

Congress St/4th Ave/Toole Ave Road Safety Assessment



Prepared for:
City of Tucson
Department of Transportation

Prepared by:



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Project Request

The Road Safety Assessment (RSA) of the Congress Street/4th Avenue/Toole Avenue intersection was conducted at the request of the City of Tucson Department of Transportation. During the Start-up Meeting, the City requested that the RSA team expand the study area to include the segment of Congress Street between 4th Avenue and South Toole Avenue. The segment being evaluated is highlighted in Figure 1. The RSA request discussed the following issues:

- Bicyclist concerns, including bicycle/motor vehicle interactions, connectivity and wayfinding, streetcar tracks and the planned streetcar stop, turn restrictions, and land-use redevelopment
- Motor vehicle sideswipe crashes
- Pedestrian concerns, which may increase with housing/commercial development

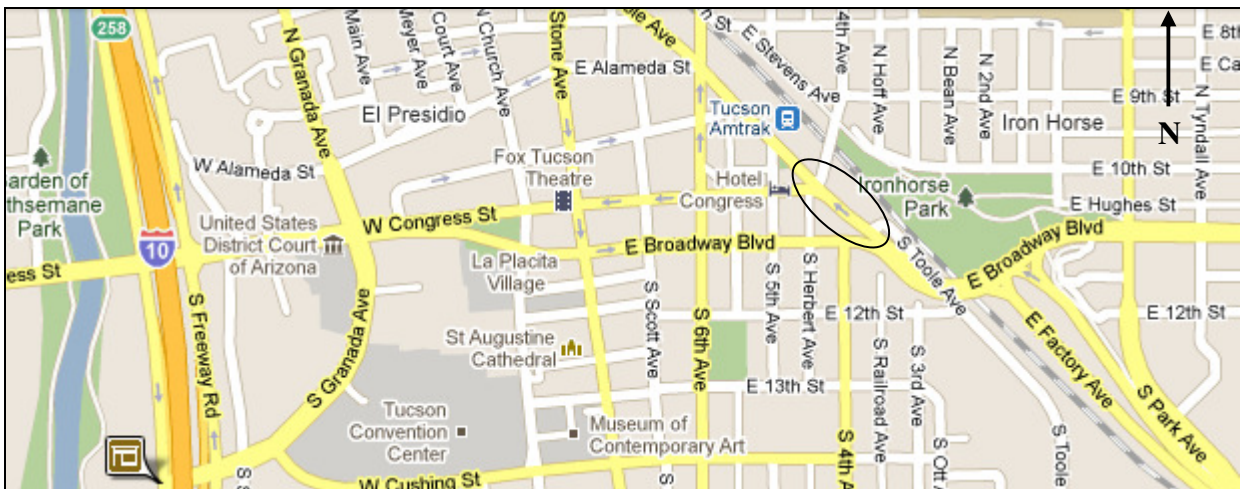


Figure 1: Location Map

RSA Team

The independent, multi-disciplinary RSA team was led by Mike Blankenship, the Arizona RSA Program Manager. The RSA team included:

- Mike Blankenship, P.E., ADOT Traffic Safety
- Jay Harper, Metro Light Rail
- Richard Nassi, P.E., independent consultant
- Gabe Thum, Pima Association of Governments
- Richard Weeks, P.E., PTOE, AECOM Technical Services
- Matt Zoll, AICP, Pima County DOT

RSA Process

A Road Safety Assessment is a formal examination of user safety of a roadway by an independent, multi-disciplinary team which includes experienced and knowledgeable members. RSAs have been shown to help promote safety by: identifying a range of safety issues; promoting awareness of safer transportation planning, design, construction, and maintenance practices; integrating multimodal interests; and, more directly considering the

effect of human factors, enforcement and education activities, and emergency responder practices.

The RSA team conducted this assessment to the best of its abilities within the time allotted. The initial recommendations are based upon background information provided during the Start-up and Preliminary Findings Meetings, an evaluation of recent crash data, and both day and night field reviews, as discussed in the following paragraphs. This information helped the RSA team identify potential opportunities to improve the safety performance of the Congress Street/4th Avenue/Toole Avenue intersection and its adjacent network links. This information was initially presented to the group at the Preliminary Findings Meeting. While every attempt has been made to identify potential safety issues, the safety performance of the roadway remains the responsibility of the roadway owner and roadway users.

The RSA team is available to provide additional clarification as the City of Tucson reviews and responds to this report and pursues countermeasures.

Start-Up Meeting

The assessment team met with the road owner to discuss background information and the RSA schedule April 26, 2011 at the City of Tucson Parkwise Conference Room. The RSA Agenda can be found in the **Appendix**. In addition to the RSA team, participants included Diahn Swartz from City of Tucson Department of Transportation, Tom Thivener from Tucson Department of Transportation, Chris Leighton from City of Tucson Parkwise, Sgt. Jerry Skeenes from Tucson Police Department, Paul Casertano from Pima Association of Governments, and Emily Yetman from Living Streets Alliance. Following is a summary of the information provided during the Start-up Meeting.

The 4th Avenue underpass project, completed in August 2009, changed the intersection geometry for road users wanting to turn onto Toole Avenue from Congress Street. This movement now requires road users to bear left into the horizontal curve and then maneuver around a bulb-out on the northeast corner; prior to the underpass project, this was a straight through maneuver. Figure 2 shows the intersection before and after the underpass project.

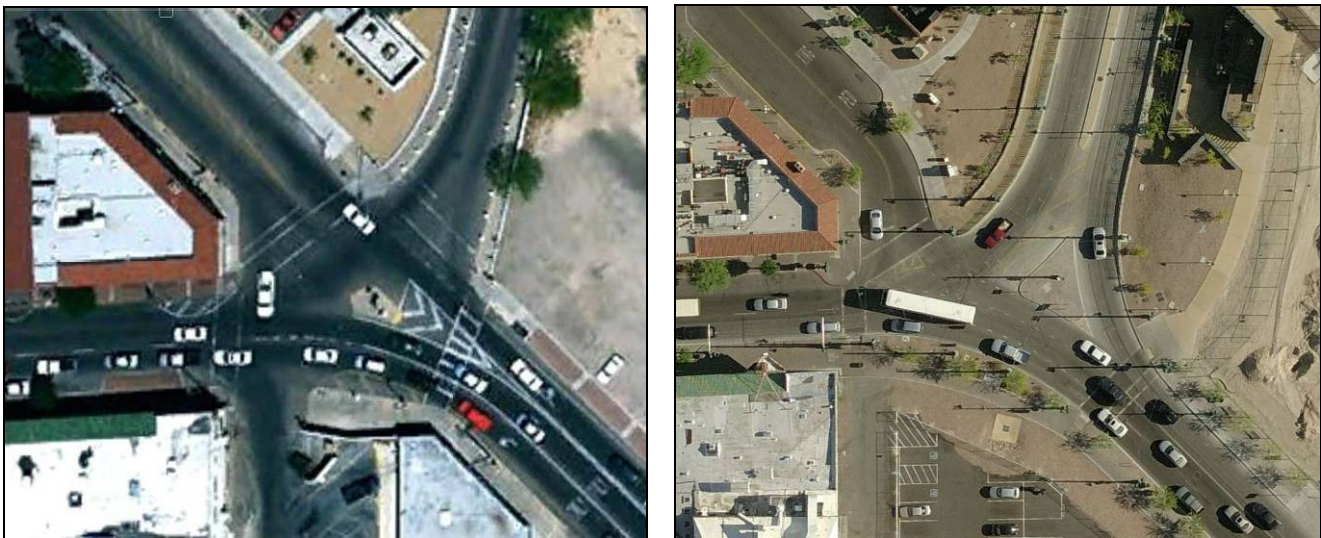


Figure 2: Aerial View of Congress St/4th Ave/Toole Ave Before and After 4th Ave Underpass Project

There are no marked crosswalks across 4th Avenue due to ADA cross slope issues. Left-turns are prohibited from Toole Avenue to 4th Avenue. The Herbert Avenue driveway at Congress Street has been closed to vehicular traffic and replaced with a pedestrian ramp, and it is frequently gated off for events at the Rialto Theater. The Downtown Links is a future roadway project that will extend Aviation Parkway to 6th Street, diverting some traffic that would use the Congress Street/4th Avenue/Toole Avenue intersection. A pedestrian bridge has been constructed over 4th Avenue just north of the intersection. A streetcar stop is planned for the north side of Congress Street between 4th Avenue/North Toole Avenue and South Toole Avenue. Streetcar tracks are installed in the travel lanes of Congress Street and 4th Avenue.

The City identified several motor vehicle issues for the team to consider, including:

- Some motorists on westbound Congress Street turn right onto Toole Avenue from the center lane instead of the right lane, creating conflicts and sideswipe crashes
- Some southbound motorists on 4th Avenue turn “right” onto Congress Street during the red signal indication, which is an illegal maneuver since the motorists is actually crossing the intersection on red (a right-turn on red onto Toole Avenue is legal)
- Some motorists on westbound Congress Street make a wide right-turn onto Toole Avenue, crossing the double yellow centerline and entering oncoming traffic lanes
- There is routine congestion that leads to gridlock due to the current signal timing plan
- When the intersection is not gridlocked, many vehicles approach the intersection from Broadway at a high rate of speed

The Congress Street/4th Avenue/Toole Avenue intersection is the busiest intersection in downtown for bicyclists, with 270 bicyclists using the intersection during the 2010 PAG four-hour bike count, which is a weekday count from 7-9 AM and 4-6 PM. Within the City limits, it is illegal to ride bikes on sidewalks unless specifically signed for bike use. Bike circulation issues include:

- Bicyclists legally can’t make a left turn from Toole Avenue to 4th Avenue. Many bicyclists make the turn anyway or use the sidewalk.
- The lack of a curb ramp on Toole Avenue near Maynard’s Market makes it difficult to access the pedestrian bridge over 4th Avenue
- The bike lane ends as you exit the 4th Avenue underpass. Pavement markings are not very visible, and vehicles crowd bikes. Motor vehicles and bikes compete for space in the shared lane on Congress Street.
- Driveway at Herbert Avenue is closed off and replaced with a pedestrian ramp. Many southbound bicyclists use it anyway.
- Bicyclists heading west on Congress Street or north on Toole Avenue must make a difficult crossing of the streetcar tracks and merge into faster moving traffic (at the same time, the bike lane ends and positive guidance is missing to help bicyclists navigate the intersection)
- The future streetcar stop platform will move the curb inward toward the existing track, eliminating the bike lane at that location

Pedestrian circulation issues include:

- The long wait for the “walk” signal leads many pedestrians to cross against the signal
- Bikes use the sidewalk through the 4th Avenue underpass
- The lack of a marked crosswalk for crossing 4th Avenue leads to a lengthy detour

- The future streetcar stop platform may lead to sharing the sidewalk with bikes
- The pedestrian ramp at Herbert Avenue/Congress Street frequently has bicyclists traveling through and it is not wide enough to share
- Gridlock, especially during the evening, leads to vehicles still clearing the intersection during the pedestrian phase

Future development in the immediate area includes two student housing facilities. The Plaza Centro Student Housing will include 720 housing units, 24,000 to 33,000 square feet of retail, and a parking garage. The El Presidio Student Housing will include 320 housing units and 18,000 square feet of retail.

Evaluation of Crash Data

For the crash data analysis, crash data was collected from the ADOT Information Technology Group's Safety Data Mart (ADOT's crash database). Crash data was also provided by City of Tucson Department of Transportation. Two time periods were evaluated for crash data: before and after the completion of the 4th Avenue underpass project. The underpass project was completed August 20, 2009. The five years prior to the project completion were evaluated (August 20, 2004 through August 19, 2009) in addition to the sixteen months after the project completion (August 20, 2009 through December 31, 2010). Following is a summary of the crashes occurring during these two periods.

Before Period (August 20, 2004 through August 19, 2009)

A total of 35 crashes occurred at this intersection during this five year period. This is an average of 7 crashes per year. (It should be noted that the underpass construction may have influenced traffic volumes and patterns during a portion of this "before" period.)

The severity of the 35 crashes is summarized below.

11% non-incapacitating injury
 6% possible injury
 83% property damage only

The crash data were reviewed in an effort to determine if there were any discernible crash patterns. The percentage of each type of collision for the 35 crashes is summarized below.

34% angle (includes 1 bicyclist)
 23% sideswipe same direction
 23% rear-end
 9% fixed object
 11% other

The light conditions at the time of each of the 35 crashes are summarized below.

60% daylight
 34% dark
 6% dawn

After Period (August 20, 2009 through December 31, 2010)

A total of 28 crashes occurred at this intersection over this sixteen month period. This is an average of 21 crashes per year. (Note that crash severity is based on 16 crashes in ADOT's database. Crash type and lighting is based on 28 crashes in City of Tucson's database.)

Severity:

6% fatal
6% non-incapacitating injury
13% possible injury
75% property damage only

Type:

50% sideswipe same direction (includes 1 bicyclist)
29% rear-end
21% other

Light conditions:

56% daylight
33% dark
11% dusk

The bicyclist collision in the "after" period was a fatal crash involving a motorized bicycle on westbound Congress Street, prior to reaching the Congress St/Toole Ave/4th Avenue intersection. According to the narrative included in the crash report filed by the responding police officer, the bicyclist lost control of his motorized bicycle as he crossed the trolley tracks traveling westbound on Congress Street at 4th Avenue, falling in front of oncoming traffic.

Field Reviews

Daytime field visits were conducted on Tuesday, April 26, 2011 and Wednesday, April 27. A nighttime field visit was also conducted on Tuesday, April 26, 2011. The specific times of the site visits can be found on the RSA Agenda, a copy of which is located in the **Appendix**. The weather was clear and warm on both days. Site reviews consisted of driving and walking the intersection and surrounding links and observing road users.

The RSA team noted several existing roadway features and programs that appeared to foster safer operations in the study area, including:

- Large overhead street name signs
- Intersection and underpass well lit by street lights
- Quick street light maintenance response (responded within 30 minutes to call-out for repairs)
- 12-inch signal heads
- Wide sidewalks
- HAWK beacon at Broadway Boulevard/4th Avenue
- Green bike lane on Broadway Boulevard
- Corner bulb-outs on Congress Street
- 360-degree delineators on sign posts
- Multiple bike rack locations

- “Lane Extension lines” guiding vehicles on Congress Street through the intersection
- Good sign retroreflectivity
- Flashing stop signs and warning signs
- Pima County Bike Safety Program, including introductory classes that teach bicyclists to safely traverse trolley and streetcar tracks and a bicycle “diversion program” (after bicyclist issued citation, allowed to take 4-hour training, including 2 hours in the field)
- Downtown Tucson Partnership (“Purple People” provide assistance, security, maintenance)
- Strong coordination between Tucson Police Department and Tucson Department of Transportation on traffic enforcement issues

Preliminary Findings Meeting

The RSA team presented the preliminary findings to the City of Tucson Department of Transportation on Thursday, April 28, 2011 at the City of Tucson Parkwise Conference Room. In addition to the RSA team members, participants included Jim Glock, Diahn Swartz, and Tom Thivener from Tucson Department of Transportation, Chris Leighton from City of Tucson Parkwise, Sgt. Jerry Skeenes from Tucson Police Department, and Paul Casertano from Pima Association of Governments. Observations and potential opportunities for improvements were discussed during this meeting.

Physical Roadway Characteristics

The Congress Street/4th Avenue/Toole Avenue intersection is traffic signal controlled. Congress Street is one-way (westbound) with three approach lanes: the two left-side lanes bear to the left to continue on Congress Street, and the right-side lane is used to turn right onto either 4th Avenue or Toole Avenue. Fourth Avenue is a divided two-way street with one lane in each direction. Toole Avenue is a two-way street with one lane in each direction. The speed limit is 25 mph on all three of these streets. The 2006 average daily traffic volumes (ADT) for these streets are 27,000 vehicles per day (vpd) on Congress Street east of the intersection, 19,000 vpd on Congress Street west of the intersection, 11,000 vpd on Toole Avenue, and 8,000 vpd on 4th Avenue (2004 data). Bicycle volumes, as noted previously, are 270 bicyclists during the four peak hours. Pedestrian counts have not been taken for this intersection.

Site Review Observations and Initial Recommendations

General Observations

The existing intersection configuration was the result of extensive community/developer input. The right-turn movement from Congress Street to Toole Avenue was made sharper because the 4th Avenue approach had to be shifted into the intersection to accommodate future streetcars waiting at the intersection after departing the 4th Avenue underpass (due to the uphill grade).

The RSA team observed numerous violations of traffic control devices by motorists, pedestrians, and bicyclists, possibly due to confusion, excessive speed, inattention, inability to directly access some destinations, excessive waits, carelessness, and willful violations.

The Plaza Centro building contractor has removed or turned some warning and lane control traffic control devices leading into the Congress St/Toole Ave/4th Ave intersection.

The road network feeding into the study area from the east is generally through traffic or mobility-oriented, and the network west of the study area is generally access-oriented. The Congress Street corridor between 4th Avenue/North Toole Avenue and South Toole Avenue is developing into more of an access-oriented, commercial corridor and very much less of a through traffic or mobility-oriented corridor. Existing conditions and issues will be magnified with future development that will greatly increase the number of pedestrians, bicyclists, and vehicles using the road network. The addition of streetcar operations will add another layer of complexity and conflicts to the road user mix. The City should consider requiring a Traffic Impact Analysis for the planned development in the study area that evaluates all modes of travel to identify solutions to address future issues.

Intersection Operations

The RSA team observed several of the issues discussed during the Start-up Meeting, including motorists on Congress Street turning right onto Toole Avenue from the center lane (Figure 3), southbound motorists on 4th Avenue turning “right” onto Congress Street during the red signal indication, and motorists on Congress Street turning right onto Toole Avenue and crossing the double yellow centerline on Toole Avenue. The team also observed last second lane changing on Congress Street at the intersection. Pavement markings at the intersection are not very visible during the day (Figure 4); nighttime visibility of the markings is better. The raised island and the bulb-out are not very visible at night (Figure 5). Vehicles turning right on red from Toole Avenue to Congress Street are sometimes in conflict with pedestrians; these right-turn-on-red motorists also may not see vehicles entering the intersection from 4th Avenue (due to the grade on 4th Avenue and the unique intersection geometry – they may be concentrating on vehicles entering from Congress Street).



Figure 3: Motorist Turning Right Onto Toole Avenue from Center Lane



Figure 4: Pavement Markings Difficult to See During the Day



Figure 5: View of Raised Island at Night

The following short-term recommendations to address intersection safety are offered for consideration:

- Install double solid white lane lines on Congress Street between the center and right-side lanes extending through the intersection to discourage turning right onto Toole Avenue from the center lane (single line will discourage crossing over, and a double line will legally prohibit crossing over)
- Install word message pavement markings on the Congress Street approach indicating proper lane assignment for 4th Avenue, Congress Street and Toole Avenue. The RSA team noted that all of the street names except “Congress” can fit in one lane. “Congress” may need to be abbreviated or spread across two lanes.
- Clean or refresh existing pavement markings periodically
- Delineate the raised island and bulb-out with reflectorized paint and/or raised pavement markers (RPMs)
- Prohibit right-turn on red from 4th Avenue (except for bicyclists)
- Install a bike-box on 4th Avenue approach entering the intersection
- Install shared lane markings and way-finding dots to help bikes navigate the intersection
- Consider prohibiting right-turn on red from North Toole Avenue
- Consider dropping the Congress Street right-side lane at the intersection, converting it into a right-turn only lane for 4th Avenue. Right-turns onto Toole Avenue would be made from the existing center lane.

A mid-term recommendation is to widen the westbound approach to the intersection on the south side to allow for a bike lane to the south of the tracks and transit stop. This widening could be integrated into the future housing development project. Also, a bike lane facility should be considered for incorporation into the Plaza Centro project to allow access to the 4th Avenue underpass in conjunction with the Garage.

In the long-term, the city should consider the closing of Toole Avenue at this intersection to vehicular traffic. This would eliminate the sideswipe conflict that currently exists with motorists turning onto Toole Avenue from the Congress Street center lane, and would reduce conflicts between vehicles and bicyclists and pedestrians. This option would also remove the “mobility” traffic from the Congress Ave/4th Street intersection, allowing the intersection to better serve

the “access” traffic. An “Event Plaza” could be provided on Toole Avenue between the Hotel Congress and Maynard’s Market (possibly leased to local businesses), creating a bicycle/pedestrian zone. Additional parking options could be provided in this Plaza area. If Toole Avenue is closed at the intersection, traffic bound for Toole Avenue from Congress Street and 4th Avenue will either divert around the area or will need to use Congress Street west of the intersection. This may necessitate converting the on-street parking on Congress Street between 4th and 5th Avenues into a right-turn lane, which would require geometric changes at the Congress Street/5th Avenue intersection and operational changes at the Toole Avenue/5th Avenue intersection. One option for the Toole Avenue/5th Avenue intersection is to provide an uncontrolled left-turn from 5th Avenue to Toole Avenue, with stop-control for Toole Avenue.

Another long-term option for consideration is to convert Toole Avenue to “one-way” northwest bound operation (departing the intersection) between either 4th Avenue and 5th Avenue or 4th Avenue and the Maynard’s Market driveway. Consider leaving Toole Avenue two-way for bikes, but one way for vehicles (eliminating the southbound to westbound turn from Toole Avenue to Congress Street and its associated conflict with the crossing pedestrians and bicyclists). This option will not provide as many safety benefits as a full closure of Toole Avenue at the intersection.

Bicyclist and Pedestrian Issues

In addition to the bicyclist and pedestrian issues listed in the Start-up Meeting section, the RSA team observed excessive vehicle speeds on the Congress Street approach to the intersection. These higher speeds are not appropriate for the mix of pedestrians and bicyclists using the intersection. Also, the last second lane-changing by vehicles at the intersection is also not appropriate for pedestrians and bicyclists using the intersection. There may be a need for marked crosswalks at the East Congress Street/South Toole Avenue, especially after the completion of the student housing developments. Bicyclists are using the sidewalk on the south side of Congress Street. The sidewalk does not have an adequate width for bicyclists, pedestrians, trees, and planters. Most downtown signalized intersections are pre-times and do not have pedestrian push buttons. This intersection is actuated, due to the infrequent movements from Toole Avenue and does require the use of the push buttons to activate the pedestrian crossing phase. The actuated operation, mixed with the pre-timed operation may be confusing for pedestrians accustomed to receiving the pedestrian walk indication automatically, without having to push the button at other intersections downtown. The future student housing developments and streetcar stop may lead to an increase in mid-block pedestrian and bicyclist crossing movements. Figures 6, 7, and 8 show examples of bicyclist and pedestrian behavior observed during the field reviews.



Figure 6: Pedestrian Using Unmarked Crossing at 4th Avenue. Note that Pedestrian or Bicyclist Is Crossing Against the Signal



Figure 7: Bicyclist Traveling the Wrong Way on Congress Street



Figure 8: Bicyclist on the Sidewalk Along Congress Street

Following are recommendations for consideration to address bicyclist and pedestrian issues. Figure 9 further illustrates many of these recommendations.

- Provide bike boxes at the intersection for 4th Avenue and for Congress Street
- Install “Bicyclist Use Ped Signal” signs to encourage safe bicycle use of the Congress Street crosswalk at Herbert Avenue and crossing Congress Street at South Toole Avenue (depending on how bicycles are routed, this will have to be done in conjunction with signs legalizing bicycle riding on the sidewalk)
- Provide a bicycle path (with appropriate Wayfinding signs) to/from North and South Toole Avenues with connections to northbound 4th Avenue, the pedestrian bridge, and the north side of the new parking garage. Provide a ramp cut along Toole Avenue near Maynard’s Market to provide access to the pedestrian bridge.
- Re-install crosswalks across 4th Avenue, and adjust the raised island as necessary to allow proper crosswalk and bike lane connections. Install “accessible route” ADA signs

to indicate that pedestrians may cross using the bike/ped bridge or using the other existing marked crosswalks.

- Install a bicycle lane, when room allows, on Congress Street as previously discussed. This improvement could include shifting the lanes on Congress Street between North and South Toole Avenues to make use of the loading zone, which may provide enough width for a bike lane on the west side of the streetcar tracks. If a bike lane cannot be provided, use appropriate merge area treatments or shared lane markings (SLMs).
- Provide a cycle track between the new transit platform and sidewalk so that westbound cyclists on Congress Street can continue to northbound Fourth Avenue and bypass the platform without having to negotiate a crossing of the tracks. Use an alternative material for the surface of the cycle track, similar to the rubberized material used on running tracks, to slow bicycles through the pedestrian conflict zone.
- Consider the use of green bike lanes as appropriate. Proper application of green lanes and other markings to be determined by Tucson DOT.
- Provide a two-way shared bike/pedestrian facility to/from South 4th Avenue. This may involve sidewalk widening on the south side of Congress Street. This could also make use of Herbert Avenue if it does not remain closed.
- Identify safe crossover points for bicyclists to cross the streetcar tracks and provide appropriate pavement markings and signs, with consideration given to green lanes
- Consider installation of a raised pedestrian crosswalk on Congress Street at South Toole Avenue (this should help decrease speeds entering this area), pending approval by the Fire Department. If North Toole Avenue is not closed, a raised pedestrian crosswalk is also recommended across North Toole Avenue at the intersection.
- Revise the traffic signal operation to allow the pedestrian crossing phase to come up without activating the pedestrian push button
- Consider a scramble pedestrian/bicyclist phase at the Congress Street/4th Avenue/Toole Avenue intersection
- Pima County DOT should follow through on plans to conduct a 1-hour seminar for incoming freshmen at the University of Arizona to provide safety awareness of sharing the road with streetcars, learning where to properly position themselves in the travel lanes, and learning how to cross tracks safely

Upon the completion of the student housing and commercial development and the opening of streetcar operations, an evaluation of pedestrian crossing activity and connectivity of developments on both sides of Congress Street should be conducted. Based on the results of this evaluation, pedestrian accommodations such as an overhead walkway across Congress Street connecting the buildings and/or a mid-block crossing may be needed. (The need for an overhead walkway connecting the buildings should be determined before the buildings are designed). In the meantime, the designer of these student housing structures should consider providing pedestrian features that encourage pedestrians to use the existing signalized intersections, such as location of building entrances/exits, sidewalk locations, and landscaping feature locations.

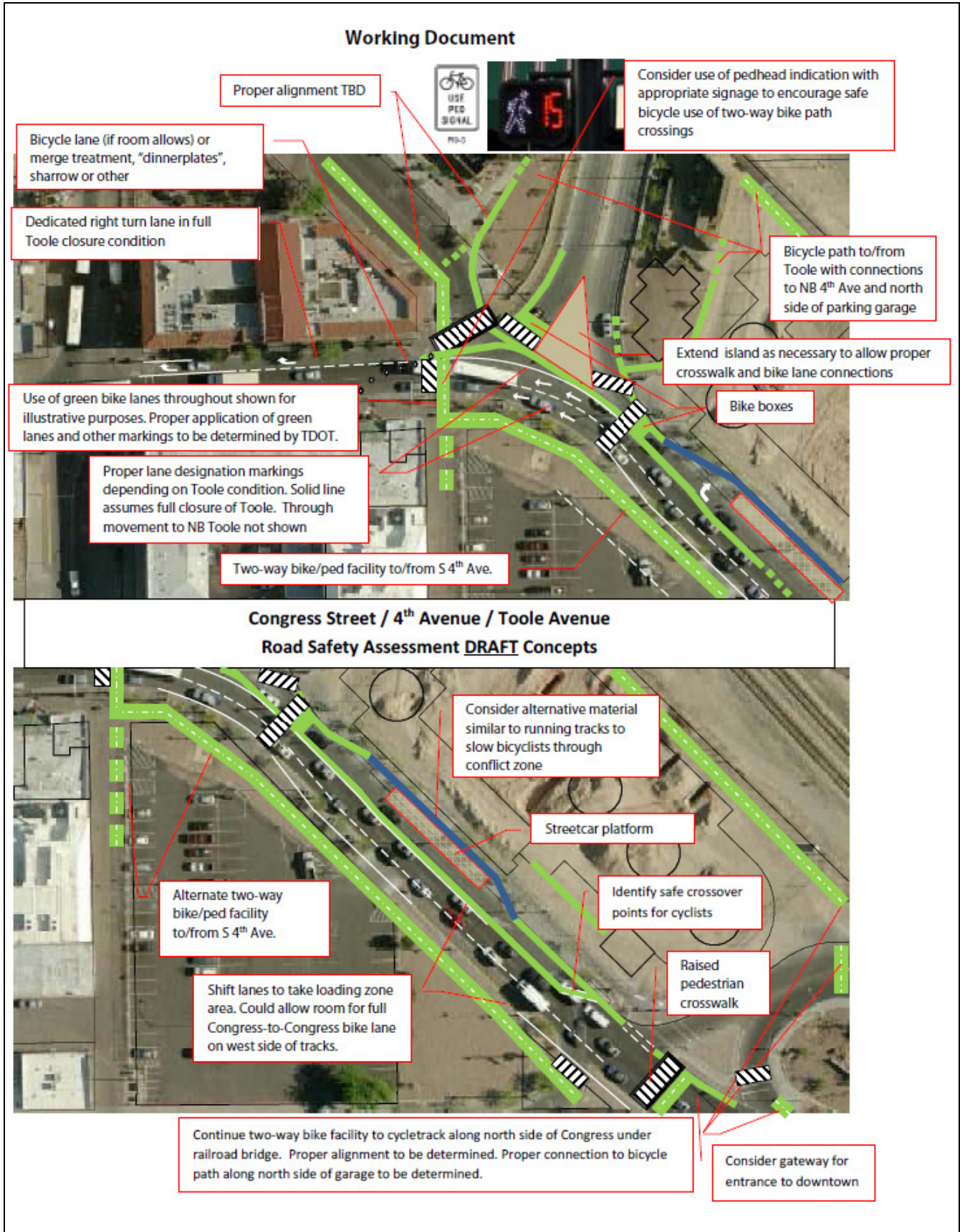


Figure 9: Illustration of Bicyclist and Pedestrian Recommendations

Streetcar Issues

The future operation of the modern streetcar will provide an additional transportation resource for the City. Following are some issues associated with the streetcar that should be addressed.

Wheel squeal as the streetcar negotiates sharp curves, such as the curves at Congress Street/South Toole Avenue and Congress Street/4th Avenue, can distract road users. Flange lubricant should be provided at the approaches to these curves (it should be strategically placed to minimize the chance of the track becoming slippery where bicycle or motorcycle traffic crosses).

Motorists making a right-turn on red from South Toole Avenue onto Congress Street are looking to their left to find a safe gap in traffic. They may not think to look across the intersection for oncoming streetcars turning in front of them. Consideration should be given to revising this traffic signal system to a 3-phase operation or installing a gate that will go across South Toole Avenue when a streetcar is traveling through the intersection.

It is recommended that an enforcement and education blitz be initiated two months in advance of the opening of streetcar operations to prepare drivers, bicyclists, and pedestrians for the safe sharing of the streets with streetcars.

There are several factors that can impact the sight lines of streetcar operators and create sight restrictions, including intersection geometry, location of poles for streetcar signals, and location and size of trees. These should be evaluated and adjusted to provide proper sight distance for the streetcar operators.

Streetcar tracks can present issues for bicyclists crossing over them, especially where the tracks run parallel to the bike movement. Currently there is no device or track design that can completely eliminate the “groove” in the pavement. In fact, continuous flange fillers can become a problem due to their failure to wear-well creating further problems for unwary cyclists. At locations where bicyclists may have track crossing concerns, consideration may be given to using flange filler material for abnormally difficult locations. Even though the alert cyclist should be able to maneuver across the tracks, special signing and markings may be provided to either warn bicyclists of the unusual crossing or to guide the bicyclists to an appropriate crossing location.

Some of the span wire mounted traffic signals at the Congress Street/4th Avenue/Toole Avenue intersection are in contact with the streetcar overhead contact system (OCS) and needs to be addressed.

A streetcar stopped at the future stop platform on Congress may block the view of traffic signs on the north side of Congress Street. These signs should be relocated. In addition, future intersection maintenance activities will need to be coordinated with the streetcar operations.

The RSA team observed queued vehicles blocking the intersections at Congress Street/4th Avenue/North Toole Avenue and Congress Street/South Toole Avenue. These queues can create operational issues for the streetcar. It is recommended that Do Not Block Intersection signs and pavement markings be installed to discourage queuing in these intersections.

Figure 10 gives an example from the City of Phoenix of signing and markings for discouraging blocking of intersections. Consideration should be given to providing priority signal operation for the streetcar to help clear queues. This may require a city ordinance giving priority to the streetcar.

There is concern that vehicles wanting to access the right-turn lane to 4th Avenue may dart in front of the streetcar as it departs the Congress Street station. Consideration should be given to installing a double white lane line between the center lane and the right-side lane on Congress Street from the streetcar station to 4th Avenue. This would encourage motorists to enter the right-turn lane prior to reaching the streetcar station.



Figure 10: Pavement markings and signing to discourage blocking of intersection by vehicles

Signing

There are numerous signs for motorists and bicyclists along Congress Street between South Toole Avenue and 4th Avenue, including lane use/lane assignment signs and bicycle warning signs (Figure 11). If possible, overhead lane use signs should be installed on Congress Street east of South Toole Avenue to encourage motorists to move into the proper lane in advance of the intersection and decrease last second lane-changing at the intersection. Possible locations for these signs include the existing railroad bridge, the existing South Toole Avenue bridge, a new sign bridge, span wire, or the existing traffic signal bridge at Aviation Parkway. Figure 12 shows the traffic signal bridge on Broadway Boulevard/Congress Street. Pavement marking messages for lane use should also be considered to encourage proper use of lanes in advance of the intersection. These overhead signs and markings may allow for the removal of some of the existing signs. The need for enhanced warning signs for bicyclists should be evaluated.



Figure 11: Signing Along Congress Street



*Figure 12: Signal Bridge on Congress Street
May Be Location for Lane Use Signs*

Vehicle Speeds on Broadway Boulevard/Congress Street

Although the speed limit is 25 mph and the speed limit signs are oversized on Broadway Boulevard/Congress Street approaching downtown, many vehicles approaching South Toole Avenue as Broadway/Congress becomes Congress Street are traveling well above 30 mph, many approaching 40 mph, based on spot speeds using a speed radar gun. Other than the 25 mph speed limit signs, the road and roadside environment do not provide cues to motorists departing the higher speed facilities to the east, including Aviation Parkway, that they are no longer on a high speed facility. In fact, it may appear to drivers that they are still on a high speed road when they encounter four lanes going westbound with large, freeway-type signing (Figure 13). The right-side lane is a bus-only lane that is rarely used.



*Figure 13: View of Roadway Environment on Congress Street
Approaching the Aviation Parkway Intersection*

It is recommended that a gateway be installed on Congress Street east of South Toole Avenue, possibly just west of the railroad bridge, to provide a visual cue to drivers that they are entering a lower speed congested area. The bus lane should be removed by installing cross hatch pavement markings or other treatments that encourage “slower speeds”. This could allow for a “cycle-track” to be created with a physical barrier to separate the travel lanes from the bike lane. It is also recommended that a raised pedestrian crosswalk be installed on Congress Street at South Toole Avenue to slow speeds, allow for visible pedestrian access across Congress Street, and to further signal to drivers that they are entering an area focused on access rather than mobility. Also, photo speed enforcement should be considered for this area, including consideration of fixed photo enforcement cameras.

Broadway Boulevard

There are bicyclist concerns with vehicle speeds and right-turn movements onto Aviation Parkway on eastbound Broadway Boulevard, which is a downhill grade in this area. Consideration should be given to narrowing the vehicle travel lanes and widening the green bike lane in this section, in addition to installing additional bike lane markings. It is also recommended that bike actuation be provided for the HAWK at the Broadway Boulevard/4th Avenue intersection.

Queuing and Clearing

The RSA team observed vehicles queuing on southbound 5th Avenue from Broadway Boulevard onto Congress Street, leaving no space for left-turning vehicles from Congress Street. The team also observed vehicles queuing on westbound Congress Street from 4th Avenue to South Toole Avenue (Figure 14), which will impact the streetcar operation in the future. The team also observed some westbound vehicles on Congress Street not clearing the intersection at 4th Avenue before 4th Avenue traffic received the green signal indication. An evaluation of the network signal timing and coordination with consideration for streetcar needs should be conducted.



Figure 14: Vehicle Queues on Congress Street Extending Beyond the South Toole Avenue Intersection

New Parking Structure

Plans for the new parking structure being constructed on the north side of Congress Street just west of South Toole Avenue show an entrance from Congress Street and an exit onto South Toole Avenue. The garage entrance and exit locations may have an impact on streetcar operations, pedestrians, bicyclists, and the Congress Street/South Toole Avenue signalized intersection operations. Vehicles entering the garage may queue onto Congress Street. An evaluation of the parking garage ingress/egress should be conducted, addressing entrance and exit locations and ticket booth location. Consideration should be given to providing “Full Lot” signing that is easily visible from Congress Street.

Maintenance and ADA Issues

The RSA team noted several pedestrian tripping concerns on the sidewalks, including deep holes around trees planted in the sidewalk and differences in elevation between the sidewalk and the tree grates (Figure 15). Tree branches can decrease the effective width of sidewalk, pedestrians and bicyclists can be struck in the face by them, and they can create sight obstructions (Figure 16). These maintenance and ADA issues should be addressed.



Figure 15: Tripping Concerns at Sidewalk Trees



Figure 16: Tree Branches Blocking Sidewalk and Blocking View of HAWK Beacon

Enforcement

Following are enforcement recommendations to help improve safety (some have been mentioned in previous sections).

- Issue citations for motor vehicle violations, including speeding, red light running, illegal lane changing, turning movements from an improper lane, blocking the intersection, and not stopping before turning right on red
- Prepare a city ordinance giving priority to streetcars so enforcement can be provided for violations involving streetcar operations, such as darting in front of a streetcar
- Provide van photo speed enforcement on Congress Street east of South Toole Avenue, and consider installing fixed cameras in this area for photo speed enforcement
- Issue warnings/citations for pedestrian and bicyclist violations, including jaywalking, biking against traffic, and biking on sidewalks

Suggested Improvements/Countermeasures

The following table summarizes the RSA team’s observations and potential opportunities to improve safety. These suggested improvements/countermeasures are presented as options for consideration; the road owner may also identify other effective alternative improvements/countermeasures. While every attempt has been made to identify potential safety issues, and provide countermeasures options, the safety performance of the roadway remains the responsibility of the roadway owner and roadway users.

POTENTIAL SAFETY ISSUE	DESCRIPTION	COUNTERMEASURES FOR CONSIDERATION
<p>General Observations</p>	<ul style="list-style-type: none"> Existing conditions and issues will be magnified with future development that will greatly increase the number of pedestrians, bicyclists, and vehicles using the road network. The addition of streetcar operations will add another layer of complexity and conflicts to the road user mix. 	<ul style="list-style-type: none"> The City should consider requiring a Traffic Impact Analysis for the planned development in the study area that evaluates all modes of travel to identify solutions to address future issues
<p>Intersection Operations</p>	<ul style="list-style-type: none"> The RSA team observed several of the issues discussed during the Start-up Meeting, including motorists on Congress Street turning right onto Toole Avenue from the center lane, southbound motorists on 4th Avenue turning “right” onto Congress Street during the red signal indication, and motorists on Congress Street turning right onto Toole Avenue and crossing the double yellow centerline on Toole Avenue. The team also observed last second lane changing on Congress Street at the intersection. Pavement markings at the intersection are not very visible during the day The raised island and the bulb-out are not very visible at night Vehicles turning right on red from Toole Avenue to Congress Street are sometimes in conflict with pedestrians; these right-turn-on-red motorists also may not see vehicles entering the intersection from 4th Avenue (due to the grade on 4th Avenue and the unique intersection geometry – they may be concentrating on vehicles entering from Congress Street). 	<p>Short-term:</p> <ul style="list-style-type: none"> Install double solid white lane lines on Congress Street between the center and right-side lanes extending through the intersection (single line will discourage crossing over, and a double line will legally prohibit crossing over) Install word message pavement markings on the Congress Street approach indicating proper lane assignment for 4th Avenue, Congress Street and Toole Avenue Clean or refresh existing pavement markings Delineate the raised island and bulb-out with reflectorized paint and/or raised pavement markers (RPMs) Install a bike-box on 4th Avenue approach entering the intersection Prohibit right-turn on red from 4th Avenue (except for bicyclists) Install shared lane markings and way-finding dots to help bikes navigate the intersection Consider prohibiting right-turn on red from North Toole Avenue Consider dropping the Congress Street right-side lane at the intersection, converting it into a right-turn only lane for 4th Avenue. Right-turns onto Toole Avenue would be made from the existing center lane.

		<p>Mid-term:</p> <ul style="list-style-type: none"> • Widen Congress to allow for a bike lane on the south side of the tracks • Incorporate a bike lane facility into the Plaza Centro project to allow access to the 4th Avenue underpass in conjunction with the Garage <p>Long-term:</p> <ul style="list-style-type: none"> • Close Toole Avenue at this intersection to vehicular traffic • Provide an “Event Plaza” on Toole Avenue between the Hotel Congress and Maynard’s Market (possibly leased to local businesses), creating a bicycle/pedestrian zone • Convert the on-street parking on Congress Street between 4th and 5th Avenues into a right-turn lane • To accommodate Toole Avenue traffic that is diverted onto Congress Street by this closure, provide an uncontrolled left-turn from 5th Avenue to Toole Avenue, with stop-control for Toole Avenue • Another option for consideration is to convert Toole Avenue to northbound one-way operation (keeping two-way bike operation) between either 4th Avenue and 5th Avenue or 4th Avenue and the Maynard’s Market driveway. This option will not provide as many safety benefits as a full closure of Toole Avenue at the intersection.
<p>Bicyclist and Pedestrians Issues</p>	<ul style="list-style-type: none"> • In addition to the bicyclist and pedestrian issues listed in the Start-up Meeting section, the RSA team observed excessive vehicle speeds on the Congress Street approach to the intersection. These higher speeds are not appropriate for the mix of pedestrians and bicyclists using the intersection. The last second lane-changing by vehicles at the intersection is also not 	<ul style="list-style-type: none"> • Provide bike boxes at the intersection for 4th Avenue and for Congress Street • Install “Bicyclist Use Ped Signal” signs to encourage safe bicycle use of the Congress Street crosswalk at Herbert Avenue and crossing Congress Street at South Toole Avenue (depending on how bicycles are routed, this will

	<p>appropriate for pedestrians and bicyclists using the intersection.</p> <ul style="list-style-type: none"> • There is a lack of marked crosswalks at the Congress Street/South Toole Avenue • Bicyclists are using the sidewalk on the south side of Congress Street. The sidewalk does not have an adequate width for bicyclists, pedestrians, trees, and planters. • Most downtown signalized intersections are pre-times and do not have pedestrian push buttons. This intersection is actuated, due to the infrequent movements from Toole Avenue and does require the use of the push buttons to activate the pedestrian crossing phase. The actuated operation, mixed with the pre-timed operation may be confusing for pedestrians accustomed to receiving the pedestrian walk indication automatically, without having to push the button at other intersections downtown. • The future student housing developments and streetcar stop may lead to an increase in mid-block pedestrian and bicyclist crossing movements. 	<p>have to be done in conjunction with signs legalizing bicycle riding on the sidewalk)</p> <ul style="list-style-type: none"> • Provide a bicycle path (with appropriate Wayfinding signs) to/from North and South Toole Avenues with connections to northbound 4th Avenue, the pedestrian bridge, and the north side of the new parking garage. Provide a ramp cut along Toole Avenue near Maynard’s Market to provide access to the pedestrian bridge. • Re-install crosswalks across 4th Avenue, and adjust the raised island as necessary to allow proper crosswalk and bike lane connections. Install “accessible route” ADA signs to indicate that pedestrians may cross using the bike/ped bridge or using the other existing marked crosswalks. • Provide a ramp cut along Toole Avenue near Maynard’s Market to provide access to the pedestrian bridge • Install a bicycle lane, when room allows, on Congress Street as previously discussed. This improvement could include shifting the lanes on Congress Street between North and South Toole Avenues to make use of the loading zone, which may provide enough width for a bike lane on the west side of the streetcar tracks. If a bike lane cannot be provided, use appropriate merge area treatments or shared lane markings (SLMs). • Use green bike lanes as appropriate. Proper application of green lanes and other markings to be determined by Tucson DOT. • Provide a two-way shared bike/pedestrian facility to/from South 4th Avenue. This may involve sidewalk widening on the south side of Congress Street. This could also make use of Herbert Avenue if it does not remain closed.
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- Provide a cycle track between the new transit platform and sidewalk so that westbound cyclists on Congress Street can continue to northbound Fourth Avenue and bypass the platform without having to negotiate a crossing of the tracks. Use an alternative material for the surface of the cycle track, similar to the rubberized material used on running tracks, to slow bicycles through the pedestrian conflict zone.
- Identify safe crossover points for bicyclists to cross the streetcar tracks and provide appropriate pavement markings and signs, with consideration given to green lanes
- Install a raised pedestrian crosswalk on Congress Street at South Toole Avenue. If North Toole Avenue is not closed, a raised pedestrian crosswalk is also recommended across North Toole Avenue at the intersection.
- Revise the traffic signal operation to allow the pedestrian crossing phase to come up without activating the pedestrian push button
- Provide a scramble pedestrian/bicyclist phase at Congress Street/4th Avenue/Toole Avenue
- Pima County DOT should follow through on plans to conduct a 1-hour seminar for incoming freshmen at the University of Arizona to provide safety awareness of sharing the road with streetcars, learning where to properly position themselves in the travel lanes, and learning how to cross tracks safely
- Upon completion of student housing and commercial development and opening of streetcar operations, an evaluation of pedestrian crossing activity and connectivity of developments on both sides of Congress Street should be conducted. Based on the results of

		<p>this evaluation, pedestrian accommodations such as an overhead walkway across Congress Street connecting the buildings (would need to be determined before buildings are designed) and/or a mid-block crossing may be needed.</p> <ul style="list-style-type: none"> • The designer of these student housing structures should consider providing pedestrian features that encourage pedestrians to use the existing signalized intersections, such as location of building entrances/exits, sidewalk locations, and landscaping feature locations
<p>Streetcar Issues</p>	<ul style="list-style-type: none"> • Wheel squeal as the streetcar negotiates sharp curves, such as the curves at Congress Street/South Toole Avenue and Congress Street/4th Avenue, can distract road users. • Motorists making a right-turn on red from South Toole Avenue onto Congress Street are looking to their left to find a safe gap in traffic and may not think to look across the intersection for oncoming streetcars turning in front of them • It is recommended that an enforcement and education blitz be initiated two months in advance of the opening of streetcar operations to prepare drivers, bicyclists, and pedestrians for the safe sharing of the streets with streetcars. • There are several factors that can impact the sight lines of streetcar operators and create sight restrictions, including intersection geometry, location of poles for streetcar signals, and location and size of trees. • Streetcar tracks can present issues for bicyclists crossing over them, especially where the tracks run parallel to the bike movement. • Some of the span wire mounted traffic signals at the Congress Street/4th Avenue/Toole Avenue intersection are in contact with the streetcar overhead contact 	<ul style="list-style-type: none"> • Provide flange lubricant at the approaches to sharp curves • Revise the traffic signal system at Congress Street/South Toole Avenue to a 3-phase operation or install a gate that will go across South Toole Avenue when a streetcar is traveling through the intersection • Initiate an enforcement and education blitz two months in advance of the opening of streetcar operations to prepare drivers, bicyclists, and pedestrians for the safe sharing of the streets with streetcars • Evaluate and address intersection geometry, location of poles for streetcar signals, and location/size of trees that may impact sight distance for streetcar operators • Use flange filler material as appropriate at locations where bicyclists may have track crossing concerns in addition to installing the previously mentioned signing and markings to either warn bicyclists of the crossing or to guide the bicyclists to an appropriate crossing location • Address traffic signals that are in contact with the streetcar overhead contact system • Relocate signs that may be blocked from driver's

	<p>system (OCS)</p> <ul style="list-style-type: none"> • A streetcar stopped at the future stop platform on Congress may block the view of traffic signs on the north side of Congress Street. • The RSA team observed queued vehicles blocking the intersections at Congress Street/4th Avenue/North Toole Avenue and Congress Street/South Toole Avenue. These queues can create operational issues for the streetcar. • There is concern that vehicles wanting to access the right-turn lane to 4th Avenue may dart in front of the streetcar as it departs the Congress Street station. 	<p>view by a streetcar stopped at the Congress Street station</p> <ul style="list-style-type: none"> • Coordinate future intersection maintenance activities with the streetcar operations • Install Do Not Block Intersection signs and pavement markings to discourage queuing in the signalized intersections • Provide priority signal operation for the streetcar (this may require a city ordinance giving priority to the streetcar) • Install a double white lane line between the center lane and the right-side lane on Congress Street from the streetcar station to 4th Avenue
Signing	<ul style="list-style-type: none"> • There are numerous signs for motorists and bicyclists along Congress Street between South Toole Avenue and 4th Avenue, including lane use/lane assignment signs and bicycle warning signs 	<ul style="list-style-type: none"> • If possible, install overhead lane use signs on Congress Street east of South Toole Avenue (possible locations for these signs include the existing railroad bridge, the existing South Toole Avenue bridge, a new sign bridge, span wire, or the existing traffic signal bridge at Aviation Parkway) • Install pavement marking messages for lane use on Congress Street at two locations: as Congress curves at the underpass, and between South Toole Avenue and the 4th Avenue/Toole Avenue/Congress Street intersection (if appropriate abbreviation can be established) • Evaluate the need for enhanced warning signs for bicyclists
Vehicle Speeds on Congress Street	<ul style="list-style-type: none"> • Although the speed limit is 25 mph, many vehicles approaching South Toole Avenue on Congress Street are traveling above 30 mph, some approaching 40 mph, based on spot speeds using a speed radar gun. Other than the 25 mph speed limit signs, the road and roadside environment do not provide cues to motorists departing the higher speed facilities to the east, including Aviation Parkway, that they are no longer on 	<ul style="list-style-type: none"> • Install a gateway on Congress Street east of South Toole Avenue, possibly just west of the railroad bridge • Remove the bus lane by installing cross hatch pavement markings or other treatments that encourage “slower speeds” and which could allow for a “cycle-track” to be created with a physical barrier to separate the travel lanes from

	<p>a high speed facility. In fact, it may appear to drivers that they are still on a high speed road when they encounter four lanes going westbound with large, freeway-type signing.</p> <ul style="list-style-type: none"> • The right-side lane is a rarely used bus-only lane 	<p>the bike lane</p> <ul style="list-style-type: none"> • Install a raised pedestrian crosswalk on Congress Street at South Toole Avenue • Conduct photo speed enforcement in this area, and consider installing fixed photo enforcement cameras
Broadway Boulevard	<ul style="list-style-type: none"> • There are bicyclist concerns with vehicle speeds and right-turn movements onto Aviation Parkway on eastbound Broadway Boulevard, which is a downhill grade in this area. 	<ul style="list-style-type: none"> • Narrow the vehicle travel lanes and widen the green bike lane in this section of Broadway Boulevard, in addition to installing additional bike lane markings • Provide bike actuation for the HAWK at the Broadway Boulevard/4th Avenue intersection
Queuing and Clearing	<ul style="list-style-type: none"> • The RSA team observed vehicles queuing on southbound 5th Avenue from Broadway Boulevard onto Congress Street, leaving no space for left-turning vehicles from Congress Street. The team also observed vehicles queuing on westbound Congress Street from 4th Avenue to South Toole Avenue, which will impact the streetcar operation in the future. The team also observed some westbound vehicles on Congress Street not clearing the intersection at 4th Avenue before 4th Avenue traffic received the green signal indication. 	<ul style="list-style-type: none"> • Evaluate and adjust the network signal timing and coordination, with consideration for streetcar needs
New Parking Structure	<ul style="list-style-type: none"> • Plans for the new parking structure being constructed on the north side of Congress Street just west of South Toole Avenue show an entrance from Congress Street and an exit onto South Toole Avenue. The garage entrance and exit locations may have an impact on streetcar operations, pedestrians, bicyclists, and the Congress Street/South Toole Avenue signalized intersection operations. Vehicles entering the garage may queue onto Congress Street. 	<ul style="list-style-type: none"> • Evaluate the parking garage ingress/egress, addressing entrance and exit locations and ticket booth location • Consider providing “Full Lot” signing that is easily visible from Congress Street

<p>Maintenance and ADA Issues</p>	<ul style="list-style-type: none"> • The RSA team noted several pedestrian tripping concerns on the sidewalks, including deep holes around trees planted in the sidewalk and differences in elevation between the sidewalk and the tree grates. Tree branches can decrease the effective width of sidewalk, pedestrians and bicyclists can be struck in the face by them, and they can create sight obstructions. 	<ul style="list-style-type: none"> • Address tree-related maintenance and ADA issues
<p>Enforcement</p>	<ul style="list-style-type: none"> • The RSA team observed numerous violations of traffic control devices by motorists, pedestrians, and bicyclists. Streetcar operations may lead to additional violations by these road users. 	<ul style="list-style-type: none"> • Issue citations for motor vehicle violations, including speeding, red light running, illegal lane changing, turning movements from an improper lane, blocking the intersection, and not stopping before turning right on red • Prepare a city ordinance giving priority to streetcars so enforcement can be provided for violations involving streetcar operations, such as darting in front of a streetcar • Provide van photo speed enforcement on Congress Street east of South Toole Avenue, and consider installing fixed cameras in this area for photo speed enforcement • Issue warnings/citations for pedestrian and bicyclist violations, including jaywalking, biking against traffic, and biking on sidewalks

Appendix

ROAD SAFETY ASSESSMENT AGENDA
4th AVENUE/CONGRESS STREET/TOOLE AVENUE
CITY OF TUCSON

Tuesday, April 26

- 1:00 PM Road Safety Assessment Start-up Meeting *All*
1. Road Safety Assessments: Objectives, Procedures *RSA Team*
2. Background on 4th Ave/Congress St/Toole Ave Intersection *City*
 Overview, History, Challenges, Specific Concerns
3. Questions and Answers *All*
- *The road safety assessment team will be led by Gabe Thum, PAG Senior Transportation Planner. The RSA Team includes Mike Blankenship (ADOT), Jay Harper (Metro Light Rail), Matt Zoll (Pima County DOT), Richard Nassi (Retired Tucson DOT), Jerry Skeenes (Tucson Police) and Richard Weeks (AECOM).*
 - *For the start-up meeting, information will be provided by Diahn Swartz, Tucson Traffic Engineering Project Manager, and Tom Thivener, Tucson Bicycle and Pedestrian Program Manager.*
- 2:30 PM Daytime Site Visit *RSA Team*
- 7:45 PM Nighttime Site Visit *RSA Team*

Wednesday, April 27

- 7:30 AM Daytime Site Visit *RSA Team*
- 9:30 AM Work Session/Analysis *RSA Team*
- 1:00 PM Daytime Site Visit *RSA Team*
- 2:30 PM Work Session/Analysis *RSA Team*

Thursday, April 28

- 9:00 AM Presentation of Preliminary Findings *All*
 - *Findings Report to owners: May 31*
 - *Owner's Response to findings: July 5*
- 11:00 AM Adjourn

All meetings will be conducted at the Parkwise Conference Room at 110 E. Pennington Street, Tucson.