

6 Recommended Alternative

Disclaimer

Locations of improvements in this report are conceptual in nature and subject to additional study, review and approval by the Arizona Department of Transportation, Federal Highway Administration and appropriate municipal jurisdiction. Final project alignments and rights-of-way will be determined following completion of appropriate planning, environmental and design studies. While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

The Spine study has concluded that an expanded managed lane system, combined with numerous localized improvements along the Spine corridor, is the recommended alternative. Generally, this means that the current managed lanes (HOV lanes) would be expanded with a second HOV lane in segments where HOV lanes currently exist, new HOV lanes would be added where none exist today, and DHOV ramps would be added to connect and terminate this expanded system. Operational flexibility regarding how these managed lanes could be used to address the uncertainty of future needs is a key advantage of this recommendation. Localized improvements target deficient interchanges, weaving sections, bicycle and pedestrian crossings, traffic interchange upgrades and sections with missing arterial redundancy. Recommended alternative features are discussed in Section 6.2. The final recommendation was presented to the MAG committees listed in Table 6-1 and was adopted into the MAG 2040 RTP, contingent on a new finding of conformity, on May 24, 2017.

As a reminder, Section 2.2 of this document discusses projects and elements of work included in the No-Build Alternative for this study. This included elements of work categorized as near-term improvements; however, as the Spine study progressed, the near-term improvement projects were cancelled and many of the work elements included in the near-term improvements on the Spine corridor, specifically on I-10, were added to the recommended alternative described in this chapter.

6.1 Purpose and Need Overview

The Spine study's purpose and need was defined in detail in Chapter 11 of the NAR, completed as part of this study in June 2015. To recap, the purpose of the study is to identify and budget for a project, or a series of projects, that would address the Spine corridor's transportation needs. The need for the project is as follows:

- I-10 and I-17 are at capacity during rush hour and are unable to handle future traffic levels.
- I-10 and I-17 experience lengthy periods of congestion. The lengths of congestion, both in time and distance, are projected to worsen over time.
- Travel times on the two freeways will worsen as the average travel speeds decrease.
- Projected growth will continue to put stress on the two freeways.
- Degradation of the two freeways will adversely affect the operations of HOV and transit modes such as freeway BRT, express buses and local bus routes.
- Aging infrastructure of the two freeways could limit economic growth opportunities in the region.
- Timely and efficient delivery of freight is vital to the region's economic health.
- Poor operations on I-10 and I-17 adversely affect local streets, especially at intersections.

Table 6-1. Spine Recommendation Presentations to MAG Committees

Date	MAG Meeting	Action
March 30, 2017	Transportation Review Committee	For information only
April 12, 2017	Management Committee	For information only
April 19, 2017	Transportation Policy Committee	For information only
April 26, 2017	Regional Council	For information only
April 27, 2017	Transportation Review Committee	Recommended accepting the final recommendation for the I-10/I-17 Corridor Master Plan for I-10 between the Pecos Stack and the Split and for I-17 between the Split and the North Stack for inclusion in the MAG 2040 RTP, contingent on a new finding of conformity.
May 10, 2017	Management Committee	Recommended accepting the final recommendation for the I-10/I-17 Corridor Master Plan for I-10 between the Pecos Stack and the Split and for I-17 between the Split and the North Stack for inclusion in the MAG 2040 RTP, contingent on a new finding of conformity.
May 17, 2017	Transportation Policy Committee	Recommended accepting the final recommendation for the I-10/I-17 Corridor Master Plan for I-10 between the Pecos Stack and the Split and for I-17 between the Split and the North Stack for inclusion in the MAG 2040 RTP, contingent on a new finding of conformity.
May 24, 2017	Regional Council	Accept the final recommendation for the I-10/I-17 Corridor Master Plan for I-10 between the Pecos Stack and the Split and for I-17 between the Split and the North Stack for inclusion in the MAG 2040 RTP, contingent on a new finding of conformity.

6.2 Features of the Recommended Alternative, by Segment

This section describes the minimum features of the recommended alternative and the justification for why they have been included. These features address the biggest problems, issues or shortcomings within the corridor and may not be comprehensive. Additional engineering and environmental study, combined with public and stakeholder input, may determine that other issues should or need to be addressed as well. However, the general scope and intent of the recommendation should be satisfied, avoiding major scope additions, especially related to the main line widening. All designs presented in this discussion are conceptual in nature, and are still subject to further engineering study through the project development process.

Common to all segments of the corridor, the recommended alternative includes using dual-lane exit ramps (one exit-only lane and one optional exit lane) wherever feasible to improve the operations and safety of all weaving sections. In addition, on I-17 where the frontage road system exists, the addition of Texas-style U-turns (described in Section 5.4.2 and Figure 5-15 of this document) should be considered during the next level of project development in areas where U-turn movements are particularly heavy and where the Texas-style U-turns can feasibly fit into the existing system.

6.2.1 Interstate 10: State Route 202L/Pecos Stack to U.S. Route 60

This segment of I-10 (SR-202L/Pecos Stack to US-60) can be generally described as having three general purpose lanes, one HOV lane and auxiliary lanes in each direction with a diamond interchange nearly every mile. This segment includes some of the newest construction elements throughout the Spine corridor. As a result, no major infrastructure deficiencies were identified, but some operational issues were identified and addressed with the recommendation. The layout for this segment of I-10 can be found in Figures 6-1 to 6-3 following this segment description.

- **I-10 Main Line Improvements**

One additional general purpose lane would be added to I-10 in each direction in this segment between Baseline and Ray roads. All lane and shoulder widths would be constructed to the current ADOT standards for urban freeway construction. Because of the existing DHOV connector at the I-10/US-60 traffic interchange, HOV demand and congestion noticeably drop on I-10 south of US-60. After the opening of the SR-202L South Mountain Freeway, traffic modeling indicates that the addition of one general purpose lane in each direction in this segment would best meet the travel demand with minimal or acceptable levels of congestion in 2040 in both the general purpose and HOV lanes. These improvements would enhance safety, reduce congestion and improve travel time reliability.

Between Elliot and Baseline roads, the recommendation is to extend the existing C-D roads north of Baseline Road south to the Elliot Road traffic interchange, eliminating the current auxiliary lane between Baseline and Elliot roads and using that width for the C-D road. This specific recommendation is included for two reasons. First, after studying the availability of parallel arterial routes for route redundancy and incident management detouring for the NAR, the study team realized that this 2-mile segment of the Spine corridor uniquely lacked adequate redundancy in the arterial system. East of I-10, Priest Drive/Avenida del Yaqui is the downtown main street of Guadalupe characterized by low speed limits, stop signs and numerous crosswalks. To the west, 48th Street/South Point Parkway is a private road that is a meandering, low-volume residential street with traffic calming elements to deter pass-through traffic. After consultations with the local agencies, it was apparent that neither of these two streets would ever be upgraded to convey large traffic volumes. Because the C-D road would be a barrier-separated facility from the I-10 main line, extending the C-D road south would provide that alternative route to the I-10 main line in the event of an incident, while at the same time providing added capacity to the main line to help minimize pass-through traffic on these two adjacent local roads. This concept was strongly supported by attendees at the public meetings, particularly those from Guadalupe.

The second reason to extend the C-D roads south is to help the traffic operations of the Baseline Road traffic interchange. By virtue of geography, the Baseline Road traffic interchange is a critical service interchange in the Spine corridor because it represents the first interchange users can use to detour off I-10 coming from the south to get to South Phoenix around the eastern point of South Mountain Park. Even after the SR-202L South Mountain Freeway opens in 2019, Baseline Road and its traffic interchange with I-10 will remain significant as a regional connection. As a result, the north-to-west and east-to-south movements at this interchange are very prominent because of the location of this interchange in the transportation system. The north-to-west movement creates backups on the I-10 westbound exit ramp to Baseline Road (sometimes extending back onto the main line). In addition, the ramp meter queuing on the I-10 eastbound entrance ramp will back up daily onto Baseline Road—one of the contributing root causes of the gridlock within that interchange. The C-D roads would help both situations. The off-ramp queuing would only back up onto the C-D road and would not affect the I-10 main line operations (which is exactly

what a C-D road should do). In addition, the Baseline Road eastbound entrance ramp meter could potentially be eliminated because it would only merge to a C-D road and not the I-10 main line, be timed to allow greater flow, or be designed to turn off when queuing approaches the crossroad to flush the backup.

It is recognized that the addition of the C-D road between Baseline and Elliot roads would create some drainage challenges along I-10. The C-D roads would cover the current roadside ditches/channels that convey the freeway stormwater to the south. While no specific drainage solution is proposed with this study, costs have been added to the cost opinion to address this issue, recognizing that costly underground storage/conveyance and/or ROW acquisition for conveyance/detention may be needed. Further study is required on this issue.

- **Interchange Modifications**

Comparing the 37 interchanges and grade separations in the Spine corridor limits, the crossings in this segment of I-10 generally scored very well, meaning traffic operations, safety and infrastructure condition performed well when compared with other crossings in the corridor. In fact, out of the 37 crossings, Chandler Boulevard, Ray Road, Warner Road, Elliot Road and Guadalupe Road ranked at 34, 29, 33, 22 and 37, respectively, in priority. Because of these rankings, no specific traffic capacity or safety improvements are proposed at Chandler Boulevard, Ray Road or Elliot Road. However, safety and capacity issues were identified at the Warner Road traffic interchange as part of the *Tempe Transportation Master Plan* (November 2015), so a project would be identified and studied to define the specific needs at this location.

It should be noted that although this Spine study does not propose improvements at the other traffic interchanges, it should not be implied that nothing should be done. Relatively low-cost interchange improvements or reconfigurations that largely stay within the existing ROW, such as additional turning/through lanes or new high-capacity geometrics, may still be warranted and could be further investigated if the need becomes apparent in the future.

The Baseline Road traffic interchange is the exception in this segment. The need to improve this location was prioritized second out of all the 37 corridor crossings. As previously noted in the I-10 main line improvement section, Baseline Road is a significant service interchange that serves regional traffic movements. It is also a regional destination because of the retail activity in the area, most notably the Arizona Mills shopping mall. The combination of these factors creates major congestion issues on Baseline Road every day of the week. There are various reasons why this interchange is congested. As previously noted, entrance ramp queuing backing up onto Baseline Road is one factor. Another major factor is that five signalized intersections are currently within 1,700 feet of either side of the current interchange. This equates to seven signals in 3,200 feet. Because of the current development, not much can be done to alleviate this issue, except possibly at Wendler Drive. Wendler Drive currently tees into Baseline Road from the north approximately 300 feet west of the eastbound ramp terminal. This intersection's proximity to the traffic interchange significantly disrupts the traffic interchange signal operations. Closing Wendler Drive is not possible because it is the sole access to several businesses north of Baseline Road.

The Spine study recommendation for the Baseline Road traffic interchange was developed with practicality in mind given the setting, and to also recognize the regional importance of the interchange. Some ROW and business impacts would occur with this improvement. Given the regional significance of this traffic interchange, the study team determined the impacts were appropriate trade-offs for the benefits gained. The Baseline Road traffic interchange recommendation is made up of four parts:

- Extend the C-D roads on I-10 to Elliot Road to address the south side ramp issues previously discussed.
- Realign Wendler Drive and consolidate its intersection with the Arizona Grand Parkway intersection. This eliminates one intersection and improves signal spacing and progression along Baseline Road. This realignment would affect a major retail operation at Wendler Drive and Baseline Road.
- Convert the Baseline Road traffic interchange into a DDI to improve capacity and safety of the significant left turning volumes in the interchange, while preserving the existing I-10 bridges crossing over Baseline Road. The study team considered other interchange geometrics at this location and found the DDI responded well to the travel patterns and provided the best fit for the available ROW.
- Extend the ADOT access control along Baseline Road at least 350 feet from the current ramp terminal intersections.

- **Arterial Improvements**

With the exception of the Baseline Road traffic interchange improvements previously noted, no other local arterial modifications are proposed in this segment.

- **Transit Improvements**

At I-10 and Galveston Street (the mid-mile location between Ray Road and Chandler Boulevard), the Spine study recommendation proposes to add a DHOV half interchange in the median of I-10, with ramps to and from the north. This DHOV interchange is envisioned to connect Galveston Road from 50th Street on the west to 54th Street on the east and would connect planned park-and-ride facilities on both sides of the freeway: one for Phoenix on the west side and one for Chandler on the east side. It is anticipated that this new DHOV traffic interchange would be heavily used by local buses and express buses for commuters.

- **Bicycle and Pedestrian Improvements**

Several bicycle and pedestrian improvements are proposed in this segment, all designed to improve or provide nonmotorized access across I-10. These locations are as follows:

- **Chandler Boulevard traffic interchange:** Upgrade this traffic interchange to extend the bicycle lanes on Chandler Boulevard from 54th Street west across the freeway. This could be done with either dedicated grade separations or improvements at grade through the interchange. More study is needed to coordinate with the stakeholders (i.e., ADOT, Phoenix and Chandler) to determine the appropriate solution.
- **Knox Road Alignment:** Add a new dedicated bicycle and pedestrian crossing over I-10 at this mid-mile location between Warner and Ray roads. This new crossing would connect Mountain Vista Park on the west with the Highline Canal trail system east of I-10. The City of Tempe's *Transportation Master Plan* (November 2015) indicated this recommendation as part of its system of bicycle trails and paths.

- **Warner Road traffic interchange:** Upgrade this traffic interchange to improve bicycle and pedestrian facilities to safely cross the freeway, consistent with the *Tempe Transportation Master Plan* (November 2015). More study is needed to determine the appropriate solution to accomplish this and should be integrated in the traffic improvement made to this interchange previously noted in the traffic interchange discussions.
- **Guadalupe Road grade separation:** Add a new dedicated bicycle and pedestrian crossing over I-10 at this grade separation to improve access from the town of Guadalupe to South Mountain Park. Because this is an existing roadway grade separation, more study is required to determine whether this new crossing should be north or south of the existing bridge. Should a crossing south of the existing bridge be chosen, an I-10 median pier is already in place to accommodate this crossing. Based on many comments from the public meeting held in Guadalupe, there is tremendous interest in getting this crossing built, but there are conflicting interests about which side of the road it should be placed. This crossing has been planned for several years and has been part of several previous studies. In addition to the bicycle and pedestrian crossing, a historical flooding issue exists in the southeastern corner of I-10 and Guadalupe Road. In partnership with the Town of Guadalupe, a lined drainage channel is planned to be built in this quadrant to address the flooding and will likely be built with the planned bicycle and pedestrian crossing improvements at this location.
- **Highline Canal trail crossing:** Add a new dedicated bicycle and pedestrian crossing over I-10 at the Highline Canal crossing, approximately 400 feet south of Baseline Road. This new bridge would connect existing and planned trails along the Highline Canal on both the Phoenix (west) side of the freeway and the Guadalupe (east) side of the freeway. This crossing, in conjunction with the Western Canal crossing, would ideally remove bicycle and pedestrian traffic from the Baseline Road interchange, further improving operations and safety. The City of Tempe's *Transportation Master Plan* (November 2015) indicated this recommendation as part of its system of bicycle trails and paths.
- **Western Canal trail crossing:** Add a new dedicated bicycle and pedestrian crossing over I-10 at the Western Canal crossing, located approximately 3,400 feet north of Baseline Road. This new bridge would connect existing trails along the Western Canal on both the Phoenix (west) side of the freeway and the Tempe (east) side of the freeway. This crossing, in conjunction with the crossing at the Highline Canal, would ideally remove bicycle and pedestrian traffic from the Baseline Road interchange, further improving operations and safety. Finally, this crossing would directly link residential neighborhoods with the Arizona Mills shopping mall. The City of Tempe's *Transportation Master Plan* (November 2015) indicated this recommendation as part of its system of bicycle trails and paths.

Figure 6-1. Recommended Alternative, Sheet 1 of 26 (I-10 Segment: SR-202L/Pecos Stack to US-60)

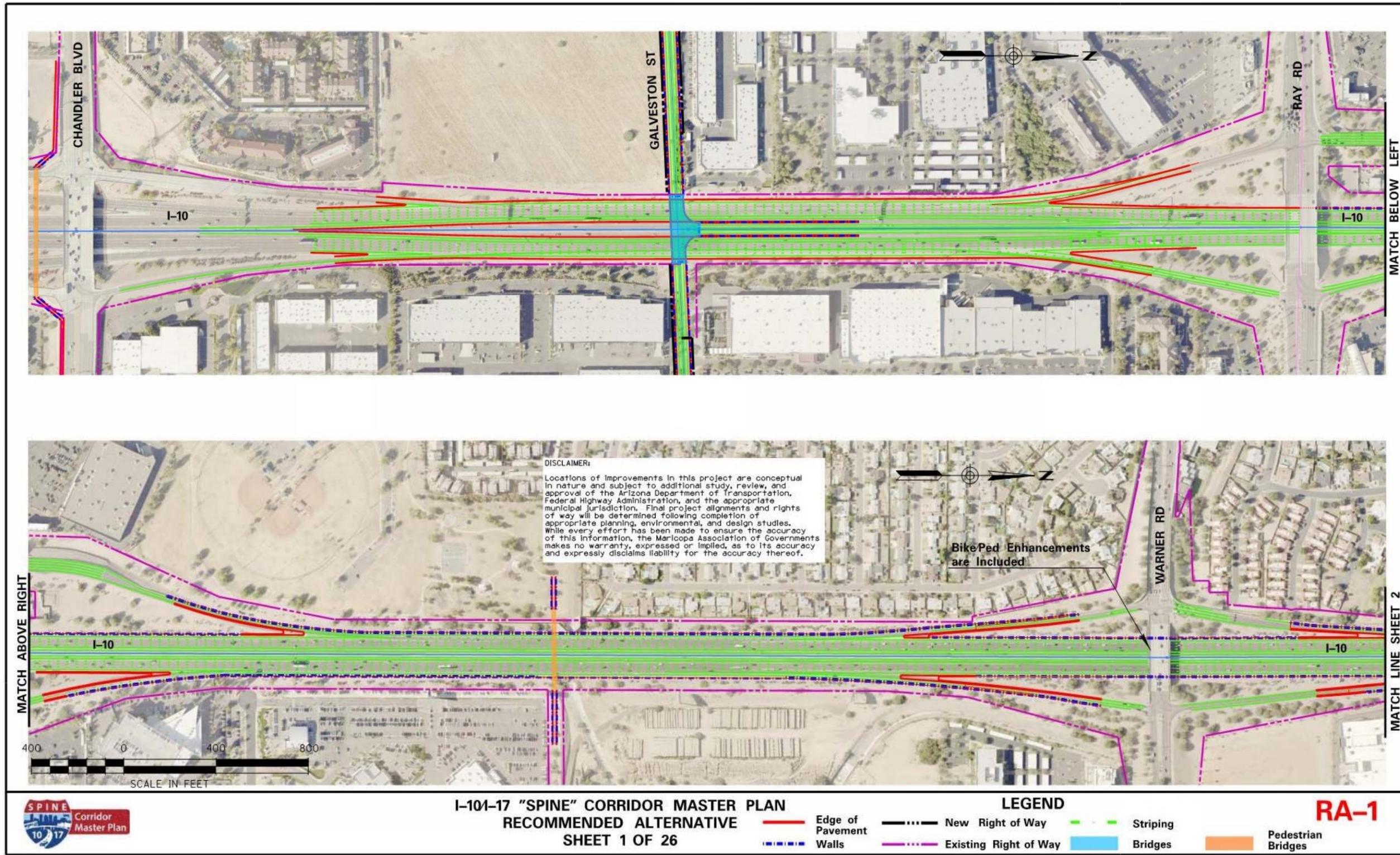


Figure 6-2. Recommended Alternative, Sheet 2 of 26 (I-10 Segment: SR-202L/Pecos Stack to US-60)

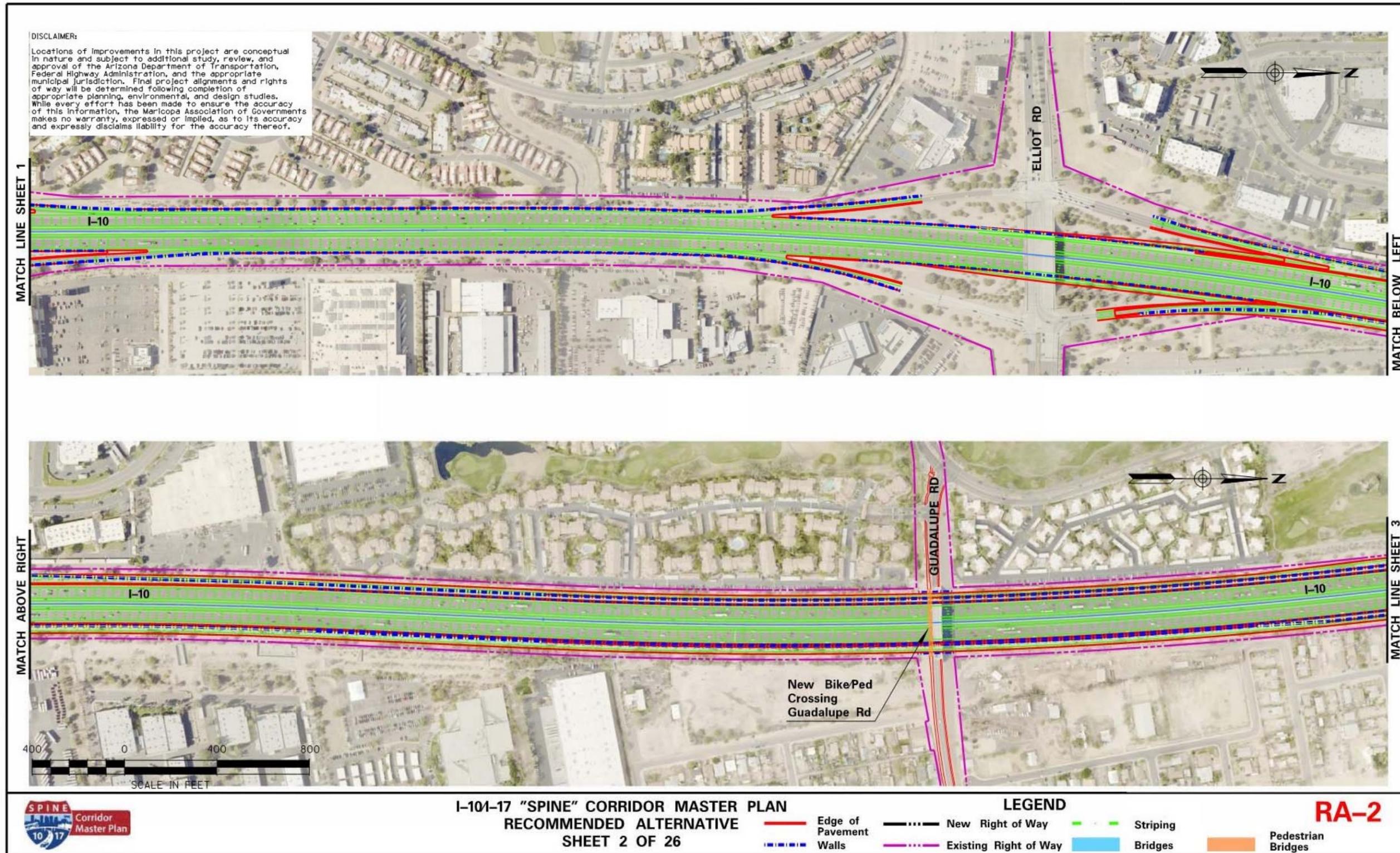
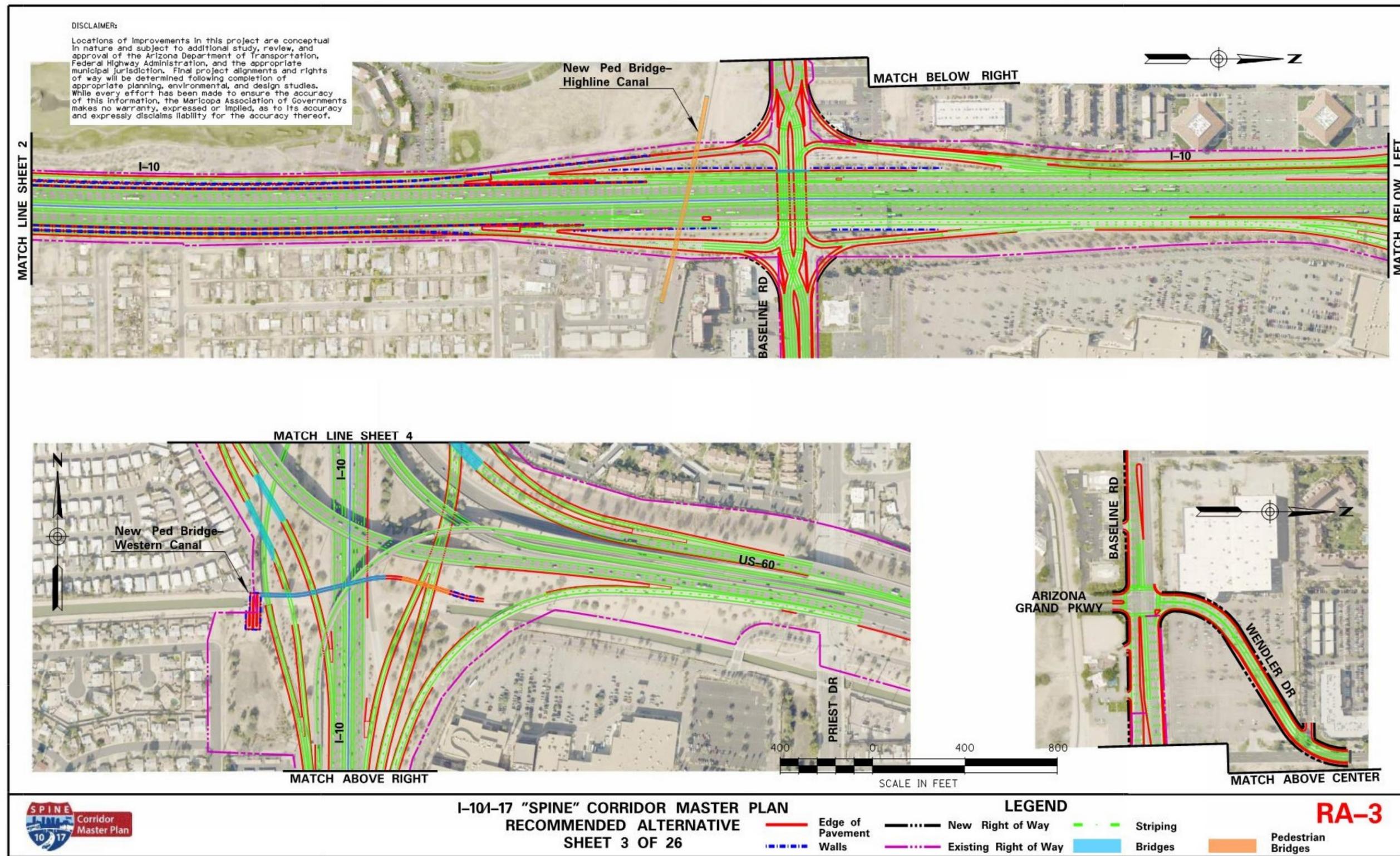


Figure 6-3. Recommended Alternative, Sheet 3 of 26 (I-10 Segment: SR-202L/Pecos Stack to US-60)



6.2.2 Interstate 10: U.S. Route 60 to State Route 143

This segment of I-10 (US-60 to SR-143) is bracketed on both ends by existing system traffic interchanges, one for US-60 and one for SR-143. In the westbound direction, the freeway includes six general purpose lanes and one HOV lane with reduced shoulders, while the eastbound direction includes five general purpose lanes and one HOV lane. The Broadway Road traffic interchange is integrated within the SR-143 traffic interchange.

This segment is recognized as a known capacity constraint in the Spine corridor because of the substantial weaving movements between US-60 and SR-143. Infrastructure condition is acceptable in this segment, although the 48th Street and Broadway Road bridges over I-10 are over 50 years old and limit the widening of I-10. The layout for this segment of I-10 can be found in Figures 6-4 to 6-5 following this segment description.

- **I-10 Main Line Improvements**

The main line improvements would add C-D roads in the westbound and eastbound directions to address the weave section between US-60 and SR-143, commonly known as the “Broadway Curve” segment of I-10 in the metro Phoenix area. Six general purpose lanes on the main line and between two and three general purpose lanes (depending on location) are required on the C-D roads to address capacity. In addition, one additional managed lane (HOV) would be added in each direction to create dual HOV lanes. The dual HOV lanes would extend farther west into the next segment, but the second dual HOV lane would begin/end at the US-60 traffic interchange DHOV ramp. All lane and shoulder widths would be constructed to the current ADOT standards for urban freeway construction to the extent practical. These improvements would enhance safety, reduce congestion and improve travel time reliability.

- **Interchange Modifications**

I-10/US-60 traffic interchange: No major improvements are proposed at the US-60 traffic interchange, except that the C-D roads would be integrated into the interchange so that connectivity to both I-10 and US-60 is maintained. The design would be consistent with the I-10 Near Term Improvements project underway during this Spine study and previous studies by ADOT for the Broadway Curve.

I-10/Broadway Road traffic interchange: The Broadway Road traffic interchange has several issues that are being addressed with this recommendation, as discussed in the following items. In addition, all improvements to the Broadway Road traffic interchange must be designed to be geometrically and operationally compatible with the SR-143 traffic interchange reconstruction, because of its proximity.

- The Broadway Road bridge over I-10 is among the oldest in the corridor. I-10 has been widened to its maximum width under this bridge, but is insufficient for the proposed widening of I-10 as part of the Spine study recommendation. As a result, the interchange reconstruction must replace this bridge.
- Broadway Road is the most continuous alternative parallel arterial route for I-10 and I-17 between 48th Street and 19th Avenue. For this route to be a suitable alternate route for these freeways during times of congestion or incidents, it is desirable to reconstruct the Broadway Road traffic interchange to give high priority to the east-to-south and north-to-west movements. Free flow movements are preferred.
- The eastbound entrance ramp is very short and, during the evening peak hour, queues back onto Broadway Road, mostly from the heavy traffic coming from the west. Because of this, the west-to-south traffic movement from Broadway Road to the freeway is frequently unable to turn left onto this ramp, creating additional congestion problems. To promote the east-to-south movement previously noted, it is desirable to discontinue merging the west-to-south movement with the east-to-south movement. A

loop ramp would accomplish this with low cost. To further enhance the Broadway Road operations, the eastbound exit ramp to Broadway Road (through the 48th Street intersection) would also be eliminated because it disrupts both the 48th Street flow and the Broadway Road operations. Because most of this traffic turns left (east onto Broadway), this movement would now occur at the 48th Street intersection with Broadway Road where left turns already exist, so as not to disrupt the Broadway Road traffic interchange itself. However, if this volume cannot be accommodated at the 48th Street/Broadway Road intersection without degrading operations to an unacceptable level, then a direct free-flow grade-separated ramp to connect eastbound I-10 with eastbound Broadway Road is recommended to avoid reintroducing signal systems on 48th Street and Broadway Road. Note that this design option is not shown in Figure 6-5.

- The northbound exit ramp frequently queues backs onto the I-10 main line. To address this, the recommendation makes the north-to-west movement a free flow movement. The north-to-east right turn movement and the through movement to 52nd Street would be the only two movements that use the ramp terminal signal, which should substantially reduce the queuing length for that exit ramp.

I-10/SR-143 traffic interchange: Like the Broadway Road traffic interchange, the SR-143 traffic interchange requires a complete reconstruction to address several factors:

- The 48th Street/SR-143 bridges over I-10 were built at the same time as the Broadway Road bridges over I-10 and have the same span constraints. As a result, as part of the traffic interchange reconstruction and main line expansion, these bridges must be replaced.
- The two major movements at this interchange are the south-to-east and west-to-north movements. The west-to-north movement is handled with a free flow two-lane ramp and rarely experiences congestion. Therefore, the proposed configuration should perpetuate this free flow two-lane ramp. In contrast, the south-to-east movement is handled with a single-lane, small-radius loop ramp that experiences heavy congestion daily, with queues extending north on SR-143 back to the Sky Harbor Boulevard interchange. The SR-143 traffic interchange reconstruction recommends developing a new free-flow two-lane ramp to handle this volume.
- Because this is an end-of-freeway interchange for SR-143, and because 48th Street extends south of the interchange, it is recommended to make the 48th Street southbound movement a right-hand exit off of SR-143 for driver expectancy.
- For driver expectancy, the DHOV ramp to I-10 coming from southbound SR-143 (discussed on the next page) should exit from the left-hand lane of SR-143.
- Weave sections exist in both directions between I-10 and University Drive along SR-143. The northbound weave rarely experiences congestion issues and may not require an upgrade, but further analysis is required to determine whether this is still true with future volumes. In contrast, the southbound weave is heavily congested on a daily basis. The south-to-east loop ramp queuing is partially to blame for this condition, but the heavy weaving movements approaching this end-of-freeway condition likely warrant a weave solution. Braiding the I-10 and University Drive ramps, coupled with slip ramps to perpetuate all existing movements, is the most likely solution, but other solutions may be equally acceptable if they accomplish the same desired outcome. Because of the tight ROW along SR-143, new ROW would likely be needed to improve these weave sections.
- The other two system ramp movements (south-to-west and east-to-north) are comparatively small compared with the heavy west-to-north and south-to-east movements. As a result, these two lower-

volume ramps should be given a lower capacity priority in the redesign. Because the east-to-north movement is a left turning ramp, a loop ramp is a proper design response for this movement, but a flyover style ramp could be used if it is determined to be a better solution.

- The I-10/SR-143 traffic interchange does not currently include a DHOV ramp. This is mostly because there are no HOV lanes on SR-143, nor are there plans to add them in the near future. As previously noted, the I-10 main line section between US-60 and SR-143 is a major weaving section between these two system connections. While the C-D roads would address the general purpose weaving, the weaving attributed to the HOV traffic on I-10 accessing SR-143 is an equally challenging problem that must be addressed. This is particularly true because a large volume of vehicles going between I-10 (and US-60) and Phoenix Sky Harbor International Airport via SR-143 is more than likely able to use the HOV lanes. Even though no HOV lanes exist on SR-143, the purpose of the DHOV ramp is to avoid HOV weaving on I-10 to realize the full system capacity of I-10. To accommodate this DHOV, the I-10 main line must be flared within the Broadway Curve to make this connection. The vertical geometry of this DHOV would be a challenge because it would need to pass under the Broadway Road bridges, and then rise to cross over the westbound I-10 lanes prior to 48th Street. To accomplish this geometric challenge, the Spine study recommendation proposes to depress the northbound 48th Street roadway under I-10 so that the DHOV connection would only have to rise one level over I-10. Additional study should be performed, however, to identify alternative solutions that may work better or be more cost effective. Elevating northbound 48th Street over I-10 may also be viable if the DHOV connection can still be accommodated geometrically.
- Because ample ROW exists within the interchange, the Spine study recommendation's traffic interchange configuration uses much of this ROW to keep the overall interchange height equal to what exists today. This should minimize visual and noise impacts, especially for residential areas in the southwestern quadrant. This has the added benefit of keeping the overall traffic interchange costs as low as possible. Note that some of the ROW within the interchange is not the current operational ROW for the freeway, but rather is used for ADOT-owned facilities. Costs would be associated with relocating ADOT's Construction and Maintenance offices and the Enforcement Compliance Division's Inspection offices.

- **Arterial Improvements**

No arterial improvements are proposed within this segment, except as noted as part of the Broadway Road traffic interchange and SR-143/48th Street traffic interchange reconstructions.

- **Transit Improvements**

No transit-specific improvements are proposed within this segment beyond adding the second HOV lane on I-10 and adding the DHOV at SR-143. The combination of these two elements should improve the HOV lane operations, safety and travel time reliability for those bus routes that currently use the I-10 corridor.

- **Bicycle and Pedestrian Improvements**

One new bicycle and pedestrian crossing is proposed in this segment at the Alameda Drive mid-mile crossing (between Southern Avenue and Broadway Road). This crossing would link to areas of Tempe, and would link Tempe Diablo stadium to land uses on the eastern side of I-10. This crossing is consistent with the *Tempe Transportation Master Plan* (November 2015).

Because the Spine study recommendation proposes to reconstruct the Broadway Road traffic interchange, it would also be upgraded with bicycle and pedestrian infrastructure presently pursued by ADOT in its construction projects.

Figure 6-4. Recommended Alternative, Sheet 4 of 26 (I-10 Segment: US-60 to SR-143)

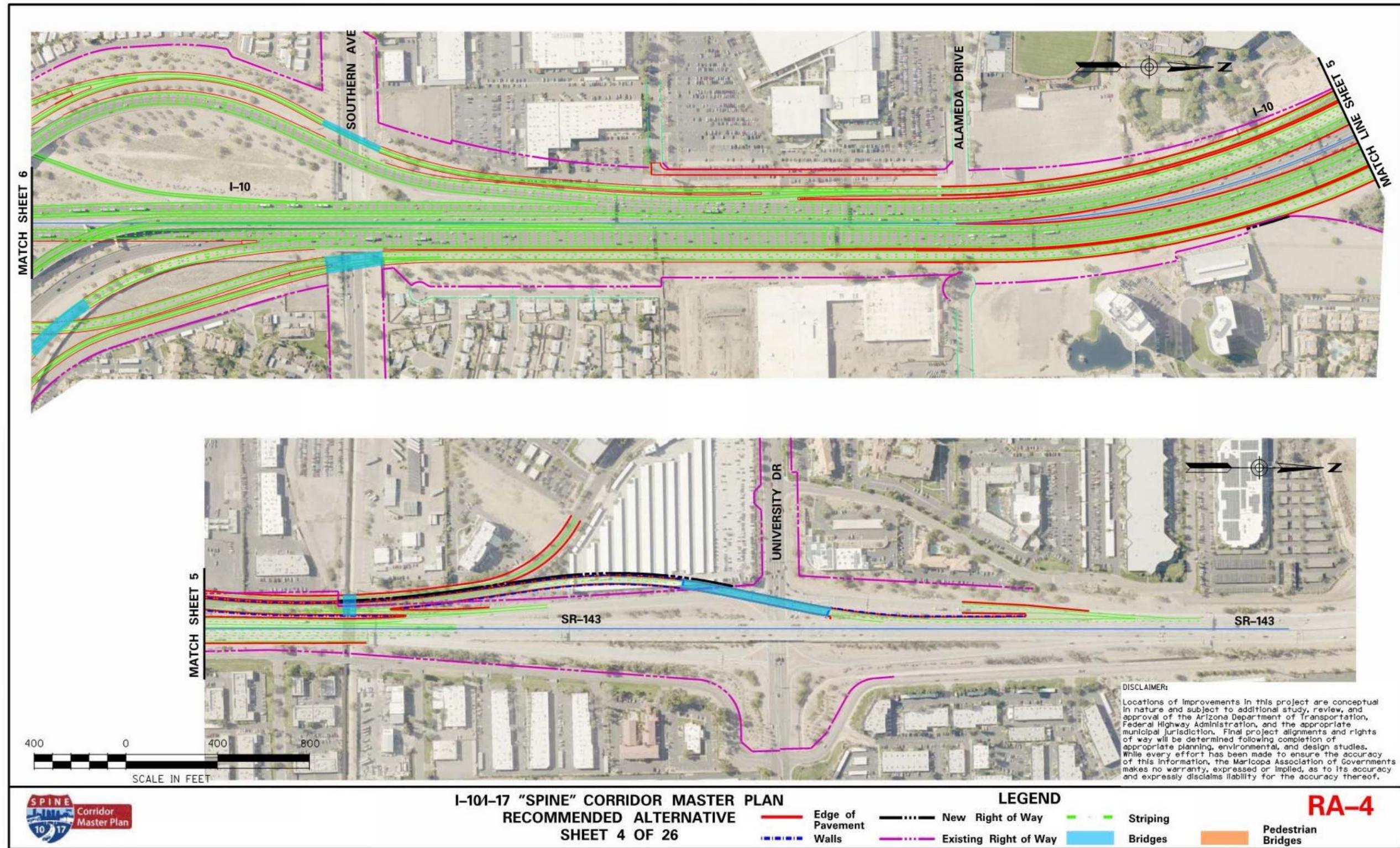
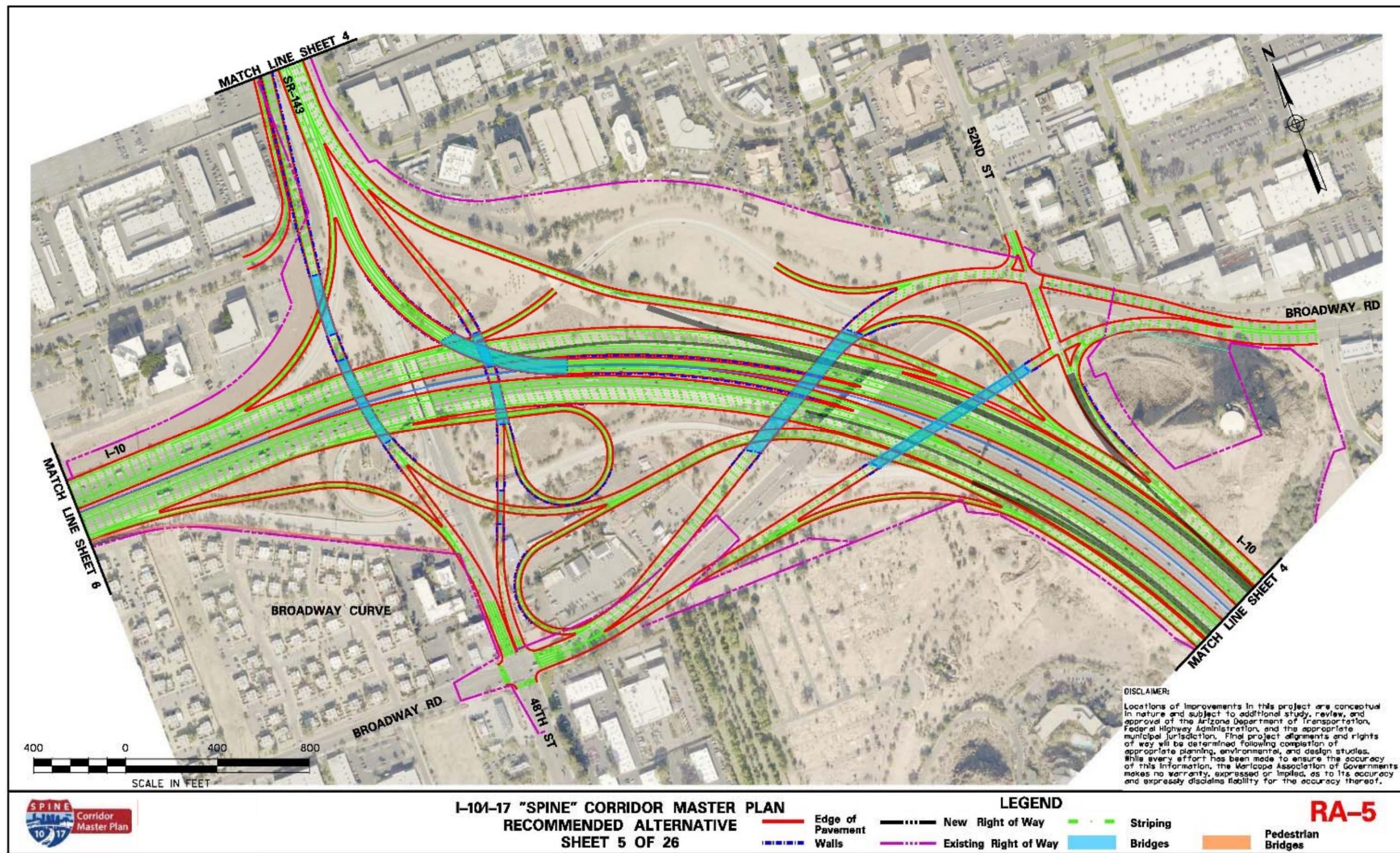


Figure 6-5. Recommended Alternative, Sheet 5 of 26 (I-10 Segment: US-60 to SR-143)



6.2.3 Interstate 10: State Route 143 to the I-17 Split

This segment of I-10 (SR-143 to the I-17 Split) is fundamentally the combination of two freeways: I-10 and I-17/US-60. As a result, all lane drops that exist in this segment create congestion. In the westbound direction, the auxiliary lane drop at the 40th Street exit ramp creates morning queuing through the SR-143 traffic interchange. In the eastbound direction, the three lane drops at 24th, 32nd and 48th streets all contribute to evening peak hour queuing that extends for several miles and can last for several hours. The single HOV lanes in each direction are frequently congested. Infrastructure condition is acceptable in this segment, including the Salt River bridge overcrossing, with no major replacements needed. The layout for this segment of I-10 can be found in Figures 6-6 to 6-7 following this segment description.

- **I-10 Main Line Improvements**

The main line improvements would widen I-10 to six general purpose lanes and two HOV lanes in each direction. All lane and shoulder widths would be constructed to the current ADOT standards for urban freeway construction. A new DHOV ramp is proposed at the Split to connect the second HOV lane on I-10 in this segment to new HOV lanes on I-17 (described for the next segment). The DHOV ramp is not technically part of this segment, but I-10 would need to be widened between the Salt River bridge and the 24th Street bridge to add the required median space for this future DHOV ramp. These improvements would enhance safety, reduce congestion and improve travel time reliability.

The Salt River bridge would need to be widened on both sides to accommodate the widening and the I-10 flaring for the future DHOV connector. The Tempe Drain wetland along the northern edge of I-10 between the Salt River and 32nd Street would require special attention, but impacts should be minimal.

With the introduction of a dual lane HOV system, the agencies may want to further explore the use of limited-access HOV lanes (as opposed to the continuous access practice in use today). Most dual HOV lane operations in other parts of the United States have introduced limited-access as a means to enhance safety and protect differing traffic flow speeds. Appendix B includes a technical study researching the limited access facilities. While inconclusive, it is apparent that further discussions are needed among the agencies to determine whether this is the correct approach for the MAG region.

- **Interchange Modifications**

I-10/40th Street traffic interchange: This location ranks 30th out of the 37 crossings in the Spine corridor. No major upgrades are proposed at this traffic interchange because the current bridge would adequately span the proposed improvements. The existing loop ramp in the southwestern quadrant may need to be removed to convert the traffic interchange to a standard diamond configuration. This removal is anticipated because the wider I-10 main line may result in a smaller and geometrically unacceptable loop ramp for the existing south-to-east movement because of ROW constraints. Other relatively low-cost interchange improvements such as additional turning/through lanes may be warranted. These issues would require further study to determine the appropriate course of action.

I-10/32nd Street traffic interchange: The 32nd Street location ranks 23rd out of 37 crossings in the Spine corridor. No major interchange upgrades are proposed except for the bicycle and pedestrian upgrades noted in the following. Relatively low-cost interchange improvements such as additional turning/through lanes may be warranted after further study, and should be coordinated with the City of Phoenix.

I-10/24th Street traffic interchange: The 24th Street location ranks 15th out of 37 crossings in the Spine corridor. Because the freeway crosses over 24th Street, the bridges are in acceptable condition, and the 24th Street bridge is close to Phoenix Sky Harbor International Airport, no major interchange upgrades are proposed except for the bicycle and pedestrian upgrades noted in the following.

- **Arterial Improvements**

No arterial improvements are proposed within this segment, except as noted as part of the traffic interchange modifications previously mentioned. However, in cooperation with the City of Phoenix, Broadway Road should be considered an alternative route in the event of Interstate closures or congestion.

- **Transit Improvements**

Transit-specific improvements are limited to adding a second HOV lane on I-10. The dual HOV lane would improve operations, safety and travel time reliability for existing and future bus routes that use the I-10 corridor.

- **Bicycle and Pedestrian Improvements**

Both the 32nd Street and 24th Street traffic interchanges warrant upgrades for bicycle and pedestrian movements, consistent with the *Phoenix Comprehensive Bicycle Master Plan* (November 2014). The nature of these improvements is not specifically defined, but is largely meant to target areas where bicycle and pedestrian movements are planned, where they exist with inadequate facilities, or where bicycle and pedestrian safety is a concern. Upgrading the 32nd Street traffic interchange would complement the University of Phoenix users in the southwestern corner. Finally, any improvements to the 40th Street traffic interchange would be done by incorporating the latest bicycle and pedestrian infrastructure for interchanges.

Figure 6-6. Recommended Alternative, Sheet 6 of 26 (I-10 Segment: SR-143 to I-17 Split)

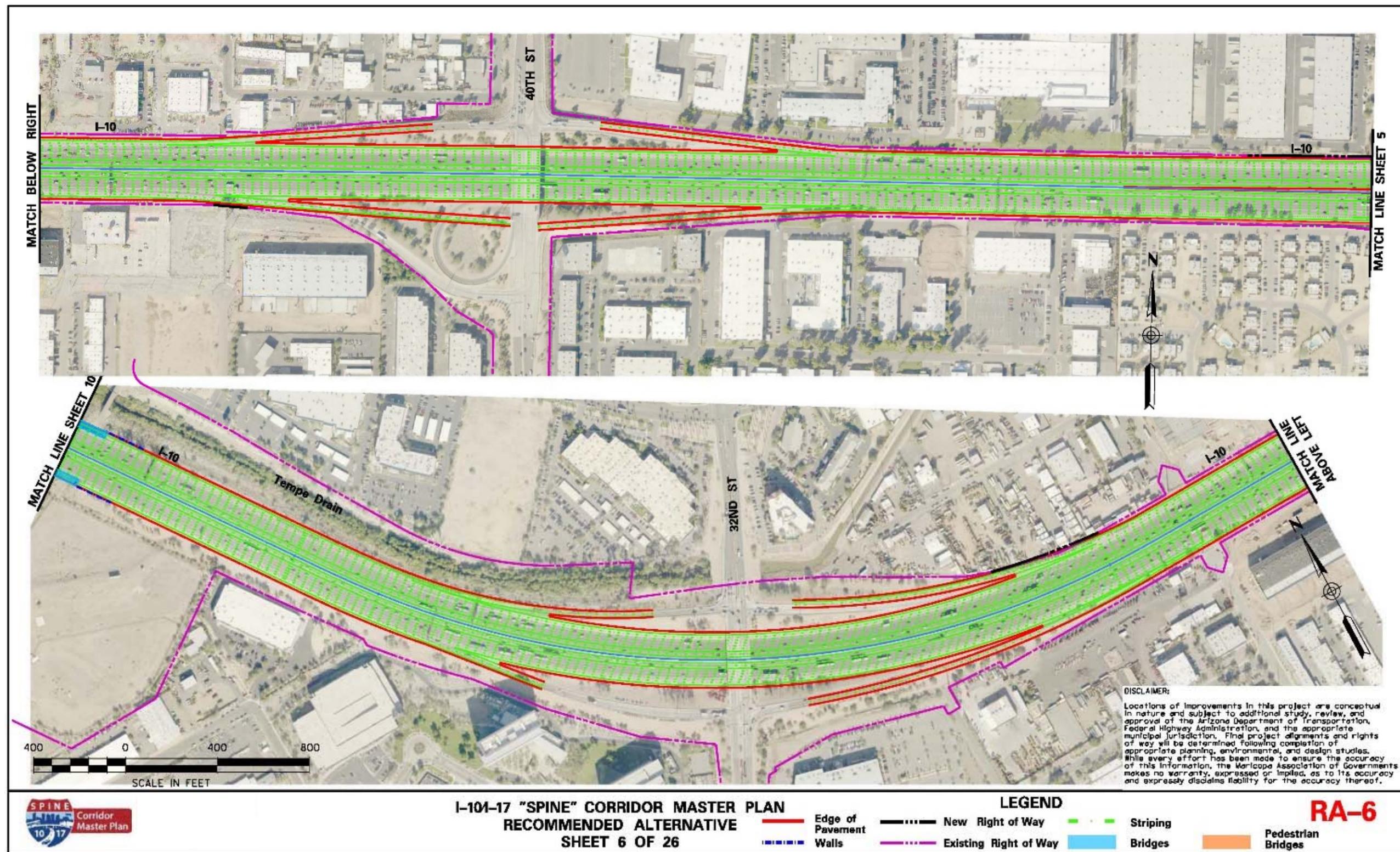
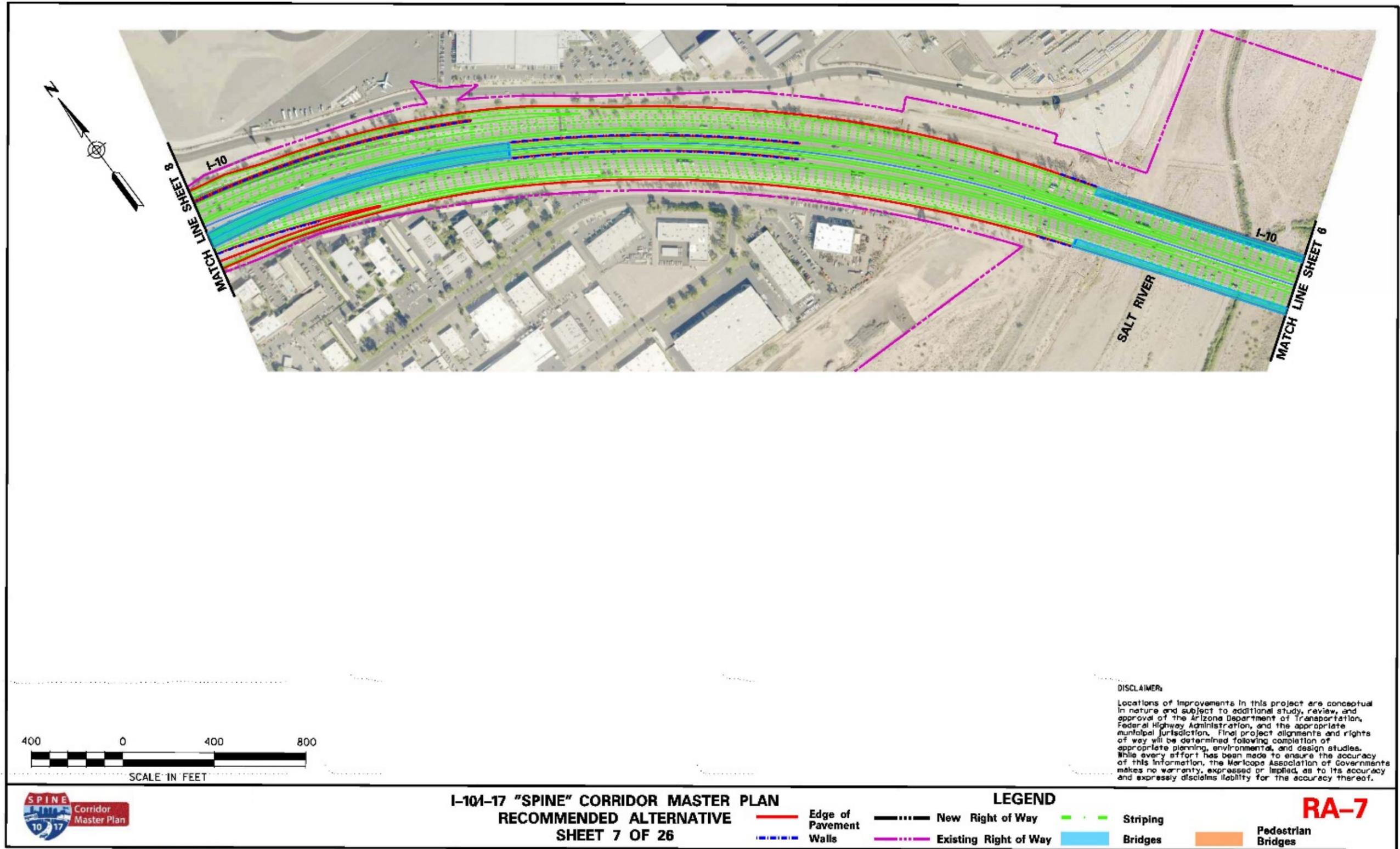


Figure 6-7. Recommended Alternative, Sheet 7 of 26 (I-10 Segment: SR-143 to I-17 Split)



6.2.4 Interstate 17: I-10 Split to the I-10 Stack

This segment of I-17 (I-10 Split to the I-10 Stack) is the oldest section of Interstate in the MAG region and includes three general purpose lanes and no HOV lanes in each direction. As noted in the NAR, bridges, pavements and drainage systems/outfalls are near the end of their service lives and need complete replacement. Expanding freight operations south of downtown Phoenix further point to the need for a complete replacement of this segment of I-17. Because portions of this segment predate the Interstate system, design elements are deficient when compared with current standards. These deficiencies are attributed to the age of construction and include substandard shoulder widths, inadequate ramp acceleration and deceleration lengths, inadequate vertical clearance at the bridge crossings and the lack of auxiliary lanes. Continuous one-way frontage roads exist along I-17, providing local access to adjacent properties and the freeway itself. From the Split to 19th Avenue, interchange designs are typical diamond-type configurations with intermixed grade separations for local roads and active and retired rail spur crossings. However, from 19th Avenue to the Stack, interchanges are fragmented into random ramps and lack any consistent access strategy. ADOT's TOC is located in the southwestern corner of the Durango Curve.

Three major transportation facilities are planned to interact with this segment of I-17. Two of these are planned Valley Metro light rail transit crossings: one at Central Avenue and one at Van Buren Street. At Central Avenue, the Valley Metro South Central Extension planning is underway. Because the Spine corridor recommendation proposes to replace this bridge and improve the vertical clearance, this bridge replacement work is being expedited early so that the new bridge can be in place prior to light rail transit passing under it. At Van Buren Street, the light rail would pass over I-17, using this crossing. Because the Spine corridor recommendation proposes replacing this bridge, its replacement should be coordinated with the Capitol/I-10 West Light Rail Transit Extension project.

Finally, MAG recently adopted a plan to extend SR-30 east from the SR-202L connection so that it ultimately connects to I-17 at or near the Durango Curve. SR-30 is a new freeway planned to extend from I-17 in downtown Phoenix to SR-85 in Buckeye, for a distance of 31 miles. This corridor is envisioned to provide relief to I-10 in the West Valley. Although a relatively new project in the freeway system, and presently unfunded at this time, all necessary care should be taken to ensure future compatibility with this connection.

The layout for this segment of I-17 can be found in Figures 6-8 to 6-13 following this segment description.

- **I-17 Main Line Improvements**

The main line improvements would reconstruct all I-17 pavements and bridges in their entirety and would provide three general purpose lanes and one HOV lane in each direction. Auxiliary lanes would be added where needed. All lane and shoulder widths would be constructed to the ADOT design standards for urban freeway construction to the extent practical. To extend HOV lanes through the Stack, no additional widening would be needed, because widening would be done through restriping and employing design exceptions where needed to avoid major reconstruction of the Stack.

3rd Street is an old railroad crossing of I-17. This track is no longer in existence and there is no need to perpetuate this crossing, so the 3rd Street bridges would be removed and not replaced. These improvements would modernize this aged section of I-17, standardize interchange configurations, enhance safety, reduce congestion and improve travel time reliability.

A new DHOV ramp is proposed at the Split interchange to connect the new I-17 HOV lanes to the dual HOV lanes on I-10 (described in the previous segment). The DHOV ramp is recommended to pass along the southern side of the Split, roughly following the south ROW line. This requires the DHOV to transition from

the median of I-17 to the south ROW just east of 16th Street and then transition back to the median of I-10 near 24th Street. This unusual (and costly) DHOV design is required to avoid adverse impacts on the Phoenix Sky Harbor International Airport airspace around the south runway.

A new DHOV interchange is also proposed at I-17 and 7th Street and is discussed in detail in the following. As it applies to the I-17 main line, the two directions of I-17 roadways need to be flared to account for the DHOV ramps that could exist from both sides of the interchange.

As previously noted, it should be expected that the Durango Curve may be the future site of the SR-30 connection. As such, design features should be included in the reconstruction to accommodate this future interchange. This could include realigning I-17 to account for a future DHOV connector to and from SR-30, altering the profile of I-17 for an easier connection, or modifying adjacent service interchange ramp locations to avoid future operational issues. More detailed study is required at this location to determine a suitable course of action.

Also, as previously noted, the future Valley Metro light rail transit crossings would need to be coordinated early to ensure these bridges are replaced with both ultimate facilities in mind.

Between the 16th Street and 7th Street traffic interchanges, and between the 7th Avenue and 19th Avenue interchanges, the study recommends reversing the ramps' order (sometimes referred to as "X-ramps") in these miles. These two 1-mile segments would be unique in the Spine corridor with this reverse ramp configuration. This configuration means that the weaving section would be removed from the main line and relocated to the frontage road.

The overarching reason for this ramp change is twofold. First, the weaving section on the main line is challenging for the heavy truck volumes to navigate, so by putting it on the frontage road and then making the ramps longer and flatter, trucks and other vehicles would be much safer. Second, the two west side 7th Street ramps are very steep because they must cross over the 11th Avenue railroad spur with 23.5 feet of vertical clearance. The reverse configuration means that these ramps would no longer cross over the railroad spur. Details about why this configuration is being recommended can be found in Appendix D in the Value Planning Report. While the reverse ramp configuration is part of the recommendation for the reasons noted, further study is warranted to test its effectiveness. Should the reverse ramps be implemented, a change of access report would be required by FHWA.

- **Interchange Modifications**

I-17/16th Street traffic interchange, I-17/7th Street traffic interchange, I-17/Central Avenue grade separation, I-17/7th Avenue traffic interchange, I-17/19th Avenue traffic interchange: These four locations ranked 18th, 21st, 20th, 9th and 5th out of the 37 crossings in the Spine corridor, respectively. Given condition and capacity issues, all of these crossings (including all other grade separations in this section) are proposed for reconstruction. These reconstructions would replace the main line bridges over the crossroads (and railroad tracks), increase vertical clearance to standard dimensions and lengthen bridges to upgrade crossroad cross sections.

At both 7th and 19th avenues, additional through and turn lanes are required to accommodate demand, resulting in their high priority scores. Furthermore, at 7th Street, this traffic interchange would be reconstructed to add a DHOV ramp to and from the east (I-17 South) in the median to provide a southern route into downtown for the express buses from the Southeast Valley.

It is assumed that the ultimate SR-30 connection would include a DHOV connection at the Durango Curve. Correspondingly, the 7th Street traffic interchange DHOV connection would be configured to accommodate future DHOV ramps to and from the west to accept those DHOV movements into the downtown core. The Central Avenue grade separation would be designed to accommodate the future light rail transit crossing under the bridge. Finally, the 15th Avenue and 11th Avenue grade separations would be replaced, the latter being an active railroad spur line crossing in the middle of 11th Avenue.

Grant Street traffic interchange, Jefferson/Adams Street traffic interchange, Van Buren Road grade separation: These three locations score 16th, 24th and 26th out of 37 crossings in the Spine corridor. This section of I-17 is a depressed freeway, so all of these crossings pass over the freeway. All bridges in this section, including those previously noted and the UPRR bridge and Buckeye Road bridge, would be replaced because of their condition and because their current configurations would not span the recommended I-17 widening. In addition, this is the section of I-17 with partial interchanges and random ramps. To standardize the access along this section of I-17, the Spine study recommendation proposes to eliminate the Grant Street traffic interchange ramps because these are very low-volume ramps and would be in conflict with the future SR-30 interchange system ramps. The I-17 frontage roads would remain, so access between I-17 and Grant Street would be altered, but maintained. All other ramps would be removed and replaced with a standard split diamond configuration at the Jefferson/Adams Street one-way couplets. This would be the only service interchange in this segment of I-17 between the Stack and the future SR-30 interchange. A change of access report would be required by FHWA. Finally, the Van Buren Road bridge over I-17 would be replaced with a longer span bridge to accommodate the I-17 widening. In addition, it is expected that the profile of Van Buren Road would be raised to the extent possible to provide additional length to the north side Jefferson/Adams traffic interchange ramps that have to cross under this grade separation. The Van Buren Road bridge would be replaced in a coordinated manner with the planned Valley Metro light rail transit Capitol/I-10 West crossing at this location. Further study is needed to determine the optimum manner in which this crossing is to be made.

I-10 Stack: The only improvement is to restripe the I-17 main line through the Stack for the addition of the new HOV lane in each direction. As previously noted, no major upgrades are envisioned for this traffic interchange because its age is not a significant factor and because modifications would be extremely expensive and would have dramatic impacts on the surrounding areas.

- **Arterial Improvements**

As previously noted, this section of I-17 has continuous one-way frontage roads along both sides of the freeway. The Spine study recommendation proposes to perpetuate and modernize these frontage roads and crossroad intersections to maintain local access, enhance safety and capacity, and provide I-17 main line redundancy during times of congestion or incidents.

Two-lane frontage roads are desirable, but single-lane frontage roads should be selectively used in areas where ROW is a substantial constraint. Because of the I-17 improvements, these frontage roads would likely be completely reconstructed, and in some cases would be relocated as well, requiring some new ROW. The exception would be the southbound frontage road between the Stack and Van Buren Road. This segment of roadway is planned to be the route for the Valley Metro light rail transit connecting downtown Phoenix with the I-10 West route. The frontage road needs to be closed for this alignment to be geometrically feasible and to avoid major impacts on the cemetery in the southwestern quadrant of the Stack. Initially, this route is being envisioned as a bus-only connection until the light rail transit is constructed.

In addition to the frontage roads, significant improvements are anticipated along 7th Street (to accommodate the DHOV connection) and 7th and 19th avenues to accommodate the additional through and turning lanes at their upgraded traffic interchanges.

- **Transit Improvements**

This segment of the Spine corridor recommendation has significant benefits for transit. The addition of HOV lanes to this segment, coupled with the DHOV at the Split, would be a welcome link that would connect the HOV systems in the North and Southeast Valley. In addition, the new DHOV traffic interchange at 7th Street would provide a long-overdue HOV connection into the downtown core from the south for both transit users and other HOV traffic. In the short term, this DHOV connection would benefit the many users of existing and future bus routes from the southeast part of the Valley. Presently, existing routes use the out-of-direction I-10/3rd Street DHOV ramp to access downtown.

Accommodations for the light rail transit crossings at both I-17/Central Avenue and I-17/Van Buren Road, including the southbound frontage road conversion to bus-only/light rail transit routes, would be important interface points of the two systems and should be coordinated early to ensure that optimum solutions are found for both the freeway and the transit.

- **Bicycle and Pedestrian Improvements**

All of the reconstructed traffic interchanges would be redesigned using current bicycle and pedestrian infrastructure design standards and features for interchanges. However, the Jefferson/Adams traffic interchange would require special attention because it is the one route in this segment identified in the *Phoenix Comprehensive Bicycle Master Plan* (November 2014) as a planned bicycle route.

Figure 6-8. Recommended Alternative, Sheet 8 of 26 (I-17 Segment: I-10 Split to I-10 Stack)

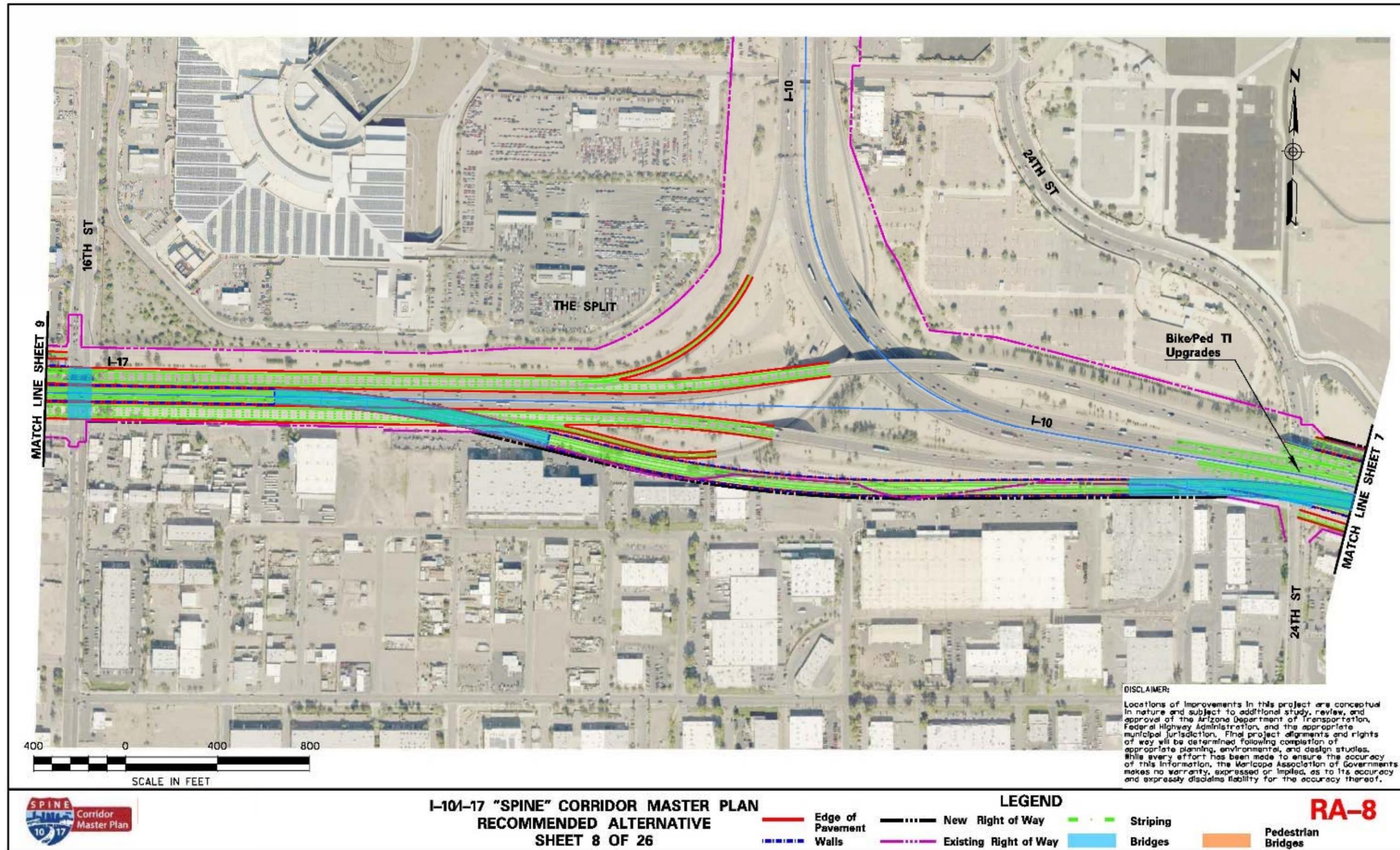


Figure 6-9. Recommended Alternative, Sheet 9 of 26 (I-17 Segment: I-10 Split to I-10 Stack)

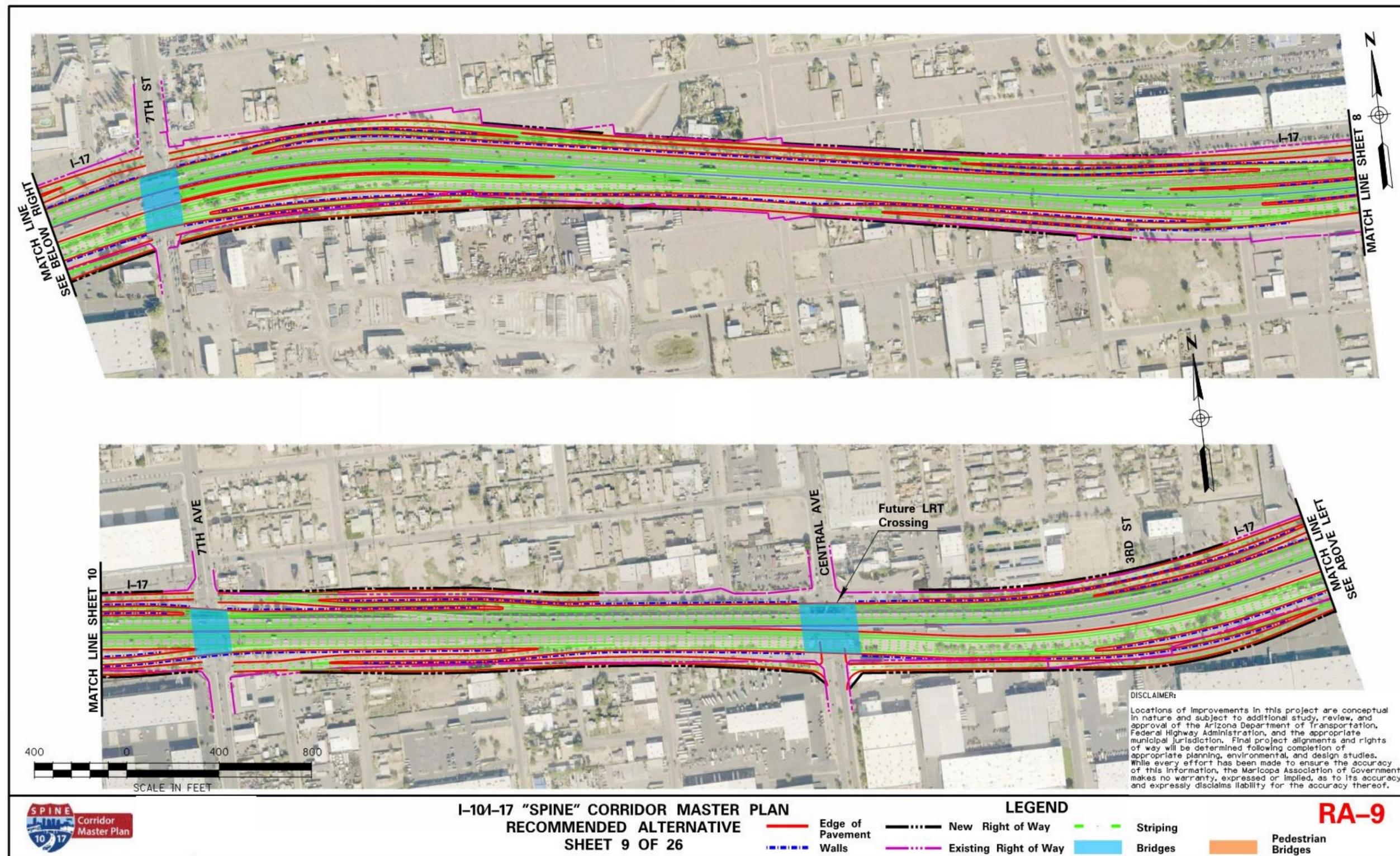


Figure 6-10. Recommended Alternative, Sheet 10 of 26 (I-17 Segment: I-10 Split to I-10 Stack)

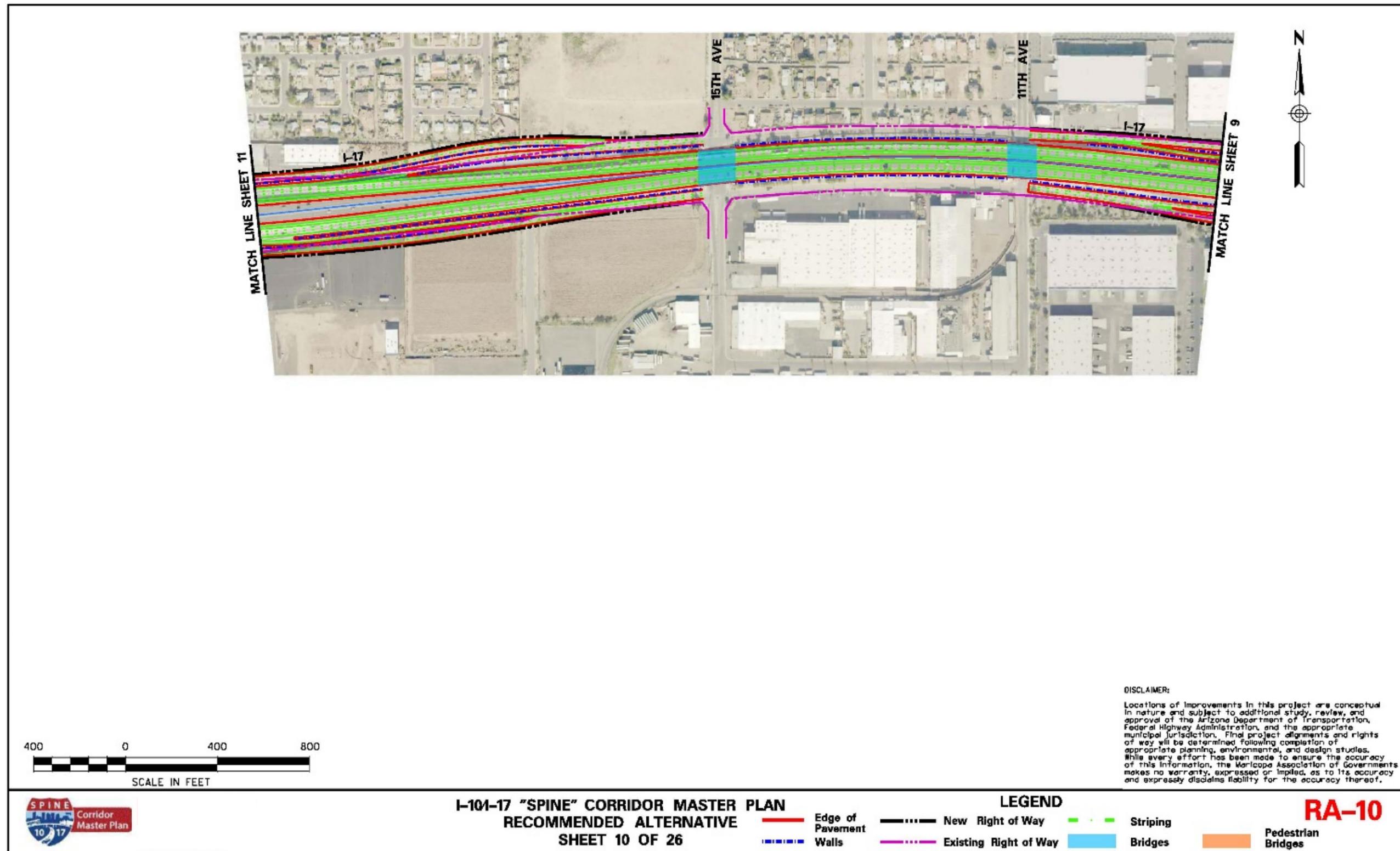


Figure 6-11. Recommended Alternative, Sheet 11 of 26 (I-17 Segment: I-10 Split to I-10 Stack)

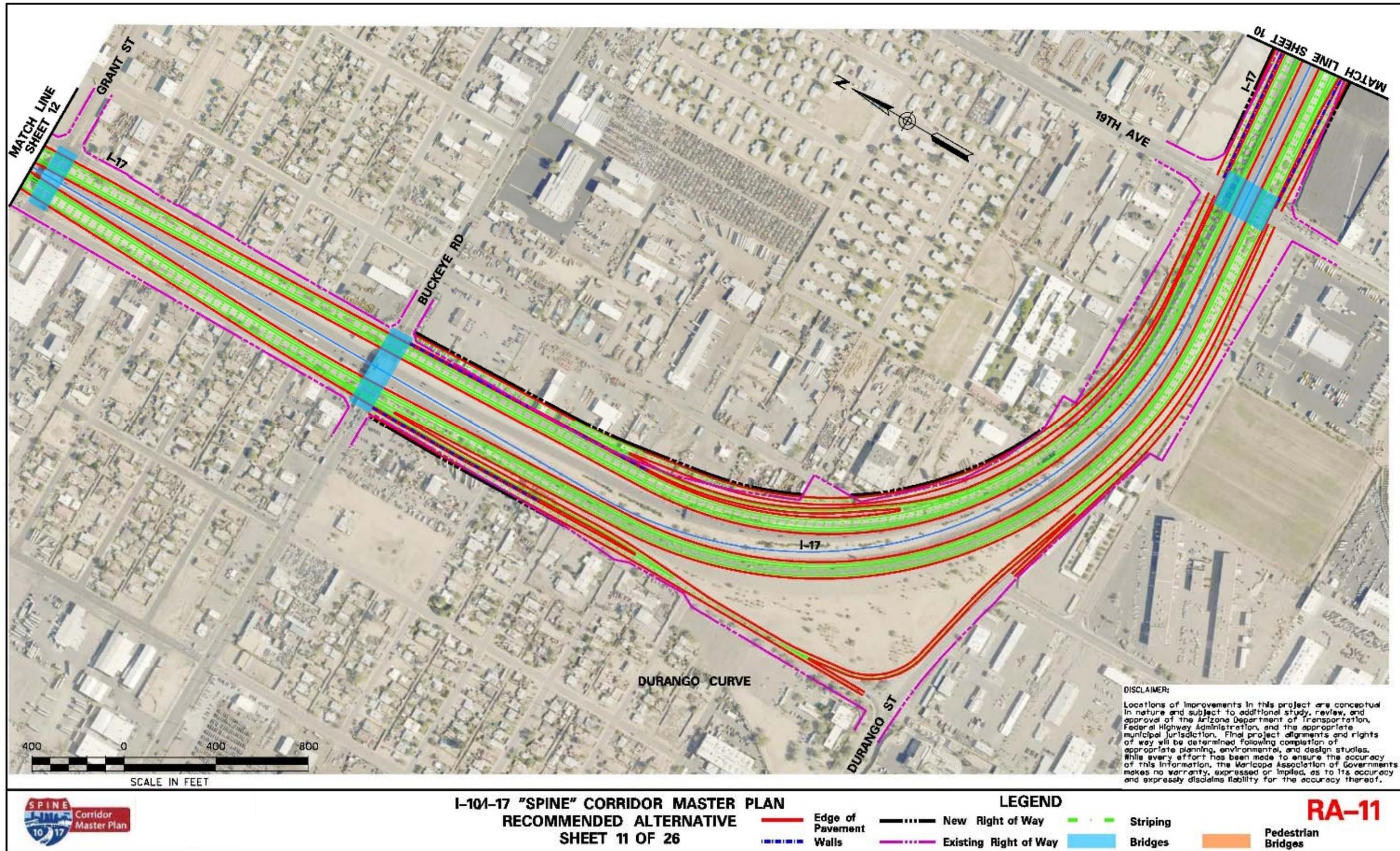


Figure 6-12. Recommended Alternative, Sheet 12 of 26 (I-17 Segment: I-10 Split to I-10 Stack)

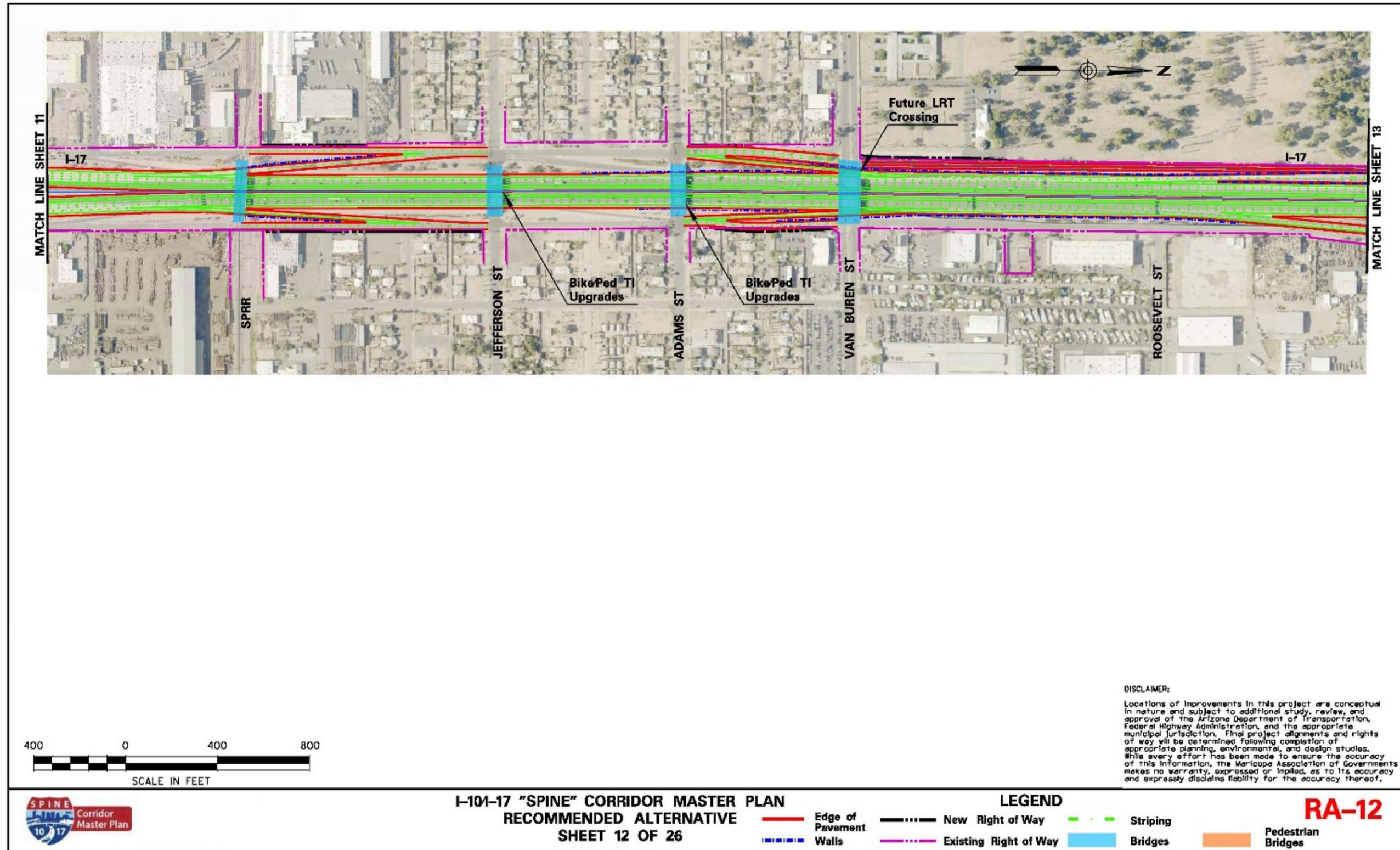
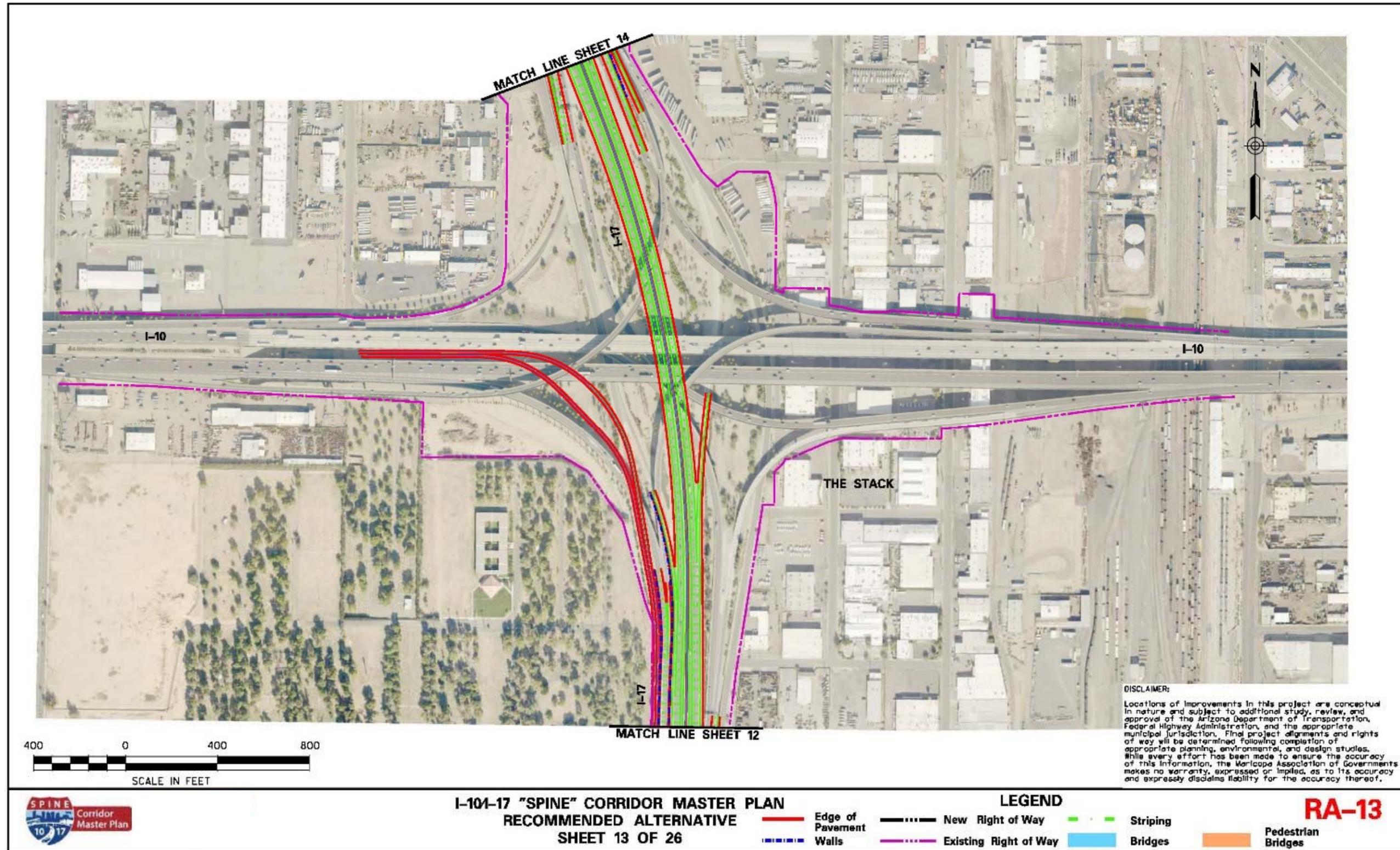


Figure 6-13. Recommended Alternative, Sheet 13 of 26 (I-17 Segment: I-10 Split to I-10 Stack)



6.2.5 Interstate 17: I-10 Stack to Dunlap Avenue

This segment of I-17 (I-10 Stack to Dunlap Avenue) is the second-oldest section of Interstate in Arizona and presently has three general purpose lanes, one HOV lane and one auxiliary lane in each direction. Some bridges and areas of pavement are old and in need of replacement, whereas other bridges are relatively new and do not require replacement. Continuous one-way frontage roads exist along I-17, providing local access to adjacent properties. In some cases, the sole access is from the frontage roads. All interchanges are either tight diamonds or SPUI configurations with frontage road movements. Currently, the northbound HOV lane begins just north of the Stack. In the southbound direction, the HOV lane abruptly turns into a general purpose lane just north of Indian School Road to allow HOV users adequate distance to transition to the Stack ramps. The profile of I-17 can be described as rolling, with the main line depressing under the arterials, but then rising up to grade through the mid-mile segments. As a result, no mid-mile crossings exist. Draining the main line sumps is handled by pump stations that outfall the flows into a large-diameter storm drain pipe under the southbound frontage road.

This segment of I-17 includes overcrossings for both US-60/Grand Avenue and BNSF at a 45-degree skewed crossing just south of Thomas Road. Until the construction of the I-10 Stack interchange, access was provided between I-17 and US-60. The Stack traffic interchange construction necessitated eliminating the US-60 access to I-17.

One Valley Metro light rail transit crossing is planned within this segment near Camelback Road. The West Phoenix-Central Glendale Extension is planned along this route and needs to cross I-17 on or near Camelback Road with the final route to be decided in early 2018.

When examining potential improvements for I-17 in this part of the Spine corridor, the study team considered how the freeway affects traffic flow in the surrounding area. A statistic that was uncovered during the Spine study is that more traffic crosses I-17 than traffic using the freeway interchange itself. Because no mid-mile crossings exist in this segment, all east-to-west traffic must cross I-17 at the traffic interchanges. This constraint breaks down the operations of the traffic interchanges and limits movement across the Interstate. A major emphasis as part of the Spine study recommendation was to provide east-to-west relief for all crossings of I-17.

The layout for this segment of I-17 can be found in Figures 6-15 to 6-21 following this segment description.

- **I-17 Main Line Improvements**

The Spine study recommendation proposes to widen I-17 throughout this length to provide three general purpose lanes, two HOV lanes and one auxiliary lane in each direction. All lane and shoulder widths would be constructed to the modern ADOT design standards for urban freeway construction to the extent practical. It is recognized that in this section of I-17, full-width standards may be cost-prohibitive or may create substantial impacts on the adjacent ROW, so more study is required to determine the appropriate solution. The *MAG Central Phoenix Framework Study* evaluated potential freeway sections and the reasonable widening limitations in this area and is a good reference for additional information. Toward the southern end of this segment, a single HOV lane would be added by widening and striping to connect to the new HOV lanes being added through and south of the Stack. The second HOV lane in each direction would terminate at Grand Avenue, where a new DHOV ramp connection to Grand Avenue would be constructed to and from the north. I-17 would need to flare to accommodate this DHOV ramp, anticipated to be located just north of Thomas Road.

Within this segment, all main line pavement would be replaced because it is far beyond its design life. However, many of the bridges over I-17 were replaced in the early 2000s and do not require replacement. The exceptions to this include the Grand Canal bridge (63 years old in 2017 and nearing the end of its useful life), the BNSF bridge, the Grand Avenue bridge and the McDowell Road bridge. These improvements would modernize this aged section of I-17, enhance safety, reduce congestion and improve travel time reliability.

As previously noted, the future Valley Metro light rail transit crossing at Camelback Road would need to be coordinated early to ensure this traffic interchange is modified with both ultimate facilities in mind, should the final alignment of the light rail transit be selected within the Camelback Road traffic interchange.

- **Interchange Modifications**

I-17/US-60 Grand Avenue and I-17/Thomas Road traffic interchange: These two locations ranked 32nd and 7th out of the 37 crossings in the Spine corridor, respectively. The bridges over I-17 for both Grand Avenue and the BNSF railroad are inadequate for the proposed I-17 widening and must both be replaced. It seems that the Thomas Road bridge span is adequate for the main line widening, and because limited improvements can be done at the Thomas Road traffic interchange, a replacement is not warranted. As part of the Grand Avenue crossing reconstruction, Grand Avenue would be developed to accept a DHOV ramp to and from the north. The Spine recommendation has conceptually developed a solution to accomplish this where the DHOV ramps would exit the I-17 median north of Thomas Road, cross to the west ROW and then stay on the structure until it crosses over Thomas Road where it would intersect with Grand Avenue. Coupled with this DHOV connection at Grand Avenue, improved connectivity between Thomas Road and Grand Avenue is proposed so that the DHOV traffic can access downtown Phoenix via Grand Avenue or the Central Avenue business district via Thomas Road and vice versa. As a result, improvements to the Thomas Road traffic interchange may be justified. This needs further study to determine the appropriate design details in this area but should consider the addition of a third eastbound lane on Thomas Road between the traffic interchange and 23rd Avenue.

I-17/Indian School traffic interchange, I-17/Camelback traffic interchange, I-17/Glendale traffic interchange, I-17/Northern traffic interchange: As previously noted in Chapter 4 of this report, several interchanges were identified where east-to-west travel demand was high, and where east-to-west regional connectivity was substantial. These four interchanges were all identified as being the best candidates for high-capacity interchanges that emphasized the east-to-west through movements. Three-level diamonds, or some equivalent high-capacity design, are proposed at these four locations. These locations rank as 17th, 8th, 11th and 13th out of 37 crossings in the Spine corridor, respectively. An example of a three-level diamond interchange is shown in Figure 6-14.

The need for upgrades is high. The primary reasons the three-level diamond configuration was recommended is because this high-capacity service traffic interchange design is compact and fits well within highly developed areas, is compatible with frontage roads, can maintain access to adjacent properties along the arterial corridor with U-turn movements, and improves bicycle and pedestrian safety within the interchange. At the Camelback Road traffic interchange, the three-level diamond has the added advantage of integrating the light rail transit into the median of the east-to-west flyover structure, significantly simplifying the light rail transit crossing of I-17 without negatively affecting the traffic interchange operations.

Figure 6-14. Example of a three-level diamond interchange in Redford Township, Michigan



Source: Bing Maps

I-17/Dunlap Avenue traffic interchange: This traffic interchange ranks 3rd out of the 37 crossings in the Spine corridor. This location scores high because of the high level of commercial activity in the area and because this traffic interchange has the second worst safety score relative to other traffic interchanges in the Spine corridor. Further study is needed to determine the appropriate design modifications that should be made at this traffic interchange to respond to these issues. One possible alternative may be to convert the traffic interchange to a tight diamond configuration and eliminate the SPUI configuration.

- **Arterial Improvements**

This section of I-17 has continuous one-way frontage roads along both sides of the freeway. The Spine study recommendation proposes to perpetuate these frontage roads to maintain local access and to provide I-17 main line redundancy during times of congestion or incidents. Two-lane frontage roads are desirable, but single-lane frontage roads may be all that is possible because of ROW constraints. Because of the I-17 improvements, these frontage roads would likely be completely reconstructed, and in some cases would be relocated, requiring some new ROW.

In addition to the frontage roads, substantial improvements are anticipated along the arterials where the interchange modifications are being proposed, noted in the previous section, especially at the three-level diamond locations.

Some east-to-west arterials in this segment were analyzed for capacity constraints between 19th and 35th avenues. Two arterial widenings are being proposed to eliminate arterial capacity constraints, but it should be noted that any arterial street improvements in Phoenix being proposed within this recommendation would be subject to City of Phoenix agreement.

- **Glendale Avenue:** Add a third eastbound lane between 24th and 19th avenues to maintain continuity. This proposed improvement would be necessary to make the three-level diamond traffic interchange

work properly. This widening would affect the frontage of Washington High School, but it is not expected that this widening would have a detrimental impact on the school.

- **Dunlap Avenue:** Add a third westbound lane between the traffic interchange and 19th Avenue. This proposed widening should be coordinated with the Valley Metro Light Rail Northwest Extension project and the improvements it proposes along this segment of Dunlap Avenue.

Finally, to help alleviate the east-to-west traffic vehicular traffic demand in the I-17 corridor, the introduction of new mid-mile crossings was evaluated. Ultimately, no suitable locations were identified because of geometric constraints, land use incompatibility or significant impacts. As a result, no new crossings are being recommended.

- **Transit Improvements**

Dual HOV lanes in each direction would improve public transportation operations, safety and travel time reliability for those bus routes that currently use the I-17 corridor. In addition, the new DHOV connection at US-60/Grand Avenue would be a convenient new way for transit to access the downtown core or the Central Avenue business district via Thomas Road, should existing routes be modified or future routes consider this new connection. This new DHOV connection would avoid the need of express buses to weave across the general purpose lanes to exit I-17.

The West Phoenix/Central Glendale light rail transit crossing of I-17 is an important interface point of the two systems and should be coordinated early to ensure that optimum solutions are found for both the freeway and the transit. At the time of this report, consideration is being given to Camelback Road as the crossing of I-17, in part due to its proximity to Grand Canyon University and its emerging student population. However, the City of Phoenix is considering multiple locations for this crossing and anticipates having a locally preferred alternative approved in early 2018.

RAPID buses and other buses using I-17 would access the park-and-ride and future light rail station at Metrocenter by using the Dunlap Avenue and Peoria Avenue traffic interchanges. While evaluated, the addition of a DHOV traffic interchange near the light rail transit station at Metrocenter is not feasible because of ROW and geometric constraints with the light rail transit crossing at Mountain View Road. As a result, it was not included in the Spine recommendation.

- **Bicycle and Pedestrian Improvements**

Chapter 6 of the NAR details the bicycle and pedestrian needs of the corridor. All reconstructed traffic interchanges would be redesigned using the current bicycle and pedestrian infrastructure design standards for interchanges. The Northern Avenue traffic interchange reconstruction would have a special emphasis on bicycle and pedestrian safety because that interchange has a high crash rate for bicycles and pedestrians.

A new dedicated grade-separated structure would cross over I-17 at Missouri Avenue, consistent with the *Phoenix Comprehensive Bicycle Master Plan* (November 2014). In addition, the existing bicycle and pedestrian bridge over I-17 at Maryland Avenue would likely have to be rebuilt because the spans are inadequate for the proposed I-17 cross section.

Finally, it should be acknowledged that the *Phoenix Comprehensive Bicycle Master Plan* (November 2014) does propose a new bicycle and pedestrian crossing over I-17 at or near Osborn Road. While that crossing was initially proposed in this plan, many public comments opposed such a crossing, and, as such, it has been removed from the Spine study recommendation pending further consideration by the City of Phoenix.

Figure 6-15. Recommended Alternative, Sheet 14 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

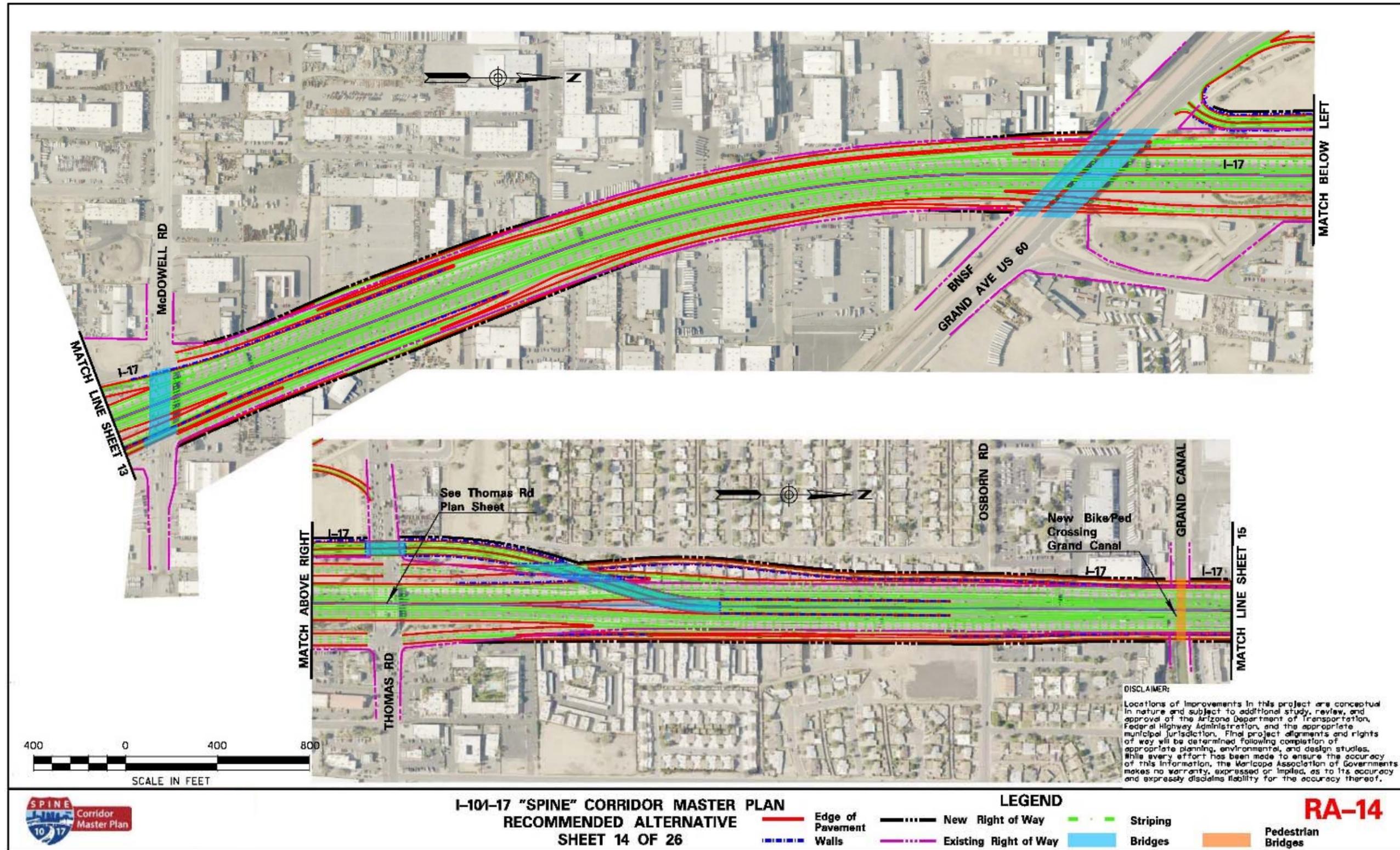


Figure 6-16. Recommended Alternative, Sheet 15 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

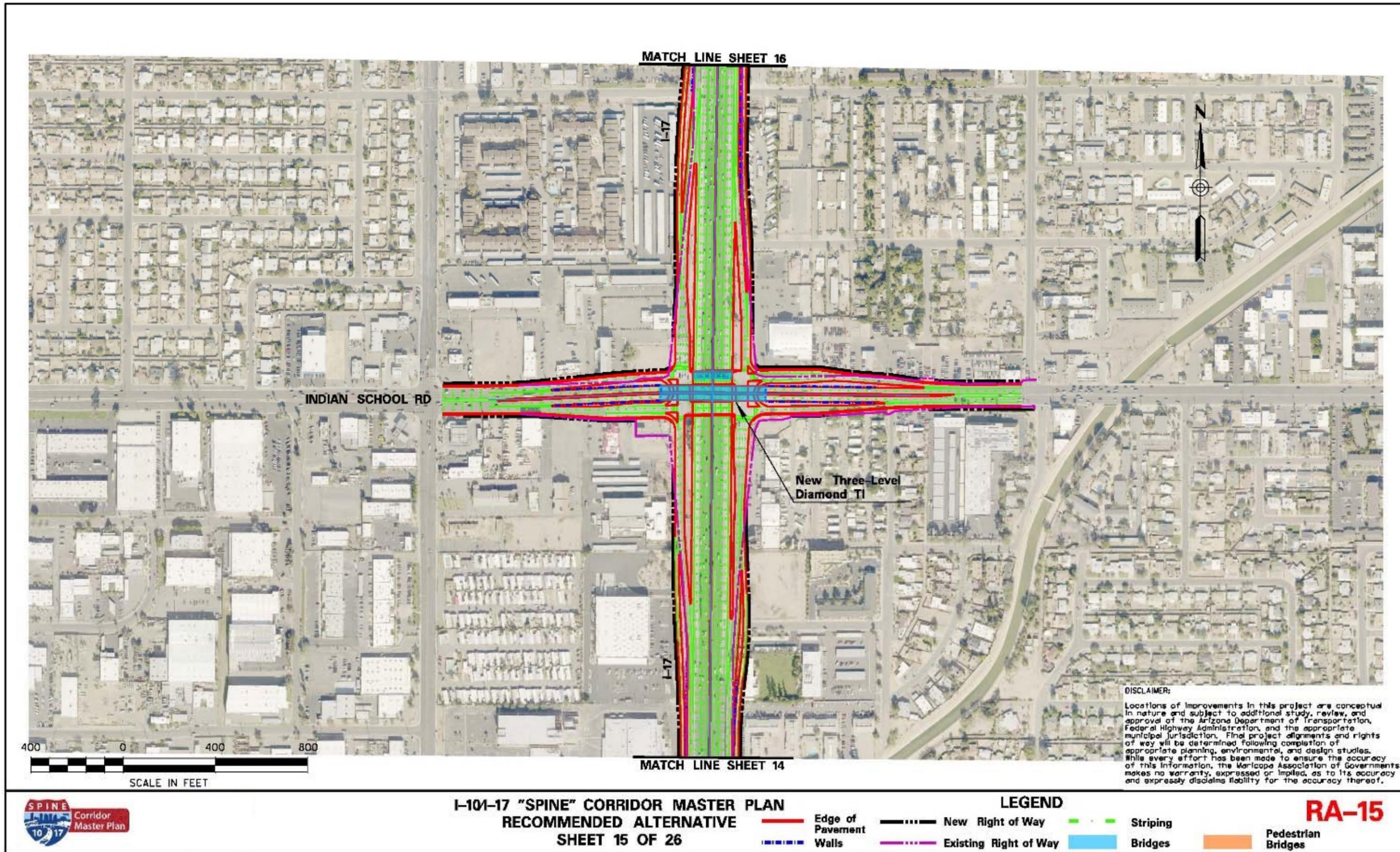


Figure 6-17. Recommended Alternative, Sheet 16 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

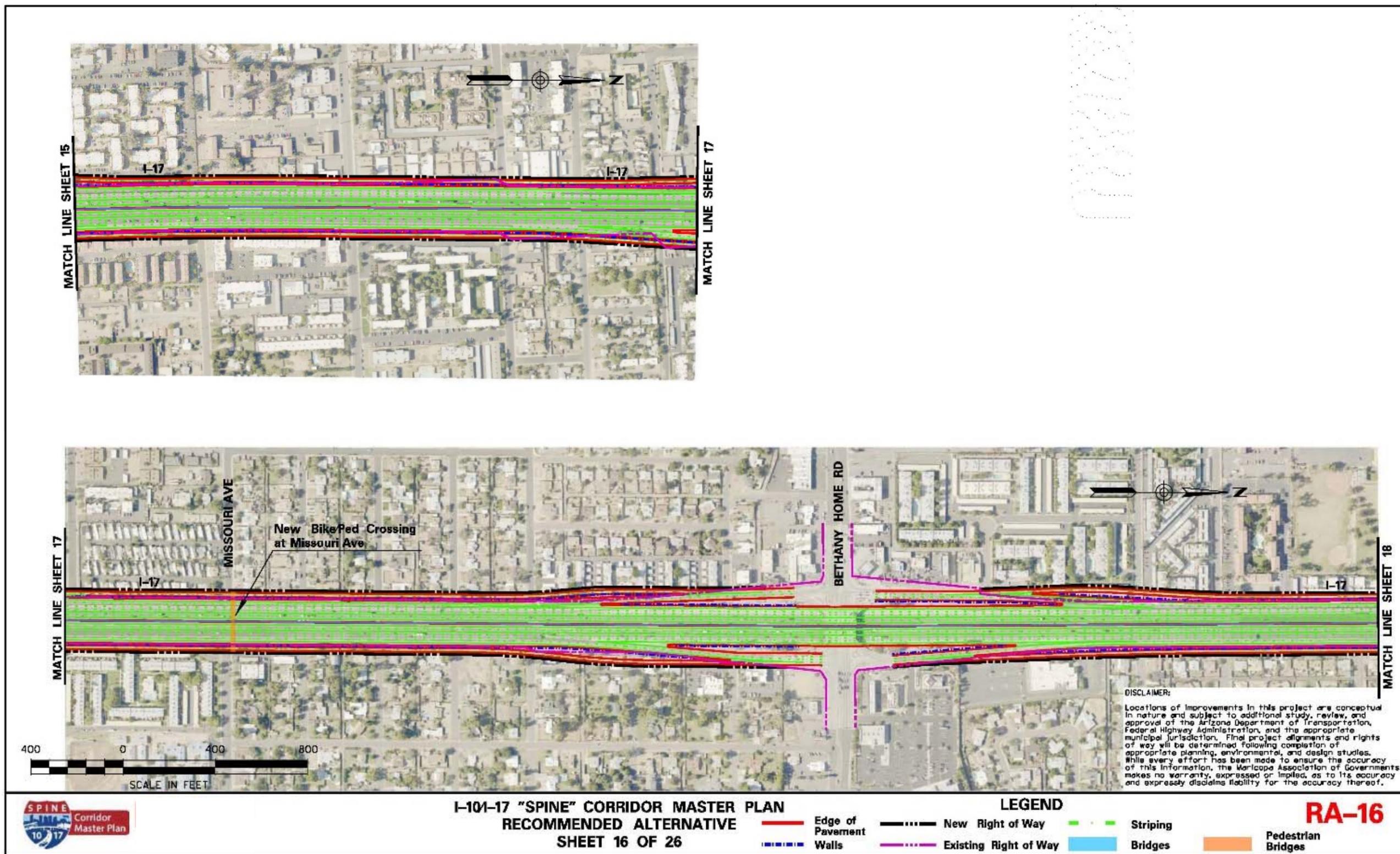


Figure 6-18. Recommended Alternative, Sheet 17 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

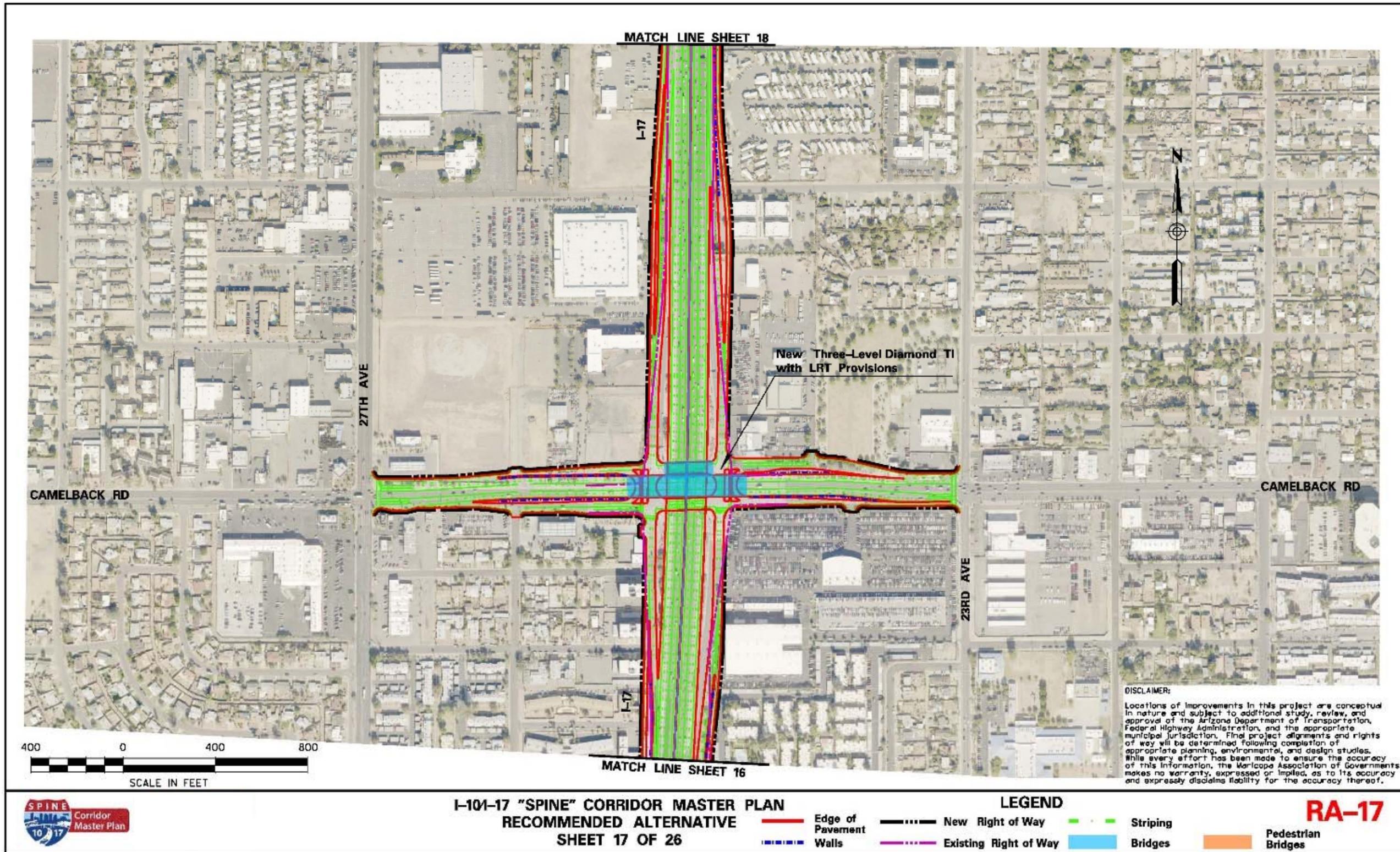


Figure 6-19. Recommended Alternative, Sheet 18 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

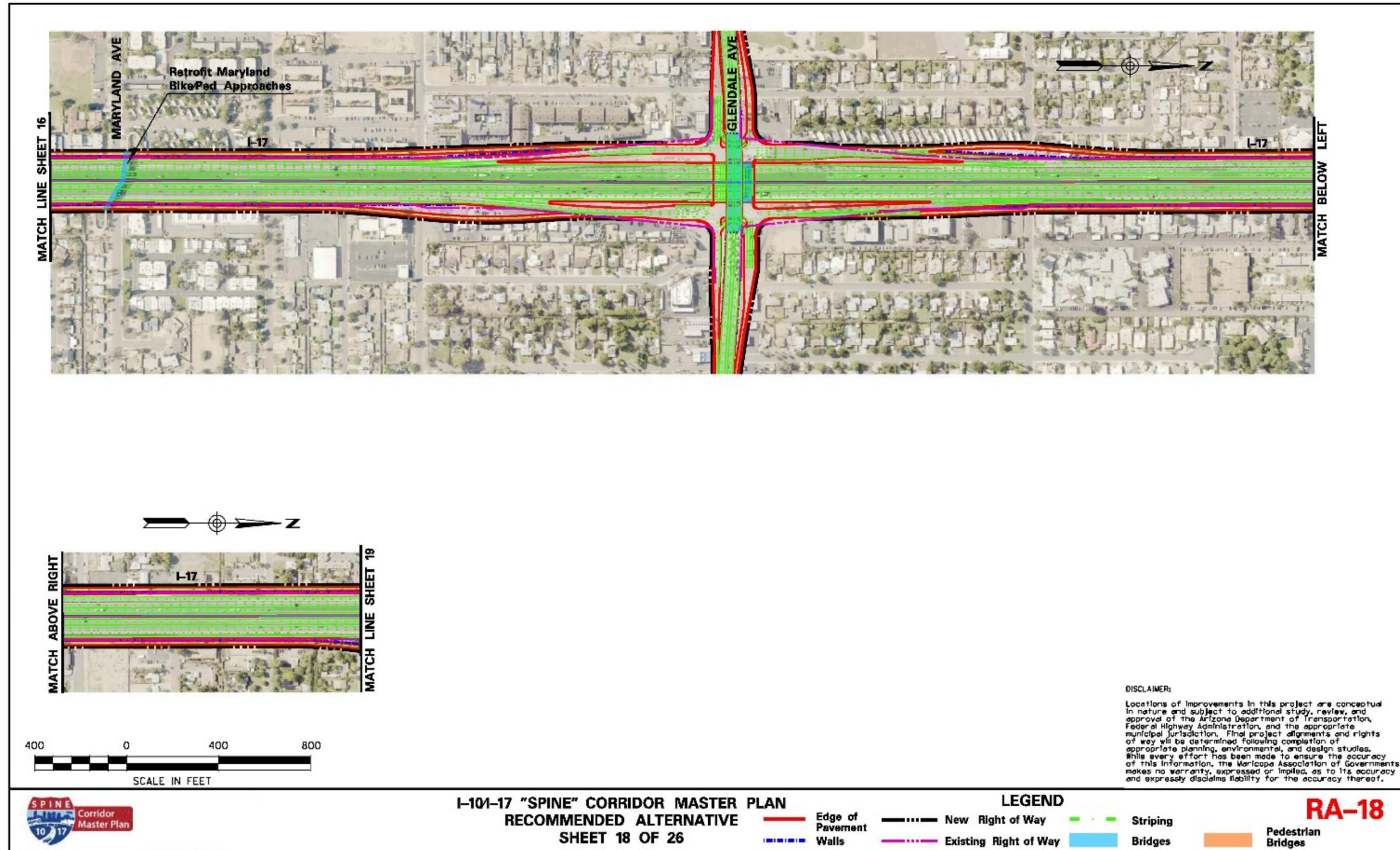


Figure 6-20. Recommended Alternative, Sheet 19 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)

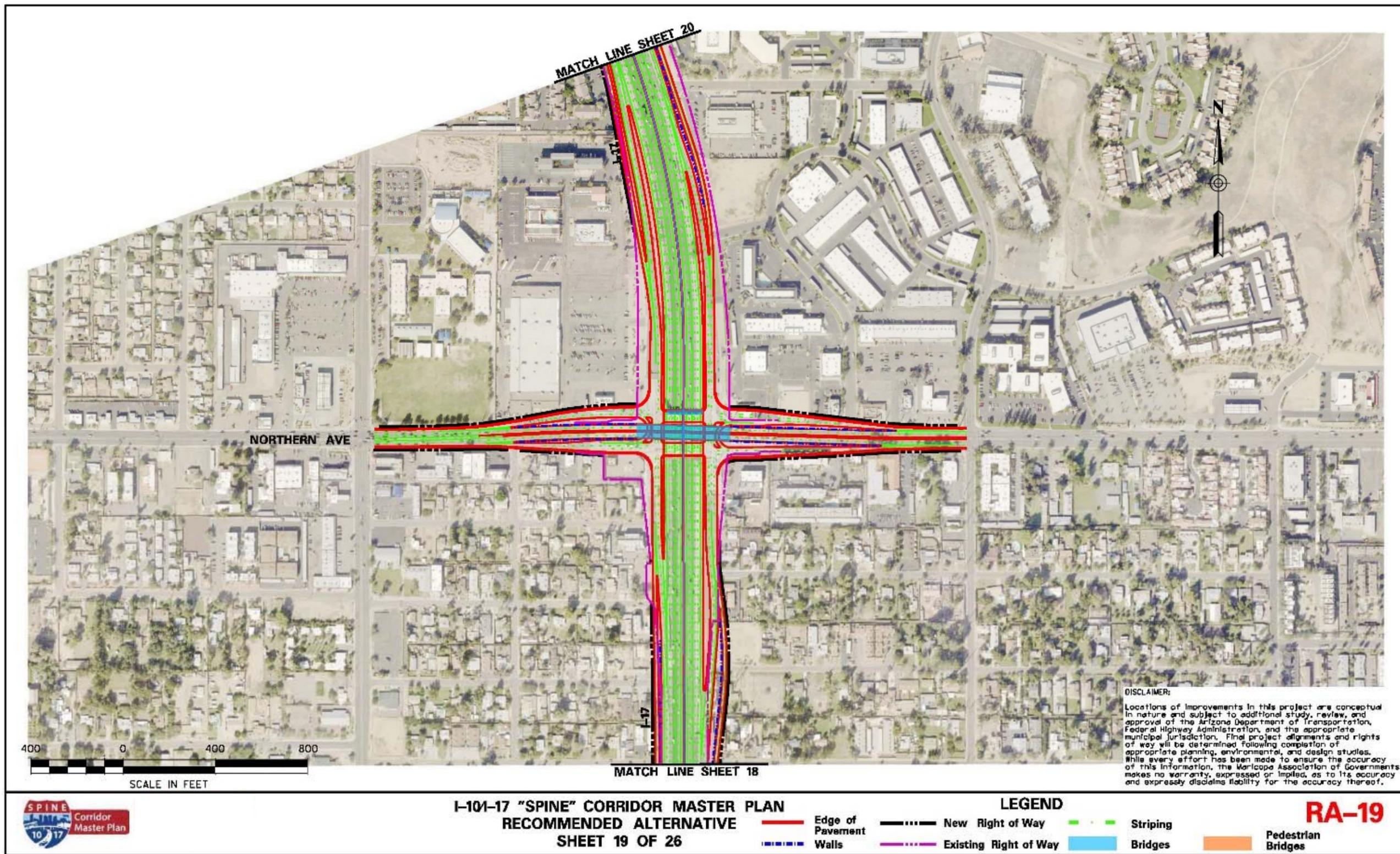
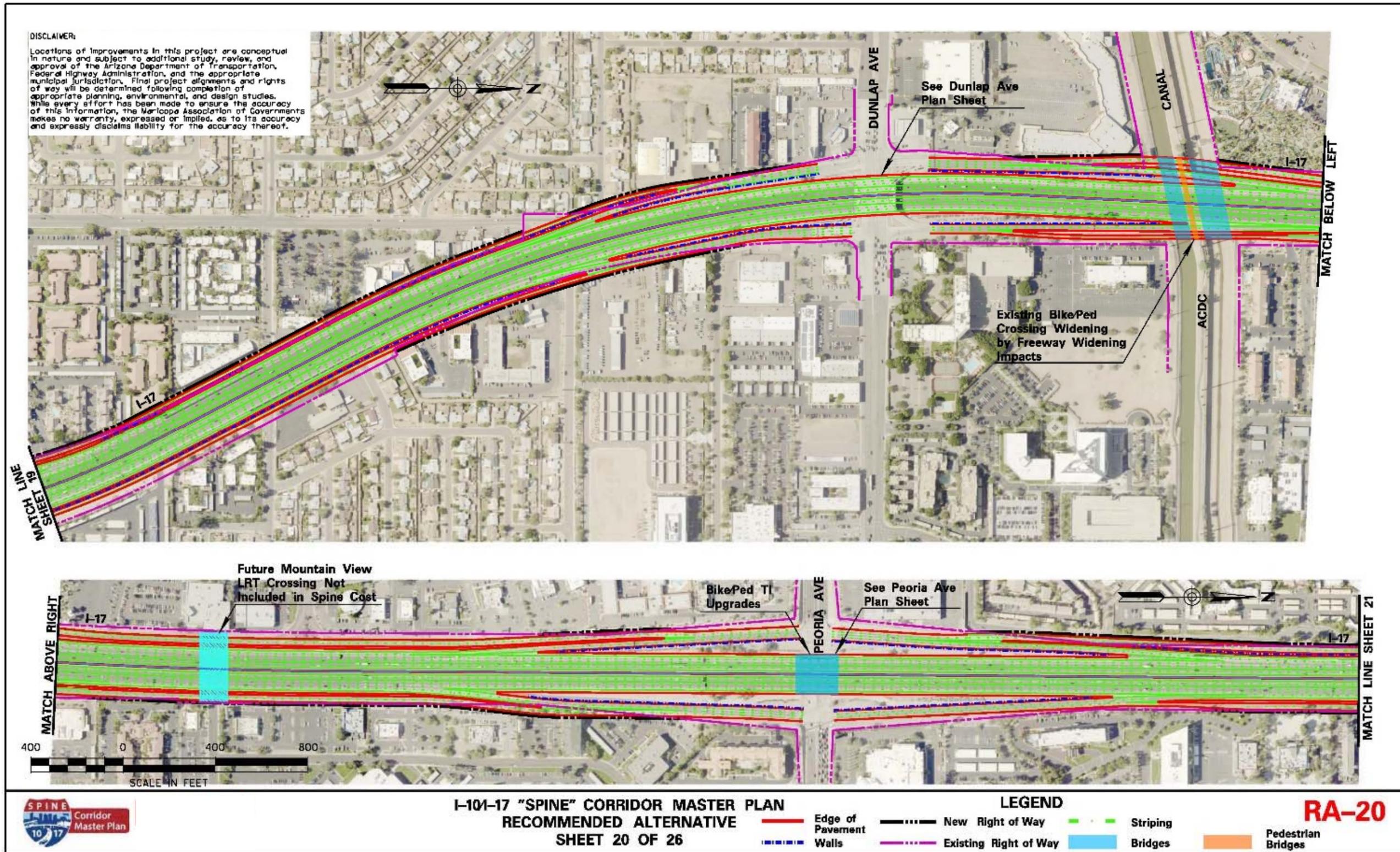


Figure 6-21. Recommended Alternative, Sheet 20 of 26 (I-17 Segment: I-10 Stack to Dunlap Avenue)



6.2.6 Interstate 17: Dunlap Avenue to SR-101L North Stack

This segment of I-17 (Dunlap Avenue to SR-101L North Stack) has a distinctly different character than the segment of I-17 to the south. After I-17 crosses over the ACDC just north of Dunlap Avenue, its profile remains at grade to the northern limits of the study area. With the exception of the Utopia Road traffic interchange, all interchange arterials undercross I-17, many drained with undersized and old pump stations that outfall into the City of Phoenix storm drain system in 35th Avenue.

The main line generally includes three general purpose lanes, one HOV lane and one auxiliary lane in each direction. The main line pavement between Dunlap and Peoria avenues is at the end of its service life, but north of Peoria, the main line pavement is less than 20 years old and can be widened. All of the bridges between the Arizona Canal/ACDC and Bell Road including these locations are at the end of their useful life and warrant replacement. North of Bell Road, the bridges do not need to be replaced.

Continuous one-way frontage roads exist along I-17, providing local access to adjacent properties. In some cases, the sole access is from the frontage roads. All interchanges are either tight/spread diamonds or SPUI configurations with frontage road movements. No mid-mile crossings exist, however, to help alleviate the east-to-west traffic vehicular traffic demand in the I-17 corridor, and the introduction of new mid-mile crossings was evaluated. Ultimately, no suitable locations were identified because of geometric constraints, land use incompatibility or significant impacts. As a result, no new crossings are recommended.

One Valley Metro light rail transit crossing is planned within this segment crossing I-17 on a dedicated bridge at Mountain View Boulevard at Metrocenter. This is the Northwest Extension of the Valley Metro light rail transit system. Early coordination has already started to accommodate this crossing to ensure that light rail transit construction (which would occur before the I-17 improvements are made) is compatible with the Spine study recommendation on I-17 and the frontage roads.

In the southwestern quadrant of I-17 and Bell Road, a heavily used park-and-ride lot exists that is already at capacity Monday through Friday every week. This is the most-used park-and-ride in the Valley.

In this segment of I-17, more traffic is trying to cross I-17 as compared with the amount of traffic using and accessing I-17. Because no mid-mile crossings of I-17 exist in this segment, all this east-to-west volume must cross I-17 at the traffic interchanges, breaking down the traffic interchange operations. A major emphasis as part of the Spine study recommendation was to provide east-to-west relief at several of these interchanges.

The layout for this segment of I-17 can be found in Figures 6-22 to 6-27 following this segment description.

- **I-17 Main Line Improvements**

The Spine study recommendation proposes to widen I-17 throughout this length to keep the existing three general purpose lanes and add another HOV lane and one auxiliary lane in each direction. All lane and shoulder widths would be constructed to the ADOT design standards for urban freeway construction to the extent practical. The MAG *Central Phoenix Framework Study* evaluated potential freeway sections and the reasonable widening limitations in this area and is a good reference for additional information. At the North Stack, a new proposed DHOV connector ramp is proposed to connect the southern leg of I-17 with the western leg of SR-101L. This DHOV was part of the 2003 RTP, but was officially added to the Spine study recommendation as a way to logically drop and add the second HOV lane in each direction. I-17 would need to flare to accommodate this system DHOV ramp, anticipated to be located between Union Hills Drive and Utopia Road. Corresponding improvements and widening would be required along SR-101L between

27th and 35th avenues. These improvements would enhance safety, reduce congestion and improve travel time reliability.

Within this segment, the main line pavement would be replaced between Dunlap and Peoria avenues because it is far beyond its expected life span. In addition, all the bridges need to be replaced and many need to be elevated to restore adequate vertical clearance at the traffic interchange crossings and to improve signal head sight distance—a possible cause of many accidents in these interchanges. This means that most of the bridge replacements would raise the I-17 profile by 3 to 5 feet, causing up to 2,000 feet of main line pavement replacement centered on each bridge site. The Thunderbird Road and Bell Road traffic interchanges are both proposed to be upgraded to three-level diamonds. The most logical way to upgrade these is to reprofile the I-17 main line one level higher (or about 25 feet) over these current interchanges, causing up to 1 mile of main line reconstruction centered on each site. Ultimately, very little I-17 main line pavement could be retained.

Four drainage pump stations exist in this segment that are the four oldest in the Phoenix area. These four pump stations drain the arterial sumps under the Peoria Avenue, Cactus Road, Thunderbird Road and Greenway Road traffic interchanges. All four pump stations pump the outflow into a City of Phoenix storm drain system that ultimately dumps into the ACDC at 35th Avenue. This drainage outfall is undersized and cannot accommodate the traffic interchange flows adequately, which means frequent flooding is an issue at these interchanges. The Spine study recommendation adopts an ADOT solution developed in 2006 that removes all four pump stations by building a new gravity drain along I-17, mostly under the southbound frontage road, to the ACDC. The infields of the Thunderbird Road traffic interchange would be used for in-line detention to mitigate the peak flow events.

The future Valley Metro light rail transit crossing at Mountain View Road and its associated proposed elevated station straddling the southbound I-17 frontage road would need to be coordinated by multiple agencies to ensure this new light rail transit crossing is compatible with the Spine corridor recommendation. This includes accommodating both the ultimate I-17 and frontage road widths proposed in the Spine study recommendation, as well as the timing and location of the proposed storm drain pipe planned under the southbound frontage road and the elevated transit station.

- **Interchange Modifications**

I-17/Peoria Avenue traffic interchange, I-17/Cactus Road traffic interchange, I-17/Greenway Road traffic interchange: These three locations ranked 1st, 10th and 14th out of the 37 crossings in the Spine corridor, respectively. All three are similar in design and all three have similar issues. The current bridges limit the crossroad section that fits under them and, with low vertical clearances, the tight diamond configuration creates sight distance issues to both the signal heads and the ramp terminal intersections. As a result, all three traffic interchanges experience higher-than-average crashes.

Peoria Avenue has the worst traffic interchange crash score in the entire Spine corridor. When replacing the bridges, the Spine study recommendation is to raise them so that not only 16.5 feet of vertical clearance is achieved, but a few extra feet to improve signal head sight distance. In addition, the bridge spans should be lengthened so that the crossroad sections through the interchanges are not restricted through the bridges much like they are today. To avoid the tunnel-effect under these bridges, it may be desirable to spread the two directions of the I-17 main line apart by 10 to 20 feet to create an open space for natural light under the interchange. This would improve visibility and improve safety. At the Peoria Avenue traffic interchange, the crossroad section should be expanded to include a third eastbound through lane between 28th and 25th avenues as part of the traffic interchange modification.

At the Cactus Road traffic interchange, the crossroad section should be expanded to be three through lanes in each direction between 28th Drive and 25th Avenue with dual west-to-south left turns and a single east-to-north left-turn bay within the traffic interchange itself as part of the traffic interchange modifications. At the Greenway Road traffic interchange, three westbound through lanes and two eastbound through lanes should be accommodated between 29th and 19th avenues, with dual west-to-south left turns and a single east-to-north left turn bay within the traffic interchange as part of the traffic interchange modifications. Finally, all three of these interchanges would include the drainage improvements noted in the main line discussion and would be integrated into the new traffic interchange improvements.

I-17/Thunderbird Road traffic interchange and I-17/Bell Road traffic interchange: As previously noted in Chapter 4 of this report, several interchanges were identified where east-to-west travel demand was high, and where east-to-west regional connectivity was significant. These two interchanges were identified as being the best candidates for high-capacity interchanges that emphasized the east-to-west through movements. Three-level diamonds, or some equivalent high-capacity design, are proposed at these two locations. These locations rank as 6th and 12th out of 37 crossings in the Spine corridor, respectively, so the need for upgrades is high. The primary reason the three-level diamond configuration was recommended is because this high-capacity service traffic interchange design is compact and fits well within highly developed areas, is compatible with frontage roads, can maintain access to adjacent properties along the arterial corridor with U-turn movements, and improves bicycle and pedestrian safety within the interchange. Unlike the other four three-level diamond locations in the Spine corridor, these two would be unique in that the I-17 main line would be reprofiled to add the third level for the interchange. Given the current geometry of these interchanges, this appears to be the simplest method to construct these interchanges while maintaining all local access. Finally, the Thunderbird Road traffic interchange is one of the traffic interchanges that would include the drainage improvements noted in the main line discussions and would be integrated into the new traffic interchange improvements.

- **Arterial Improvements**

This section of I-17 has continuous one-way frontage roads along both sides of the freeway. The Spine study recommendation proposes to perpetuate these frontage roads to maintain local access and to provide I-17 main line redundancy during times of congestion or incidents. Two-lane frontage roads are desirable, but single-lane frontage roads may be all that is possible. Given the I-17 improvements, these frontage roads would likely be completely reconstructed, and in some cases would be relocated, requiring some new ROW.

In addition to the frontage roads, substantial improvements are anticipated along the arterials where the interchange modifications are being proposed, as noted in the previous section.

While improvements to both parallel arterials (19th and 35th avenues) was considered, no improvements were ultimately recommended because 19th Avenue is becoming a transit corridor that is not a good candidate for rerouting I-17 traffic during incidents. Similarly, 35th Avenue is also not a good candidate corridor to improve capacity because of the numerous school zones along that arterial.

- **Transit Improvements**

Dual HOV lanes in each direction would improve public transportation operations, safety and travel time reliability for those bus routes that currently use the I-17 corridor. In addition, the new DHOV connection at the North Stack traffic interchange would improve transit operations between I-17 and the Northwest Valley destinations.

The accommodations for the light rail transit crossings at the I-17/Mountain View Road crossing would be an important interface point of the two systems and should be coordinated early to ensure that optimum solutions are found for both the freeway and the transit, both in space and in time. This work has started and is progressing under the current assumption that the I-17 drainage improvements project is advancing early to precede the light rail transit construction.

The proposed three-level diamond at the I-17/Bell Road traffic interchange creates an opportunity to expand the park-and-ride facility in the southwestern quadrant. Today, expansion of that park-and-ride is not feasible, despite it being the most-used park-and-ride in the Valley. The three-level diamond would allow for that park-and-ride to be expanded into the current freeway ROW, allowing it to at least double in size. This park-and-ride expansion is included in the Spine study recommendation and would retain the express bus stop along the southbound entrance ramp and the dedicated HOV entrance ramp to I-17 at the Bell Road traffic interchange. This location can be seen in Figure 6-25.

- **Bicycle and Pedestrian Improvements**

All of the reconstructed traffic interchanges would be redesigned using the latest bicycle and pedestrian infrastructure design standards for interchanges. The Peoria Avenue traffic interchange reconstruction would have a special emphasis on bicycle and pedestrian safety because that interchange has a high crash rate for bicycles and pedestrians. Other interchanges are specifically noted in the *Phoenix Comprehensive Bicycle Master Plan* (November 2014) as having bicycle routes through them, including the Thunderbird Road, Greenway Road, Bell Road and Union Hills Road traffic interchanges. All but the Union Hills traffic interchange would be reconstructed, so integrating bicycle and pedestrian elements would occur with those efforts. The Union Hills traffic interchange, which ranks 35th out of 37 crossings in the Spine corridor, does not warrant a traffic interchange upgrade, but bicycle and pedestrian enhancements are proposed at this crossing to be consistent with the *Phoenix Comprehensive Bicycle Master Plan* (November 2014).

A new dedicated grade-separated structure would cross over I-17 at Paradise Lane, consistent with the *Phoenix Comprehensive Bicycle Master Plan*.

Figure 6-22. Recommended Alternative, Sheet 21 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)

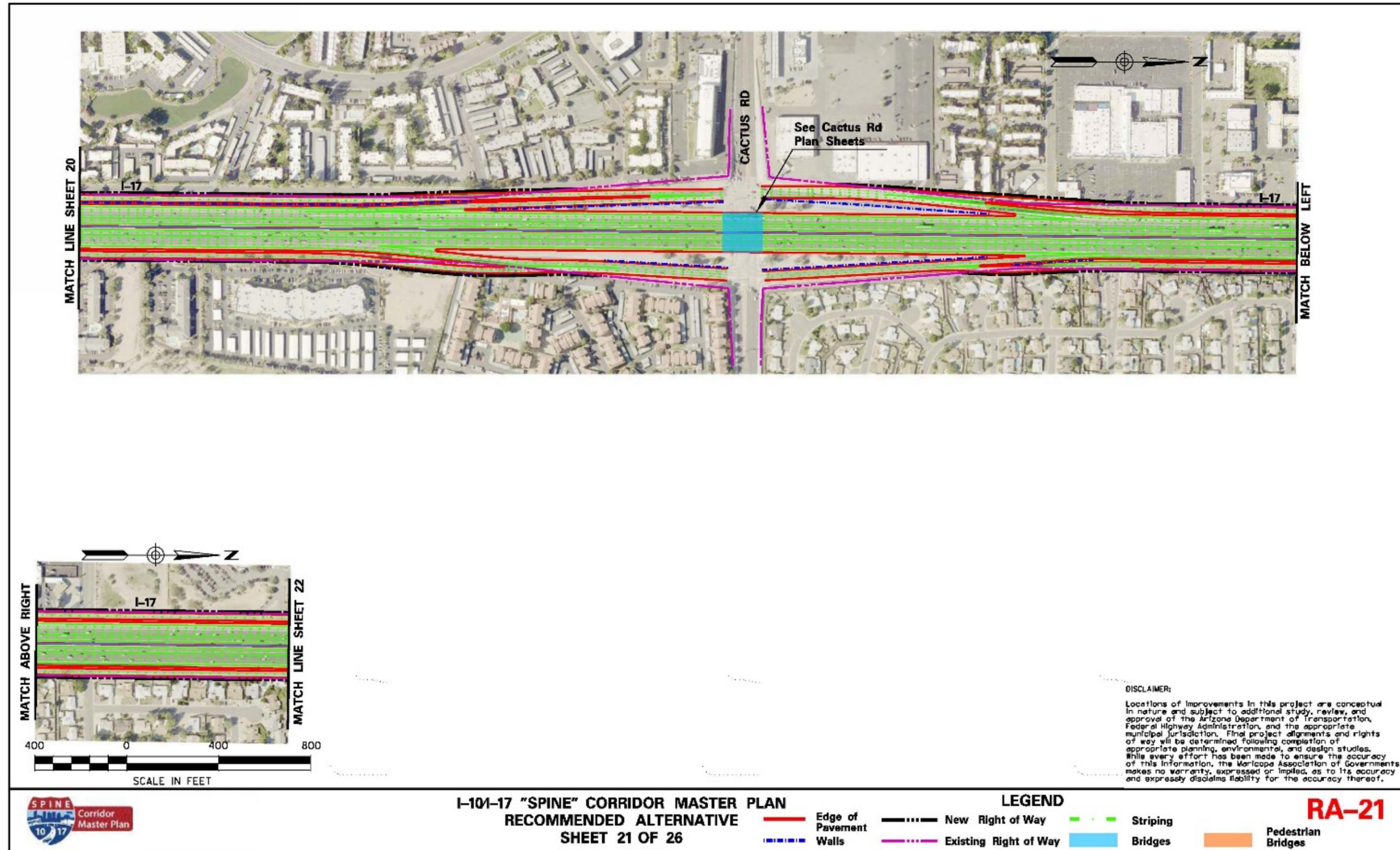


Figure 6-23. Recommended Alternative, Sheet 22 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)

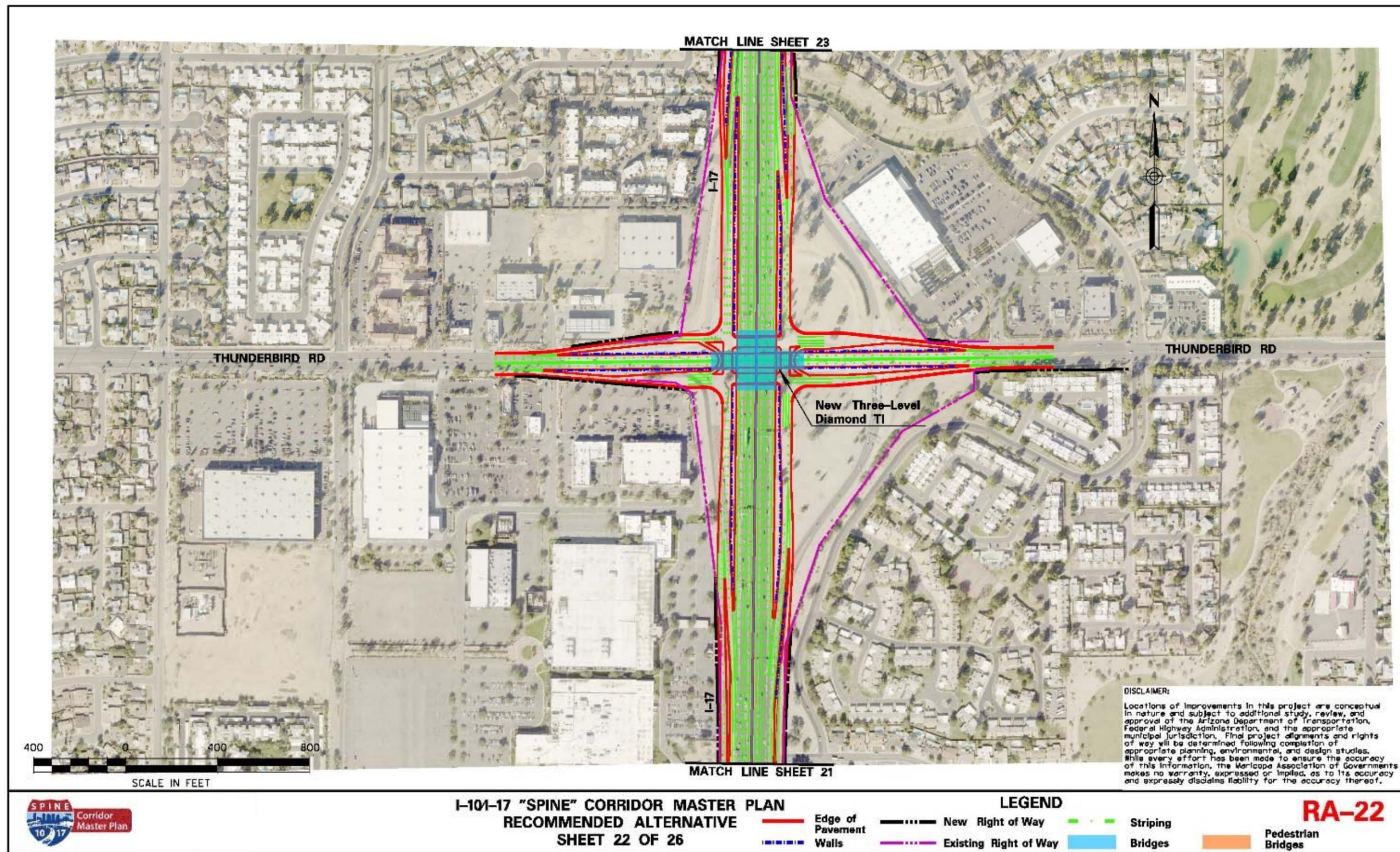


Figure 6-24. Recommended Alternative, Sheet 23 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)

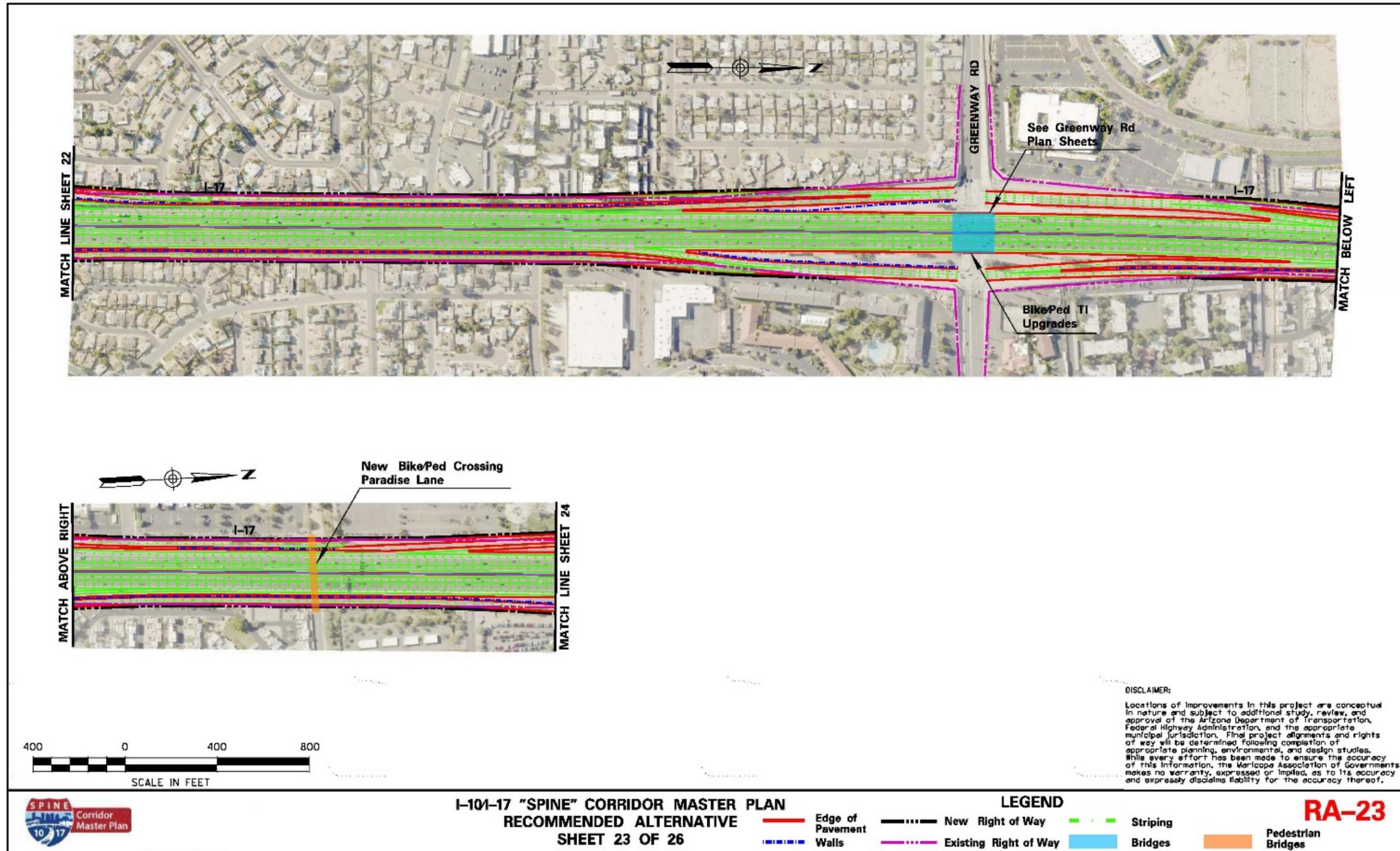


Figure 6-25. Recommended Alternative, Sheet 24 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)

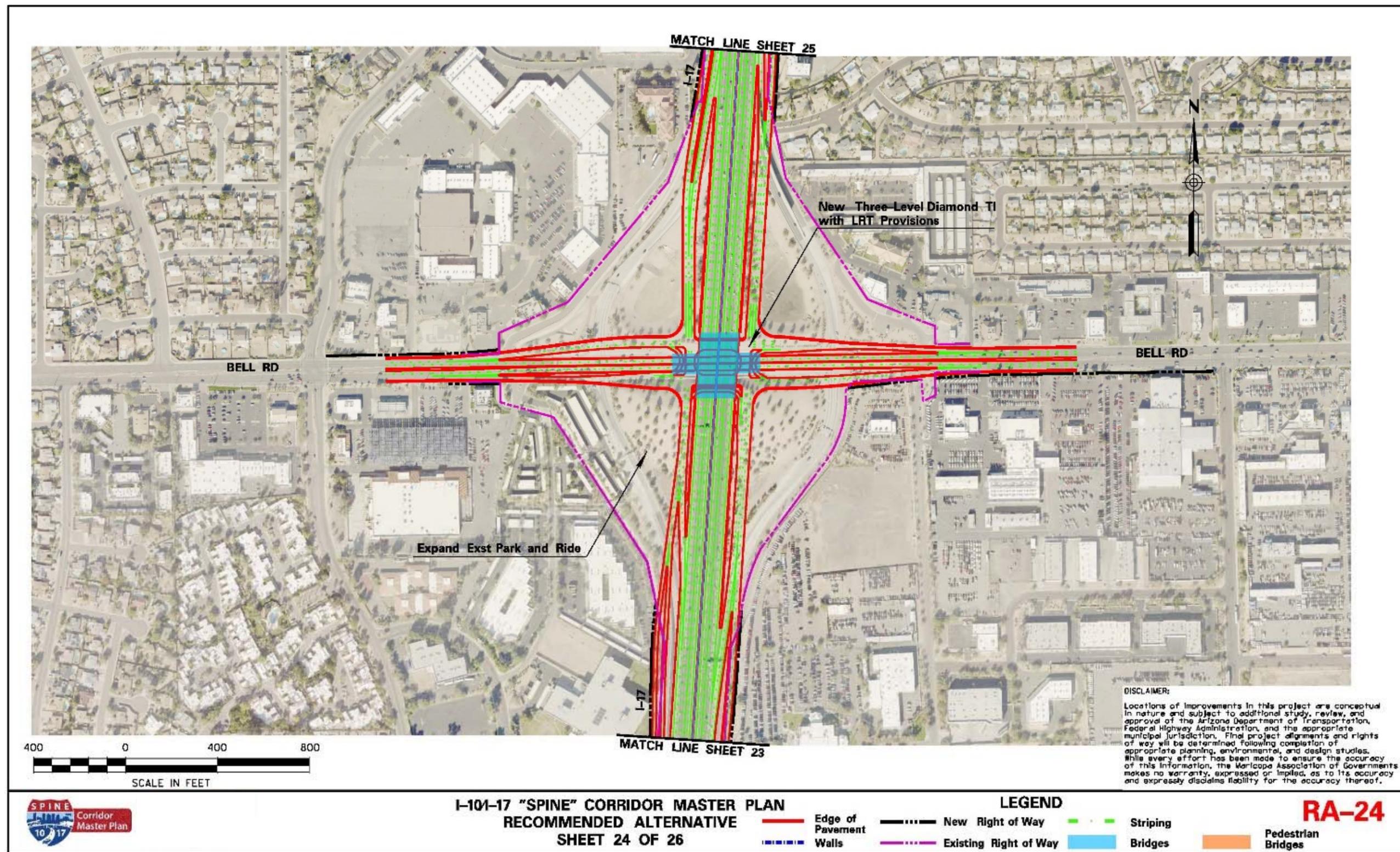


Figure 6-26. Recommended Alternative, Sheet 25 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)

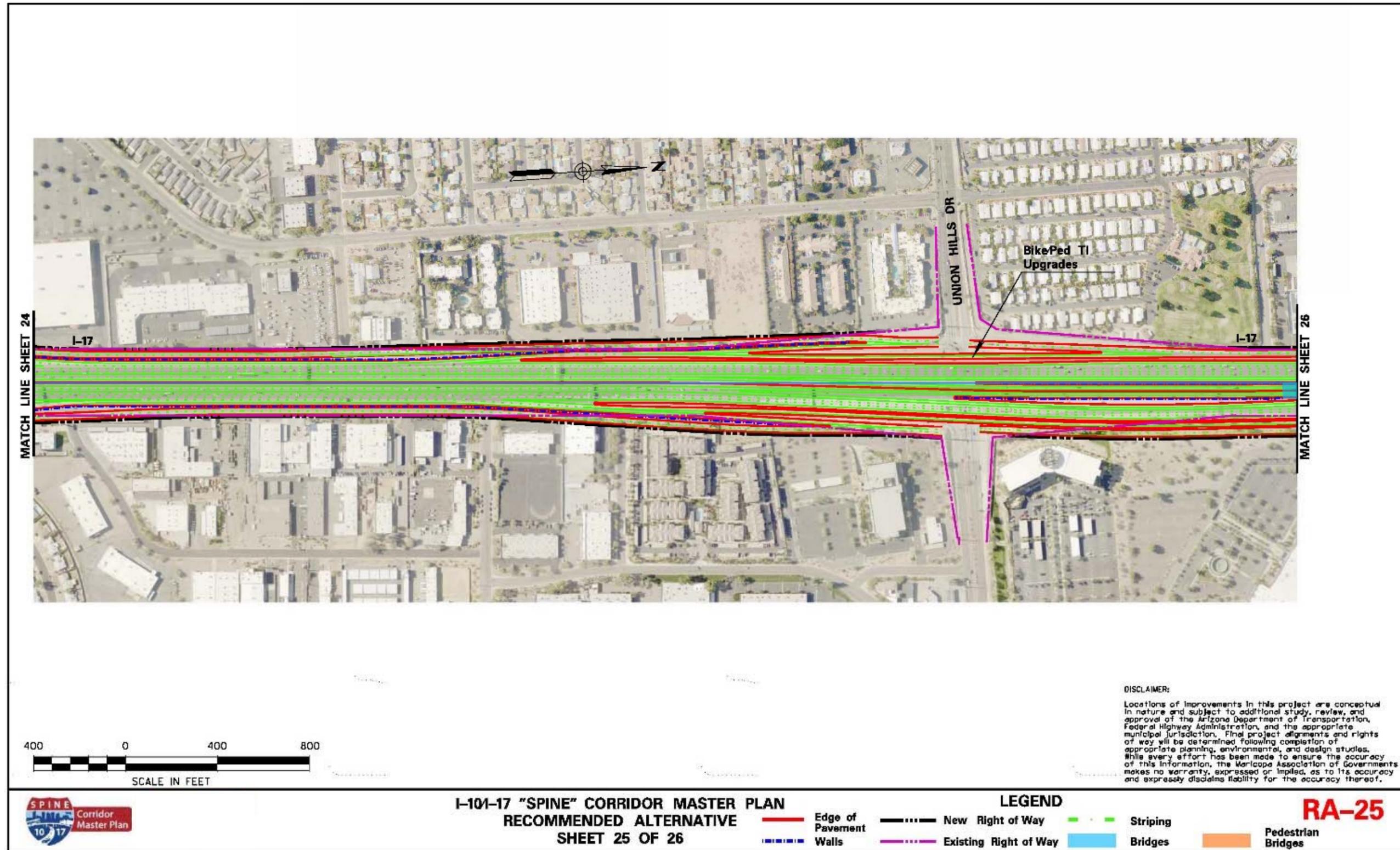
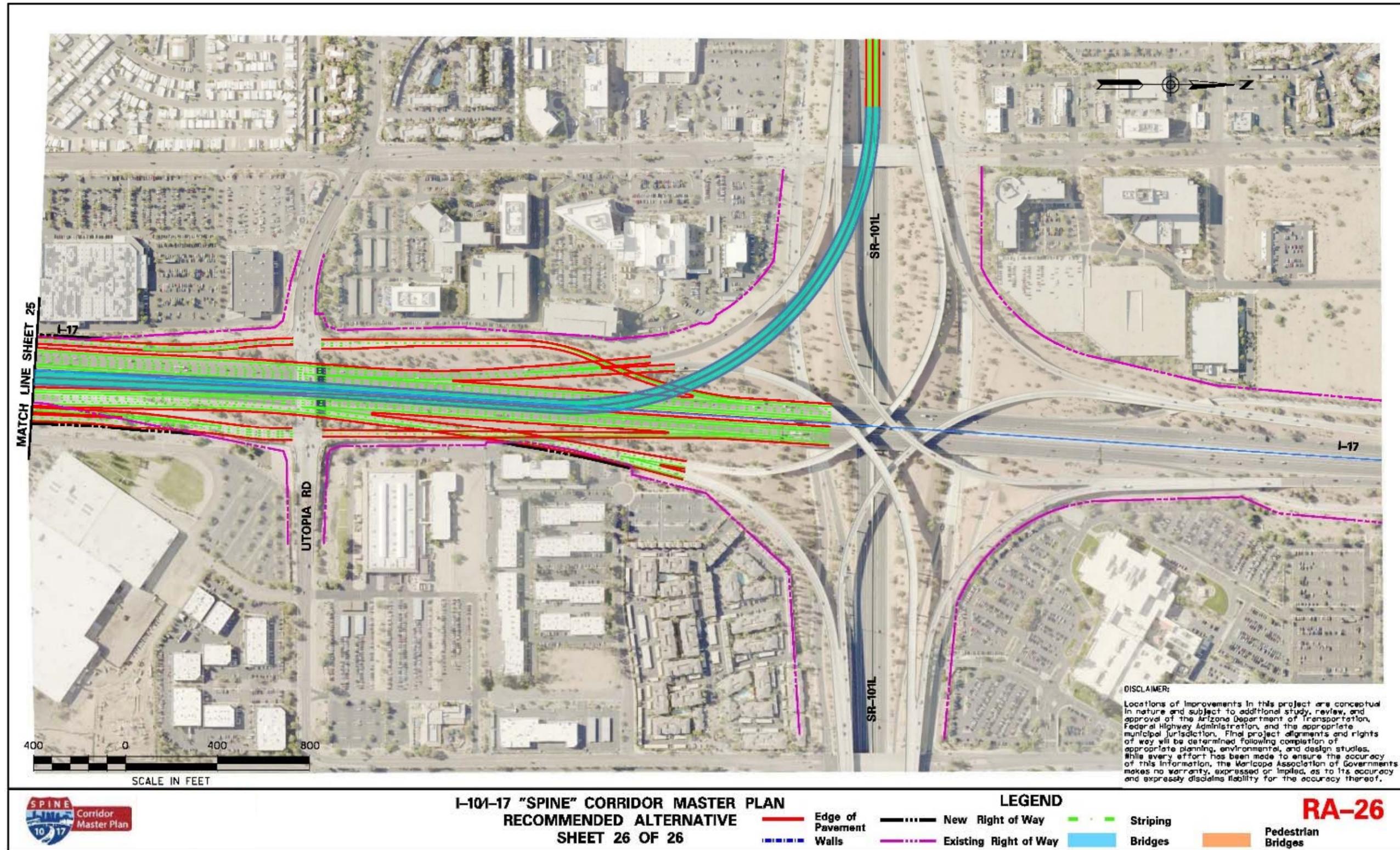


Figure 6-27. Recommended Alternative, Sheet 26 of 26 (I-17 Segment: Dunlap Avenue to SR-101L North Stack)



6.2.7 Technology Integration

The Spine study recommendation is not limited to roadway and transit expansion projects. From the beginning of this study, it has been recognized that integrating the latest technology into the Spine corridor to expand capacity would be mandatory. Because technology in this field is changing so rapidly, it is unclear exactly which technology would be used and where, but Chapter 7 of this report attempts to summarize what is known at this time. For the purpose of this recommendation, it should be assumed that information contained in that chapter is included in the Spine study recommendation.

6.3 Operational Characteristics of the Recommended Alternative

The recommended alternative was assessed with a variety of metrics to address the effectiveness of the proposed strategy in enhancing operations within the corridor. The analysis focused on the evening peak commute period for the forecast year (Table 6-2).

Each analyzed segment experienced a 2 to 4 percent increase in VMT, with an associated reduction in congested VMT. Corridor wide, the recommended alternative would facilitate nearly 200,000 more vehicle miles of travel during the evening commuting peak, and would accommodate an additional estimated 40,000 person-trips beyond that forecast under the base condition. The most notable increase in person trips would occur in the segment of I-17 between 24th Street and McDowell Road, where the recommended alternative would provide HOV opportunities not available under the base condition. In this segment, an estimated 16,700 additional persons would be accommodated in the future year peak period as compared with the base condition.

Travel speeds during the peak period are forecast to increase throughout the corridor, although only marginally (0.5 to 1.3 mph, depending on the segment). However, the duration of congestion along the corridor would decrease. The greatest decrease in the duration of congestion is anticipated to occur in the segments between Southern Avenue and McDowell Road. In this portion of the corridor, congestion is anticipated to last 9 hours per day in the northbound/westbound direction and over 11 hours per day in the southbound/eastbound direction. Essentially, this means that traveling through this segment of the corridor would be very slow (25 mph or less) and would be hard to avoid during daylight hours. With implementation of the recommended improvements, the duration of congestion is anticipated to decrease to 4 hours per day in the northbound/westbound direction and 6 hours per day in the southbound/eastbound direction—5 fewer hours of congestion each day per direction.

6.4 Design Exceptions Associated with the Recommended Alternative

Overall, the Spine study recommendation proposes to eliminate the most critical design exceptions in the corridor—lane and shoulder widths, short acceleration and deceleration lengths, substandard vertical clearances under structures and inadequate sight distance. However, the study team realizes that some of these design exceptions would still be necessary to execute the Spine study recommendation, especially as it relates to implementing context-sensitive or practical design solutions in areas where tight, sensitive or protected ROW exists.

The following is a list of areas where design exceptions would or may be necessary, depending on how the design process evolves. This list is not meant to be comprehensive, nor should it be construed that these design exceptions have been preapproved. Rather, it is meant to define expectations of all stakeholders going into the preliminary design phase of the project.

- **Inside shoulder widths:** Every bridge pier and foundation within the median barrier would restrict the inside shoulder to less than the desirable width for a short distance.
- **Weave lengths:** With regard to Chapter 10 of the American Association of State and Highway Transportation Officials 2011 *Green Book*, the desirable weave lengths will rarely be achievable throughout the corridor. Because the traffic interchanges in this corridor already exist, the available length for the weave area is a function of the current spacing. Ultimately, this means that the design will not be able to increase the weave length much beyond what exists today.
- **I-17 – Split to the Stack:** ROW is constrained in this segment, and in some cases contains EJ or Title VI communities. New ROW should be carefully considered to minimize impacts on businesses and communities. This may require some shoulder width design exceptions, ramp geometry exceptions or weaving length exceptions to balance impacts with the design. In addition, the Spine study recommendation does not attempt to address the large floodplain issue that exists along the eastern side of I-17 between the Durango Curve and I-10 because it is not within the scope of this Spine study. FCDMC has developed a preliminary design to solve the floodplain issue, but it does require large amounts of ROW in EJ and Title VI communities. As such, the Spine study recommendation relies on FCDMC to implement its solution or another solution to address the floodplain issue.
- **I-17 – Stack:** The restriping of I-17 through the Stack to extend the HOV lanes south through the Stack would require at least shoulder width but also possible lane width design exceptions.
- **I-17 – Stack to Dunlap Avenue:** This segment of I-17 is bordered on both sides by commercial and residential development that would have impacts with new ROW acquisition. Further study is required in this area to find the right balance between the needs of the Spine corridor and minimizing impacts on developed ROW. It is reasonable to conclude that some segments of I-17 in this area would use shoulder and/or lane width design exceptions to construct the required number of lanes.

6.5 Concept Plans Associated with the Recommended Alternative

Throughout this chapter, concept plans have been developed to illustrate the recommended alternative. This concept represents one possible interpretation of the features described in this chapter resulting from the Spine recommendation. This concept should not be interpreted as the only possible solution since further engineering, environmental and public outreach is needed to refine the project(s). The concept was developed so that a project, or list of projects, could be defined both in terms of costs, schedules and implementation for inclusion in the RTP. Details of how this has been done can be found in Chapter 8.

In addition to the concept plans, Figures 6-28 through 6-34 are included in the following pages to show the lane diagram for the recommended alternative.

Table 6-2. Operational Comparison of Recommended Alternative with No-Build

Alternative		VMT	% VMT Congested	VHT	% VHT Congested	VMT/VHT (mph)	General Purpose Travel Time (Minutes, 2-6 p.m. Peak)	HOV Travel Time (Minutes, 2-6 p.m. Peak)	Person-Trips ^a	Average General Purpose v/c	Average HOV v/c	Freeway Duration of Congestion (Hours)
I-10: SR-202L to Southern Avenue												
No-Build	Northbound/Westbound	1,103,239	38.6%	32,110	45.3%	34.4	5.25	4.28	32,194.90	0.76	0.40	0.5
No-Build	Southbound/Eastbound						7.71	5.87	43,077.96	1.11	0.53	0.0
Recommended Alternative	Northbound/Westbound	1,133,254	33.6%	32,471	41.2%	34.9	4.86	4.40	33,624.46	0.83	0.47	1.3
Recommended Alternative	Southbound/Eastbound						7.39	6.14	31,420.94	1.17	0.62	0.0
I-10: Southern Avenue to 24th Street												
No-Build	Northbound/Westbound	1,476,599	55.5%	54,810	58.1%	26.9	8.83	6.79	58,490.04	0.95	0.56	9.0
No-Build	Southbound/Eastbound						9.02	7.46	51,086.32	1.01	0.64	11.3
Recommended Alternative	Northbound/Westbound	1,533,154	53.2%	54,236	56.5%	28.3	5.45	3.64	65,915.24	0.96	0.51	4.3
Recommended Alternative	Southbound/Eastbound						5.57	4.01	55,570.04	0.94	0.48	0.5
I-17: I-10 24th Street to McDowell Road												
No-Build	Northbound/Westbound	1,585,619	53.4%	66,877	57.2%	23.7	17.89	13.99	26,548.77	1.09	N/A	6.8
No-Build	Southbound/Eastbound						10.40	10.40	19,004.80	0.74	N/A	6.0
Recommended Alternative	Northbound/Westbound	1,620,144	51.1%	66,640	55.5%	24.3	16.64	7.67	37,346.33	1.12	0.68	0.0
Recommended Alternative	Southbound/Eastbound						8.49	5.70	24,913.98	0.78	0.35	5.8
I-17: McDowell Road to Dunlap Avenue												
No-Build	Northbound	1,320,490	65.3%	56,416	69.4%	23.4	15.44	7.78	38,525.02	1.46	0.75	5.5
No-Build	Southbound						10.16	7.01	28,615.24	1.09	0.54	3.3
Recommended Alternative	Northbound/Westbound	1,368,625	61.1%	56,593	68.0%	24.2	16.13	6.76	45,633.44	1.25	0.58	4.8
Recommended Alternative	Southbound/Eastbound						10.22	5.99	35,387.72	0.97	0.37	5.3

Table 6-2. Operational Comparison of Recommended Alternative with No-Build

Alternative		VMT	% VMT Congested	VHT	% VHT Congested	VMT/VHT (mph)	General Purpose Travel Time (Minutes, 2-6 p.m. Peak)	HOV Travel Time (Minutes, 2-6 p.m. Peak)	Person-Trips ^a	Average General Purpose v/c	Average HOV v/c	Freeway Duration of Congestion (Hours)
<i>I-17: Dunlap Avenue to SR-101L</i>												
No-Build	Northbound	1,213,005	45.0%	40,251	49.0%	30.1	16.21	10.55	41,260.33	1.27	0.69	5.3
No-Build	Southbound						8.37	6.26	31,308.74	1.07	0.50	4.8
Recommended Alternative	Northbound/Westbound	1,242,816	46.4%	40,433	50.4%	30.7	16.05	7.93	46,325.66	1.21	0.61	4.5
Recommended Alternative	Southbound/Eastbound						8.37	5.47	34,139.88	1.07	0.40	4.0

^a Person-trips includes HOV, general purpose and transit trips.

Figure 6-28. Recommended Alternative Lane Line Diagram, Sheet 1 of 7

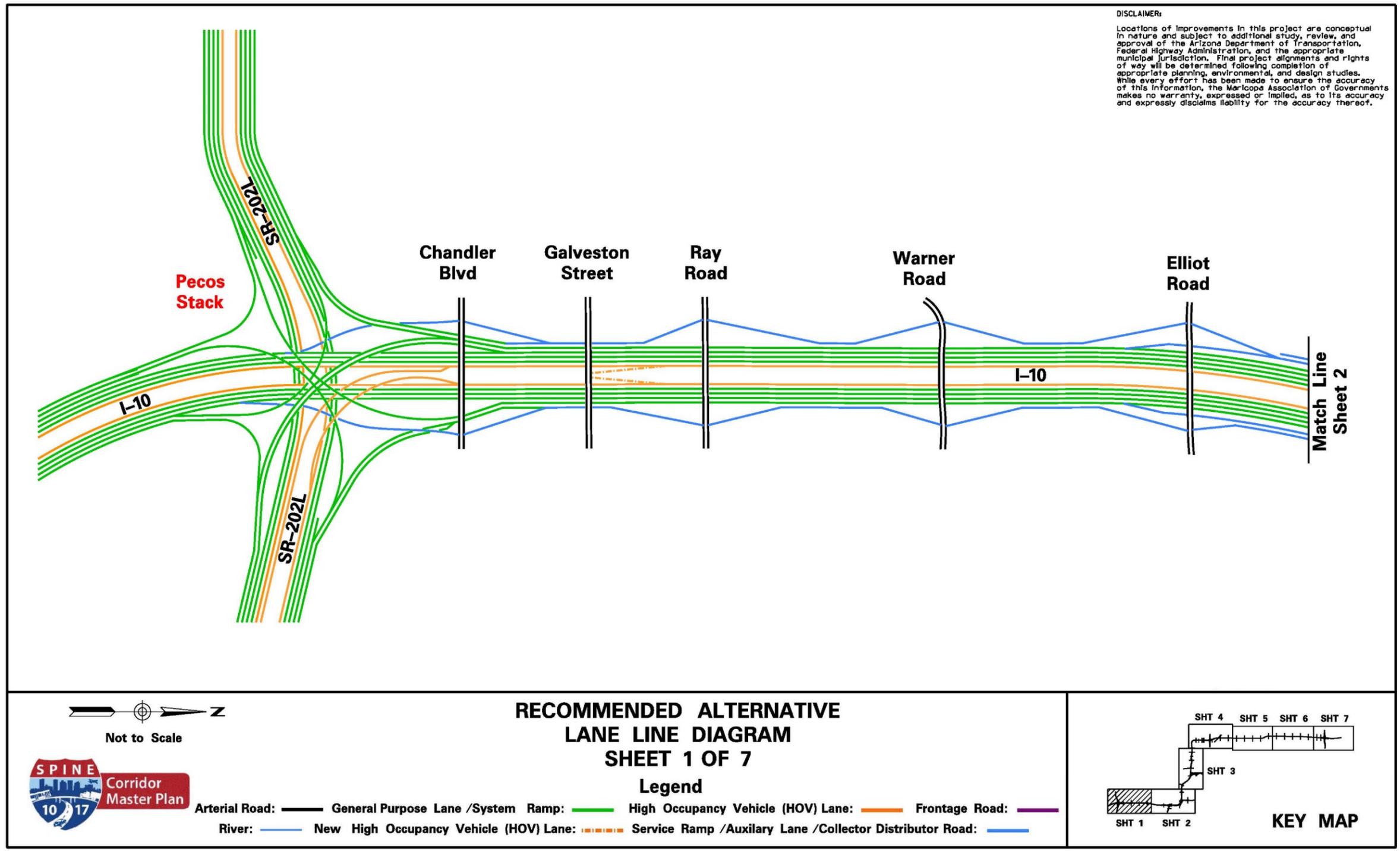


Figure 6-29. Recommended Alternative Lane Line Diagram, Sheet 2 of 7

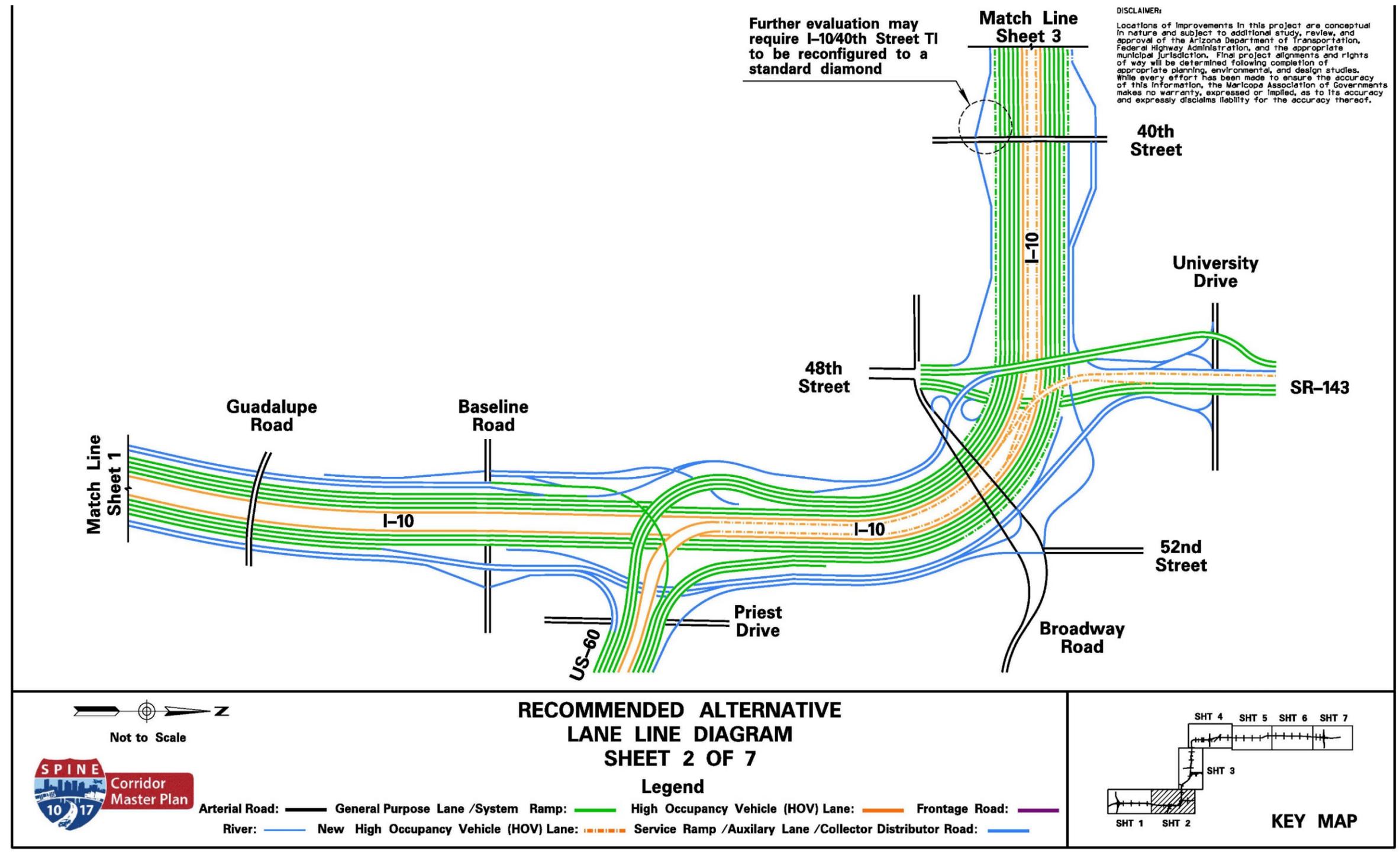


Figure 6-30. Recommended Alternative Lane Line Diagram, Sheet 3 of 7

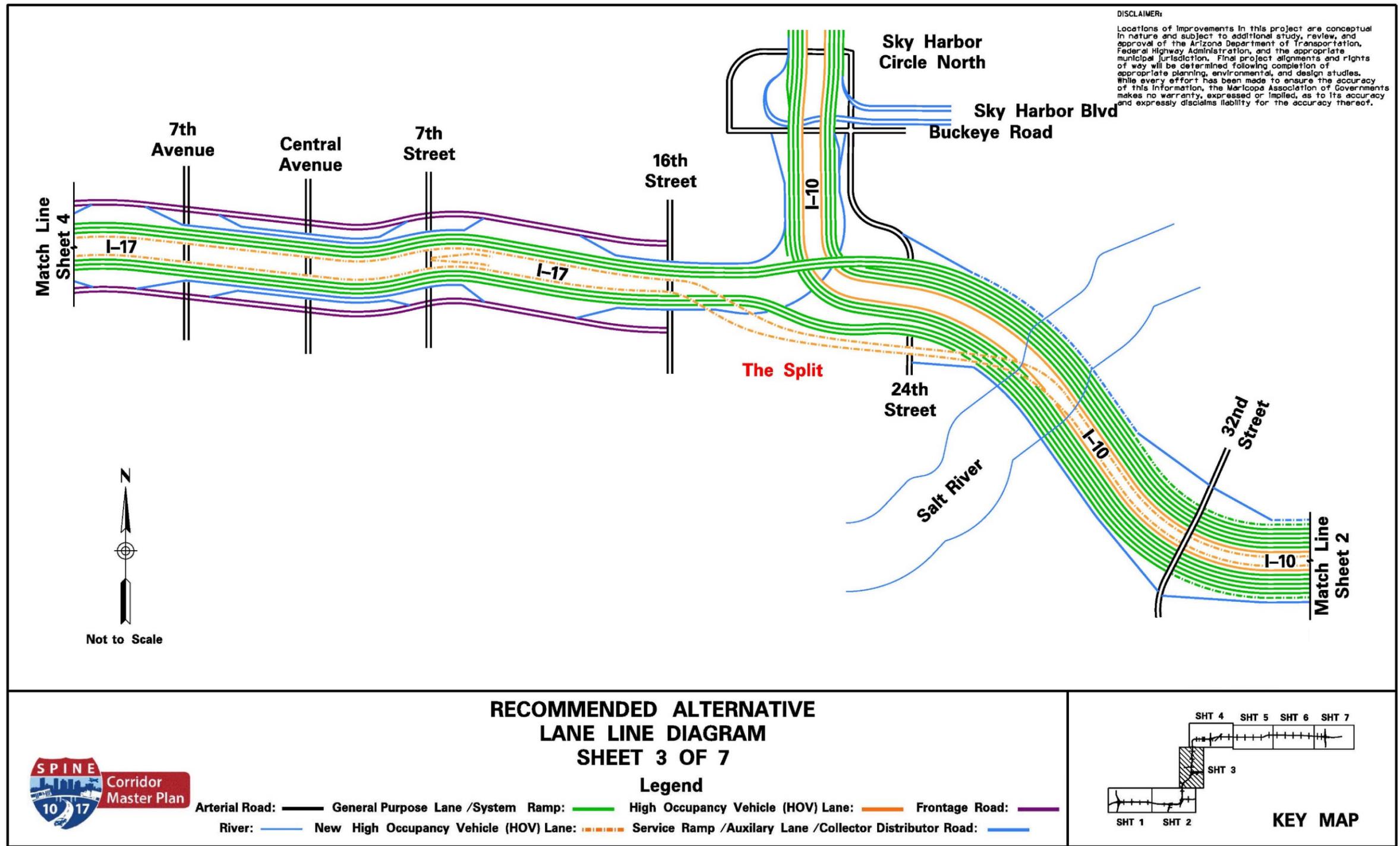


Figure 6-31. Recommended Alternative Lane Line Diagram, Sheet 4 of 7

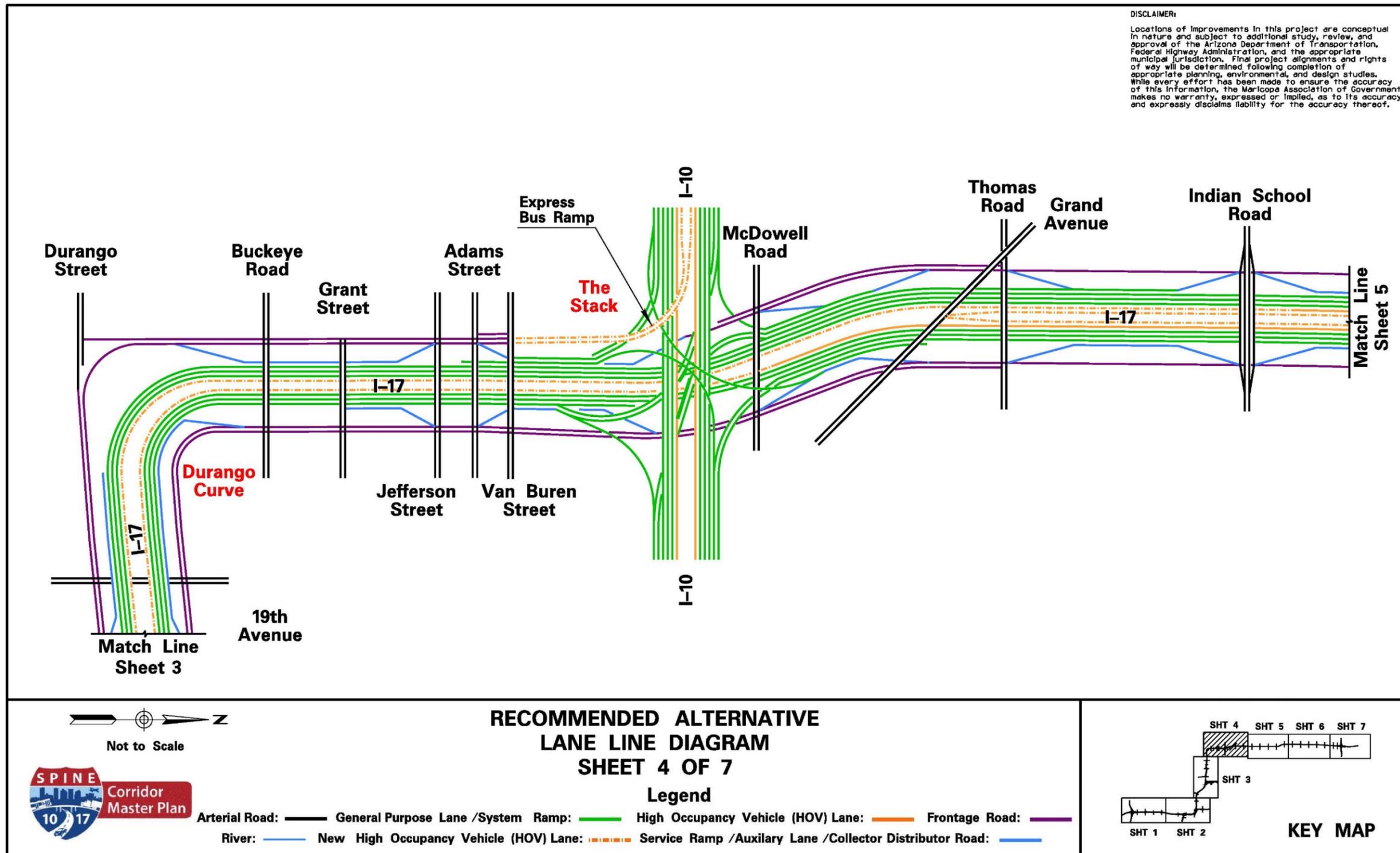


Figure 6-32. Recommended Alternative Lane Line Diagram, Sheet 5 of 7

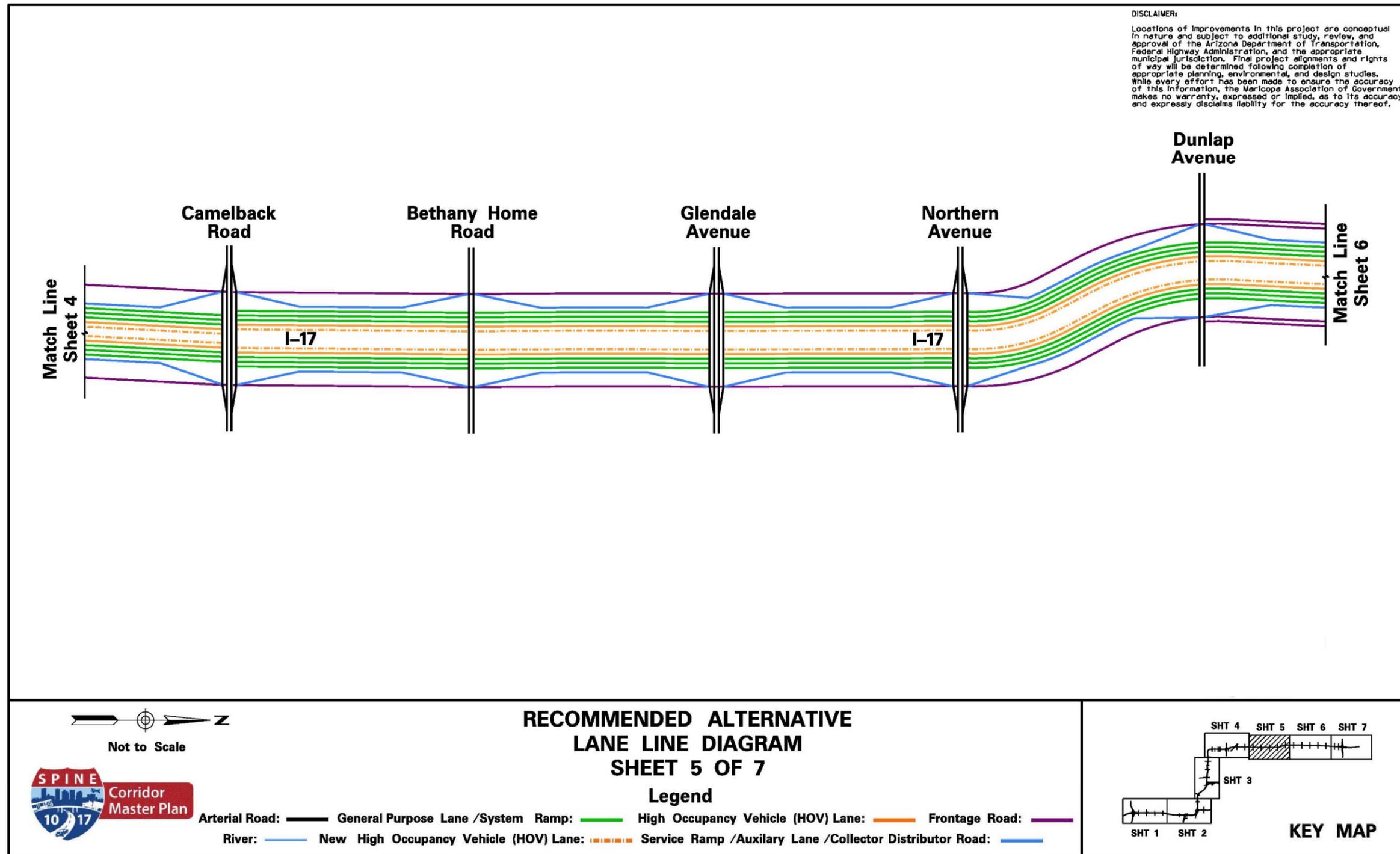


Figure 6-33. Recommended Alternative Lane Line Diagram, Sheet 6 of 7

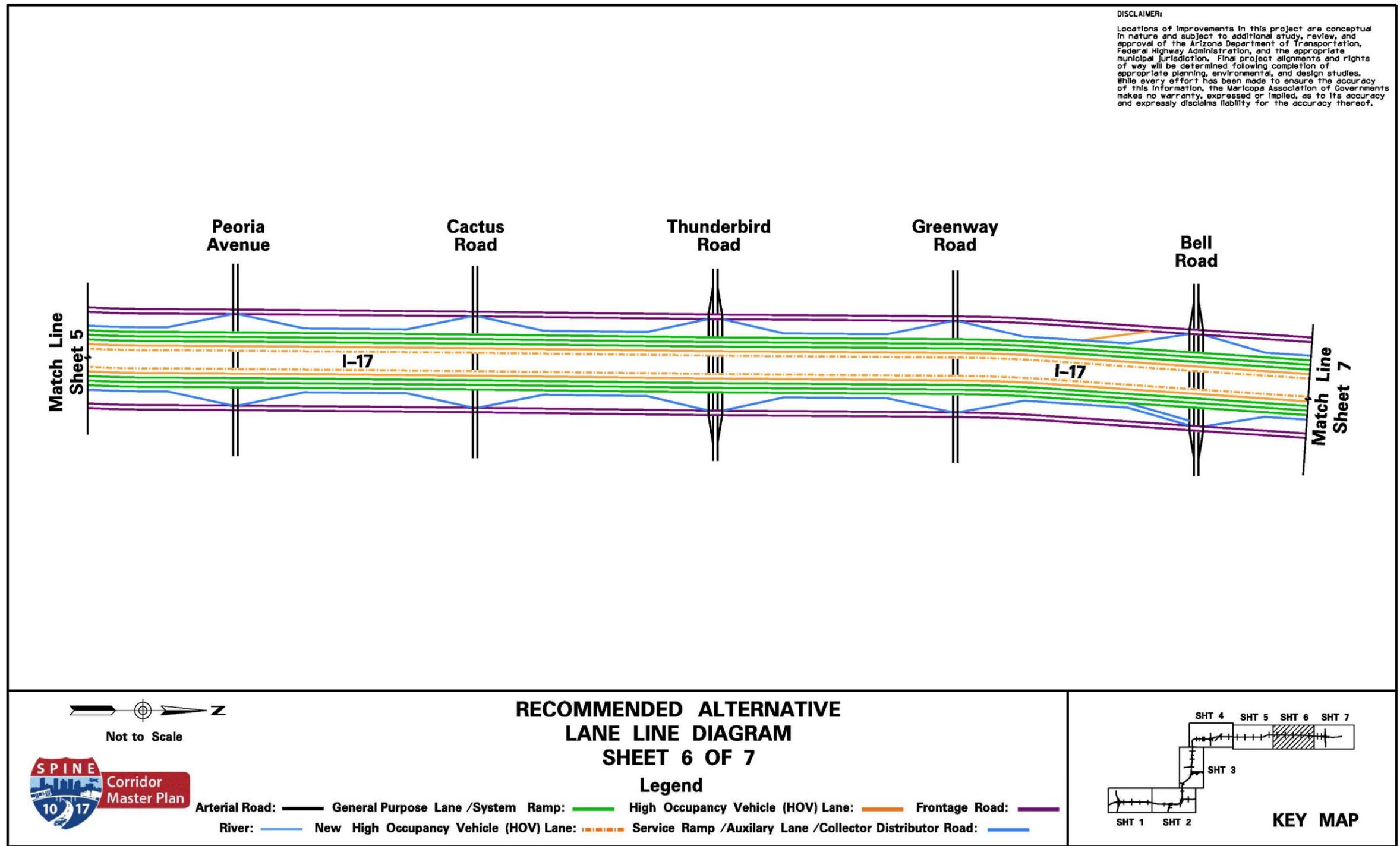


Figure 6-34. Recommended Alternative Lane Line Diagram, Sheet 7 of 7

