CY	$20	estimate volume based on vertical profile modeling; volume subtracted from Corridor 1 to reflect potential tunnel	Kimley-Horn and Associates
13	Tunnel Boring	LF	$30,000	Assume tunnel is utilized on Segment No. 1. This represents a conservative.	Dulles Rail Project tunnel boring cost using drilling machine

5.4 Crossing Cost Elements

Vehicular crossings of the future freight rail line were classified as either at-grade or grade separated. Grade separated crossings were assumed for restricted access highways and major arterials. All other crossings were considered at-grade crossings with Quiet Zone-compliant gate arms and signals.

Positive Train Control

Corridor cost elements assume that Positive Train Control (PTC) will be implemented on the new rail corridors. As described by the FRA[6]:

> PTC technology is capable of automatically controlling train speeds and movements should a train operator fail to take appropriate action for the conditions at hand. For example, PTC can force a train to a stop before it passes a signal displaying a stop indication, thereby averting a potential collision. PTC systems will be required to reliably and functionally prevent:
>
> - Train-to-train collisions
> - Over-speed derailments
> - Incursion into an established work zone; and
> - Movement through a main line switch in the improper position

The Rail Safety Improvement Act of 2008 (RSIA) mandates that PTC be implemented across a significant portion of the nation's rail industry by December 31, 2015, although the railroad industry has requested the FRA delay implementation requirements for PTC until 2018-2020. Lines requiring PTC are essentially Class I railroad main lines (i.e., over which 5 million or more gross tons are transported annually) that handle any poisonous-inhalation-hazardous (PIH) materials; and, any railroad main lines over which regularly scheduled intercity passenger or commuter rail services are provided. PTC is expected to be implemented over a total of approximately 70,000 miles of track, or half of the U.S. network of 139,000 miles.[7]

PTC is included as a separate item (item 22) within **Table 4**.

Table 4. Crossing Cost Elements

Item No.	Description	Unit	Unit Cost	Assumptions and Notes	References
14	At-Grade Crossing	EA	$500,000	Public crossing includes gates and signals	State of Arizona Rail Safety & Security Resource Guide, Oregon Rail Study Appendix G
15	At-Grade Crossing - Future	EA	$500,000	-	State of Arizona Rail Safety & Security Resource Guide, Oregon Rail Study Appendix G
16	Grade Separated Crossings (Roadway Bridge Overpass)	EA	$25,000,000	-	-

[6] http://www.fra.dot.gov/Page/P0358

[7] https://www.fra.dot.gov/Page/P0621

Item No.	Description	Unit	Unit Cost	Assumptions and Notes	References
17	Grade Separated Crossings - Future Planned Roadways	EA	$25,000,000	-	-
18	Active Grade Crossing Equipment Upgrades	EA	$352,000	-	Wellton Branch Cost Analysis Alt #3
19	Active Grade Crossing Equipment - New	EA	$352,000	-	Wellton Branch Cost Analysis Alt #3 (URS)
20	Passive Sign Upgrades (NOT RECOMMENDED)	EA	-	-	-
21	Passive Sign - New (NOT RECOMMENDED)	EA	-	-	-
22	Install Positive Train Control	MI	$400,000	excludes rolling stock	Wellton Branch Cost Analysis Alt #3

5.5 Right-of-Way Cross-Section

A typical ROW cross-section was developed based on typical UPRR sections.[8] The typical cross-section served as the basis for earthwork quantity estimates. A single-track typical ROW cross-section is depicted in **Figure 22.** A double-track/siding typical ROW cross-section is shown in **Figure 23.**

The following was assumed in ROW calculations:

- 100’ for ROW cost-estimating purposes.
- Easements may be required to accommodate cut/fill outside of the ROW.

[8] UPRR Roadbed Sections for Concrete Tie Construction, STD DWG 0002A, Revised March 1, 1998.

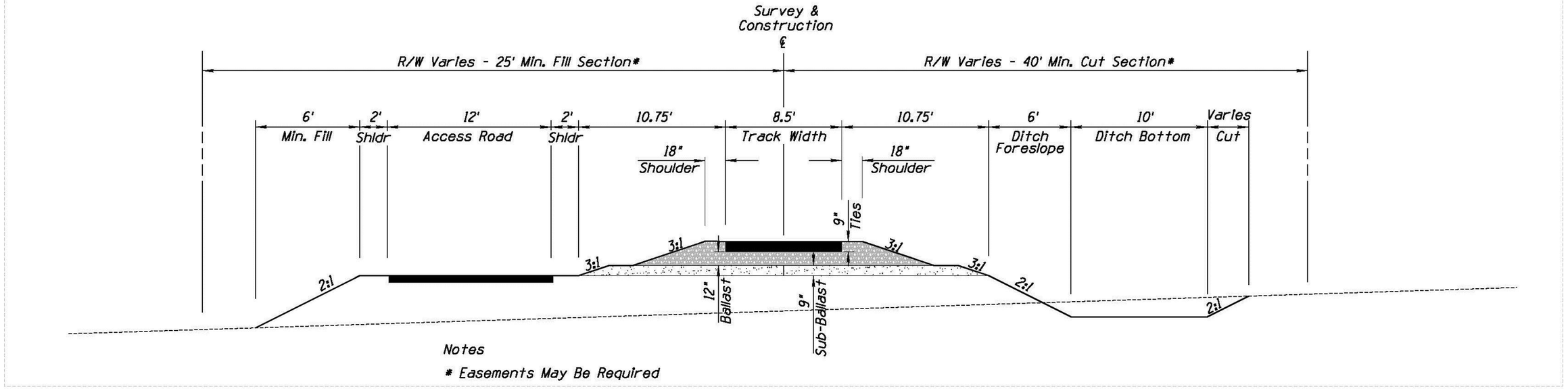


Figure 22. ROW Typical Cross-section (single-track) with Access Road

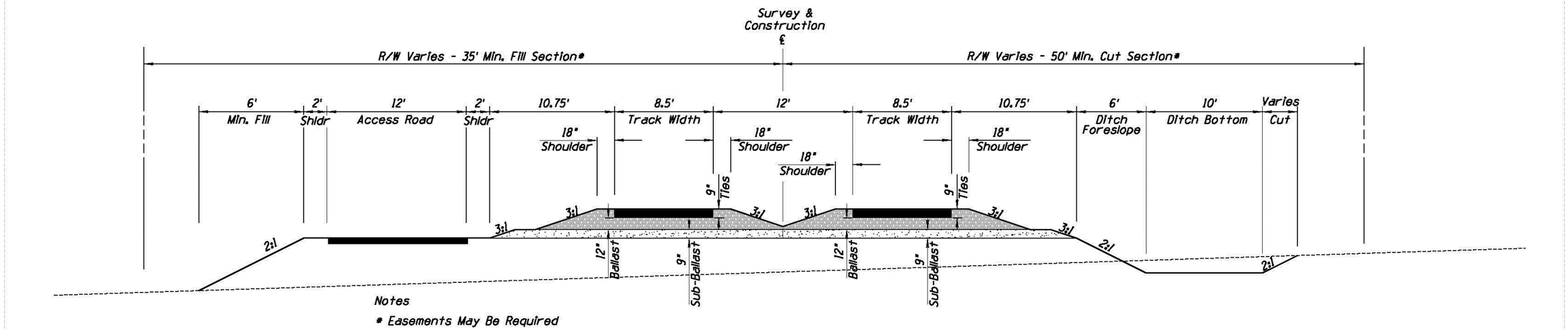


Figure 23. ROW Typical Cross-section (double-track/siding) with Access Road

6.0 Conceptual Alignment Alternatives and Cost Estimate

Conceptual alignment alternatives were developed within each corridor to minimize impacts to existing development features, and minimize earthwork (cut/fill/tunnel/bridge) required to achieve maximum grade criteria. This chapter describes in additional detail each of the segment alternatives.

A preliminary horizontal alignment and vertical profile are provided for each segment. The plan and profile of the conceptual alignment alternatives are provided in **Appendix B1, B2,** and **B3.** The purpose of the preliminary horizontal alignment and vertical profile are to provide a basis for quantities and cost-estimating.

Finally, a planning-level estimate of probable cost is included for each segment based on cost assumptions presented in Chapter 4.

6.1 General Assumptions

The following is a list of general assumptions that guided development of the planning-level horizontal alignment and vertical profile of the proposed railway.

- The sharpest curve that can be negotiated by a normal diesel locomotive (four-axle or six-axle) is not less than a 250' radius, or 23°. Curves throughout the alignment have been designed to a radius equal to or larger than 1000', or a 6° curve.
- The maximum profile grade in a main line freight track is not to exceed 1.5%.
- A 1.5-mile siding is assumed every four miles.

6.2 Segment No. 1: Morristown/Castle Hot Springs to UPRR

Alignment segment No. 1 consists of approximately 47.4 miles of proposed track, and begins at the existing UPRR track just west of 355th Avenue. From the existing track, the alignment heads to the northwest and then turns north approximately following 361st Street. The alignment turns northwest again to briefly follow W. Salome Highway to 371st Avenue where it then turns north again. At approximately Station 30761+00, the alignment turns northeast to avoid more mountainous terrain and remain on consistent grades. After crossing Aguila Road at approximately Station 31021+00, the alignment begins to roughly follow Aguila Road, to the northwest. Before reaching Vulture Mine Road, Segment 1 heads to the northeast following the east side of the road and passing to the west of the Toyota Proving Grounds facility. The alignment gradually turns east, crossing Cloud Road then skirting the north edge of Maricopa and Whispering Ranch before crossing the Hassayampa River, terminating at the existing BNSF railway Phoenix Subdivision in a 'Y' configuration with two turnouts on either side of Gates Road near Morristown/Castle Hot Springs. Throughout the alignment, a minimum track radius of 2,000' was used in certain locations. If higher speeds are required along the alignment, those radii may be able to be increased depending on vertical profile information. Segment No. 1 alignment is shown in **Appendix B1.**

6.2.1 Major features

Segment No. 1 consists of 47.4 miles of new track construction including a 'Y' tie-in to the existing BNSF railway Phoenix Subdivision near Morristown/Castle Hot Springs. The cost for the tie-in to the UPRR Wellton Line near Buckeye/Arlington is included in Segment No. 2A and Segment No. 2B.

This new railroad will include all associated special track work, sidings, railroad signaling, elevated structures across canals and washes, at-grade vehicular crossings at minor road intersections, and grade separated crossings at major highway crossings.

Segment No. 1 Existing Roadway Crossing Locations

The following (**Table 5)** are locations of existing roadways where active at-grade or grade separated crossings would be required.

Table 5. Segment No. 1 Existing Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
W. Elliot Road	approx. Sta. 30043+00	at-grade
Southern Avenue	approx. Sta. 30203+50	at-grade
W. Salome Highway	approx. Sta. 30247+50	underpass
W. Broadway Road	approx. Sta. 30265+50	at-grade
S. 363rd Avenue	approx. Sta. 30266+00	at-grade
S. 365th Street	approx. Sta.30282+00	at-grade
S. 366th Street/367th Street	approx. Sta. 30300+50	at-grade
W. Lower Buckeye Road	approx. Sta. 30344+50	at-grade
W. Watkins Street	approx. Sta. 30359+00	at-grade
W. Durango Street	approx. Sta. 30371+00	at-grade
W. Buckeye Road	approx. Sta. 30397+00	at-grade
W. Van Buren Street	approx. Sta. 30450+00	at-grade
I-10	approx. Sta. 30551+50	underpass
W. Osborn Road	approx. Sta. 30580+00	at-grade
W. Whitton Avenue	approx. Sta. 30587+00	at-grade
W. Amelia Avenue	approx. Sta. 30601+00	at-grade
Indian School Road	approx. Sta. 30608+50	at-grade
Aguila Road	approx. Sta. 31021+00	at-grade
Painted Wagon Trail	approx. Sta. 31801+00	at-grade
349th Avenue	approx. Sta. 31833+00	at-grade
Cloud Road	approx. Sta. 31884+00	at-grade
Match existing BNSF track	approx. Sta. 32500+10	Tie to Existing

Segment No. 1 Future Roadway Active or Grade Separated Grade Crossing Locations

The following (**Table 6**) are locations of future roadways where active at-grade, or grade separated crossings would be required. Future roadway network is derived from the *MAG Hassayampa Transportation Framework Study*.

Table 6. Segment No. 1 Future Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
Future Crossing	approx. Sta. 30027+00	at-grade
Future Crossing	approx. Sta. 30035+50	at-grade
Future Crossing	approx. Sta. 30206+00	at-grade
Future Crossing	approx. Sta. 30502+75	at-grade
Future Crossing	approx. Sta. 30543+00	grade separated
Future Crossing	approx. Sta. 30663+00	at-grade

Roadway	Station	Crossing Type
Future Crossing	approx. Sta. 30715+00	at-grade
Future Crossing	approx. Sta. 30754+50	at-grade
Future Crossing	approx. Sta. 30830+00	at-grade
Future Crossing	approx. Sta. 30858+00	at-grade
Future Crossing	approx. Sta. 30899+00	at-grade
Future Crossing	approx. Sta. 30989+50	at-grade
Future Crossing	approx. Sta. 31136+50	at-grade
Future Crossing	approx. Sta. 31289+00	at-grade
Future Crossing	approx. Sta. 31392+00	at-grade
Future Crossing	approx. Sta. 31520+50	at-grade
Future Crossing	approx. Sta. 31736+00	at-grade
Future Crossing	approx. Sta. 32221+00	at-grade
Future Crossing	approx. Sta. 32451+00	grade separated
Future Crossing	approx. Sta. 32499+50	grade separated

Segment No. 1 Bridge and Culvert Crossings Locations

Table 7 details where bridge and culvert crossings would be required. These locations were identified based on visual inspection of the vertical profile (**Appendix B1).** Long drainage crossings were assumed to require bridges; short drainage crossings were assumed to required culverts. **Appendix B1** identifies locations of potential bridges. In addition, major river crossings are identified as delineated by the 100-year flood plain.

Table 7. Segment No. 1 Water Crossings Locations with Future Railway

Crossing	Station	Crossing Type
Water Crossing	approx. Sta. 30151+00	Culvert
Water Crossing	approx. Sta. 30159+00	Culvert
Water Crossing	approx. Sta. 30170+00	Culvert
Water Crossing	approx. Sta. 30185+00	Culvert
Water Crossing	approx. Sta. 30193+00	Culvert
Water Crossing	approx. Sta. 30219+50	Culvert
Water Crossing	approx. Sta. 30974+50	Culvert
Water Crossing	approx. Sta. 31004+00	Culvert
Water Crossing	approx. Sta. 31067+00	Culvert
Water Crossing	approx. Sta. 31215+00	Bridge (600’)
Water Crossing	approx. Sta. 31245+00	Bridge (600’)
Water Crossing	approx. Sta. 31458+00	Culvert
Water Crossing	approx. Sta. 31494+00	Culvert
Water Crossing	approx. Sta. 31678+00	Culvert
Water Crossing	approx. Sta. 31847+50	Culvert
Water Crossing	approx. Sta. 31880+00	Culvert
Water Crossing	approx. Sta. 31904+50	Culvert
Water Crossing	approx. Sta. 31925+50	Culvert
Water Crossing	approx. Sta. 32039+50	Culvert
Water Crossing	approx. Sta. 32077+50	Culvert
Water Crossing	approx. Sta. 32120+00	Culvert
Water Crossing	approx. Sta. 32177+00	Bridge (500’)
Water Crossing	approx. Sta. 32192+00	Bridge (600’)

Crossing	Station	Crossing Type
Water Crossing	approx. Sta. 32204+00	Culvert
Water Crossing	approx. Sta. 32224+50	Culvert
Water Crossing	approx. Sta. 32254+00	Culvert
Water Crossing	approx. Sta. 32262+00	Culvert
Water Crossing	approx. Sta. 32300+00	Bridge (500')
Water Crossing	approx. Sta. 32305+50	Bridge (300')
Water Crossing	approx. Sta. 32311+50	Culvert
Water Crossing	approx. Sta. 32324+00	Culvert
Water Crossing	approx. Sta. 32331+00	Culvert
Water Crossing	approx. Sta. 32346+00	Bridge (2300')
Water Crossing	approx. Sta. 32380+00	Bridge (3600')
Water Crossing	approx. Sta. 32401+00	Culvert
Water Crossing	approx. Sta. 32404+00	Culvert
Water Crossing	approx. Sta. 32406+50	Culvert
Water Crossing	approx. Sta. 32412+50	Culvert

6.2.2 Segment No. 1 Major Constraints

Major constraints associated with Segment No. 1 include:

Land Use/Development

- Between Elliot Road and I-10 there is scattered low-density residential development generally along 355th Avenue and nearby parallel roadways.
- Arlington Elementary School is located at 9347 South 355th Avenue, on the west side of 355th Avenue, south of Dobbins Road.
- Ellsworth Park is located South of Ellwood Street and east of 355th Avenue.
- Winters Well Elementary School is located on W. Buckeye Road at 350th Avenue.
- As the alignment crosses Wickenburg Road, the major constraint is the CAP canal.
- Toyota Proving Grounds is located in a large area east of 355th Avenue and south of Dove Valley Road.

Topography

- At Mile 43, there is an approximately 200' outcrop of the Vulture Mountains. Options include a slope cut or a tunnel. Cost estimates assume a nearly 2,600' long tunnel. This represents a conservative assumption for cost-estimating purposes.

Environmental Constraints

- Segment No. 1 crosses wildlife habitat blocks, wildlife linkages (White Tank-Belmont-Hieroglyphic Mountains and White Tanks Wildlife Wash Corridors), Waters of the U.S., and habitat suitable for protected species (burrowing owl, Sonoran desert tortoise, Tucson shovel-nosed snake, etc.). These resources will be avoided to the extent practicable and impacts will be evaluated during the planning and design phases of the project.
- The Hassayampa River will need to be crossed with a new bridge west of Gates Road-Morristown/Castle Hot Springs Junction near Mile 45. The Hassayampa is an intermittent river, the headwaters of which are just south of Prescott, Arizona, and flows mostly south towards Wickenburg entering the Gila River near Arlington. Although the river has only subsurface flow for much of the year, it has significant perennial

flows above ground within the Hassayampa River Canyon Wilderness and the Nature Conservancy's Hassayampa River Preserve, near Wickenburg.[9] Streamside habitat is home to wildlife dependent on the river for riparian habitat.

Other

- Segment No. 1 crosses land managed by the Bureau of Land Management. Coordination will be required to minimize impacts to planned recreational uses.

6.2.3 Planning-Level Estimate of Probable Cost

A planning-level estimate of probable cost for Corridor Segment No. 1 is presented in **Table 8.** A total cost in 2013 dollars and 2033 dollars is provided. 2033 Total Corridor Cost assumed a 2.1% annual inflation rate based on Engineering News Record (ENR) 20-city average construction inflation rates.[10]

[9] http://gosw.about.com/od/bestsightstosee/a/hassayampa.htm

[10] http://enr.construction.com/economics/

Table 8. Segment No. 1 Estimate of Probable Cost

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
Corridor Improvements					**$523,053,713**	**$104,610,743**	**$630,000,000**
1	Main Track - New (On New ROW)	47.35	miles	$2,500,000.00	$118,376,179	$23,675,236	$142,051,415
2	Main Track - Upgrades	0.32	miles	$1,600,000.00	$518,182	$103,636	$621,818
3	Second Main Track	0.00	miles	$2,500,000.00	$0	$0	$0
4	Sidings	17.76	miles	$2,500,000.00	$44,391,067	$8,878,213	$53,269,281
5	Turnouts/Switches New #20 TO	28.00	each	$188,000.00	$5,264,000	$1,052,800	$6,316,800
6	Diamond Crossing New	0.00	each	$300,000.00	$0	$0	$0
7	Bridges Steel Ballast Deck	9,000.00	linear feet	$8,000.00	$72,000,000	$14,400,000	$86,400,000
8	Culverts, Concrete pipes 36"	6,000.00	linear feet	$250.00	$1,500,000	$300,000	$1,800,000
9	Canals (Railroad Steel Ballast Deck Bridge)	0.00	each	$8,000.00	$0	$0	$0
10	Signalization System (signals and Communication)	47.35	miles	$1,600,000.00	$75,760,755	$15,152,151	$90,912,905
11	Utilities (Allowance 5% of Construction cost)	1.00	lump sum	$37,500,000.00	$37,500,000	$7,500,000	$45,000,000
12	Earthwork	4,487,176.53	cubic yards	$20.00	$89,743,531	$17,948,706	$107,692,237
13	Tunnel Boring	2,600.00	linear feet	$30,000.00	$78,000,000	$15,600,000	$93,600,000
Crossing Improvements					**$168,628,189**	**$33,725,638**	**$210,000,000**
14	At-Grade Crossing	19.00	each	$500,000.00	$9,500,000	$1,900,000	$11,400,000
15	At-Grade Crossing - Future	17.00	each	$500,000.00	$8,500,000	$1,700,000	$10,200,000
16	Grade Separated Crossings (Roadway Bridge Overpass)	2.00	each	$25,000,000.00	$50,000,000	$10,000,000	$60,000,000
17	Grade Separated Crossings - Future Planned Roadways	3.00	each	$25,000,000.00	$75,000,000	$15,000,000	$90,000,000
18	Active Grade Crossing Equipment Upgrades	0.00	each	$352,000.00	$0	$0	$0

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
19	Active Grade Crossing Equipment - New	19.00	each	$352,000.00	$6,688,000	$1,337,600	$8,025,600
20	Passive Sign Upgrades	0.00	each	-	-	-	-
21	Passive Sign - New	0.00	each	-	-	-	-
22	Install Positive Train Control	47.35	miles	$400,000.00	$18,940,189	$3,788,038	$22,728,226
Total Construction Costs					**$691,681,902**	**$138,336,380**	**$840,000,000**
ROW					**$2,950,894**	**$2,950,894**	**$6,000,000**
44	Needed ROW	590.18	ACRE	$5,000.00	$2,950,894	$2,950,894	$5,901,788
Maintenance of Way							
46	Maintenance of Way (Per Year)	47.35	MI/YEAR	$10,000	$470,000 / YEAR	-	$470,000/YEAR
Engineering and Planning							**$350,000,000**
51	Preliminary Engineering	-	-	4% of Construction	-	-	$27,667,276
52	Final Design	-	-	7% of Construction	-	-	$48,417,733
53	Project Management for Design and Construction	-	-	2% of Construction	-	-	$13,833,638
54	Construction Admin. and Management	-	-	8% of Construction	-	-	$55,334,552
55	Insurance	-	-	4% of Construction	-	-	$27,667,276
56	Legal; Permits; Review Fees by Other Agencies	-	-	2% of Construction	-	-	$13,833,638
57	Surveys, Testing, Investigation, Inspection	-	-	2% of Construction	-		$13,833,638
58	Agency Force Account Work	-	-	6% of Construction	-	-	$41,500,914
59	Contingency	-	-	15% of Construction	-	-	$103,752,285
10% Contingency							**$119,600,000**
Segment No. 1 Hassayampa Valley Corridor Total Cost							**$1,315,600,000**

6.3 Segment No. 2A: UPRR to Gila Bend along Old Highway 80

Segment No. 2A consists of 30.5 miles of proposed track, and begins just south east of the Gila Bend Municipal Airport along the existing UPRR track that parallels SR 238. From the proposed turnout, the alignment turns north crossing SR 238 and winding around the east side of the airport before crossing SR 85. Segment No. 2A then crosses over Old Highway 80 and runs parallel to the roadway along the west side. Old Highway 80 is located in more varied terrain than SR 85 to the east, and tends to follow the contours. The strategy in laying out the alignment for Segment No. 2A was to follow a similar path to the roadway, except where grades, water crossings, and significant structures or properties did not allow. At approximately station 21122+00, the alignment turns south of the existing historic bridge over the Gila River, and then deviates west away from the roadway slightly to avoid steeper terrain. At this stage in planning, 2,000' radii were used just before and after the river crossing to keep the alignment as unobtrusive to surrounding terrain as possible. If higher speeds are required and the vertical profile through that section allows, those radii may be increased. Toward the north end of the alignment where Old Highway 80 turns east towards Arlington, the proposed Segment No. 2A continues north to an at-grade diamond crossing of the existing UPRR Wellton Line which separates Segment No. 1 from Segment No. 2A. Segment No. 2A terminates at the existing track with a series of turnouts allowing trains to move in any direction.

6.3.1 Segment No. 2A Major features

Segment No. 2A consists of 30.5 miles of new track construction including tie-ins to the existing UPRR Gila Mainline near Gila Bend and the existing UPRR Wellton Line at the northern end. The cost for this segment includes all turnouts and the diamond crossing at the connection to the Union Pacific Wellton Line and Segment No. 1. This new railroad will include all associated special track work, sidings, railroad signaling, elevated structures across canals and washes, at-grade vehicular crossings at minor road intersections, and grade separated crossings at major highway crossings.

Existing Roadway Crossing Locations

Table 9 details locations of existing roadways where active at-grade or grade separated crossings would be required.

Table 9. Segment No. 2A Existing Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
SR 238	approx. Sta. 20014+75	at-grade
SR 85	approx. Sta. 20155+00	underpass
Old highway 80	approx. Sta. 20191+50	at-grade
S Old US 80	approx. Sta. 20288+00	at-grade
W Fornes Road	approx. Sta. 20349+00	at-grade
W Pierpoint Road	approx. Sta. 20508+00	at-grade
W Patterson Road	approx. Sta. 20884+50	at-grade
Enterprise Road	approx. Sta. 21146+50	at-grade
Agua Caliente Road	approx. Sta. 21315+75	at-grade
Narramore Road	approx. Sta. 21597+50	at-grade
Match existing UPRR track	approx. Sta. 21609+79.14	-

Future Roadway Active or Grade Separated Grade Crossing Locations

Table 10 details locations of future roadways where active at-grade or grade separated crossings would be required. Future roadway network is derived from the *MAG Hassayampa Transportation Framework Study*.

Table 10. Segment No. 2A Future Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
Future crossing	approx. Sta. 20041+00	at-grade
Future crossing	approx. Sta. 20150+50	grade separated
Future crossing	approx. Sta. 20173+25	at-grade
Future crossing	approx. Sta. 20355+75	at-grade
Future crossing	approx. Sta. 20512+50	at-grade
Future crossing	approx. Sta. 20614+00	at-grade
Future crossing	approx. Sta. 21132+75	grade separated
Future crossing	approx. Sta. 21471+50	at-grade
Future crossing	approx. Sta. 21597+50	grade separated (x2)

Bridge and Culvert Crossings Locations

Table 11 identifies locations where bridge and culvert crossings would be required. These locations were identified based on visual inspection of the vertical profile (**Appendix B2**). **Appendix B2** identifies locations of potential bridges. In addition, major river crossings are identified as delineated by the 100-year floodplain.

Table 11. Segment No. 2A Water Crossings Locations with Future Railway

Crossing	Station	Crossing Type
Water Crossing	approx. Sta. 20013+00	Culvert
Water Crossing	approx. Sta. 20043+00	Culvert
Water Crossing	approx. Sta. 20063+00	Culvert
Water Crossing	approx. Sta. 20121+00	Culvert
Water Crossing	approx. Sta. 20251+00	Culvert
Water Crossing	approx. Sta. 20288+00	Culvert
Water Crossing	approx. Sta. 20310+00	Culvert
Water Crossing	approx. Sta. 20350+00	Culvert
Water Crossing	approx. Sta. 20362+50	Culvert
Water Crossing	approx. Sta. 20521+50	Culvert
Water Crossing	approx. Sta. 20645+00	Culvert
Water Crossing	approx. Sta. 20673+00	Culvert
Water Crossing	approx. Sta. 20887+00	Culvert
Water Crossing	approx. Sta. 21075+00	Culvert
Water Crossing	approx. Sta. 21113+00 to 21168+00	Bridge (5500’)
Water Crossing	approx. Sta. 21184+50	Culvert
Water Crossing	approx. Sta. 21224+00	Bridge (700’)
Water Crossing	approx. Sta. 21246+00 to 21288+00	Bridge (4200’)
Water Crossing	approx. Sta. 21309+00	Culvert
Water Crossing	approx. Sta. 21403+00	Culvert
Water Crossing	approx. Sta. 21448+50	Culvert

6.3.2 Major constraints

Following is a summary of major constraints associated with each corridor.

Land Use/Development

- In general, there is extensive agricultural development primarily west of Old Highway 80, from south of Gila Mountain Road to Patterson Road.
- Near the UPRR/Butterfield Trail/SR 85 area there are mixed uses, including industrial (warehouses), retail, and medium-density residential in the area of influence.
- Gila Bend Municipal Airport is located in the area of influence for this alternative.
- South of Gila Mountain Road and west of SR 85 is property designated as "other employment." There are also some low-density residential properties in this area.
- South of Woods Road, Lakeside Airpark is located on the east side of Old Highway 80.
- There is some scattered low-density residential development north of the Lakeside Airpark, on both sides of Old Highway 80. There are approximately five locations north between the Airpark and Patterson Road.
- Spring Mountain Ski Ranch is categorized as a developing residential area and is a gated lake community located south of SR 80.
- At the north end of this corridor there some retail development at the intersection of Desert Rose Road and Old Highway 80. There is also agricultural land uses on the east side of Old Highway 80, between Komatke Road and Arlington Canal Road.
- Between Arlington Canal Road and Carver Road, there is low-density residential development on the east side of the proposed alignment.

Topography

- A lengthy bridge is required at Mile 22 to cross the Gila River.
- Significant fill is required over Mile 24 and Mile 25.
- There is significant topography (rock outcroppings/hills) west of the Gila River that will require cuts.

Environmental

- Segment No. 2A crosses wildlife habitat blocks, wildlife linkages (Gila Bend-Sierra Estrella and White Tanks Wildlife Wash Corridors), Waters of the U.S. (Gila River, etc.), and habitat suitable for protected species (burrowing owl, Sonoran desert tortoise, Tucson shovel-nosed snake, birds associated with the riparian habitat along the Gila River, etc.). These resources will be avoided to the extent practicable and impacts will be evaluated during the planning and design phases of the project.
- There are archeological constraints within the corridor area near the crossing with the Gila River.

6.3.3 Planning-Level Estimate of Probable Cost

A planning-level estimate of probable cost for Corridor Segment No. 2A is presented in **Table 12.** A total cost in 2013 dollars and 2033 dollars is provided. 2033 Total Corridor Cost assumed a 2.1% annual inflation rate based on ENR 20-city average construction inflation rates.

Table 12. Segment No. 2A Estimate of Probable Cost

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
Corridor Improvements					**$289,874,350**	**$57,974,870**	**$350,000,000**
1	Main Track - New (On New ROW)	30.49	miles	$2,500,000.00	$76,221,184	$15,244,237	$91,465,420
2	Main Track - Upgrades	0.00	miles	$1,600,000.00	$0	$0	$0
3	Second Main Track	0.00	miles	$2,500,000.00	$0	$0	$0
4	Sidings	11.43	miles	$2,500,000.00	$28,582,944	$5,716,589	$34,299,533
5	Turnouts/Switches New #20 TO	24.00	each	$188,000.00	$4,512,000	$902,400	$5,414,400
6	Diamond Crossing New	1.00	each	$300,000.00	$300,000	$60,000	$360,000
7	Bridges Steel Ballast Deck	10,400.00	linear feet	$8,000.00	$83,200,000	$16,640,000	$99,840,000
8	Culverts, Concrete pipes 36"	3,600.00	linear feet	$250.00	$900,000	$180,000	$1,080,000
9	Canals (Railroad Steel Ballast Deck Bridge)	0.00	each	$8,000.00	$0	$0	$0
10	Signalization System (signals and Communication)	30.49	miles	$1,600,000.00	$48,781,558	$9,756,312	$58,537,869
11	Utilities (Allowance 5% of Construction cost)	1.00	lump sum	$17,500,000.00	$17,500,000	$3,500,000	$21,000,000
12	Earthwork	1,493,833.24	cubic yards	$20.00	$29,876,665	$5,975,333	$35,851,998
13	Tunnel	0.00	linear feet	$30,000.00	$0	$0	$0
Crossing Improvements					**$147,863,389**	**$29,572,678**	**$180,000,000**
13	At-Grade Crossing	9.00	EA	$500,000.00	$4,500,000	$900,000	$5,400,000
14	At-Grade Crossing - Future	6.00	EA	$500,000.00	$3,000,000	$600,000	$3,600,000
15	Grade Separated Crossings (Roadway Bridge Overpass)	1.00	EA	$25,000,000.00	$25,000,000	$5,000,000	$30,000,000
16	Grade Separated Crossings - Future Planned Roadways	4.00	EA	$25,000,000.00	$100,000,000	$20,000,000	$120,000,000
17	Active Grade Crossing Equipment Upgrades	0.00	EA	$352,000.00	$0	$0	$0
18	Active Grade Crossing Equipment - New	9.00	EA	$352,000.00	$3,168,000	$633,600	$3,801,600

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
19	Passive Sign Upgrades (NOT RECOMMENDED)	0.00	EA	-	-	-	-
20	Passive Sign - New (NOT RECOMMENDED)	0.00	EA	-	-	-	-
21	Install Positive Train Control	30.49	MI	$400,000.00	$12,195,389	$2,439,078	$14,634,467
Total Construction Costs					**$437,737,739**	**$87,547,548**	**$530,000,000**
Right-of-Way					**$1,880,159**	**$1,880,159**	**$4,000,000**
44	Needed ROW	376.03	ACRE	$5,000.00	$1,880,159	$1,880,158.51	$3,760,317
Maintenance of Way							
46	Maintenance of Way (Per Year)	30.49	MI/YEAR	$10,000	$300,000 / YEAR	-	$304,900 / YEAR
Engineering and Planning							**$220,000,000**
51	Preliminary Engineering	-	-	4% of Construction	-	-	$16,121,510
52	Final Design	-	-	7% of Construction	-	-	$28,212,642
53	Project Management for Design and Construction	-	-	2% of Construction	-	-	$8,060,755
54	Construction Administration and Management	-	-	8% of Construction	-	-	$32,243,019
55	Insurance	-	-	4% of Construction	-	-	$16,121,510
56	Legal; Permits; Review Fees by Other Agencies	-	-	2% of Construction	-	-	$8,060,755
57	Surveys, Testing, Investigation, Inspection	-	-	2% of Construction	-	-	$8,060,755
58	Agency Force Account Work	-	-	6% of Construction	-	-	$24,182,264
59	Contingency	-	-	15% of Construction	-	-	$60,455,661
10% Contingency							**$75,400,000**
Segment 2A - Hidden Waters – Gila Bend Corridor Total Cost							**$829,400,000**

6.4 Segment No. 2B: UPRR to Gila Bend along Existing UPRR and SR 85

Segment No. 2B consists of approximately 30.1 miles of new rail line, and utilization of 11.7 miles of the existing east-west UPRR Wellton Line between approximately 355th Avenue and SR 85. The total length of Segment No. 2B is 41.8 miles. Before reaching SR 85, the alignment turns south and runs parallel to southbound SR 85 along the west side of the roadway. Segment No. 2B heads almost due south, crossing the Gila River before crossing under SR 85 at approximately station 11316+00. At this point in the planning stage, 1,500' radii were used along the track alignment before and after crossing SR 85. If higher speeds are required through this section, those radii can be increased to accommodate higher speed. For the majority of Segment No. 2B, an existing small dirt road on the east side of SR 85 is utilized, and it is assumed that following this road with the track alignment would result in lower earthwork costs and fewer roadway crossing locations. At the southern terminus of Segment No. 2B, the track turns west to connect to a turnout preliminarily located on a secondary run of existing UPRR track just east of the SR 84/SR 85 interchange in Gila Bend.

6.4.1 Major features

Segment No. 2B consists of 30.1 miles of new track construction including tie-ins to the existing UPRR Wellton Line at the northern end and the UPRR Gila Mainline near Gila Bend. Segment No. 2B also consists of 11.7 miles of upgraded existing track along the UPRR Wellton Line between Buckeye and the connection to Segment No. 1. The costs for this segment include the connection between the UPRR Wellton Line and Segment No. 1. This new railroad will include all associated special track work, sidings, railroad signaling, elevated structures across canals and washes, at-grade vehicular crossings at minor road intersections, and grade separated crossings at major highway crossings. The upgraded track will include all associated special track work and crossing upgrades.

Existing Roadway Crossing Locations

Table 13 details locations of existing roadways where active at-grade or grade separated crossings would be required.

Table 13. Segment No. 2B Existing Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
SR 238	approx. Sta. 10014+75	at-grade
Development access road	approx. Sta. 10358+00)	at-grade
S. Woods Road	approx. Sta. 10680+00	at-grade
Development access road	approx. Sta. 10758+00	at-grade
W Patterson Road	approx. Sta. 10933+00	at-grade
Komatke Road	approx. Sta. 11029+75	at-grade
Rainbow Wash	approx. Sta. 11080+00	at-grade
Buckeye Hills Drive	approx. Sta. 11208+50	at-grade
Northbound SR 85	approx. Sta. 11313+00	underpass
Southbound SR 85	approx. Sta. 11318+50	underpass
W. Robbins Butte Game Road	approx. Sta. 11368+25	at-grade
W. Old Hwy 80	approx. Sta. 11477+25	at-grade
W. Hazen Road	approx. Sta. 11501+25	at-grade
MC 85	approx. Sta. 11555+50	at-grade
Match existing UPRR track	approx. Sta. 11587+30.80	-
S. Turner Road	approx. Sta. 11612+25	upgrade

Roadway	Station	Crossing Type
S. Wilson Avenue	approx. Sta. 11665+25	upgrade
S. Palo Verde Road	approx. Sta. 11719+00	upgrade
S. Johnson Road	approx. Sta. 11826+25	upgrade
W. Salome Highway	approx. Sta. 11922+75	upgrade

Future Roadway Active or Grade Separated Grade Crossing Locations

Table 14 identifies locations of future roadways where active at-grade or grade separated crossings would be required. The future roadway network is derived from the *MAG Hassayampa Transportation Framework Study*.

Table 14. Segment No. 2B Future Roadways Crossing Locations with Future Railway

Roadway	Station	Crossing Type
Future crossing	approx. Sta. 10041+00	at-grade
Future crossing	approx. Sta. 10620+25	at-grade
Future crossing	approx. Sta. 10737+00	at-grade
Future crossing	approx. Sta. 10890+75	at-grade
Future crossing	approx. Sta. 10996+50	at-grade
Future crossing	approx. Sta. 11054+50	grade separated
Future crossing	approx. Sta. 11472+75	at-grade
Future crossing	approx. Sta. 11494+25	at-grade
Future crossing	approx. Sta. 11551+00	at-grade
Future crossing	approx. Sta. 11772+00	at-grade (Bruner Rd)
Future crossing	approx. Sta. 11992+25	at-grade
Future crossing	approx. Sta. 12070+00	grade separated
Future crossing	approx. Sta. 12096+75	grade separated
Future crossing	approx. Sta. 12177+50	grade separated

Bridge and Culvert Crossings Locations

Table 15 details locations where bridge and culvert crossings would be required. These locations were identified based on visual inspection of the vertical profile (**Appendix B3**). **Appendix B3** identifies locations of potential bridges. In addition, major river crossings are identified as delineated by the 100-year flood plain.

Table 15. Segment No. 2B Water Crossings Locations with Future Railway

Crossing	Station	Crossing Type
Water Crossing	approx. Sta. 10014+00	Culvert
Water Crossing	approx. Sta. 10161+50	Culvert
Water Crossing	approx. Sta. 10171+00	Culvert
Water Crossing	approx. Sta. 10417+00	Culvert
Water Crossing	approx. Sta. 10434+50	Culvert
Water Crossing	approx. Sta. 10486+00	Culvert
Water Crossing	approx. Sta. 10493+50	Culvert
Water Crossing	approx. Sta. 10529+00	Culvert
Water Crossing	approx. Sta. 10562+00	Culvert
Water Crossing	approx. Sta. 10568+00	Culvert
Water Crossing	approx. Sta. 10573+00 to 10583+00	Bridge (1000’)

Crossing	Station	Crossing Type
Water Crossing	approx. Sta. 10822+00	Culvert
Water Crossing	approx. Sta. 10895+00	Culvert
Water Crossing	approx. Sta. 10899+50 to 10904+50	Bridge (500')
Water Crossing	approx. Sta. 10911+00 to 10919+00	Bridge (800')
Water Crossing	approx. Sta. 10930+00	Culvert
Water Crossing	approx. Sta. 11113+00	Culvert
Water Crossing	approx. Sta. 11121+00	Culvert
Water Crossing	approx. Sta. 11337+00	Culvert
Water Crossing	approx. Sta. 11406+00 to 11447+00	Bridge (4100')
Water Crossing	approx. Sta. 11466+00	Culvert
Water Crossing	approx. Sta. 11478+00	Culvert
Water Crossing	approx. Sta. 11846+00	Culvert
Water Crossing	approx. Sta. 11889+00 to 11906+50	Bridge (1750')
Water Crossing	approx. Sta. 11910+00	Culvert
Water Crossing	approx. Sta. 12036+00	Culvert
Water Crossing	approx. Sta. 12065+00	Culvert
Water Crossing	approx. Sta. 12074+00 to 12103+00	Bridge (2900')
Water Crossing	approx. Sta. 12126+00 to 12161+00	Bridge (3500')

6.4.2 Major constraints

Land Use/Development

- Near the UPRR/Butterfield Trail/SR 85 area there are mixed uses, including industrial (warehouses), retail, and medium-density residential in the area of influence.
- Gila Bend Municipal Airport is located in the area of influence for this alternative.
- South of Gila Mountain Road and west of SR 85 is property designated as "other employment." There are also some low-density residential properties in this area.
- South of Woods Road, there is Lakeside Airpark and some agricultural uses west of SR 85 and immediately east of Old Highway 80.
- Property classified as retail-low density approximately 1.5 miles south of Patterson Road interchange (138) on SR 85, east of SR 85.
- Arizona State Prison Complex- Lewis – 26700 Highway 85 (on both sides of SR 85, north of Patterson Road.
- Arizona Cycle Park, located immediately west of Lewis Prison.
- Planned area categorized as "other employment" at southeast corner of SR 85/ Komatke Road
- Buckeye Hills Regional Park is located west of SR 85. The General Joe Foss Shooting Complex is also in this area.
- There are other employment areas south of Gila River and east of SR 85.

Topography

- Mile 17 includes a significant hillside cut.
- Mile 19 (near Patterson Road) includes significant grade and topography.
- Mile 21 includes a crossing of the Gila River.

Environmental

- Segment No. 2B crosses wildlife habitat blocks, wildlife linkages (Gila Bend-Sierra Estrella and White Tanks Wildlife Wash Corridors), waters of the U.S. (Gila River, etc.), and habitat suitable for protected species (burrowing owl, Sonoran desert tortoise, Tucson shovel-nosed snake, birds associated with the riparian habitat along the Gila River, etc.). These resources will be avoided to the extent practicable and impacts will be evaluated during the planning and design phases of the project.

Other

- Coordination with ROW along SR 85 will be required. SR 85 is planned to be improved to two lanes in each direction.

6.4.3 Planning-Level Estimate of Probable Cost

A planning-level estimate of probable cost for Corridor Segment No. 2B is presented in **Table 16.** A total cost in 2013 dollars and 2033 dollars is provided. 2033 Total Corridor Cost assumed a 2.1% annual inflation rate based on ENR 20-city average construction inflation rates.

Table 16. Segment No. 2B Estimate of Probable Cost

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
Corridor Improvements					**$347,233,104**	**$69,446,621**	**$420,000,000**
1	Main Track - New (On New ROW)	30.06	miles	$2,500,000.00	$75,156,629	$15,031,326	$90,187,955
2	Main Track - Upgrades	11.68	miles	$1,600,000.00	$18,684,200	$3,736,840	$22,421,040
3	Second Main Track	0.00	miles	$2,500,000.00	$0	$0	$0
4	Sidings	11.27	miles	$2,500,000.00	$28,183,736	$5,636,747	$33,820,483
5	Turnouts/Switches New #20 TO	25.00	each	$188,000.00	$4,700,000	$940,000	$5,640,000
6	Diamond Crossing New	0.00	each	$300,000.00	$0	$0	$0
7	Bridges Steel Ballast Deck	14,550.00	linear feet	$8,000.00	$116,400,000	$23,280,000	$139,680,000
8	Culverts, Concrete pipes 36"	4,400.00	linear feet	$250.00	$1,100,000	$220,000	$1,320,000
9	Canals (Railroad Steel Ballast Deck Bridge)	0.00	each	$8,000.00	$0	$0	$0
10	Signalization System (signals and Communication)	30.06	miles	$1,600,000.00	$48,100,242	$9,620,048	$57,720,291
11	Utilities (Allowance 5% of Construction cost)	1.00	lump sum	$20,000,000.00	$20,000,000	$4,000,000	$24,000,000
12	Earthwork	1,745,414.85	cubic yards	$20.00	$34,908,297	$6,981,659	$41,889,956
13	Tunnel	0.00	linear feet	$30,000.00	$0	$0	$0
Crossing Improvements					**$183,180,111**	**$36,636,022**	**$220,000,000**
14	At-Grade Crossing	12.00	each	$500,000.00	$6,000,000	$1,200,000	$7,200,000
15	At-Grade Crossing - Future	9.00	each	$500,000.00	$4,500,000	$900,000	$5,400,000
16	Grade Separated Crossings (Roadway Bridge Overpass)	2.00	each	$25,000,000.00	$50,000,000	$10,000,000	$60,000,000
17	Grade Separated Crossings - Future Planned Roadways	4.00	each	$25,000,000.00	$100,000,000	$20,000,000	$120,000,000
18	Active Grade Crossing Equipment Upgrades	5.00	each	$352,000.00	$1,760,000	$352,000	$2,112,000

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost	Allocated Contingency	Final Cost
19	Active Grade Crossing Equipment - New	12.00	each	$352,000.00	$4,224,000	$844,800	$5,068,800
20	Passive Sign Upgrades (NOT RECOMMENDED)	0.00	each	-	-	-	-
21	Passive Sign - New (NOT RECOMMENDED)	0.00	each	-	-	-	-
22	Install Positive Train Control	41.74	miles	$400,000.00	$16,696,111	$3,339,222	$20,035,333
Total Construction Costs					**$530,413,215**	**$106,082,643**	**$640,000,000**
Right-of-Way					**$1,822,417**	**$1,822,417**	**$4,000,000**
44	Needed ROW	364.48	ACRE	$5,000.00	$1,822,417	$1,822,417	$3,644,833
Maintenance of Way							
46	Maintenance of Way (Per Year)	30.06	MI/YEAR	$10,000	$300,000/YEAR	$0	$306,000/YEAR
Engineering and Planning							**$270,000,000**
51	Preliminary Engineering	-	-	4% of Construction	-	-	$21,216,529
52	Final Design	-	-	7% of Construction	-	-	$37,128,925
53	Project Management for Design and Construction	-	-	2% of Construction	-	-	$10,608,264
54	Construction Administration and Management	-	-	8% of Construction	-	-	$42,433,057
55	Insurance	-	-	4% of Construction	-	-	$21,216,529
56	Legal; Permits; Review Fees by Other Agencies	-	-	2% of Construction	-	-	$10,608,264
57	Surveys, Testing, Investigation, Inspection	-	-	2% of Construction	-	-	$10,608,264
58	Agency Force Account Work	-	-	6% of Construction	-	-	$31,824,793
59	Contingency	-	-	15% of Construction	-	-	$79,561,982
10% Contingency							**$91,400,000**
Segment 2B - Hidden Waters –Gila Bend Corridor Total Cost							**$1,005,400,000**

6.5 Cost Summary

Costs for each individual segment alternative (Segment 1, Segment 2A, and Segment 2B) were presented in previous sections. **Table 17** summarizes the estimate of probable cost for each corridor alternative. **Table 17** also includes a summary of costs per mile for each segment alternative.

Table 17. Summary of Segment Alternatives Estimate of Probable Cost

Corridor	Corridor Improvements	Crossing Improvements	Right of Way	Maintenance of Way (per year)	Engineering and Planning Costs	10% Contingency	Corridor Total Cost (2013$)	Corridor Total Cost (2033$)
Segment No. 1 - Hassayampa	$630,000,000	$210,000,000	$6,000,000	$470,000	$350,000,000	$119,600,000	$1,315,600,000	$1,993,604,000
Segment No. 2A - Hidden Water-Gila Bend via Old Highway 80	$350,000,000	$180,000,000	$4,000,000	$300,000	$220,000,000	$75,400,000	$829,400,000	$1,256,837,000
Segment No. 2B - Hidden Water-Gila Bend via SR 85	$420,000,000	$220,000,000	$4,000,000	$300,000	$270,000,000	$91,400,000	$1,005,400,000	$1,523,540,000
Planning-Level Estimate of Probable Cost						Segments 1 and 2A	**$2,145,000,000**	**$3,250,441,000**
						Segments 1 and 2B	**$2,321,000,000**	**$3,517,144,000**

Corridor	Total Length	Total Cost / Mile (2013 $)	Total Cost / Mile (2033 $)
Segment No. 1 - Hassayampa	47.35	$27,785,000	$42,104,000
Segment No. 2A - Hidden Water-Gila Bend via Old Highway 80	30.49	$27,204,000	$41,224,000
Segment No. 2B - Hidden Water-Gila Bend via SR 85	41.74 (30.1 miles of new track)	$24,088,000	$36,501,000