Transit Choices Workshop Report

JUNE 23, 2015

Pima Association of Governments

JARRETT WALKER + ASSOCIATES

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1. Executive Summary

1. Executive Summary

Workshop Goals and Objectives

The major objective of this workshop was to collect input from people representing a broad array of organizations and constituencies on their visions for the future of transit in Tucson. While no single workshop can clarify such a vision for an entire community, in combination with ongoing outreach efforts, the results of this event are intended to form the framework for the development of a vision to be included in PAG's 2045 Regional Transportation Plan.

The organizations shown in Figure 1 and their representatives participated in the workshop.

Additional transit workshops were held with members of the public in May. These workshops used some of the same tools and exercises as the stakeholder workshop, the results of which are described in Appendix C.

Bus Friends Forever	Partners for Housing Solutions
Bus Riders Union	Pima Community College
City of South Tucson	Pima Council on Aging
City of Tucson City Manager's Office	Pima County Environmental Quality
City of Tucson Transportation	Pima County Transportation
City of Tucson Transit Task Force	RTA CART Committee
City of Tucson Ward 1 Office	Southern Arizona Leadership Council
City of Tucson Ward 3 Office	Southern Arizona Transit Advocates
Drachman Institute	Sun Tran
Friends of the Streetcar	Town of Oro Valley
Living Streets Alliance	Tucson Association of Realtors
PAG/RTA Transit Working Group	Tucson Metropolitan Housing Commission

Figure 1: Participating Organizations

Silent Polling

At several points in the workshop, stakeholders were asked to respond to questions using silent polling devices. These devices allow a user to respond to a question asked by a presenter in real time, anonymously. Thus, stakeholders could be assured that nobody would know which answer to a particular question they selected except themselves.

Stakeholders were asked questions pertaining directly to the two interactive planning exercises completed during the workshop, as well as general questions about their priorities for transit in Tucson. Questions regarding each exercise are discussed in their respective sections and throughout; each question regarding each of the two major exercises of the workshop are reproduced in Appendix A and B as well.

Fictional City Game

The first workshop exercise gave the participants a chance to acquire some knowledge of the basic tools of transit planning, using a map of a fictional city called Prairieville. This exercise introduces the tools of transit planning, and asks players to consider major questions of transit planning in a place where they have no constituents or agendas to advocate for. This exercise is discussed in detail in Chapter 2, and the results of the game are compiled in Appendix A.

1. Executive Summary

Figure 2: Stakeholder Workshop

Tucson Planning Game

After designing a fictional transit network for Prairieville, the stakeholders were asked to do the same thing for Tucson. They were provided with a budget equal to a 25% expansion of service, and asked to show what they would do with it using a map and tools very similar to the Prairieville game. At the end, each group also indicated where they would put Tucson's next High Capacity Transit (HCT) line in the future. This exercise is discussed in Chapter 3, and the results of the game are compiled in Appendix B.

Priorities for Transit Development

This report presents the outcomes of the exercises described above, and then makes some preliminary observations about priorities for the future development of transit in Tucson. These observations are not a plan, but rather a framework for decisionmaking on transit investment, comprising three major elements, as shown in the map in Figure 3 on page 6. :

- A prioritized list of future Frequent Network improvements, drawn from stakeholder input, observations drawn from existing data of land use and ridership, and network design principles of continuity and connectivity.
- A set of potential study corridors for future High Capacity Transit investment. These are not recommended corridors for any particular technology or service. Instead, they are a larger set of corridors that seem likely to be included in a more thorough process to identify where such an investment would be planned.
- Several study areas for future coverage expansion, where new service might be needed depending upon future development.

Acknowledgements

This project has been made possible with financial support from the Federal Transit Administration (FTA) and the following partners providing a portion of the local match contributions from the City of Tucson, COX Communications, Drachman Institute, TEP, AT&T and Casa Maria.

1. Executive Summary

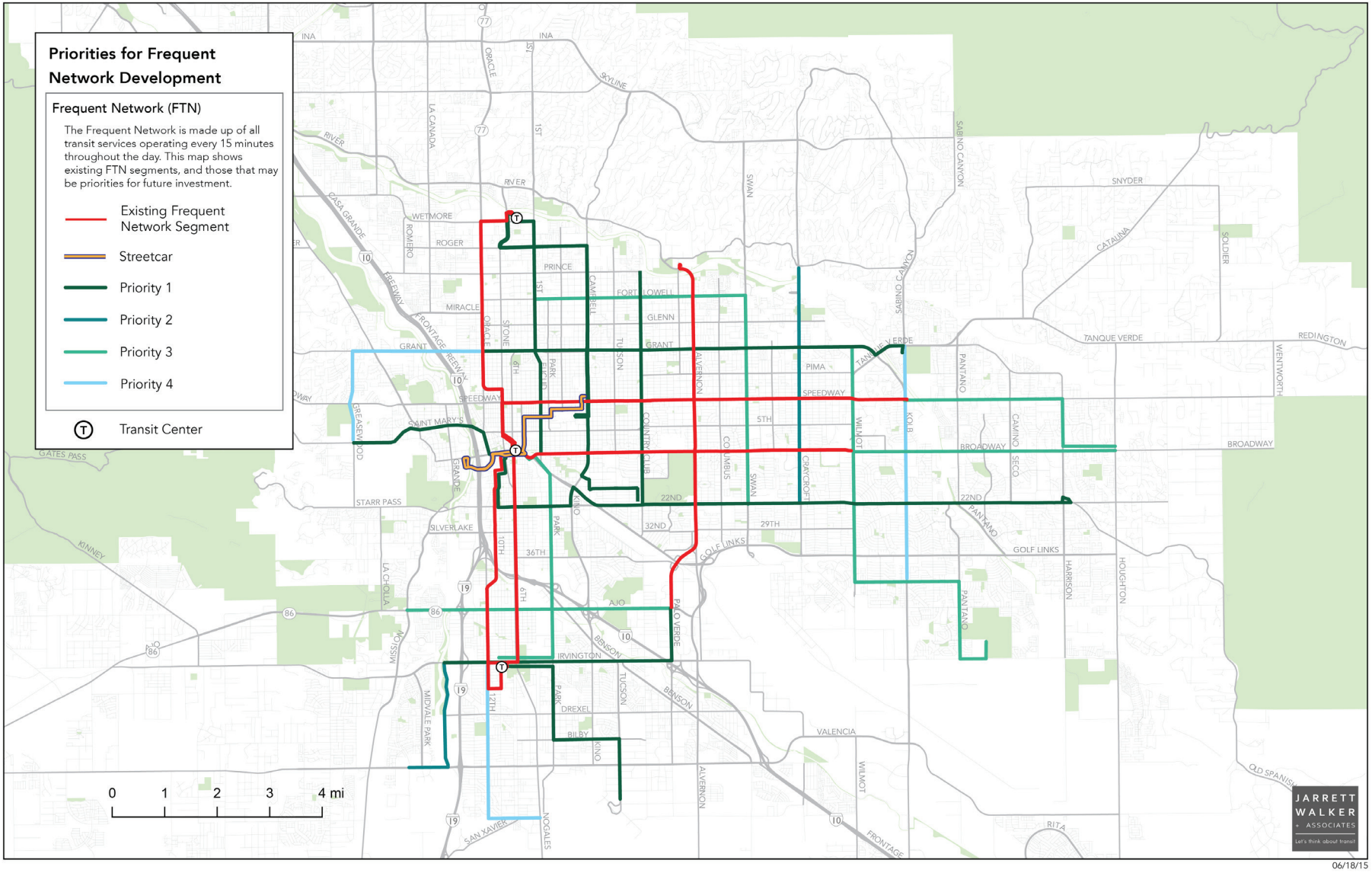


Figure 3: Priorities for Future Transit Development Map

2. Fictional City Game

2. Fictional City Game

The first activity was a transit planning game called Prairieville. This game introduces players to the principles and tradeoffs of transit network planning, using a map of a simple fictional city. Prairieville is designed as a generic city containing features that are common to many urban areas, and posing questions about transit that people in any community may encounter when thinking about their system. This game provides an opportunity to learn about and consider these high-level questions in the abstract.

The Prairieville map is shown in Figure 4. This map shows the population and employment density of different areas of the city, and labels a number of typical major destinations – for instance, downtown, the university, shopping centers, and a hospital. The groups were also advised that income follows latitude, declining toward the south and rising toward the north. They were also informed that the old port area in the south near the river is the target of a future redevelopment scheme, though not one with any committed funding at this stage.

At each table, four to five participants cooperated to design a network of transit routes of varying frequencies, within a limited budget. The game is played by

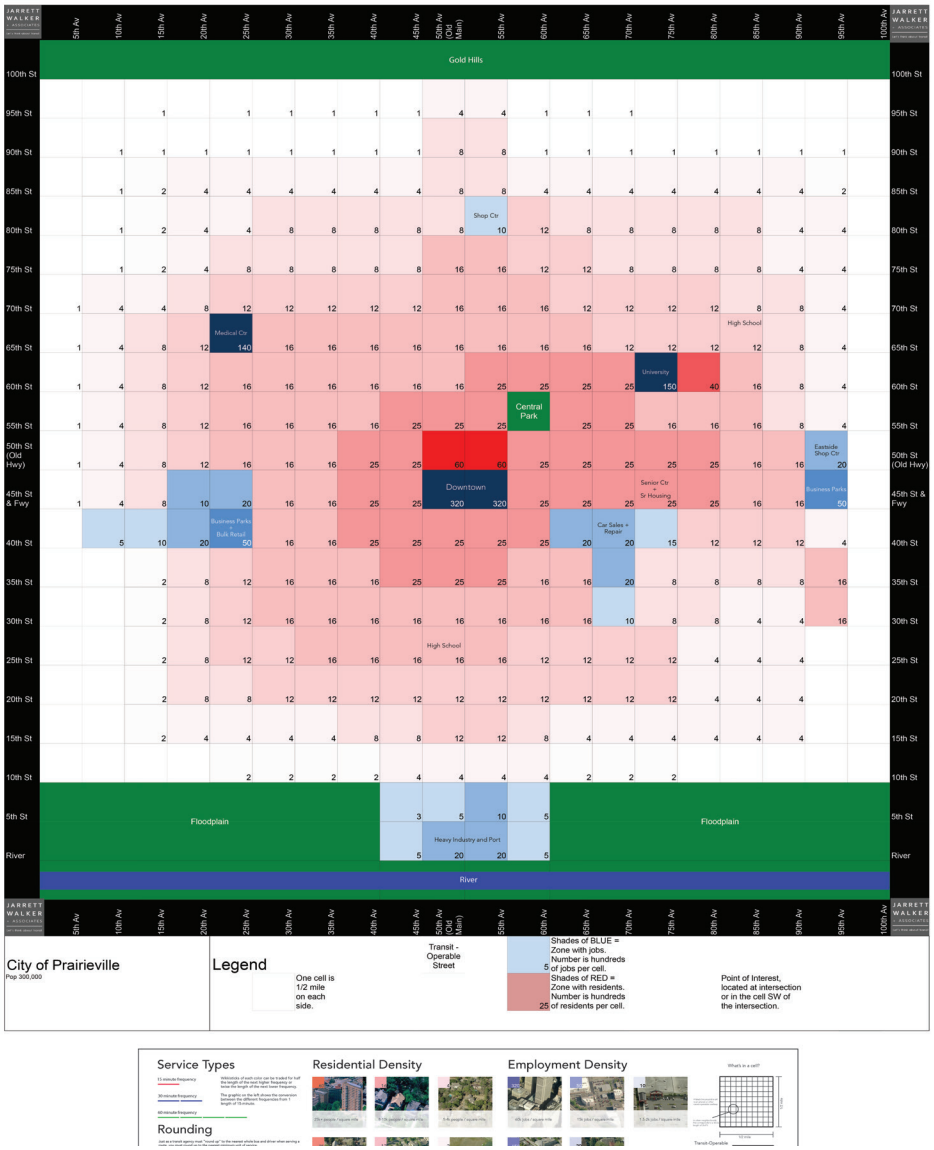


Figure 4: Prairieville Game Map

2. Fictional City Game

using flexible sticks of waxed string of different colors to indicate different frequencies. Players place a stick on a road on the map to show transit service of a particular frequency:

- Red = every 15 minutes
- Blue = every 30 minutes
- Green = every 60 minutes

While each group is given an initial budget of a mixture of frequency types, each type can be exchanged for any other. For instance, 1 red stick (representing the distance that can be served by one bus at 15-minute frequency) can be exchanged for 1 blue stick that is twice as long (representing the distance that can be served by one bus at 30-minute frequency). A bus operating at 30-minute frequency can serve twice the distance, since it only comes half as often. Thus, a core tradeoff of transit planning – that at a fixed budget, transit can either be extensive or intensive – is immediately evident to players as they place service onto the map.

Then, the group had the opportunity to pin their new network maps up on the wall and compare their work. Stakeholders were then invited to discuss which networks might best serve different goals transit is often asked to achieve. Some typical goals include:

- Generating high ridership
- Providing some level of service to everyone
- Serving low-income people
- Serving the university or medical center
- Serving downtown businesses
- Stimulating dense or walkable development

As intended, the networks produced by the groups varied substantially in the type of transit service provided. By comparing this variation in fictional transit systems in a fictional city, participants were able to get a sense for the consequences of choices based on different transit values.

Prairieville Results

The Prairieville game is designed to generate many different solutions to the same problem, reflecting not only different ideas but also different mixes of values that participants bring. The collaboration at the tables requires a degree of consensus, but the results are still usually highly contrasting, as they were here. The contrast is the whole point.

At the end of the exercise, in a pin-up session, all participants reviewed all the maps and we had a discussion about what we could learn from the similarities and differences among the maps.

In the discussion, we asked the group a series of informal questions about which table would likely generate different outcomes, including (a) approval by various interest groups, (b) best access to all parts of the city, and (c) total ridership. This section presents some highlights from that discussion. The six Prairieville maps are presented side by side in Figure 5 on page 10.

Ridership vs Coverage

One of the most obvious differences between the groups' maps is the extent to which the transit network serves the land area of Prairieville.

Some groups, like groups 1 and 5, concentrated service very heavily in the center of the city. Group 1's map shows an intense network of red lines representing 15-minute service, mainly concentrated in the dense core of the city around downtown, with connections to each of the major destinations. These frequent routes are typically

2. Fictional City Game

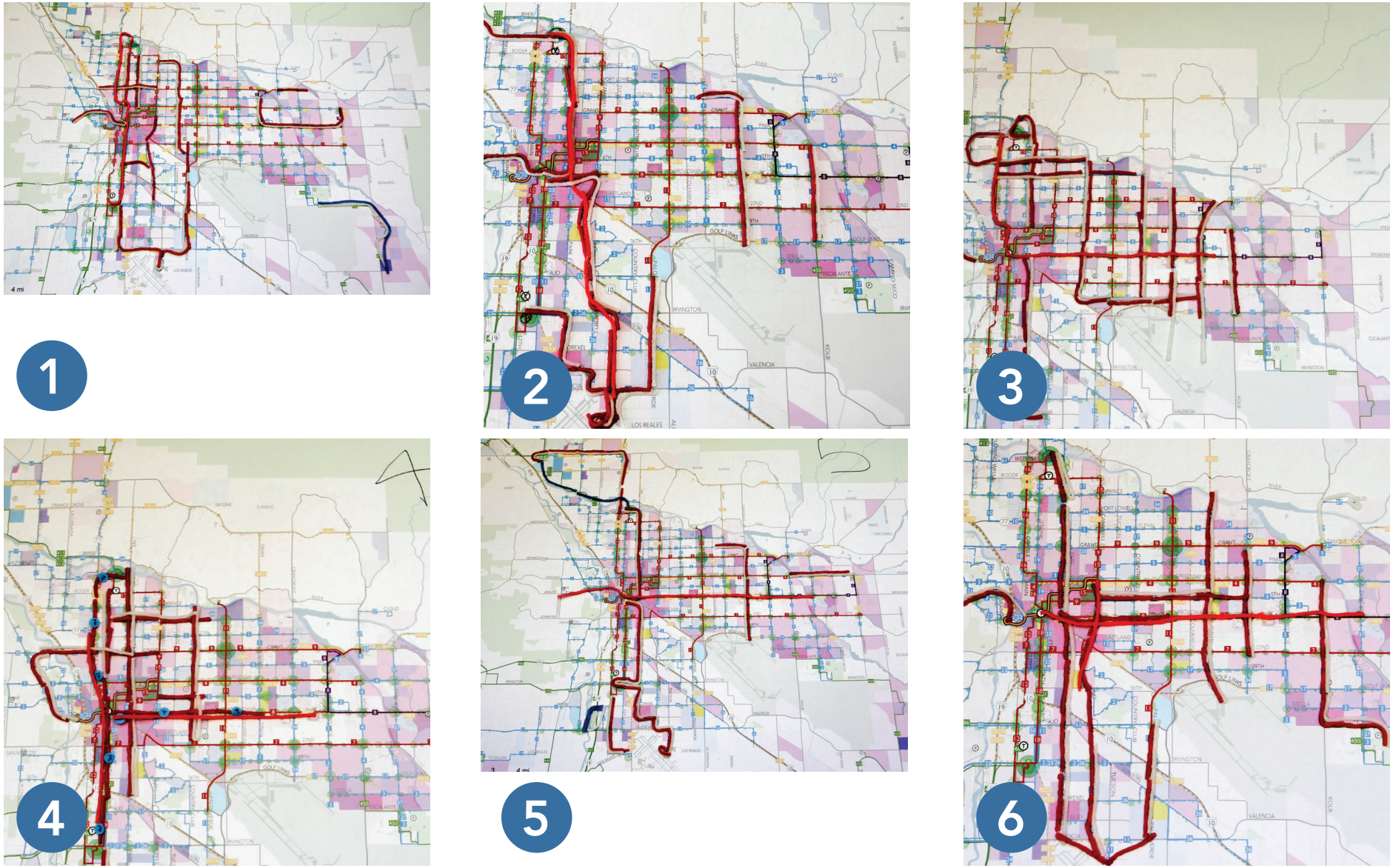


Figure 5: Prairieville Game Results

2. Fictional City Game

located every 1 mile (2 map cells), except near downtown where a spacing is tighter to serve the most dense area. This type of network provides a high level of convenience and mobility for residents of the urban core, but offers almost nothing to people located outside of the dense central area; for instance, the entire NE and NW quadrants of the map are without transit service of any kind.

Group 5's network (shown in Figure 6) spreads the network out a bit further, into a grid of alternating 15-minute and 30-minute routes. This is a service design reminiscent of the east-west frequent routes of Sun Tran's network, where 15-minute lines run on arterials every mile, with 30-minute routes serving the streets in between.

When we asked the participants to share which network they thought would generate the highest ridership, 35% said "Group 5", and 20% said Group 1. The results of this question are shown in Figure 8.

35% also said "Group 4", which is an interesting case as a network that provides extremely high (sub-five-minute) frequency through the downtown. Group 4's network is shown in Figure 9. Over short distances, it can often be faster to walk then to wait even 5 or 10 minutes for a bus. This

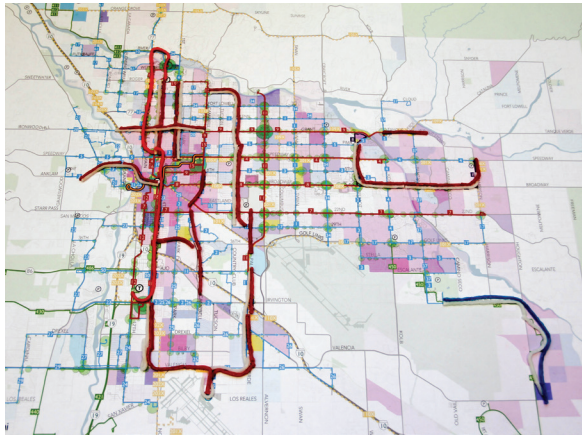


Figure 7: Group 1 Prairieville Map

Figure 6: Group 5 Prairieville Map

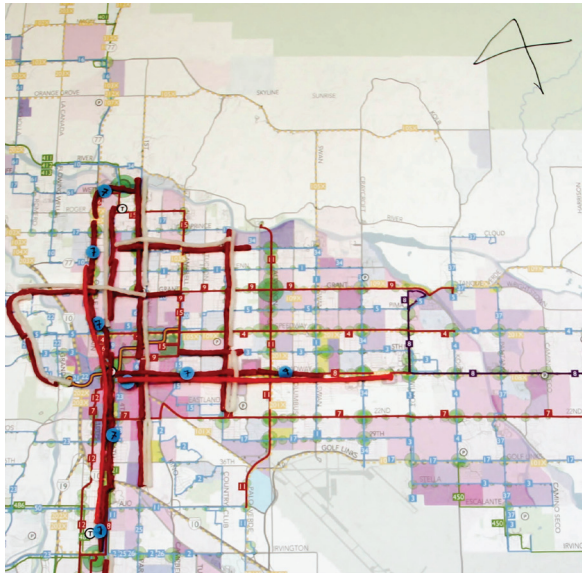


Figure 9: Group 4 Prairieville Map

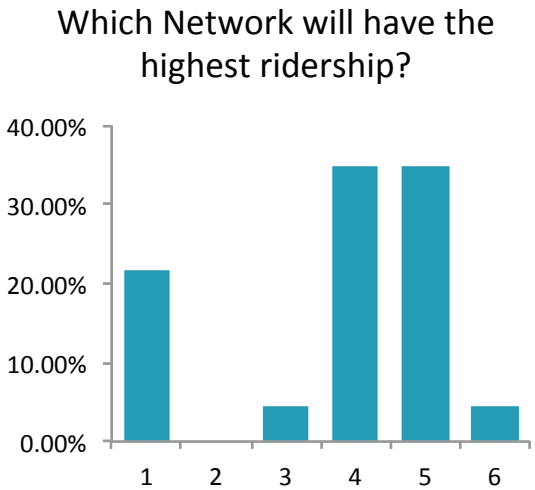


Figure 8: Prairieville Ridership Question

2. Fictional City Game

network invests in downtown frequency to the level required to be competitive with walking over short distances, in the most dense part of the city.

However, this very intense investment in the core means that the rest of the service is generally lower frequency.

By contrast, groups 2 and 3 designed transit networks more focused on extending service across the area of the city. These networks look quite different from those of Groups 1 or 5: they contain many more lower-frequency blue and green lines, and their routes touch more of the parts of Prairieville that 1 and 5 didn't serve at all. These networks offer service to a greater sheer area and number of people, but more of this service is less convenient, since lower frequencies mean longer waits.

When we asked the group to identify the network they thought was best at getting a little service to everyone in Prairieville, 75% answered "Group 2", with the second most frequent response "Group 3".

Grids

When we discuss network structure in transit systems, we typically draw a distinction between radial networks, where routes converge downtown, and grid networks,

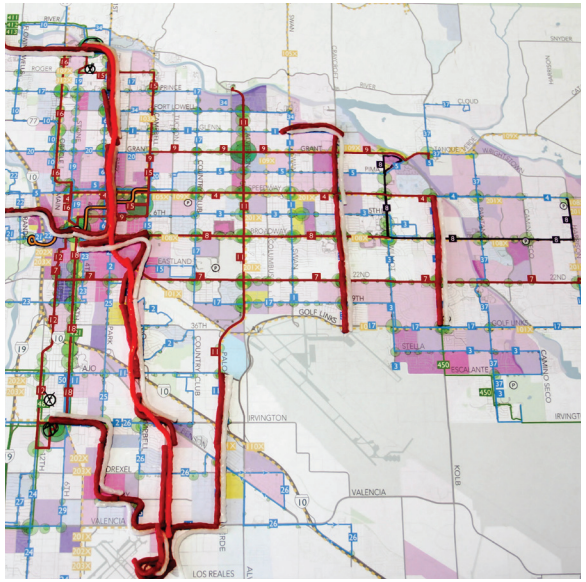


Figure 10: Group 2 Prairieville Map

where perpendicular routes cross throughout the city. The key difference is that in a grid network, it is possible to move around the city without going downtown by transferring between intersecting routes, so long as the frequency is high enough to prevent a long wait time.

Each of the maps we've looked at so far include intersection routes arranged in a grid, and in fact all but one group designed a network with many interconnecting routes. However, the utility of grid connections is largely determined by their frequency. Where two red lines cross, a connection is possible in four different

Figure 11: Group 3 Prairieville Map

Which network is best at getting a little service to everyone, no matter where they live?

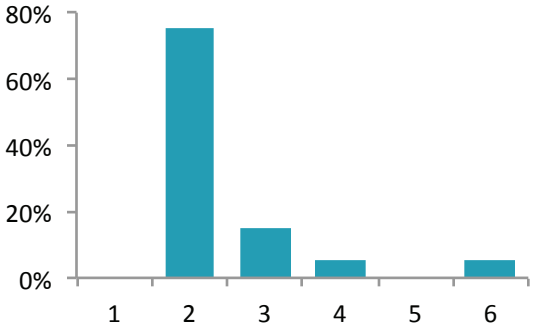


Figure 12: Prairieville Coverage Question

2. Fictional City Game

directions, with an average wait time of 7.5 minutes (half the headway). But if the frequency is lower, waits are longer, and the connection becomes much less useful. In Group 4's network (Figure 9), it is technically possible to connect between a number of green and blue grid lines, but these connections will require average waits of 15, or even 30 minutes.

Sun Tran's network, and the networks of Groups 1 and 5, have elements that can thus be described as part of a Frequent Network Grid, a network design that employs intersecting frequent routes to make it easier to travel around a multi-centered urban area.

Loops

It is common, in Prairieville, to see very short routes ("circulators") and routes consisting of loop patterns. Loops are very common in interest-group-driven design, because they focus tightly on a favored area. However, they have two geometric problems. First, very few people want to travel in circles, so they do not match the actual desire line for many actual customer trips. Second, they turn away from the larger city in a way that makes many other trips impossible.

The very short route or circulator has a similar issue. Extremely short routes must be extremely frequent. A route that is only a mile long needs to be extremely frequent to be faster than walking. Even at a 15-minute frequency, you need only walk a brisk 4 miles per hour to get to the other end of the line before the bus comes. This is why very short circulators are usually not all that successful, unless they can be run with vastly higher frequency than this game's resources provided.

Among the participants, only Group 6 drew many loops. This network features a core north-south frequent axis, but nearly every other route encircles the city. These loops hit many destinations, but have the disadvantages described above. For instance, travel from the west to east sides of the city (between the two Business Park areas) would require a wait for the yellow-marked 30-minute route, a long out of direction trip around the loop, a transfer to the green-marked 15-minute route, and then another out of direction trip around its loop.

Figure 13: Group 6 Prairieville Map

3. Tucson Planning Game

3. Tucson Planning Game

After playing Prairieville, the participants had been acquainted with a basic set of transit network design tools, and were ready to use those tools to share ideas about their visions for transit in Tucson. The second exercise asked them to show what they would do if the budget for transit increased by 25%.

Participants were given a map of Tucson similar in style to that of Prairieville, showing existing transit, density, and ridership. Each group was given a fixed budget of wax sticks to create new transit routes, or add frequency to existing routes. Figure 14 shows the basemap used in this exercise. The pink and blue shading represents population and employment density, while the colored lines show existing Sun Tran routes by frequency.

Each group was given a budget of red sticks representing 15-minute bus service. They could trade these red pieces in for blue or green similar to the Prairieville game, or use an additional set of white pieces to delete existing segments of routes (for each white piece placed on the map, they would receive one additional red piece).

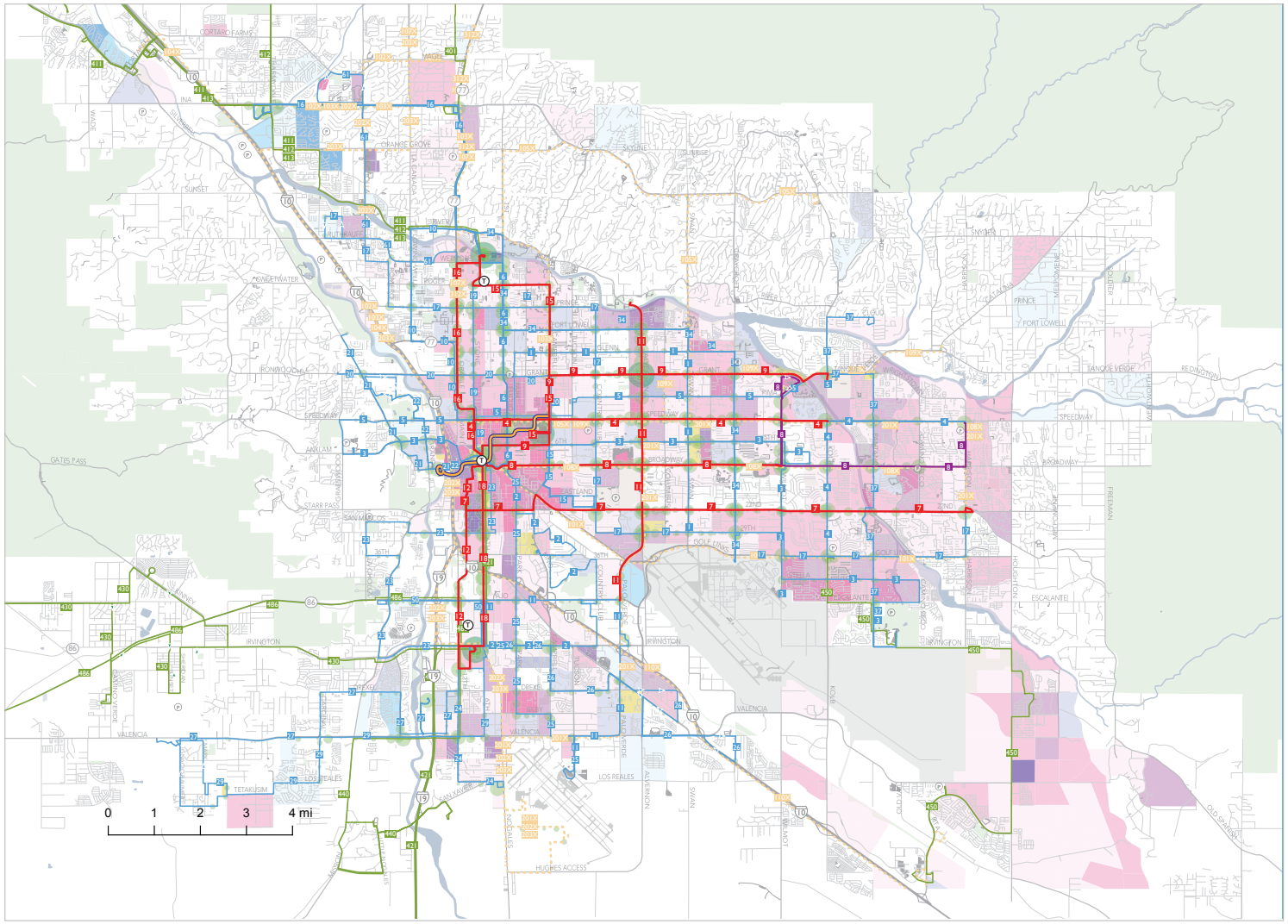
Groups also had the opportunity to spend their new resources on increasing the weekend service level on the existing network, by placing an equivalent number of red pieces into Saturday and Sunday piles such that the necessary resources had been spent to run each weekend day as a weekday.

After spending their budget of new resources, and making any other changes to the existing network, each group had one final task: show where they would put Tucson's next High-Capacity Transit line. It is important to note that this portion of the exercise was strictly technology-agnostic; instead, stakeholders were solely asked to show which corridor they thought was important for some type of investment.

Each group took a unique approach to service design and HCT corridor prioritization. However, some common themes emerge when the six maps are combined and examined together, as explored in the next section.

Please note that the 6 Tucson exercise maps are presented side by side in Appendix B.

3. Tucson Planning Game



Tucson Transit Network Visioning Exercise

The Existing System

The map to the left shows Tucson's existing transit network, color-coded by each route's midday frequency. Overlaid on this base layer are scaled dots representing the estimated average weekday daily boardings at each stop in the system.

Estimated Average Daily Boardings

- 0 -10
- 10 - 25
- 25 - 50
- 50 - 100
- 100 - 300

- Streetcar (15 minutes ore better)
- 15 minutes or better
- 20 minutes
- 30 minutes
- Peak-only
- Shuttle services (frequencies vary; typically greater than 60 minutes)
- One-way segment
- Transit Center
- Park & Ride lot

2045 Projected Activity Density

Activity Density is a method of visualizing and comparing the combined activity level in parts of a region. The scale at left displays the combined projected 2045 population (pink) and jobs (blue) by Census Block Group for Tucson and the surrounding area. Where greater mixed uses occur, the shades mix to form purple. The highest-density, most mixed areas are highlighted in yellow.

Data Source : PAG 2045 Forecasts

Transit Service Types

Transit service may be added to the map in 1 bus increments at different frequency levels. The more frequent the service is, the less distance one bus can serve, since it must serve that distance more frequently.

Each frequency can be traded for 1 bus at a lower frequency as shown below:

Every 15 minutes

Every 30 minutes

Every 60 minutes

You may also create express service.

The base express service operates 3 trips during the 3-hour AM and PM rush hour periods. This is a base frequency of 60 minutes, though the exact timing of those trips may create a higher frequency for a short period of time.

One express bus goes the length of two orange Wiki Sticks. This is because express service runs at higher speeds because it either stops much less often, or uses the freeway.

Every 60 minutes / Express Service

For more frequent express service, simply double-up orange segments.

Figure 14: Tucson Transit Network Planning Game Map

3. Tucson Planning Game

Frequent Network

Every group used all or the vast majority of their budget for transit expansion to enrich the Frequent Network in Tucson and South Tucson. Stakeholders increased frequency on a variety of corridors, enriching the existing network by adding new frequent crosstown routes similar to the 11-Alvernon, or extending frequency to important destinations like the airport.

Figure 15 shows a map of where groups placed their Frequent Network segments. Where lines are thicker, more groups included frequent service (even in addition to existing frequency) in that corridor. The existing Frequent Network is drawn in brown lines beneath the stakeholders' additions.

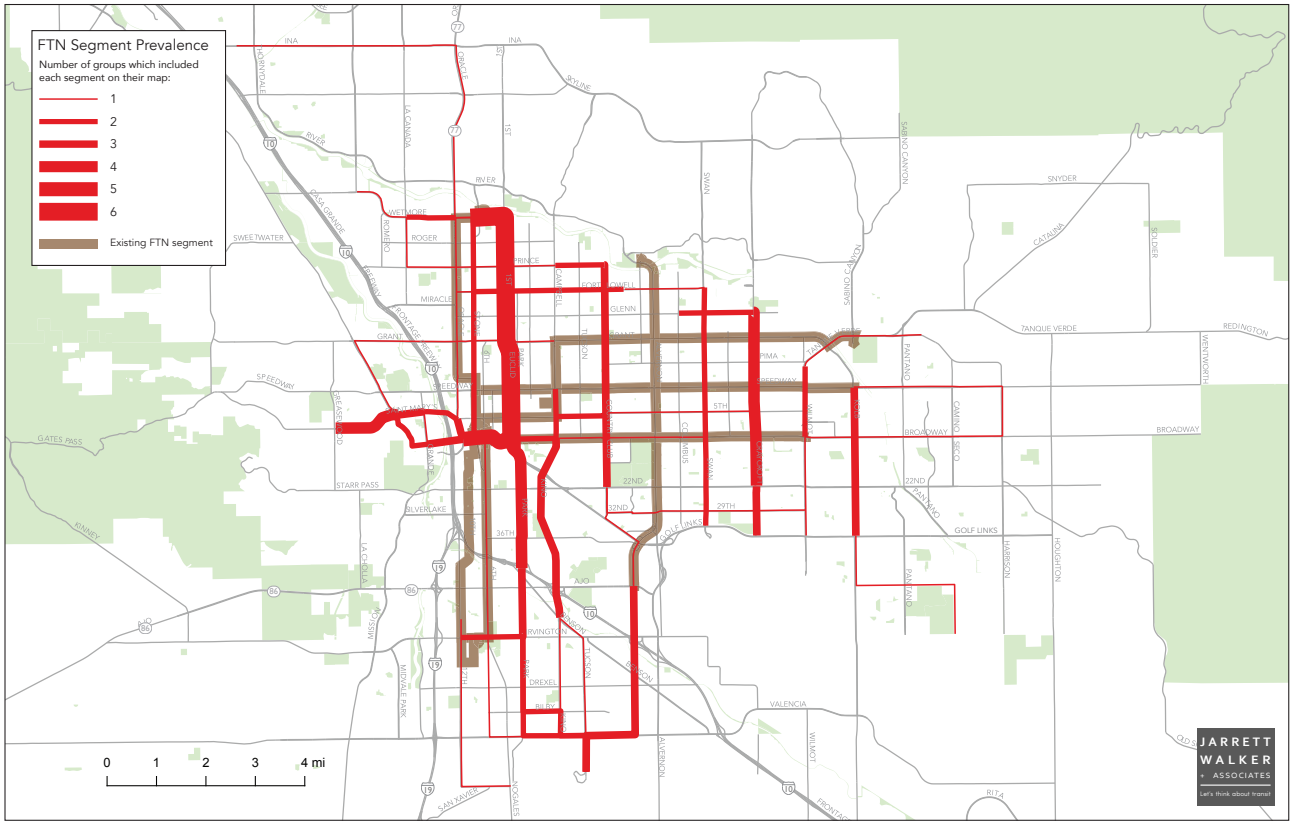


Figure 15: Frequent Network Segment Prevalence

Euclid/N. 1st Ave

The only corridor included in all 6 groups' maps was Euclid/1st Avenue between downtown and Tohono Tadai Transit Center. This segment is currently served by the 6-Euclid/N. 1st Ave., a relatively productive route averaging over 30 boardings per revenue hour. The Euclid/1st corridor is located approximately 1 mile from Frequent Network routes to the east and west. Adding frequency here would create a similar 1-mile spacing of frequent routes as is found on the east side of Tucson.

New Destinations for Frequent Service

A few common destinations for frequent service stand out from the combined stakeholder responses:

- The Pima Community College West Campus, located at Greasewood and Anklam. 5 of 6 groups provided frequent service to PCC via Anklam, and the 1 group that did not terminated a HCT line at the campus. There was some variation in how the groups served the area between I-10 and Silverbell. Two simply added frequency to St. Mary's Rd., while other groups

increased frequency on Silverbell or Grande.

- The passenger terminal of Tucson International Airport. Every group extended frequent service to the airport, with some running as many as three lines south to the airport via Park, Campbell, or Palo Verde (the most common segment).

Frequent Network Grid

Every group used at least some of their budget to create new north-south cross-town routes similar to the 11-Alvernon on Tucson's east side. Figure 15 on page 17 displays how stakeholders filled in gaps in the existing frequent grid.

Generally, stakeholders created new frequent crosstowns on streets preserving a 1-mile spacing of frequent grid routes. However, exactly which streets were used, and how many, varied substantially from group to group.

The most common new north-south cross-towns were:

- Craycroft
- Country Club
- Kolb
- Swan

Alvernon and Campbell already have north-south frequent service, and no group created a frequent crosstown east of Kolb.

Though not every table was in agreement as to which streets should be added to the Frequent Network, stakeholders clearly indicated a desire for additional service of this type at a 1-mile spacing, extending approximately between Oracle and Kolb.

South Tucson

All groups added frequent service in South Tucson, often oriented towards the airport as described earlier. The most common corridors for this were Park and Palo Verde, with others using South Kino Parkway and one or both of Campbell or Tucson.

While the stakeholders all added frequent service in South Tucson, the service they designed was entirely north-south running. Currently, transit service in South Tucson is mostly oriented towards feeding people to Laos Transit Center and connections to north-south frequent routes. In the future, if additional frequent routes were added to South Tucson, there would also be an opportunity to reconsider the service design of this area more broadly in order to best take advantage of such an investment.

Other Frequent Network Additions

Several other additions to the Frequent Network were found on only one or two groups' maps, but are worth acknowledging as important stakeholder suggestions.

One group chose to increase the frequency of the longline segment of the 16-Oracle/Ina out Ina, providing 15-minute service to Foothills Mall, and all the way to Thornydale and the commercial and employment area near Old West Business Park.

Several groups made small extensions of the Frequent Network into the far eastern parts of Tucson. One sent the frequent routes on Speedway and Broadway all the way out to Harrison at 15-minute headways. Another included frequent service on Kolb south of Golf Links, turning east on Escalante and south on Camino Seco to terminate at Irvington. While most groups spent most of their resources west of Wilmot, at least a few considered service expansion to further to the east.

New Coverage

The stakeholders were typically much more focused on enriching the Frequent Network than on expanding the coverage area. In general, stakeholders did not spend substantially on new coverage. Between all six

3. Tucson Planning Game

groups, only two included large new coverage segments.

The first was in the far southeast area of the region east of Houghton, which according to current land use projections is likely to see substantial population growth in the coming decades. This area is currently served very infrequently by a Sun Shuttle route, the 450. One group added a 30-minute all-day route serving the area similarly, via Houghton.

The second new coverage segment was found in Group 5's map. Group 5 added 30-minute all day service in the northwest along River Rd. between Tohono Tadai TC and the shopping and employment area near Ina and Thornydale. Those segments are currently served by the 411,412, and 413 Sun Shuttle routes, each operating every 60 minutes or worse. The main impact of this coverage expansion would be to improve the frequency and span available, rather than provide new transit service where none had existed previously. This group also extended frequent service to the same destination via Oracle and Ina.

Figure 16: New coverage in NW area (Group 1)

Figure 17: New coverage in SE area (Group 1)

3. Tucson Planning Game

High Capacity Transit

In the last step of the Tucson exercise, each group had to decide where to place 12 miles of HCT infrastructure. HCT refers not to a particular technology or vehicle, but simply to an investment in a capital project that would result in capacity, speed and reliability improvements to transit in that corridor.

The map shown in Figure 18 displays the location of each HCT segment groups of stakeholders placed on the map, shaded by how prevalent each segment was among the various maps.

Four of the six groups placed HCT on Broadway. Broadway is the location of Sun Tran's most productive frequent bus route, and is a place where a very large transit market is proven to be in place. A HCT line in the corridor would capitalize on existing ridership, improving speed and reliability, as well as connections to intersecting grid routes.

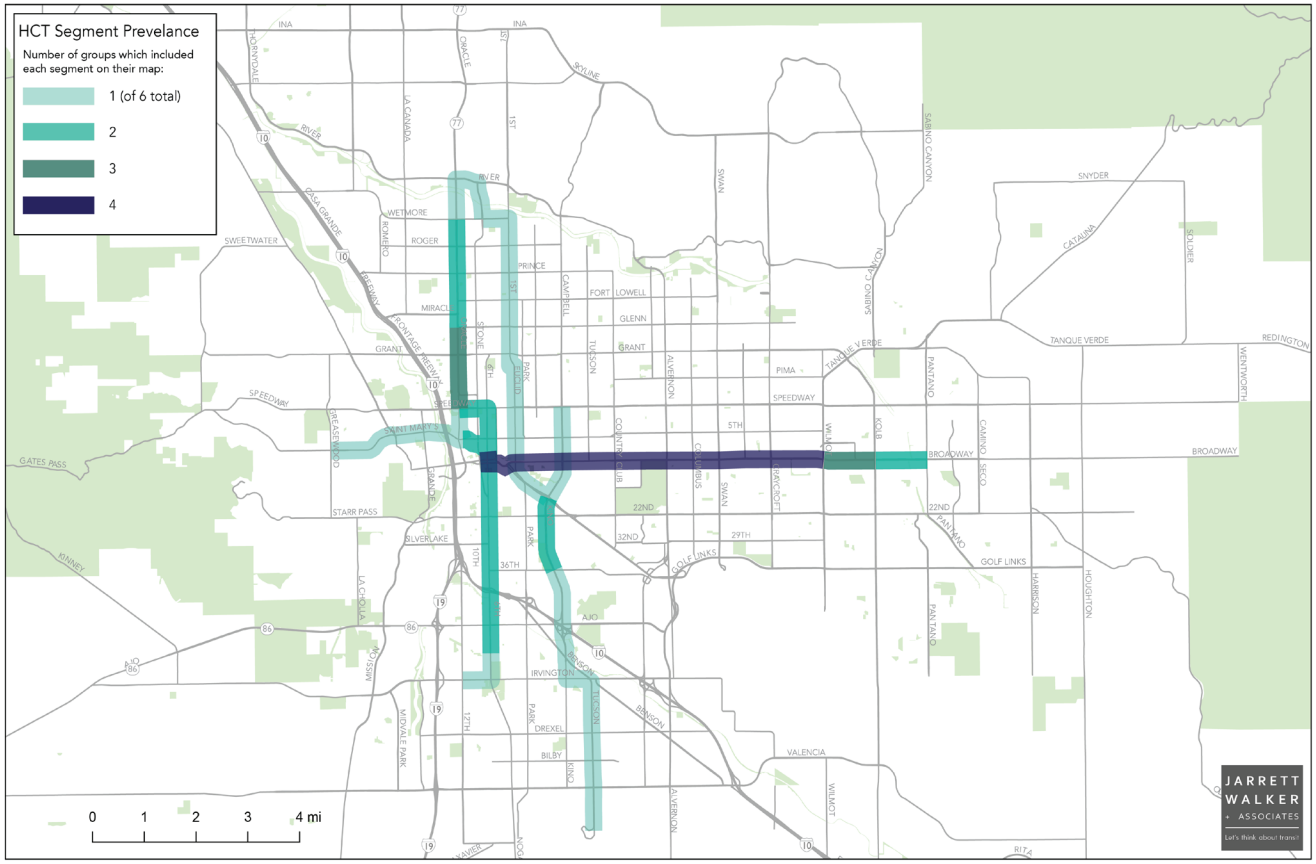


Figure 18: High Capacity Transit segment prevalence

Exactly how far out Broadway HCT should extend was a subject of some disagreement. While all four of the maps that included Broadway HCT ran it as far as Wilmot, three continued HCT to Kolb, and two sent it to Pantano. Any future HCT corridor study would revisit this issue.

All but one group also placed HCT along at least one north-south corridor. Three groups' maps included some HCT on Oracle, while one used Euclid/1st to reach Tohono Tadai TC. South of downtown, two groups placed transit infrastructure on S. 6th, while two put the line on Kino (one running HCT all the way to the airport).

One group each extended HCT to the airport and to Pima Community College west of downtown. Overall, though, many more groups provided frequent service than HCT to these locations.

While stakeholders were split on the exact placement of any future HCT infrastructure,

3. Tucson Planning Game

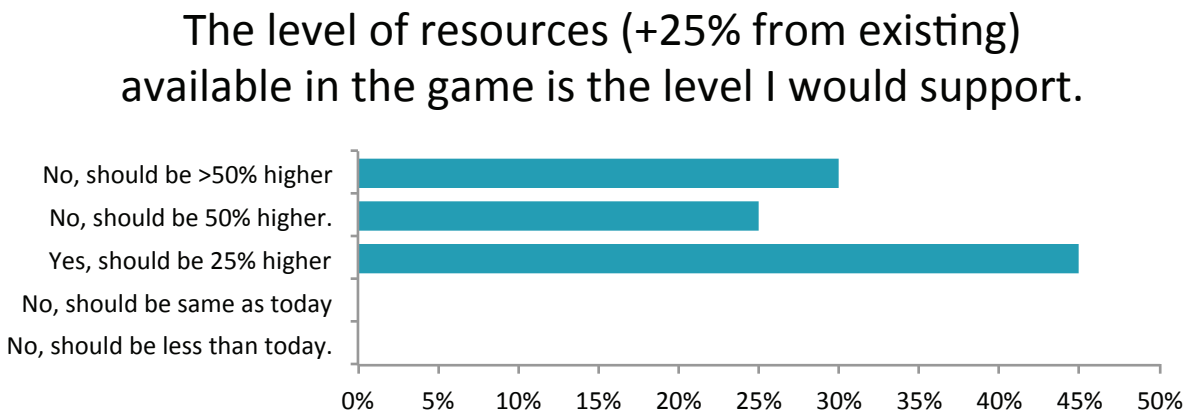
it is clear that at the high level, they favor a combination of a Broadway line and accompanying north-south alignment. Sun Tran's existing Frequent Network is already present in most of these corridors, and is already used by many people for trips that would be made faster and more reliable by a future HCT investment.

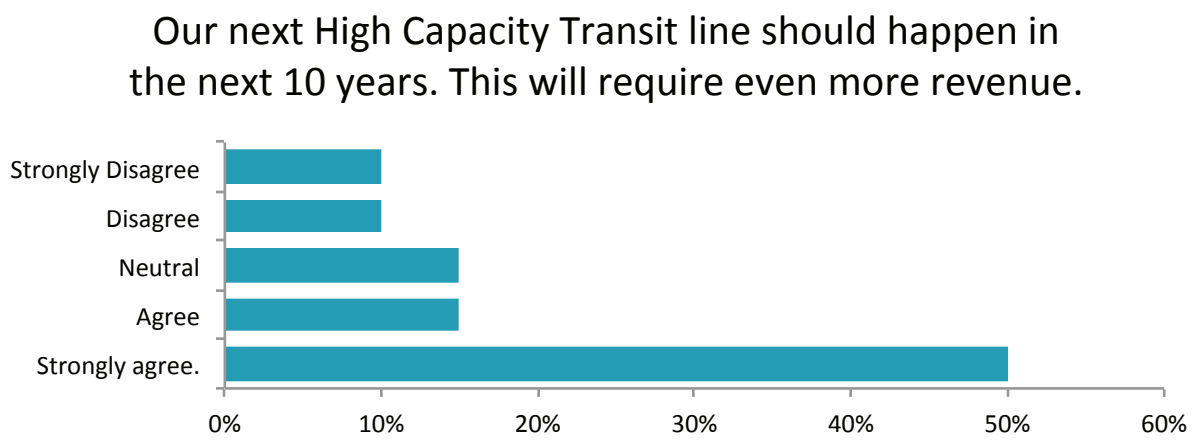
Polling

After concluding the Tucson planning exercise, stakeholders were asked general questions about their views on transit, having now had the opportunity to confront some of the big questions both abstractly and in their own city.

The first question asked stakeholders about the resource level available. The game asked them to spend a budget equal to a 25% increase in Sun Tran service. They were then asked whether that amount was enough, too little, or too much.

45% of participants said that the resources available in the game (+25% from today) were a level they would support, while all other respondents picked an even higher answer. All stakeholders expressed a view that in the future, it is desirable that there be more transit than there is today in Tucson.





The second question asked stakeholders for their view on High Capacity Transit. A new HCT line would require even more revenue on top of the 25% each group was able to spend on new service. Despite this, 65% of respondents strongly agreed or agreed that Tucson should build a HCT line in the next ten years, even if it required new revenue. 20% disagreed or strongly disagreed, and 15% were neutral.

4. Future Transit Vision

4. Future Transit Vision

After evaluating the input received from the stakeholder exercises, in combination with land use and ridership data and network planning principles, we have created a sketch of priorities for the growth of Tucson's transit network. These priorities fall broadly into three groups:

- Prioritized future Frequent Network segments (Figure 20 on page 25).
- Study corridors for a possible future High Capacity Transit investment (Figure 22 on page 30).
- Study areas for future Coverage expansion (Figure 23 on page 32).

In the workshop, stakeholders were given an arbitrary 25% service increase to allocate. This was provided as a way of eliciting the group's vision for what a larger and more useful transit system might look like, but in reality, the actual pace of transit expansion will depend on the growth of existing funds and development of new funding sources.

Future Frequent Network Prioritization

As described in Chapter 3, a major focus for the stakeholders was to add new elements to today's grid of Frequent Network routes. They expressed a high level of comfort with a 1-mile spacing between grid routes, and generally designed this type of service in the area bounded by Oracle, Kolb, Fort Lowell, and 22nd.

Figure 20 on page 25 presents a series of Frequent Network segments, color-coded in priority order. While the stakeholders' exercise gave them the freedom to imagine a large expansion of transit happening at one time, this map translates that into a sketch of how such improvement might occur more gradually, depending on resources.

This priority map is not simply the stakeholder segment prevalence map (Figure 15 on page 17) discussed earlier in the report. Starting from their work, we then evaluated FTN segments based on four main criteria:

- **Stakeholder prevalence**. Did many stakeholders include this segment on their maps?
- **Development and street pattern**. Does existing density indicate that frequent service would be highly successful? Is the street network designed in a way that allows people to access transit easily?
- **Current ridership**. Is there strong ridership on existing service in the corridor, given the present service level?
- **Network continuity**. Is the segment important to improving the usefulness of the network for many different types of trips? (For example, new Frequent Network grid segments are very important to network continuity).
- **Major destinations**. Does the segment provide service to a major regional destinations, such as large employers or educational institutions?

A simple table of this assessment is shown in Figure 21 on page 26.

Based on this assessment, we arranged FTN segments into four tiers of priority, from the most immediately important onward. This structure offers a guide to inform future decision making on the expansion of the Frequent Network.

Priority 1

Priority 1 contains the segments that should be considered for immediate promotion of the Frequent Network as resources become available. We have included 7 segments into this tier, based on the factors described previously. In Priority 1, the main focus is on network

4. Future Transit Vision

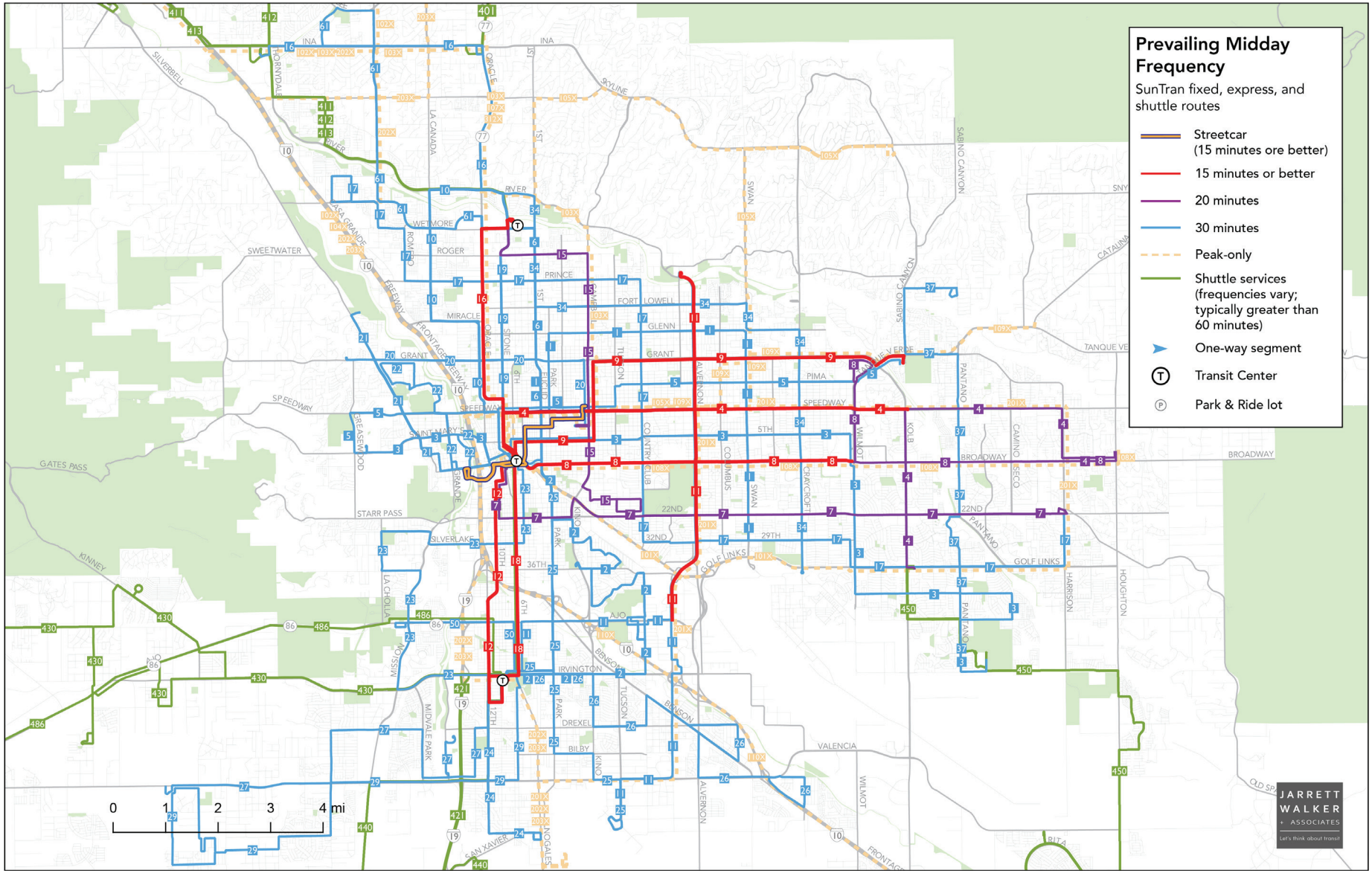


Figure 19: Existing Network Map (May 2015)

4. Future Transit Vision

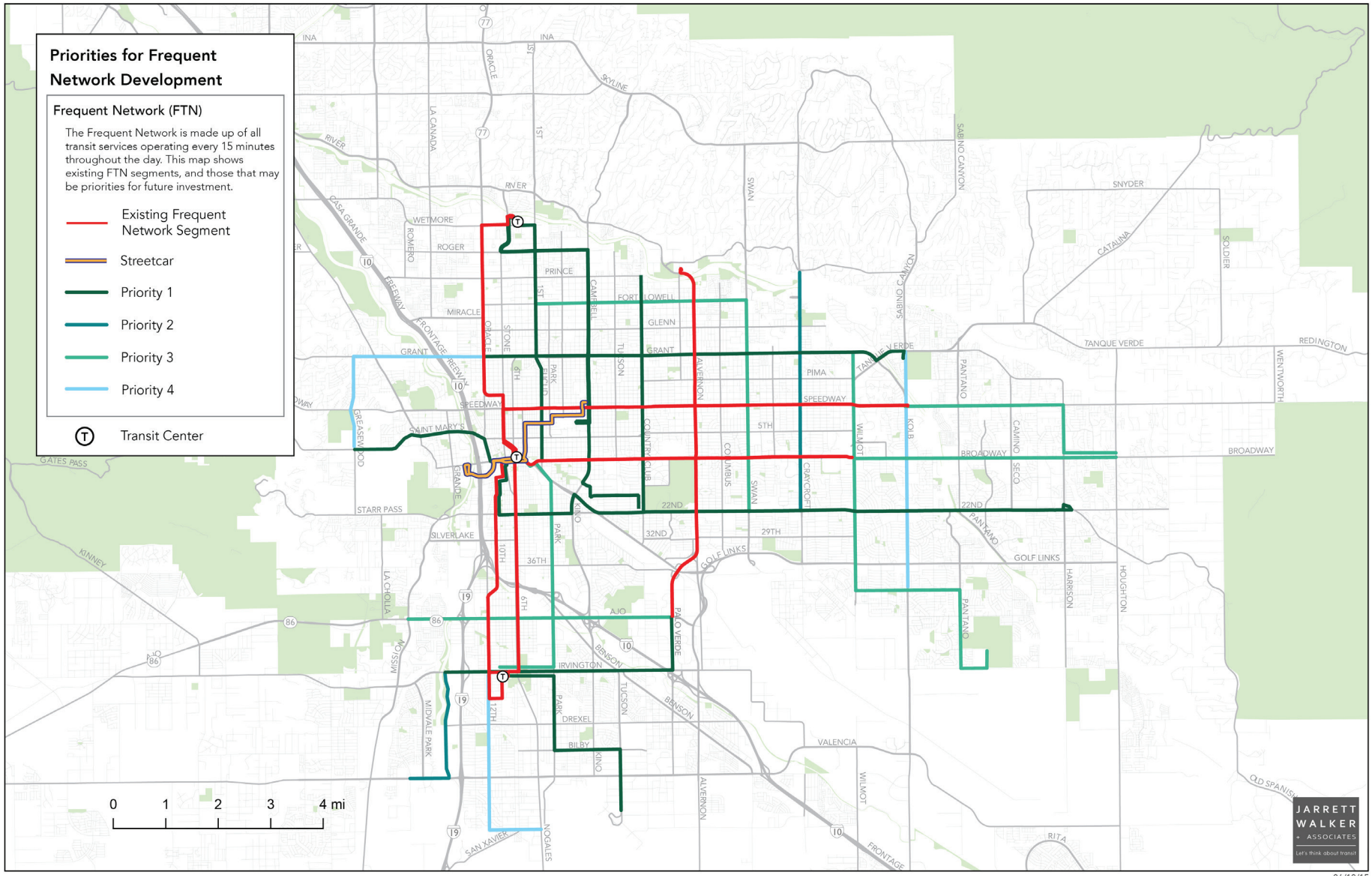


Figure 20: Priorities for Future Transit Development

4. Future Transit Vision

intensification in the dense, high-demand central area of Tucson, by adding more routes to a Frequent Network grid where a bus is coming every 15 minutes.

Two existing routes operating at 20 minute frequency, the 7-22nd and 15-Campbell, should be brought to Frequent Service as soon as possible. Both of these routes are important grid elements, where the ease of connections is an important driver of their utility.

In the case of the 15-Campbell, service was recently changed to every 20 minutes

FTN Segment	Stakeholder Agreement	Land Use	Existing Ridership	Network Continuity	Major Destination	Priority
22nd		√	√	√	√	1
Campbell		√	√	√	√	1
Euclid / 1st	√	√	√	√	√	1
Country Club	√	√	√	√		1
Grant Rd (Oracle to Tanque Verde)		√	√	√	√	1
Anklam (to PCC)	√		√		√	1
Palo Verde - Irvington	√	√		√	√	1
S. Park - Bilby (to Airport)	√		√	√	√	1
Calle Santa Cruz (Irvington to PCC Desert Vista)	√	√		√	√	2
Craycroft	√	√	√	√		2
Wilmot	√	√		√	√	3
S. Park (downtown to Laos TC)	√			√		3
Fort Lowell	√		√	√		3
Swan	√	√	√	√		3
Broadway (Wilmot to Harrison)		√	√	√		3
Kolb	√			√		4
W. Grant / Greasewood				√		4
S. 12th (south of Laos TC)		√				4

Figure 21: FTN Corridor Priority Assessment

along the entire route, from the previous structure of 15-minute service north of the University, with 30-minute service to the south. It is important to restore the previous 15-minute frequency level in the future, since ridership tends to be especially sensitive to frequency changes in this range.

Euclid/N. 1st Ave was the only segment included on all stakeholder exercises. It serves dense land uses, has strong existing ridership, and if promoted to the Frequent Network, would add a new and important grid element between Oracle and Campbell. Subsequently, this would establish one-mile spaced frequent radial grid routes in Tucson's north side, similar to the current network structure on the east side of the city.

Similar to Euclid, Country Club is another north-south grid element serving dense land uses, with substantial existing ridership. With both Euclid and Country Club added to the Frequent Network, a 1-mile frequent grid would be fully in place across Tucson's inner east side, an area of extremely high ridership potential.

Grant Road is also included as a Priority 1 segment. While Grant currently has frequent service during the midday (from approximately noon to early evening), cuts have been proposed that would reduce this to every 20 minutes in the future. It is a high priority that this existing frequent route be restored to its current service level as resources are available.

In the context of frequent service on other north-south crosstown corridors (Campbell, Euclid/1st, Country Club), Grant could be extended to Oracle as an east-west frequent crosstown, completing the frequent network grid across much of the north side of Tucson. This would disrupt the direct connection between outer Grant and the U of A, but at that point in the development of the frequent grid, connections may be so convenient that this direct radial service design is no longer necessary.

Nearly every group of stakeholders included a frequent element on Anklam, serving the PCC campus at Anklam and Greasewood. This is an important destination that generates many trips between its employees and students. Given the proximity of the campus to downtown, transit could be competitive for many of these trips if sufficient frequency to make them convenient were available.

There are two Priority 1 elements located in South Tucson. All stakeholders included Frequent Network elements in this area, but typically oriented them toward the airport. While the airport is certainly an important destination, when it comes to South Tucson, we are concerned that stakeholder consensus may not have fairly represented the area's needs, as South Tucson was underrepresented in the workshop. It is not clear that South Tucson's public transit needs are as oriented toward the airport as they appear from the outcome of the stakeholder process.

South Tucson is certainly dense enough to support extensions of the Frequent Network. In Priority 1, airport service is provided from Laos TC via Irvington, Park, Bilby, and Tucson (this is identified in the table as "S. Park - Bilby (to Airport)"). This segment serves a number of areas of high residential and employment density in South Tucson, and if operated as an extension of existing frequent routes on S. 12th/10th or S. 6th, would provide a new frequent connection to downtown from the airport and throughout the south area.

Additionally, Priority 1 includes an initial grid crosstown element in South Tucson, along Irvington to the commercial area just west of I-19. In the table, this segment is referred to as Palo Verde - Irvington.

Promotion to frequent service would dramatically improve the ease of travel both within South Tucson and between this area and the eastern side of the city. Finally,

this first grid element would prepare the network to take advantage of connections possible with lower-priority FTN elements that may be implemented later.

Depending upon when a frequent cross-town was implemented in South Tucson, Ajo Way may also be worth consideration, as it is currently served as a branch of the frequent 11-Alvernon. Frequent service on Ajo would thus be easier to implement, and also has transit-supportive land uses through much of the corridor.

Priority 2

Priority 2 is mainly focused on beginning to expand the frequent grid eastward, by adding Craycroft. Craycroft was a very popular segment among stakeholders, and boasts relatively strong existing ridership and density. While there are also arguments for frequent service on Swan in this priority tier, the principle here is to first establish a wider two-mile grid (Alvernon, Craycroft, Kolb), and then increase the frequency of intermediate segments later on. This is similar to how Country Club is dealt with in Priority 1.

Also included in Priority 2 is the extension of the west end of the Irvington frequent segment south along Calle Santa Cruz and west along Valencia to serve the PCC Desert Vista campus, WalMart, and the Casino. This would dramatically expand access to this area, both from downtown, via a connection at Laos TC, and directly from eastside Tucson as this route flows through into the Alvernon crosstown.

Priority 3

Priority 3 fills in some of the remaining missing inner grid elements, adds new grid elements in the eastern area of the city, and extends frequency further east on Broadway and Speedway.

In central Tucson, Swan and Fort Lowell would be added to the Frequent Network. This would complete the 1-mile grid throughout most of the city, with one gap along Grant between Oracle and Campbell (this gap is discussed in Priority 1).

This tier also includes frequent service on S. Park between downtown and Laos TC. This was a common segment among the stakeholders, and an obvious choice for network connectivity, though it lacks the ridership and density indicators of other corridors.

Wilmot is added as a frequent grid element between Grant and the PCC East campus just east of Irvington and Pantano. In addition to grid connections to east-west radial routes, a frequent route on Wilmot would also provide a high level of service for north-south trips in the corridor, which includes several nodes of substantial residential and employment density, as well as intense commercial activity: Broadway & Wilmot (Park Place Mall), St. Joseph's Hospital, smaller shopping centers and multifamily residential development near Wilmot & Speedway, and other dense housing along Wilmot between Pima and Grant.

South of 22nd, the Wilmot frequent route would continue south to Stella, then turn east to Pantano, and continue south along Pantano before terminating at the PCC campus just east of Pantano & Irvington. This area is less dense and has fewer commercial centers than between 22nd and Grant, but PCC East is a major destination which is likely to generate significant ridership when connected at high frequency with other frequent routes.

With a Frequent Network route serving Wilmot, it would be possible to consider extending frequency east on Broadway to Harrison. This would imply the deletion of the north Wilmot branch of the 8-Broadway (now redundant, given the new easy transfer to the frequent service on Wilmot), and reallocation of those resources to focus on the eastern Broadway corridor.

This would provide frequent service to the densest areas east of the limit of the grid, as well as a foundation for any additional Frequent Network expansion (such as Kolb) depending on the nature of future development in the area.

Priority 4

Tiers 1, 2, and 3 largely complete a Frequent Network grid across most of the area of Tucson that currently has the density and street network capable of supporting it. However, by the time when tier 4 is actionable (with the majority of higher-priority improvements in place), there may be new, pressing needs that are not apparent today.

With that in mind, three segments are shown in Priority 4. The first extends frequent service on Grant west from Oracle to Greasewood, and then south to PCC. This would further extend the Grant crosstown route described in Priority 1. This extension would help to complete the grid across Tucson's north side, but serves a weaker market in land use terms, as so is a much lower priority than the core segment of Grant.

A final eastside grid route, on Kolb, is included in Priority 4. Kolb is not currently sufficiently dense to be a high priority for frequent service, but is projected to continue to grow over the next two decades. A Kolb crosstown would extend the grid another mile further east, enabling another set of useful anywhere-to-anywhere connections. Finally, current City of Tucson plans would extend Kolb north to connect to Sabino Canyon Rd., offering the possibility of an anchoring destination at Colonia Verde shopping center. This provides a common endpoint with the high-frequency service on Grant, which means that the Grant and Kolb line could potentially be combined to reduce the need to transfer.

Priority 4 could also include new extensions of the Frequent Network outside of the limits of grid routes. S. 12th south of Laos is one such example. While only one stakeholder group drew a route there, the corridor contains similarly dense (smaller-lot single family homes, with a mixture of two-story apartments and commercial) land uses to the rest of South Tucson, oriented around a connected street grid.

High Capacity Transit Study Corridors

The process of building any sort of HCT is always a long-term effort requiring the cooperation of all agency and stakeholder partners, bolstered by a robust public process and strong voter approval of new funding. Of course, all of these elements are only prerequisites for a federal funding application that is never guaranteed.

With these cautions in mind, at least three corridors appear to be well-suited for further study. These corridors are all currently served by high-frequency routes, so future investment would capitalize on existing ridership while reinforcing the utility of key grid elements. Figure 22 on page 30 shows these study corridors.

We present these corridors as general indications of alignments that possess land use, ridership, and network continuity advantages that position them as candidates for infrastructure investment.

BROADWAY CORRIDOR

Broadway is the existing transit corridor with the highest level of investment, generating the strongest ridership. The corridor has dense land uses throughout, particularly between downtown and Wilmot, and

4. Future Transit Vision

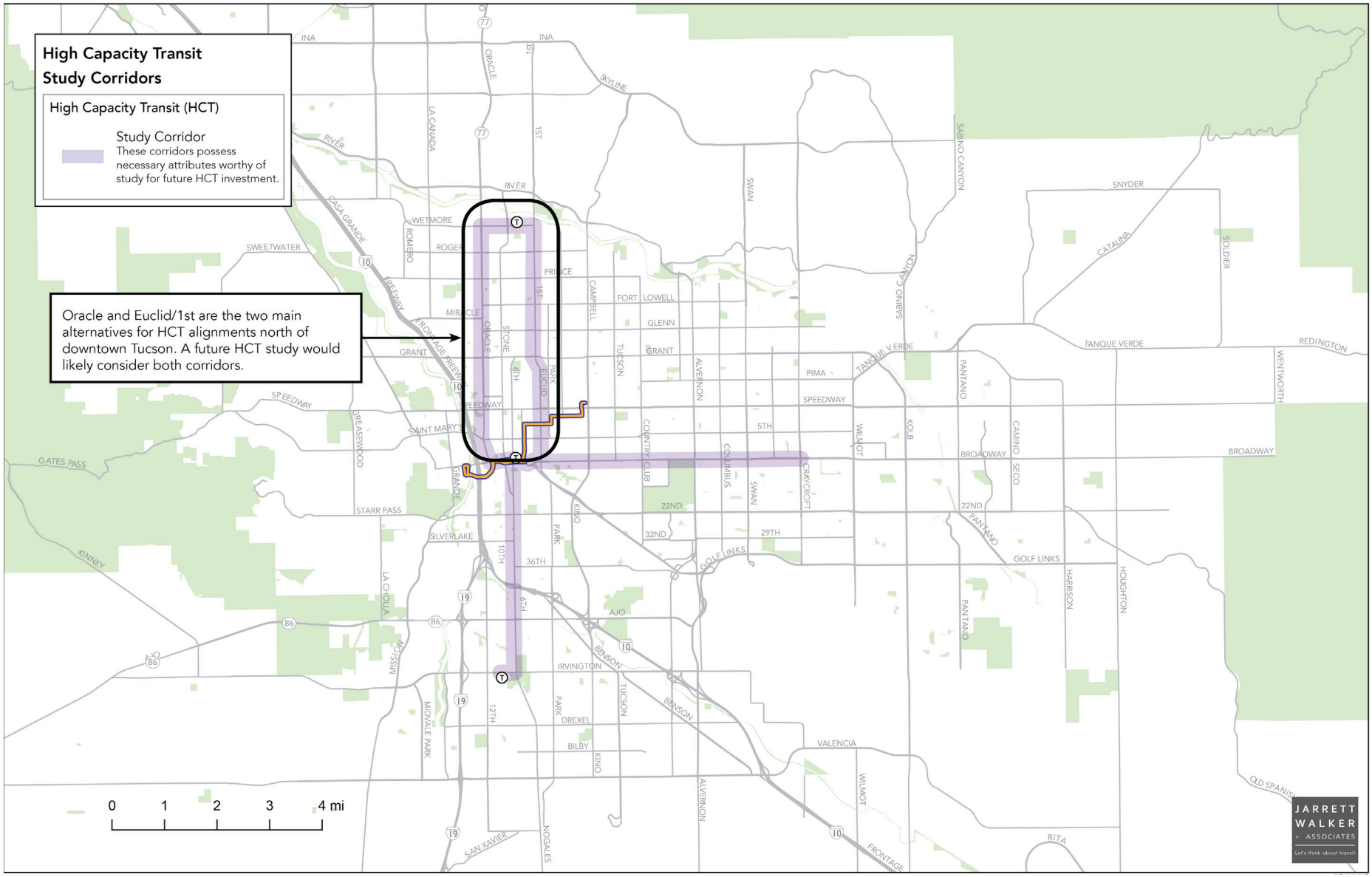


Figure 22: High Capacity Transit Study Corridors

has proven to be a market in which transit can be quite competitive. This was also the most common place where the stakeholders told us they would place a future HCT line.

NORTH CORRIDOR

Figure 18 on page 20 showed the prevalence of HCT segments across the six groups. One area of strong agreement was that a future HCT alignment should form a north-south axis from South Tucson through downtown, and north to Tohono Tadai TC. North of downtown, Oracle was the most popular choice for this purpose, and it has proven ridership (29 boardings per revenue hour in FY 2014) and relatively dense land uses.

However, Oracle is not the only possibility for HCT in northwest Tucson. Euclid has comparable or higher-density land use, and passes the university, but would compete with the streetcar for some trips. The existing route 6-Euclid is also a strong performer (32.2 boardings per revenue hour in FY 2014), one that we identify as a high priority for frequent service regardless of whether any infrastructure is located there.

SOUTH CORRIDOR

South of downtown, we have included S. 6th Avenue as a study corridor. This was the most frequent HCT segment in this area created by stakeholders. S. 6th has reasonably dense surrounding land uses compared to parallel streets, and existing ridership on the segment is much stronger than on the route on S. 10th/12th St., to the west.

Coverage Expansion Study Areas

While the stakeholders did not create many new coverage routes, future expansion of transit would certainly require consideration of this issue. Coverage service is crucial to achieving the type of equity-focused goals transit is often asked to pursue, particularly in future planning efforts.

Sun Tran's network offers relatively comprehensive coverage across most of the urbanized area of Tucson, generally at 30-minute frequency. The main "coverage area" of Sun Tran's network is the area served by all-day, fixed route service. Some very-low density, or outlying areas, are connected to the transit system via Sun Shuttle services.

We have identified three initial study areas for the extension of the 30-minute coverage area. These are shown in Figure 23 on page 32; the stakeholder maps featuring service in this area were described on page 15 and 16. The blue area on this map is the approximate extent of the existing 30-minute coverage area; the areas shaded in orange are where study may be required to decide whether new 30-minute routes should be added in future. Sun Shuttle routes are shown on this map as well. These infrequent routes provide a very basic level of coverage access to a large area outside of the core Tucson area.

The first is in the northwest, where currently all-day routes are only spaced every two miles. A potential coverage increase could include 30-minute all-day service on Shannon or La Canada, or along River as one of the stakeholder groups drew.

The second study area is in the far southeast, where current population and employment projections indicate substantial growth potential in the future. Obviously development in this area is very limited presently, but as that changes in the future, study will be required to determine if coverage service is needed.

The third study area is the area approximately north of I-10 and south of Davis-Monthan Air Force Base. While the stakeholders did not provide coverage service in this area, Sun Tran staff have

4. Future Transit Vision

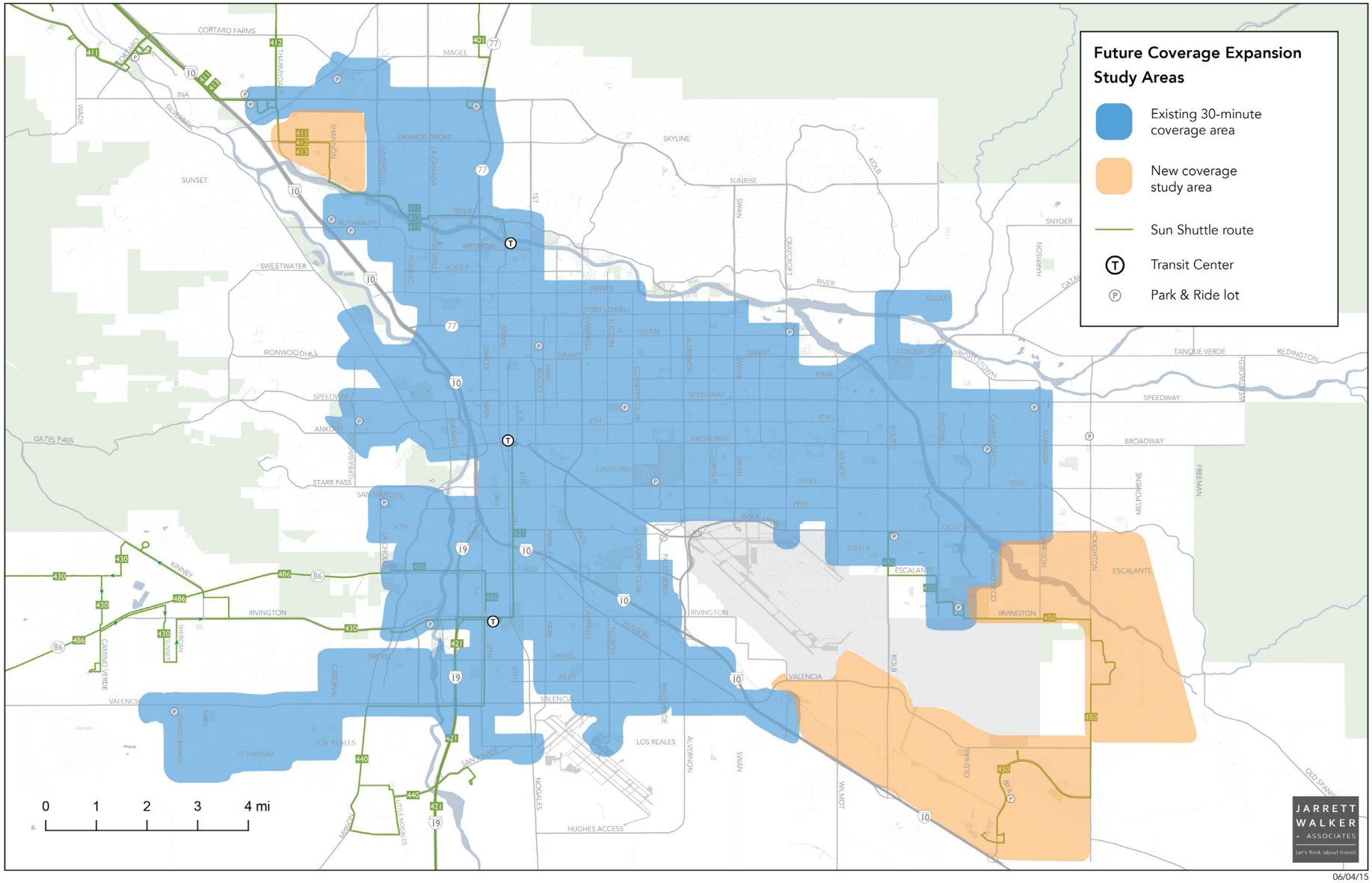


Figure 23: Coverage Expansion Study Areas

noted a number of important destinations (such as the UA Tech Park and Air and Space Museum) and potential future residential and commercial development. For these reasons, this may be an additional area requiring future study to determine how to serve these emerging transit needs.

A Vision for Transit

This document is not intended to be a plan for the future transit network of Tucson. Instead, it presents a preliminary vision of a transit system where buses come more often, waits are shorter, connections are easier, and ultimately transit is more useful.

In the workshop, the stakeholders expressed a strong sense that transit should focus on ridership, and that it should do that by investing in a rich Frequent Network, providing a high level of service to the parts of Tucson where density and urban form suggest that it can be most competitive with other modes of transportation.

The stakeholders' strongest point of agreement was a rich and extensive Frequent Network for Tucson. The existing network has already introduced this principle across a wide area of the city. Where it exists, frequent service is able to offer a high degree of freedom of movement, and thus access to opportunity, without requiring complete reliance on a personal automobile.

People who want to live in transit-intensive areas where this is possible should be able to do so at any price point. This is why the network is extensive, encompassing many parts of Tucson where density, walkability, street connectivity and linear transit paths combine to present a strong market for service. For those who do not care about having this type of transit mobility, many areas of Tucson offer an urban form and level of density more suited to their travel choices.

The existing Sun Tran network proves that in Tucson, frequent service to supportive land uses can generate high transit ridership, as people make the choice to use a travel option that is convenient and well-suited to their everyday life. This is the case today on routes like the 8-Broadway, 4-Speedway, and of course along the streetcar route. The network sketched here extends this principle to more people in more parts of the city, inviting a larger portion of the citizens of Tucson to share in the type of transit mobility that already exists in core areas.

The point of such a network is to grow ridership by making transit more useful and liberating, especially in areas where the pattern of development is favorable to transit's success. The point is not just the ridership, of course, but all of the benefits to the community that flow from that: greater mobility with less congestion and emissions, increased access to jobs and education, and ultimately the potential to grow the city in a more sustainable form in which every resident, business or institution, at any price point, has the option to reduce their dependence on cars by choosing to locate on the Frequent Network.

Appendix A : Prairieville Results

Appendix A : Prairieville Results

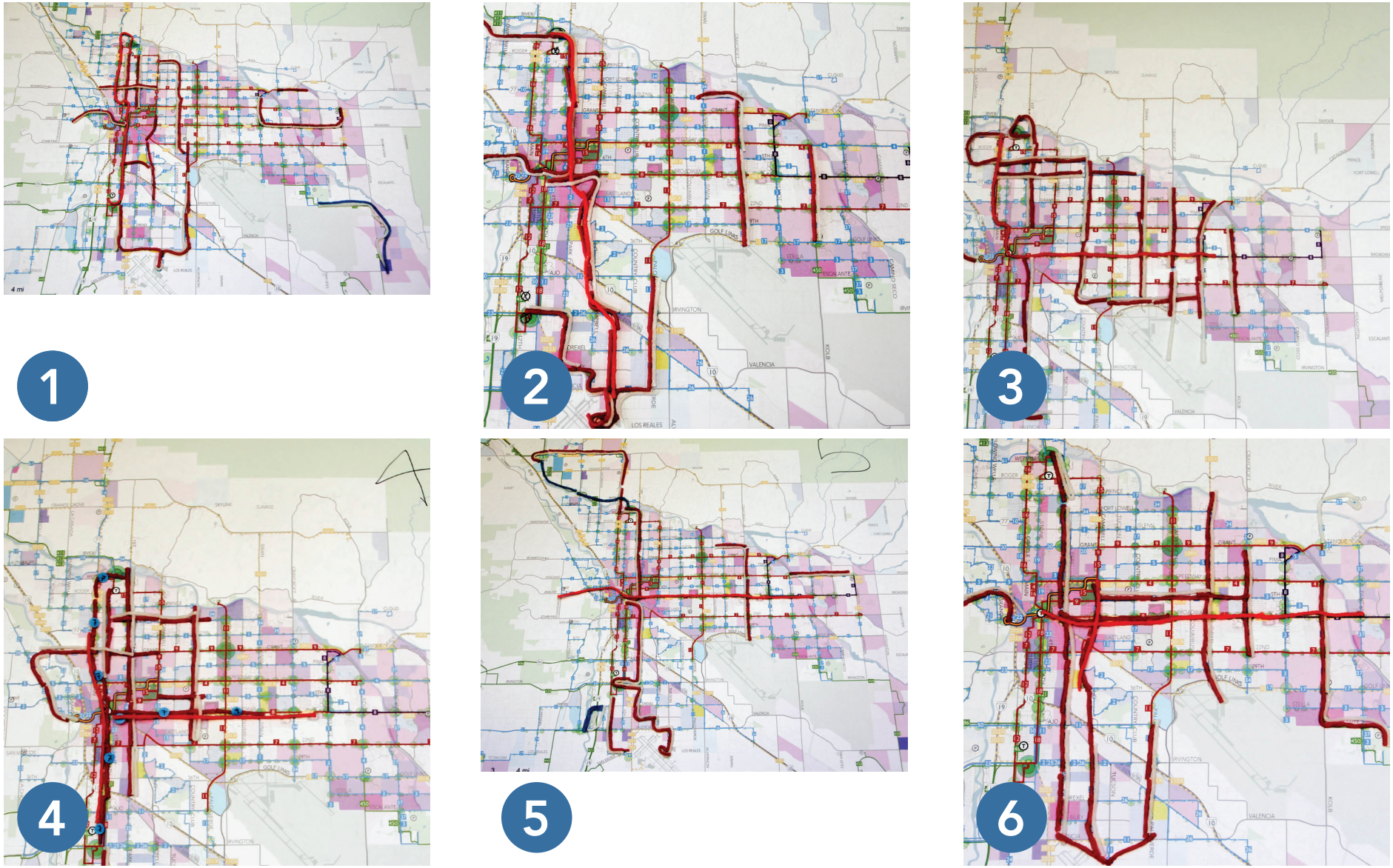
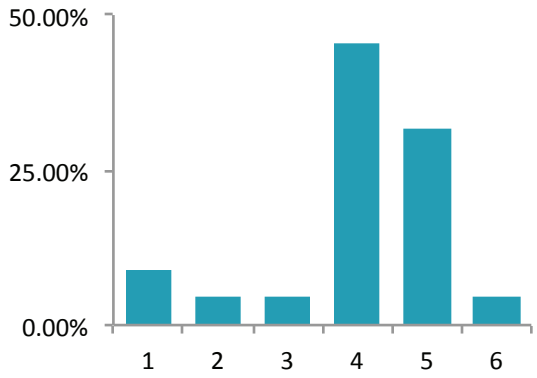


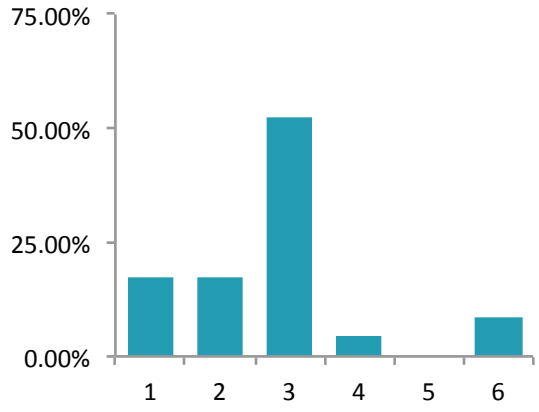
Figure 24: Prairieville Game Results (labeled by group)

Appendix A : Prairieville Results

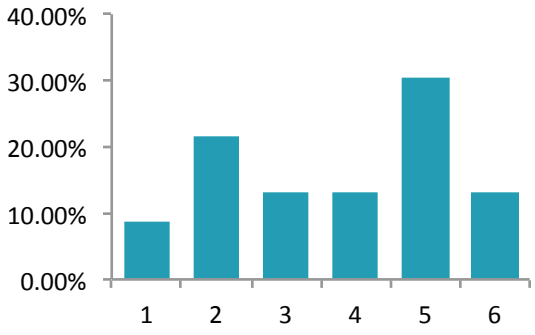
Which network is best for encouraging dense and walkable development?



Which network is best for low income people?

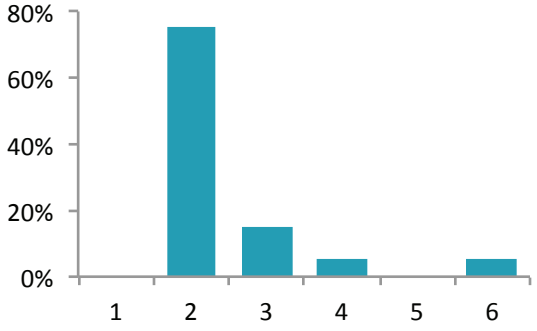


Which network makes it easiest to travel between any two points in the network?



The numbers shown on the x-axis of each graph refer to the stakeholder Prairieville maps, as numbered in "Figure 24: Prairieville Game Results (labeled by group)" on page 35.

Which network is best at getting a little service to everyone, no matter where they live?



Which network will have the highest ridership?

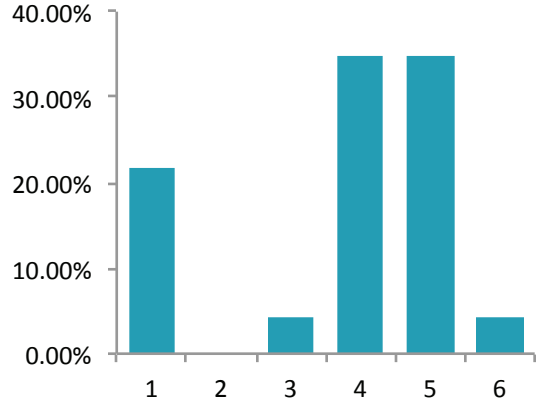


Figure 25: Complete Stakeholder Polling Responses (Prairieville Questions)

Appendix B : Tucson Exercise Results

Appendix B : Tucson Exercise Results

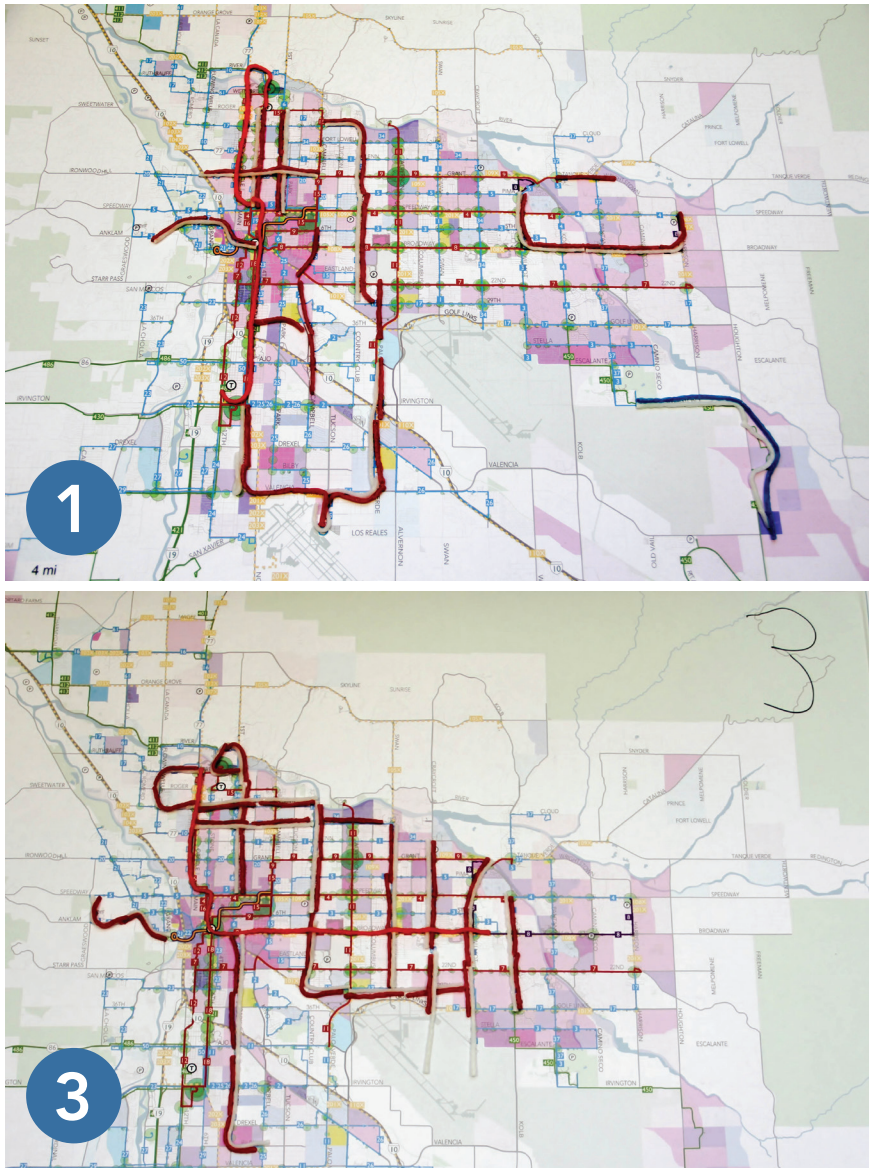
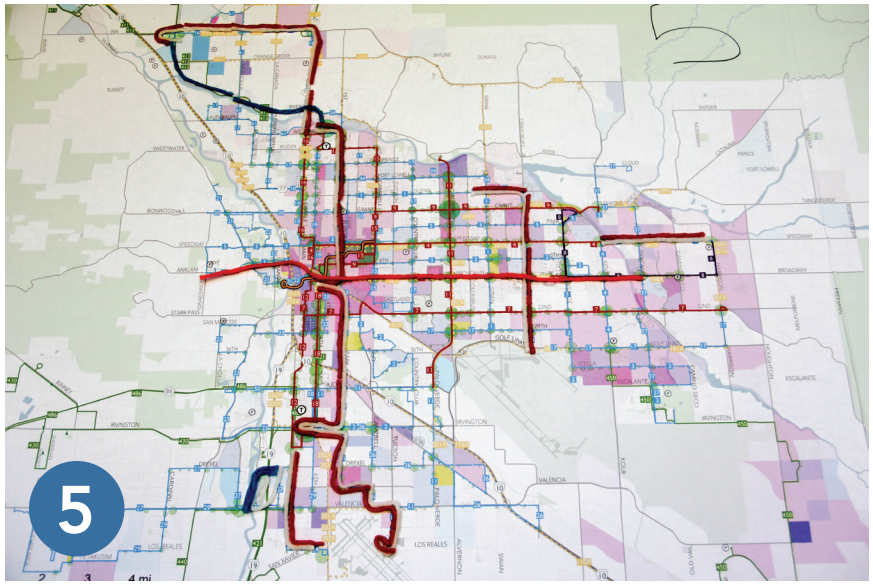


Figure 26: Tucson Exercise Results by Group (Groups 1-4)

Appendix B : Tucson Exercise Results



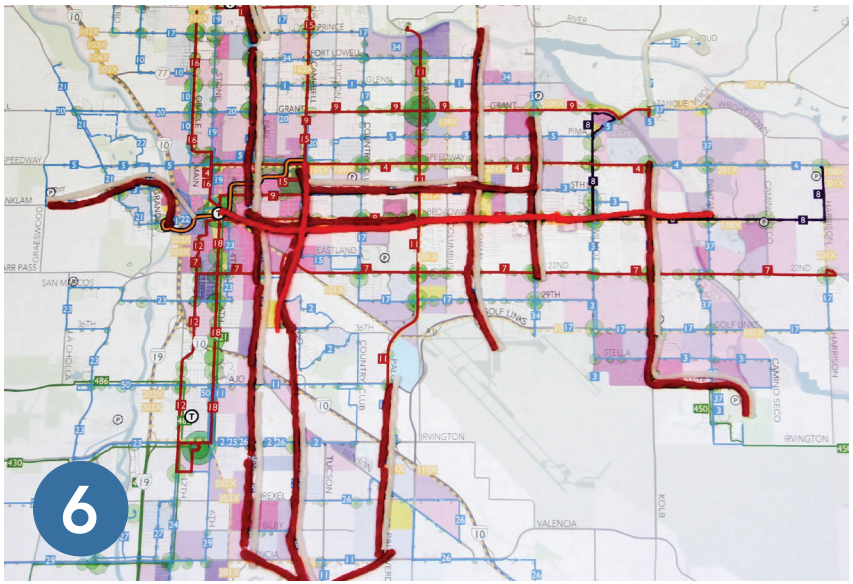
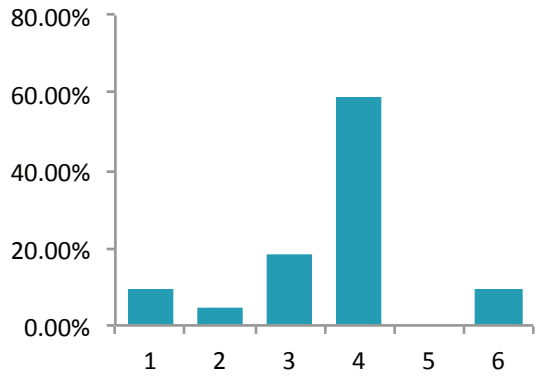


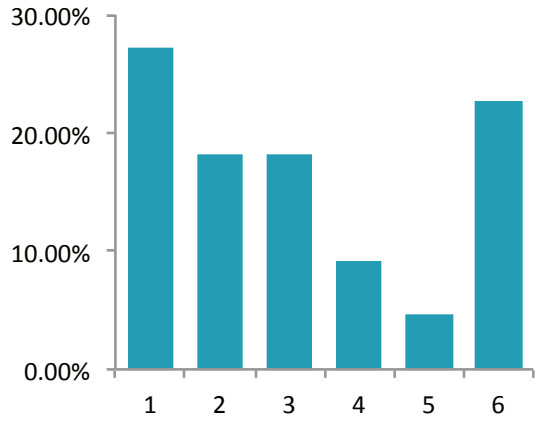
Figure 27: Tucson Exercise Results by Group (Groups 5-6)

Appendix B : Tucson Exercise Results

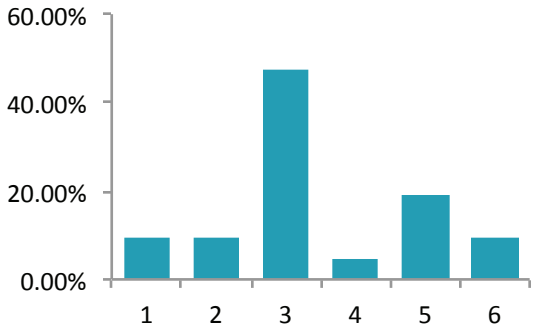
Which network is best for encouraging dense and walkable development?



Which network is best for low income people?

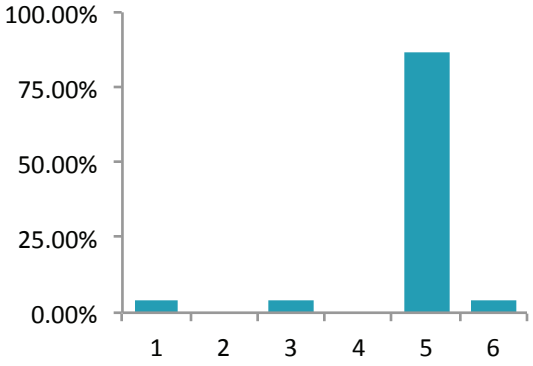


Which network makes it easiest to travel between any two points in the network?



The numbers shown on the x-axis of each graph refer to the stakeholder Tucson exercise maps, as numbered in Figure 26 and Figure 27 on the preceding pages.

Which network is best at getting a little service to everyone, no matter where they live?



Which network will have the highest ridership?

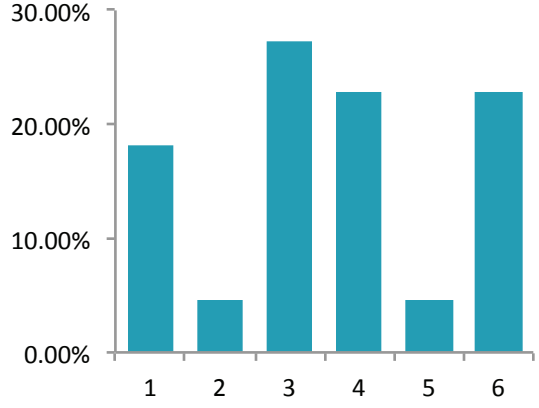


Figure 28: Complete Stakeholder Polling Responses (Tucson Exercise Questions)

Appendix C : May Workshop Summaries

Appendix C : May Workshop Summaries

PAG offered additional transit visioning workshops open to the public, which included the Tucson Transit Network Visioning Exercise. Thirty participants attended three workshops on May 13, 19 and 21st, with eight groups in total. Workshop exercises focused on a discussion of the competing goals of ridership and service coverage, including route frequencies and accessibility.

Each group was given an additional 25% budget of nine blue sticks (representing 30-minute bus service) and nine red sticks (representing 15-minute bus service). They could trade in these pieces for different frequencies. Groups also had the opportunity to spend their new resources on increasing the weekend service level on the existing network.

Most groups used all or most of their available budget for transit expansion. A few groups chose to not use the additional budget, and instead used the sticks to realign the existing system.

Although approaches from participants in each workshop varied, there were several common themes that emerged among the three public outreach workshops. The workshop maps are presented in Figure 31 on page 46 and Figure 32 on page 47.

Common approaches included completing the current transit network grid, creating a core of frequent service, reducing frequency on routes outside the core, matching frequencies on North-South routes to current East-West routes, connecting currently split routes with increased 15 minute frequency, more connections to intersections with existing high ridership, and increasing on ridership by focusing on frequent service to shopping centers (which can be good locations for park and ride lots).

Frequent network additions

Groups increased frequency on several common corridors, and extended frequency to important destinations such as the airport, hospitals, transit centers, and shopping centers (Bridges, La Encantada, and Williams Center).

Figure 29 on page 43 displays the prevalence of FTN segments among the groups from the May workshops.

Frequent Network segments that were common among many groups included:

- Country Club
- 7.5-minute service on Alvernon
- 7.5-minute service on Oracle
- Speedway east of Kolb
- Broadway east of Wilmot and Kolb
- Kolb
- Euclid
- Grant west of Campbell

New coverage

- Houghton Road needs service to support density – 30 minute service along Houghton and Tanque Verde
- New 60 minute route to La Encantada
- Express service to airport
- Express service between transit centers
- Extend route 3 and 16
- East/West connection between Campbell and Oracle
- Additional service on routes 4 and 8 farther east

Weekend Service

Most groups expressed the need for additional weekend service. Two groups chose to spend their new resources on increasing some service to 15 minute frequency on Saturday only, while another group chose

Appendix C : May Workshop Summaries

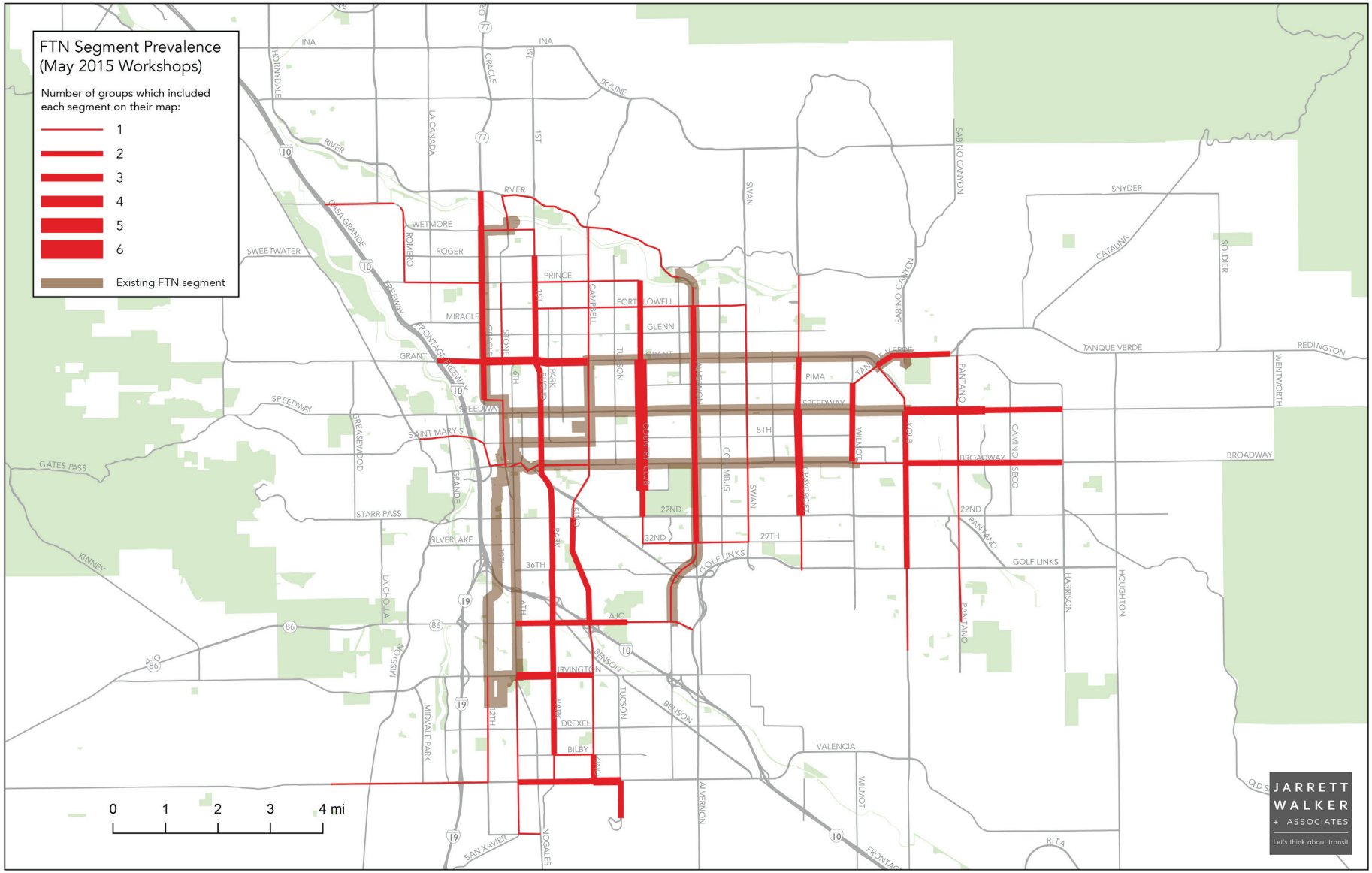


Figure 29: Frequent Network segment prevalence (May 2015 workshops)

to increase some service to 15 minute frequency on both Saturday and Sunday. Two groups chose to increase all weekend service to 15 minute and 30 minute frequencies. Three of eight groups chose to not increase weekend service span or frequency. Several groups also highlighted the need for expanded evening service.

High Capacity Transit

Groups were also given the task of showing where they would put Tucson's next high capacity transit line. Figure 30 on page 45 shows the prevalence of high-capacity transit segments among the groups in the May workshops.

The following corridors were selected:

- Airport
- Campbell Avenue
- Broadway Boulevard (to Pantano and to Williams Center)
- Speedway Boulevard
- South 6th Avenue
- Grant
- Oracle

One group suggested converting express routes to light rail service.

After concluding the exercise, participants were asked a series of questions to encourage discussion on their approaches to the exercise and their views on transit. The majority of groups from all of the workshops agreed that they support more funding than the current level of resources available.

Appendix C : May Workshop Summaries

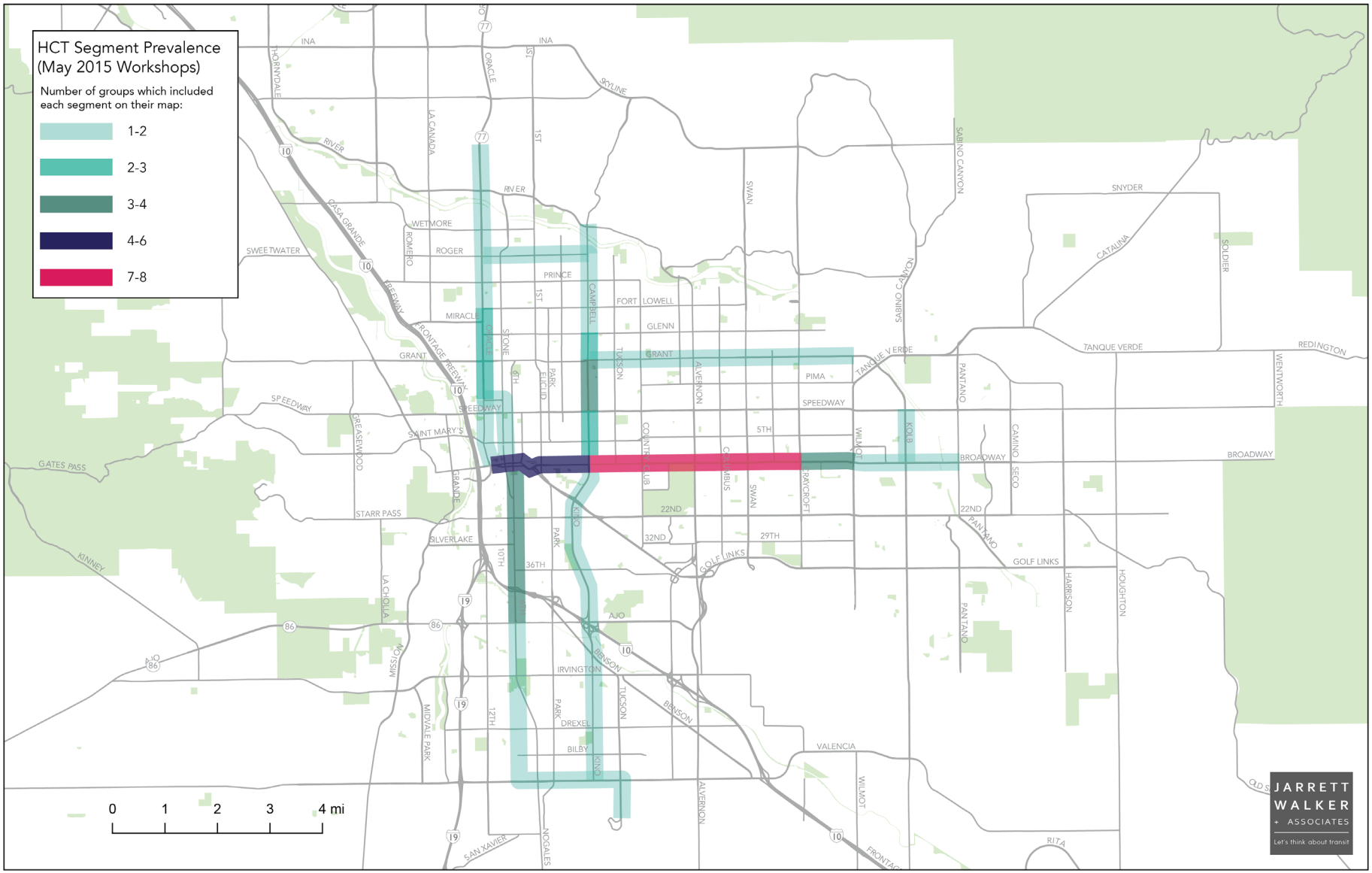
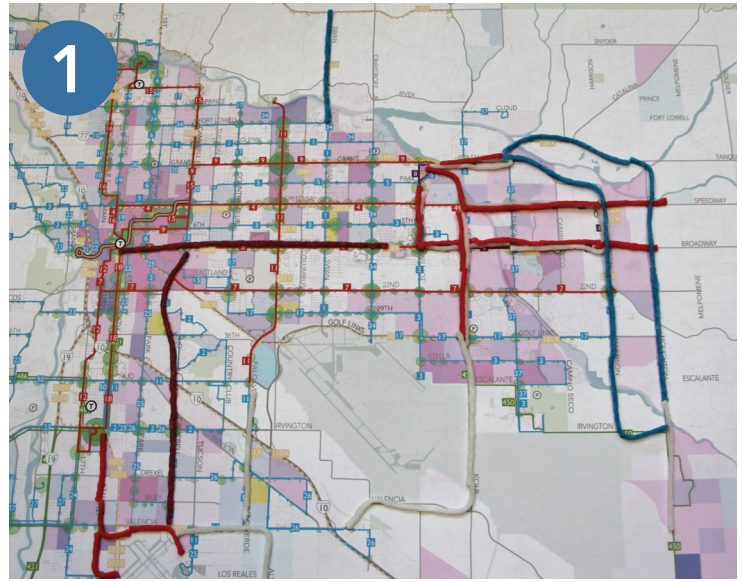


Figure 30: High Capacity Transit segment prevalence (May 2015 workshops)

Appendix C : May Workshop Summaries



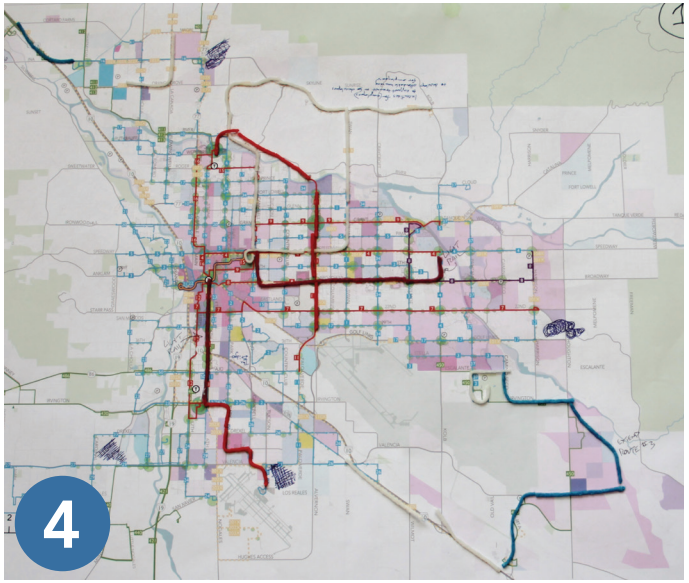


Figure 31: May Workshop maps (Groups 1-4)

Appendix C : May Workshop Summaries

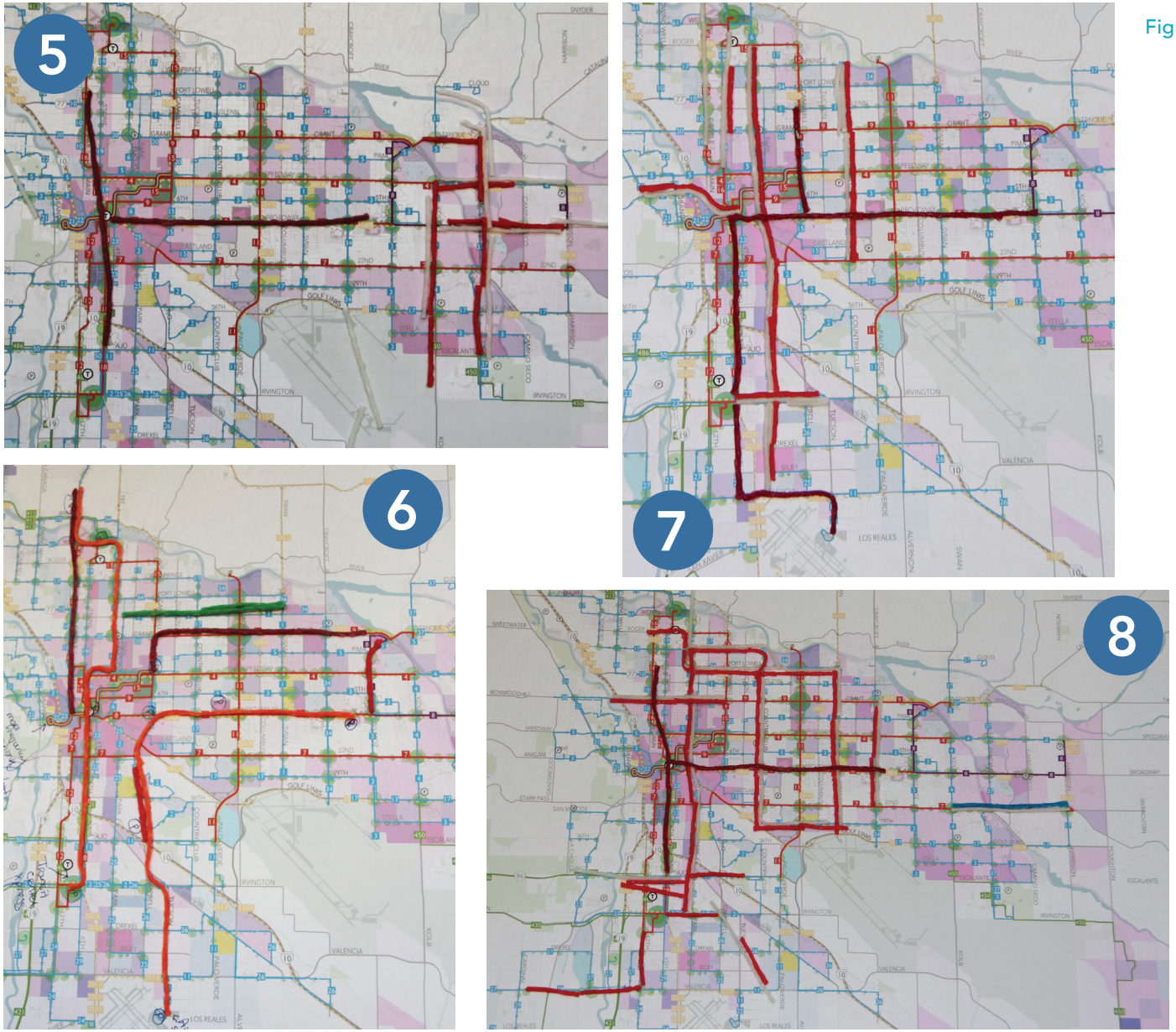


Figure 32: May Workshop maps (Groups 5-8)