Appendix C - Relationship of the Long Range Regional Transit Plan and the High-Capacity Transit Plan

Previous studies have identified potential BRT or streetcar corridors. How do these fit in?

Following on the successful development of the Sun Link streetcar, there has been considerable interest in the idea of building one or more additional high-capacity transit lines.

In 2017, Pima Association of Governments (PAG) carried out a study called the High Capacity Transit Implementation Plan (HCTIP), which narrowed down the transit technologies and corridors under consideration. This study is included as an appendix to the Long Range Regional Transit Plan.

Two types of high-capacity transit were deemed potentially viable:

- **Rapid streetcar**, similar to the initial Sun Link segment, but with potentially wider stop spacing (1/4 to 1 mile) and more transit priority measures.
- **Bus Rapid Transit (BRT).** This would be a bus route with wide stop spacing (1/2 to 1 mile), whose speed and reliability is supported by exclusive bus lanes in some segments. As defined in the HCTIP, a BRT line may require the use of 60-foot buses and would likely feature all-door boarding. The study leaves open the question of whether BRT would be "open" or "closed."
  - » Closed BRT lines are similar to streetcars or light rail. They use special vehicles and high platforms at stations, so the bus cannot operate at regular bus stops.
  - » Open BRT lines run as a "rapid" bus route on improved segments, but can continue as a regular bus route in outlying areas.

The HCTIP initially studied 15 potential corridors. Through a feasibility analysis, it narrowed these down to six possibilities:

- **Broadway Boulevard**, as either a shorter streetcar extension or longer BRT segment.
- **Speedway Boulevard**, as a BRT segment.
- **Stone Avenue**, as a streetcar extension.
- **Oracle Road**, as BRT segment.
- **South 6th Avenue**, as a streetcar segment.

Chapters 1 to 4 of this plan have focused on faster travel and access to opportunity, without taking a position on whether any route should be operated as a regular bus route, BRT or streetcar.

Nonetheless, it is important to understand how the different BRT and streetcar options studied to date would fit in the bigger picture, and the potential benefits and impacts they might have with regard to operations, cost and ease and speed of travel.

Figure 1: Tier 3 High-Capacity Transit corridors, as identified in the 2017 draft High-Capacity Transit Implementation Plan study. Solid lines represent potential Bus Rapid Transit (BRT) projects. Dotted lines represent potential extensions to the Sun Link streetcar system.

1. Broadway Streetcar

The 2017 HCTIP envisioned a potential streetcar extension extending eastward from Downtown Tucson to Alvernon Way, operating every 10 minutes at midday. This would be an improvement over the existing 15-minute service frequency on Broadway, and would position the streetcar well to connect with existing frequent service on Euclid Ave, Campbell Ave. and Alvernon Way. Developing a streetcar may also provide benefits in terms of economic development and urban regeneration.

However, this short streetcar segment would pose some interesting service planning challenges on Broadway itself:

- In the long term, this plan envisions service every 10 minutes on Broadway from Downtown to Kolb Road, splitting into less frequent branches on the outer east side. In other words, service would be more frequent than it is today, and the split point into branches would be half a mile further east than it is today.
- A streetcar segment between Downtown and Alvernon Way would require certain decisions that could impact transit operating costs and passenger travel times. Options include:
  - » **Separate service: a streetcar as far as Alvernon Way, and a bus line from Alvernon Way to points further east.** This would be the least disruptive option in terms of operations, and would still allow for service every 10 minutes along the entire Broadway corridor. However, it would require passengers to transfer between services at Alvernon Way. On average, trips between points east and west of Alvernon would take at least 5 minutes longer on average.
  - » **Overlaid service: a "local" streetcar from Downtown to Alvernon Way, on top of a "rapid" bus route that would make fewer stops in this inner segment**. The bus route would continue as the same service to points further east, but switching to local service. This has the advantage of providing the fastest possible travel times throughout the Broadway corridor. However, reliably operating a bus every 10 minutes on top of a streetcar every 10 minutes would require significant more investment in transit-supportive infrastructure (lanes, signals etc.) and result in higher operating cost overall in the corridor. It may be possible to mitigate the cost impact by running the bus route less frequently, but this would result in slightly longer travel times.

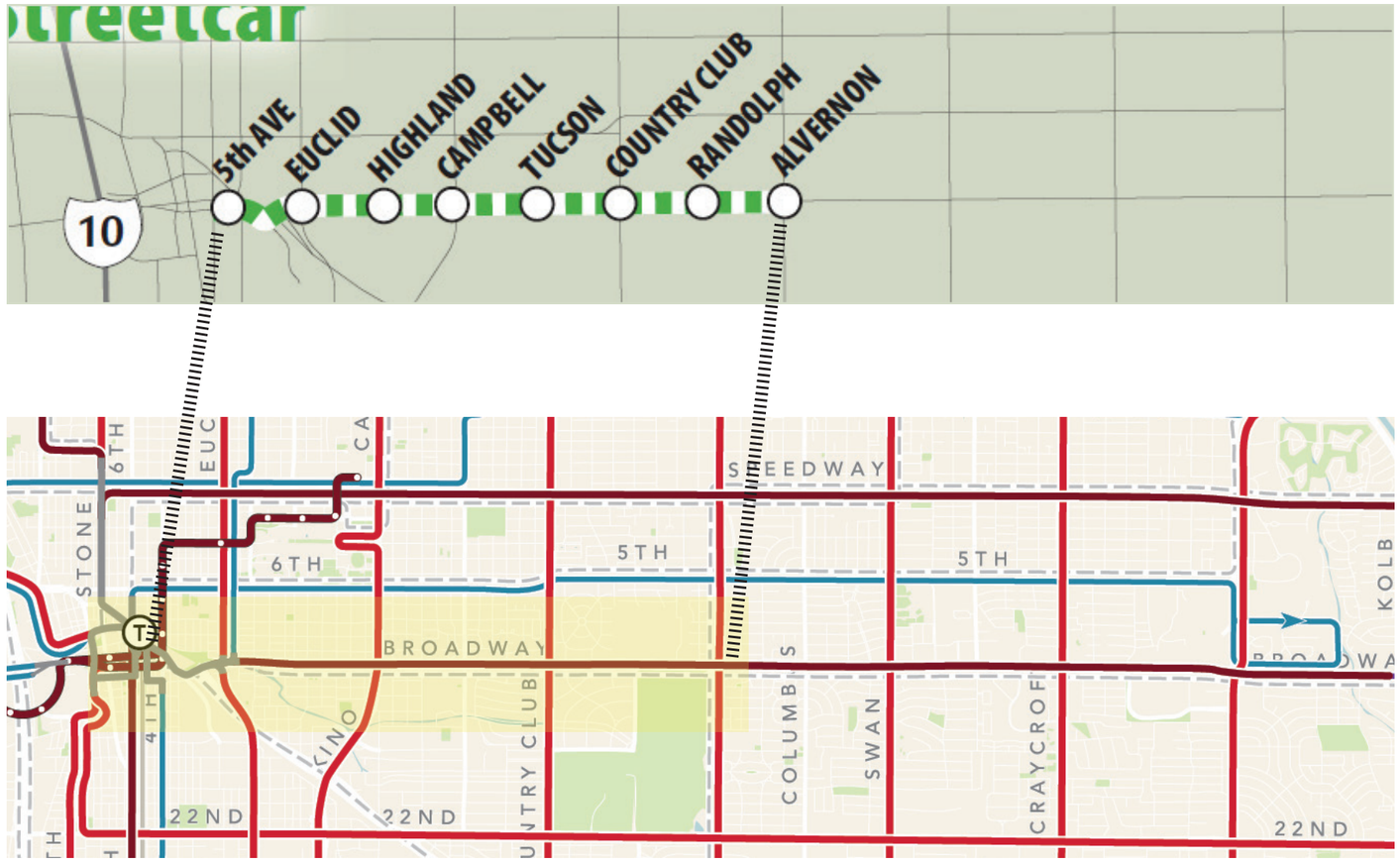

Figure 2: Proposed Broadway streetcar alignment (top), and relationship to long-term service as envisioned in this plan (bottom).

This plan envisions continuous service every 10 minutes on Broadway from Downtown Tucson to Kolb Road, with significant improvements to intersections (queue jumps and transit priority) and bus-only lanes at key chokepoints.

A streetcar in the segment envisioned at the top could be paired with a shorter bus line with a transfers required at Alvernon Way. In that case, travel times would be longer between points east and west of Alvernon.

Alternatively, it could function as a local overlay between Downtown and Alvernon, with the bus route only making stops every half-mile or every mile. In that case, the total budget to operate transit on Broadway would need to increase, or else the frequency on the bus route would need to decrease (and travel times would get longer).

2. Broadway BRT

The 2017 HCTIP envisions a potential BRT segment from Downtown Tucson to Wilmot Road, operating every 10 minutes at midday and making connections to existing frequent routes at Euclid Ave, Campbell Ave, Alvernon Way, and Craycroft Road.

The Broadway BRT concept is in many ways consistent with the long-term service and capital improvements proposed in this plan. As an FTN Tier 1 route, Broadway would be served with 10-minute frequency, supported by investments in transit priority and premium stations.

The HCTIP leaves open whether BRTs would operate as a "closed" and independent line with special vehicles, or as an "open" segment to be used by any bus that happens to be running on Broadway. This leaves two possible options:

- **"Closed" option: a BRT route from Downtown to Wilmot Road, and a separate bus line to points further east.** This option would help justify the highest possible level of infrastructure improvement, and may result in the fastest possible travel times between Downtown and Wilmot Road. However, it would require passengers to transfer between services at Wilmot Road. On average, trips between points east and west of Wilmot would take at least 5 minutes longer on average.
- **"Open" option: a highly-improved segment allowing faster and more reliable travel as far as Wilmot Road, and continuing service to points further east on the same bus route.** Even if the segment is open, explicitly designating the Broadway corridor as a BRT project may open up the way for federal funding that would allow for more capital improvements than would otherwise occur.

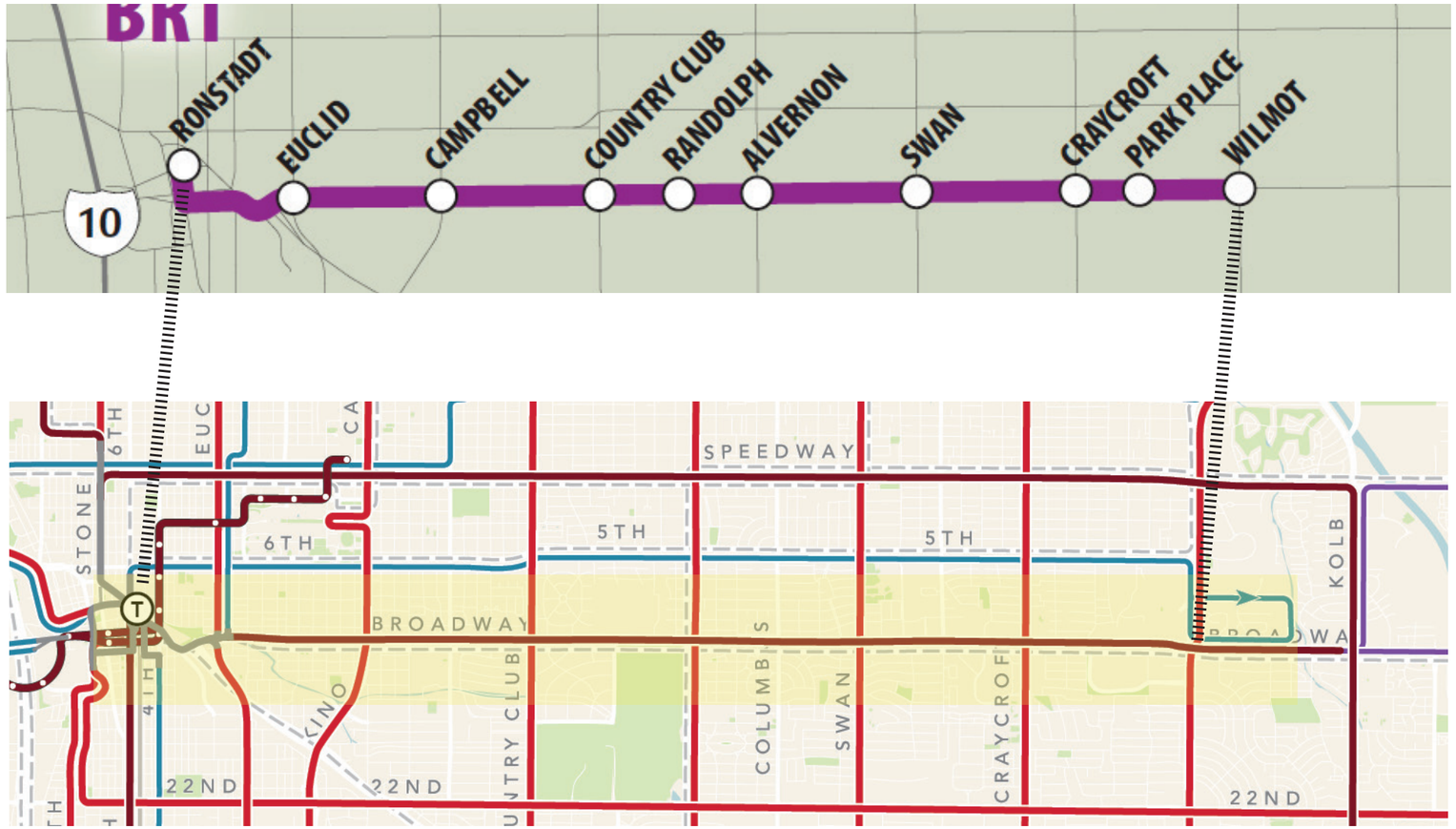

Figure 3: Proposed Broadway BRT alignment (top), and relationship to long-term service as envisioned in this plan (bottom).

This plan envisions service every 10 minutes on Broadway from Downtown Tucson to Kolb Road, with significant improvements to intersections (queue jumps and transit priority) and bus-only lanes at key chokepoints. This would effectively create BRT-like conditions, just on a slightly longer alignment than previously drawn.

The main question would be whether the BRT should be "closed" (i.e. special vehicles and stations that require transfers at the end of the BRT segment) or "open" (i.e. regular transit vehicles that can continue on east beyond the enhanced segment). Requiring transfers to and from a closed system would result in longer travel times from the outer east side.

3. Speedway BRT

The 2017 HCTIP envisions a potential BRT segment from Main Road to Kolb, operating every 10 minutes at midday and making connections to existing frequent routes at Main (Oracle) Road, Euclid Ave, Campbell Ave, Alvernon Way and Craycroft Road.

The Speedway BRT concept is in many ways consistent with the long-term service and capital improvements proposed in the long term scenario. As an FTN Tier 1 route, Speedway would be served with 10-minute frequency, supported by investments in transit priority and premium stations.

However, the HCTIP leaves open whether BRTs would operate as a "closed" and independent line with special vehicles, or as an "open" segment to be used by any bus running on Broadway.

This leaves two possible options:

- **"Closed" option: a BRT route from Main Road to Kolb Road, and separate bus lines to Downtown, and points further east.** This option would help justify the highest possible level of infrastructure improvement, and may result in the fastest possible travel times between Main Road and Kolb Road.
  - » It's unlikely that a closed option is consistent with the intent of the HCTIP, since terminating a route with this level of service and infrastructure investment 1 mile north of Downtown poses significant issues in terms of ridership and convenience. At this distance, many people will feel that the route does not serve Downtown, and that they are forced between two unpleasant choices: a 20 minute or longer walk at one end, or a last-minute transfer just to take the next bus a few stops down the road.
  - » At the east end, the "closed" concept would require passengers to transfer between services at Kolb Road. Passengers continuing down Kolb Road would have travel times at least 5 minutes longer on average.
- **"Open" option: a highly improved segment allowing faster and more reliable travel as far as Kolb Road, and continuing service to points farther east on the same bus route.** This would be similar to what is implied by the long-term map in this plan, although it is likely the improved segment should continue to Downtown.

In either case, explicitly designating the Speedway corridor as a BRT project may open up the way for federal funding for capital improvements.

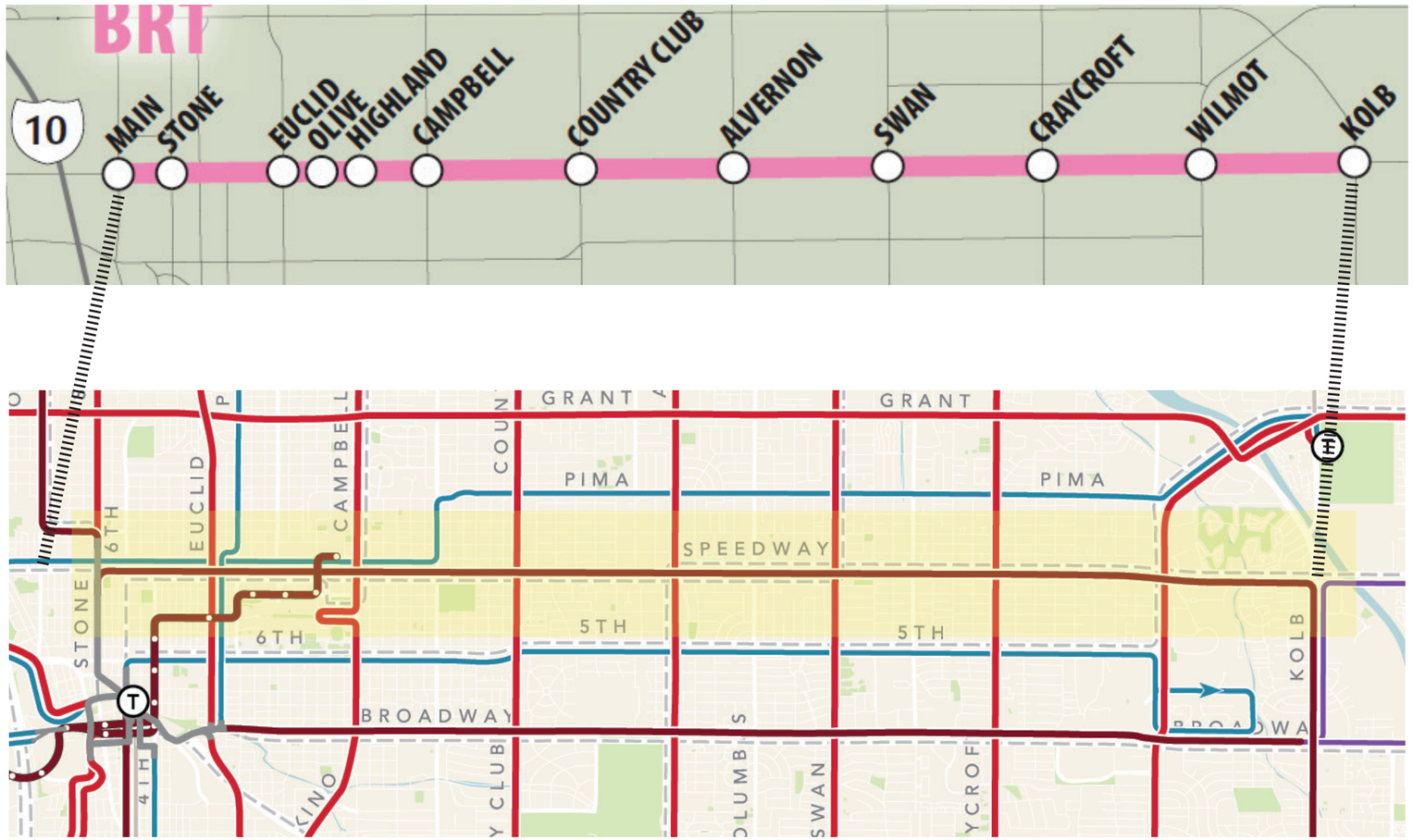

Figure 4: Proposed Speedway BRT alignment (top), and relationship to long-term service as envisioned in this plan (bottom).

This plan envisions service every 10 minutes on Speedway from Downtown Tucson (via Stone Ave) to Kolb Road, with significant improvements to intersections (queue jumps and transit priority) and bus-only lanes at key chokepoints. This would effectively create BRT-like conditions from Kolb Road to Downtown.

The main question would be whether the BRT should be "closed" (i.e. special vehicles and stations that force transfers at the ends of the BRT segment) or "open" (i.e. regular transit vehicles that can continue on beyond the enhanced segment). Requiring transfers to and from a closed system would result in longer travel times from the outer east side.

4. Stone Ave Streetcar

The 2017 HCTIP envisions a potential streetcar extension from Downtown Tucson to Tucson Mall, operating every 10 minutes. This would be an improvement over the existing 30 minute frequency on Stone Ave, and would position the streetcar to connect with existing frequent service on Speedway, Grant Road, and in the vicinity of Tucson Mall. Developing a streetcar may also provide benefits in terms of economic development and urban regeneration.

However, this short streetcar segment would pose several service planning challenges:

- In the long term, we envision a continuous frequent bus route running every 15 minutes on Stone Ave. to Tucson Mall, continuing north to Casas Adobes via N Oracle Road. In other words, service frequency would increase both north and south of Tucson Mall, while a direct connection between north and south would be maintained, although on a different street than the existing Route 16, which operates on Oracle Road. in Tucson. This would result in average travel time improvements of 5-10 minutes both north and south of Tucson Mall.
- A streetcar segment on Stone Ave. operating every 10 minutes could be even better for passengers remaining in Tucson, but would require a transfer at Tucson Mall to points further north. This would likely cancel out any travel time improvements between points north and south of Tucson Mall.
- At the same time, because the streetcar would operate as a branch extension of the existing Sun Link, its path to Downtown would be longer than for the 19-Stone bus route, so the travel time benefits of higher frequency may be cancelled out by longer times in-vehicle.
- It's not clear that service every 10 minutes would be justified by demand on Stone Ave, even in the long term. Stone Ave is located 1/4 mile east of Oracle Road, which would have service every 7 minutes. An efficient use of resources might suggest keeping the frequency to every 15 minutes on Stone Ave, but this would mean that Sun Link service between Downtown and the University would need to be set at a matching 15 minute frequency. This would be less than in existing service, resulting in longer travel times between the region's two most important transit destinations.
- The location of the terminus at Tucson Mall would need to be finalized. Ideally, the terminus should be in or very near the existing Tohono Tadai Transit Center to allow for maximum connectivity between different transit services.

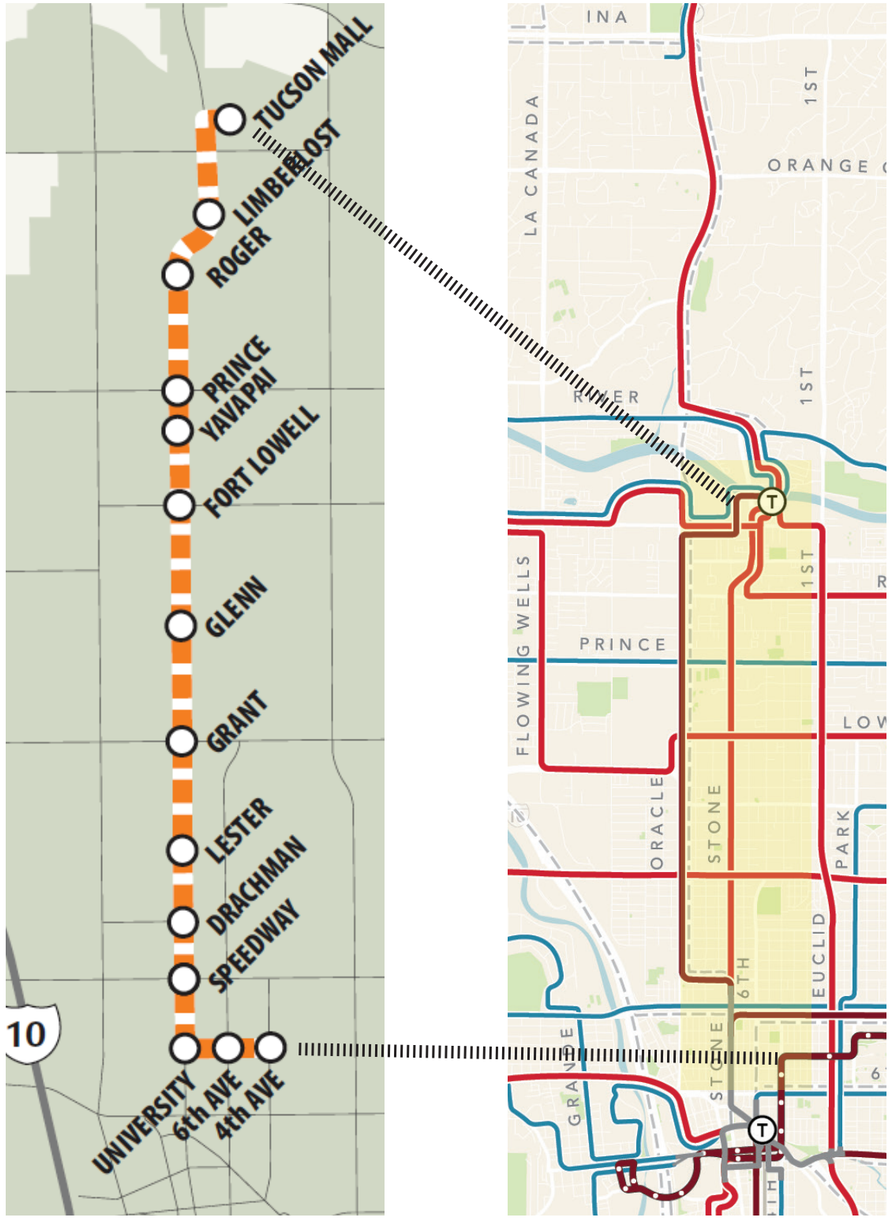

Figure 5: Proposed Stone Ave. streetcar alignment (left), and relationship to long-term service as envisioned in this plan (right).

This plan envisions service every 15 minutes on Stone Way from Downtown Tucson to Tucson Mall, potentially continuing as the same frequent route to Casas Adobes on N Oracle Road.

If service on Stone Way were provided with a streetcar, the path to Downtown would be slightly longer, via existing tracks on 4th Ave., and there would be a necessary transfer point at Tucson Mall to service going farther north. That means travel times to and from areas north of Tucson Mall would be longer.

As envisioned in 2017, the Stone Ave. streetcar would have a 10-minute frequency. However, it's likely that a 15-minute frequency would better match demand, because Stone Ave is only a quarter of a mile from Oracle Road. Service every 7 to 10 minute on both streets would likely result in relatively unproductive service. But operationally, 15-minute service on the Stone streetcar might require 15-minute streetcar service from Downtown to the University of Arizona as well, which would be less than existing service.

5. Oracle Road BRT

The 2017 HCTIP envisions a potential BRT segment from Downtown Tucson to Tucson Mall, operating every 10 minutes at midday and making connections to existing frequent routes at Speedway, Grant Road, and in the vicinity of Tucson Mall.

The Oracle Road BRT concept is in many ways consistent with the long-term service and capital improvements proposed in this plan. As an FTN Tier 1 route, Oracle would be served by a bus route with 10-minute frequency, supported by investments in transit priority and premium stations.

In other ways, the Oracle Road BRT may miss some key opportunities. Specifically, this plan envisions linking service every 7 minutes on Oracle Road to service every 7 minutes on South 6th Ave to improve connections between areas north and south of Downtown and tying together the region's two highest-demand transit streets.

The HCTIP leaves open whether BRTs would operate as a "closed" and independent line with special vehicles, or as an "open" segment to be used by any bus that happens to be running on Oracle Road. This leaves two possible options:

- **"Closed" option: a BRT route from Downtown to Tucson Mall, and a separate bus line or streetcar line on South 6th Ave.** This option would help justify the highest possible level of infrastructure improvement, and may result in the fastest possible in-vehicle travel times between Downtown and Tucson Mall. However, it would require passengers to transfer to travel to and from the south side. On average, trips between points north and south of Downtown would take at least 5 minutes longer than with the "open" option. The closed option would weaken the argument for 7-minute frequency on Oracle.
- **"Open" option: a highly improved segment allowing faster and more reliable travel between Tucson Mall and Downtown, and continuing service to points farther south on the same bus route.** This would be similar to what is implied by the long-term map in this plan, although it's possible the improved segment should continue at least as far south as Irvington Road.

In either case, designating this corridor (or this corridor + South 6th Ave) as a BRT project makes it more likely that federal funding can be secured for capital improvements.

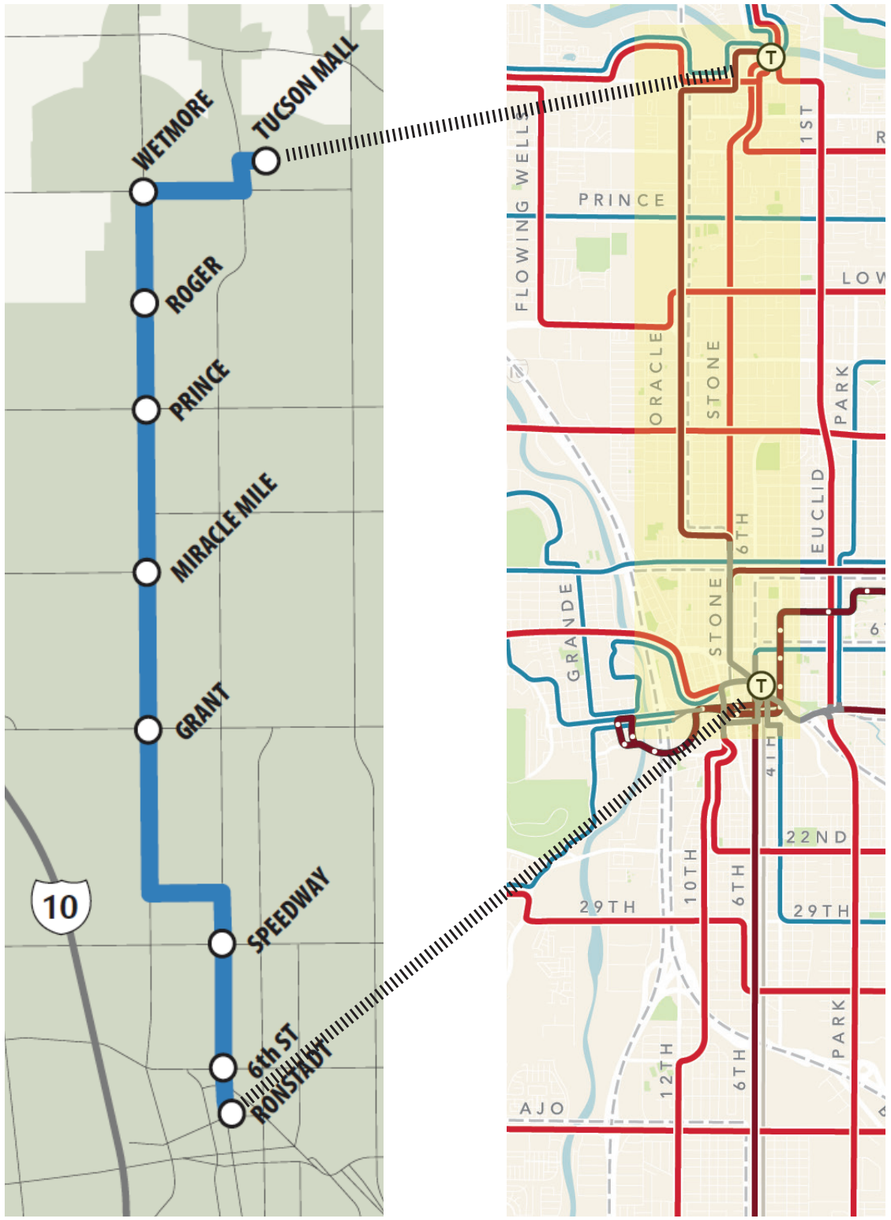

Figure 6: Proposed Oracle Road BRT alignment (left), and relationship to long-term service as envisioned in this plan (right).

This plan envisions service every 7 minutes on Oracle Road from Tucson Mall to Downtown Tucson, with significant improvements to intersections (queue jumps and transit priority) and bus-only lanes at key chokepoints.

This service would continue as a single route to the south side, branching into three routes running every 20 minutes south of Irvington Road. This would effectively create BRT-like conditions from Tucson Mall to Irvington Road.

The main question would be whether any BRT should be "closed" (i.e. special vehicles and stations that force transfers at the ends of the BRT segment) or "open" (i.e. regular transit vehicles that can continue on beyond the enhanced segment).

For the envisioned route to continue to the south side and branch as in this plan, the BRT would need to be open. Otherwise, transfers would be required either downtown or at Irvington Road, resulting in longer travel times.

6. South 6th Ave Streetcar

The 2017 HCTIP envisions a potential streetcar extension from Downtown Tucson to Irvington Road, operating every 10 minutes at midday. This would in many ways be like existing service on Route 18, but with larger vehicles, improved stations, and more transit priority measures. Developing a streetcar may also provide benefits in terms of economic development and urban regeneration.

The South 6th Ave streetcar concept is consistent with existing trends as the next logical step in improving service without impacting other local or regional transit connections. However, it has become clear that this concept could miss some key opportunities:

- In the long term, we envision a continuous transit route every 7 minutes from Tucson Mall to Irvington Road, splitting into three 20-minute branches that would serve Valencia Road, Midvale Park, Drexel Heights and the Pascua Pueblo. This would improve transit travel times in two important ways:
  - » Areas south of Irvington Road would gain direct access to Downtown Tucson with no transfers at Laos Transit Center, and at higher frequency than existing service, with average time savings in the range of 10-15 minutes.
  - » Areas north and south of downtown would be connected directly, saving even passengers on segments that are already frequent at least 5 minutes on average.
- A streetcar segment between Downtown and Irvington Road would require certain decisions that would impact transit operating costs and passenger travel times. Options include:
  - » **Separate service: a streetcar as far south as Irvington Road, and bus lines to points further south.** This would be the least disruptive option in terms of operations, but it would reproduce all of the existing disadvantages of public transit on the south side.
  - » **Overlaid service: a "local" streetcar from Downtown to Irvington Road, on top of a "rapid" bus route that would make fewer stops in this segment**. The bus route would continue as the same service to points farther north and south, operating as a regular FTN Tier 1 bus route. This has the advantage of providing the most options to travelers on South 6th Ave. But it would also require the highest possible level of capital investments to reliably run a bus route every 7 minutes on top of a bus route every 10 minutes, and the highest possible operating costs as well.

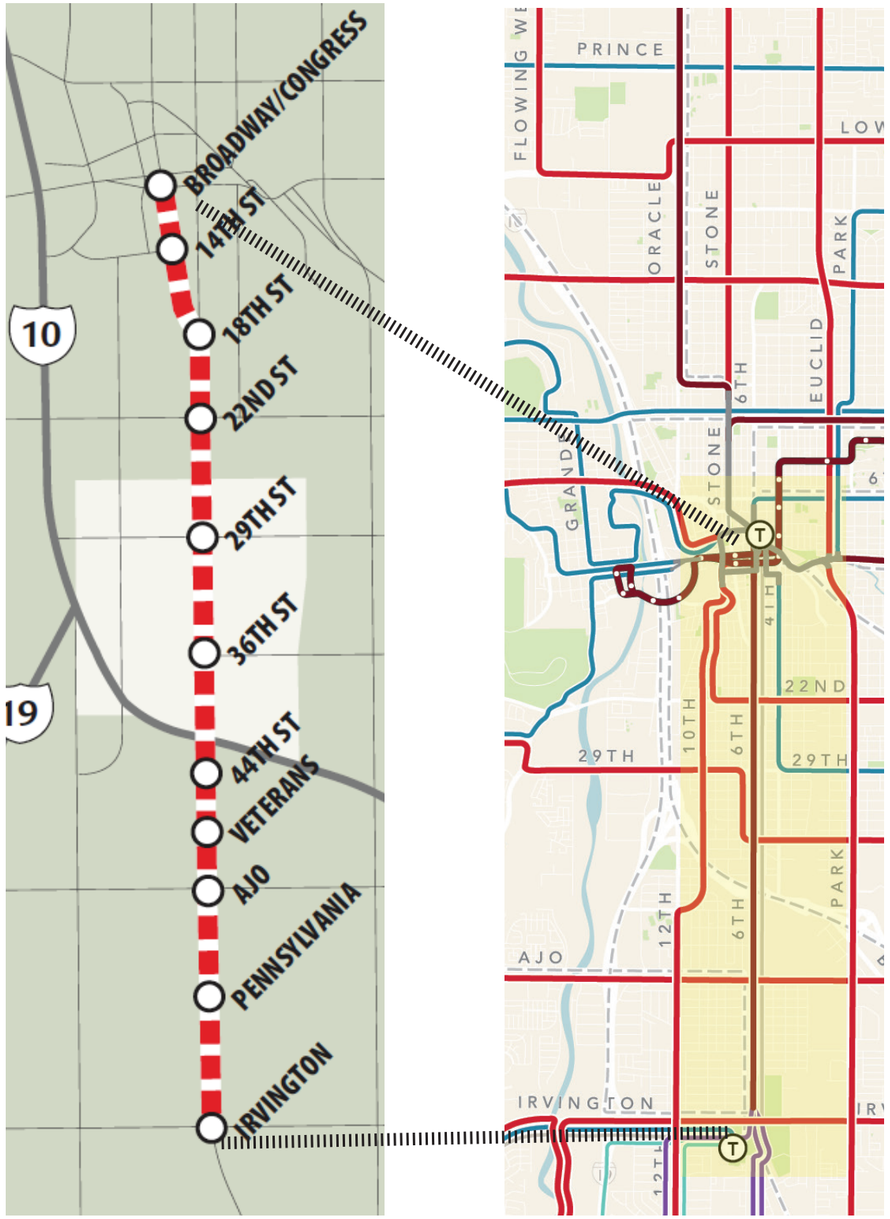

Figure 7: Proposed South 6th Ave. streetcar alignment (left), and relationship to long-term service as envisioned in this plan (right).

This plan envisions service every 7 minutes from Tucson Mall to Downtown Tucson, continuing as the same route onto South 6th Ave. and branching into three routes running every 20 minutes south of Irvington Road.

There would be significant improvements to intersections (queue jumps and transit priority) and bus-only lanes at key chokepoints. This would effectively create BRT-like conditions from Tucson Mall to Irvington Road.

A streetcar in the segment envisioned at left could be paired with a separate route on Oracle Road, and feeder lines ending at Laos Transit Center, similar to existing service. In that case travel times would be longer between points north and south.

Alternatively, the streetcar could function as a local overlay between Downtown and Irvington Road, with the bus route only making stops every half-mile or every mile. In that case, the total budget to operate transit on South 6th Ave. would be much higher.