CONNECTING PROGRESS

Final Plan

August 2018

Presented to

TULSA TRANSIT

INCOG
Regional Partners - Regional Solutions

Submitted by

CTG Connetics Transportation Group

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Chapter 1 Executive Summary

The Metropolitan Tulsa Transit Authority[1] will soon begin construction of its first AERO Bus Rapid Transit (BRT) service along Peoria Avenue, while a second AERO BRT line is proposed to serve 11th and 21st streets. The *Connecting Progress Plan* was undertaken by Tulsa Transit to support the successful launch of AERO BRT, while simultaneously reviewing and improving the rest of the local bus network. The overarching theme of the Connecting Progress Plan is to determine the best way to deploy and reorganize resources to best serve existing and future transit customers. Improvements to trip speed, frequency, connections, and access are all expected outcomes when the proposed network is implemented.

1.1 Study Goals

Five goals were identified for the Connecting Progress Plan, including:

- Goal 1: Help Tulsa Transit determine how to improve service frequencies and reduce rider travel time without additional operating costs.
- Goal 2: Build network off the AERO Peoria BRT in the short term and AERO Route 66 BRT in the intermediate term
- Goal 3: Improve Tulsa Transit's presence in the community through a robust and meaningful public outreach process as well as aligning services with stakeholder goals.
- Goal 4: Make recommendations related to Tulsa Transit's "hub and spoke" design while also addressing schedule adherence issues.
- Goal 5: Recommend other non-traditional service delivery approaches like private providers, TNCs, and demand response zones, as appropriate.

These goals provided guidance throughout the study. They were also used to review the recommended plan to ensure the final recommendations fulfil the desired outcome of the Connecting Progress Plan. The goal review is discussed in Section 5.4 of Chapter 5.

[1] Referred throughout this document as Tulsa Transit or MTTA

1.2 Recommended Plan

The Connecting Progress Plan included extensive data collection and analysis. All work was vetted through a robust outreach process that included:

- A Tulsa Transit working group consisting of drivers, customer service representatives, planning and administrative staff, a member of the Tulsa Transit Board of Trustees, and INCOG staff;
- An advisory committee consisting of regional stakeholders, social service representatives, and staff from Cities of Tulsa, Broken Arrow, Jenks, and Sand Springs.
- Public open houses held in multiple locations in downtown Tulsa, West Tulsa, East Tulsa, and North Tulsa
- An on-line community survey on desired improvements.

This work led to two main recommendations for the plan: a cost-neutral short-term plan to restructure the route network to be implemented in 2019, and a mid-term service expansion plan to be implemented in 3 to 5 years as funding becomes available.

Short-Term Plan

The short-term plan recommends a major restructuring of the Tulsa Transit network. Among the highlights of this plan:

- A series of hubs established throughout Tulsa to facilitate timed connections at locations other than Denver Avenue Station (DAS) and Midtown Memorial Station (MMS).
- Establishment of Peoria AERO BRT, the region's first BRT line. Peoria AERO BRT will operate at a high frequency, providing excellent north-south mobility in the revised network.
- Establishment of five daytime corridors operating every 30 minutes:
    - Route 1 - MLK
    - Route 2 - Southwest Boulevard
    - Route 10 - 3rd/Admiral
    - Route 11 - 11th/21st (the future Route 66 BRT alignment)
    - Route 13 - 31st Street
- Establishment of new (or longer) corridor-based service on Harvard, Yale, Sheridan, and 31st Street corridors.
- Improvement in Saturday network headways, with all routes to operate every 60 minutes except for Peoria AERO BRT, which is to operate every 20 minutes.
- Revising the night and Sunday network so that it is a subset of Daytime routes operating at a consistent 60-minute headway.
- Introduction of three policy changes:
    - Establishment of performance standards for monitoring the new network
    - Elimination of flag stops throughout the system
    - A stop amenity policy for the provision of shelters at local stops.

Figures 1-1 through 1-3 show the recommended weekday daytime, Saturday daytime, and night/Sunday networks.

Figure 1-1. Recommended Weekday Daytime Network

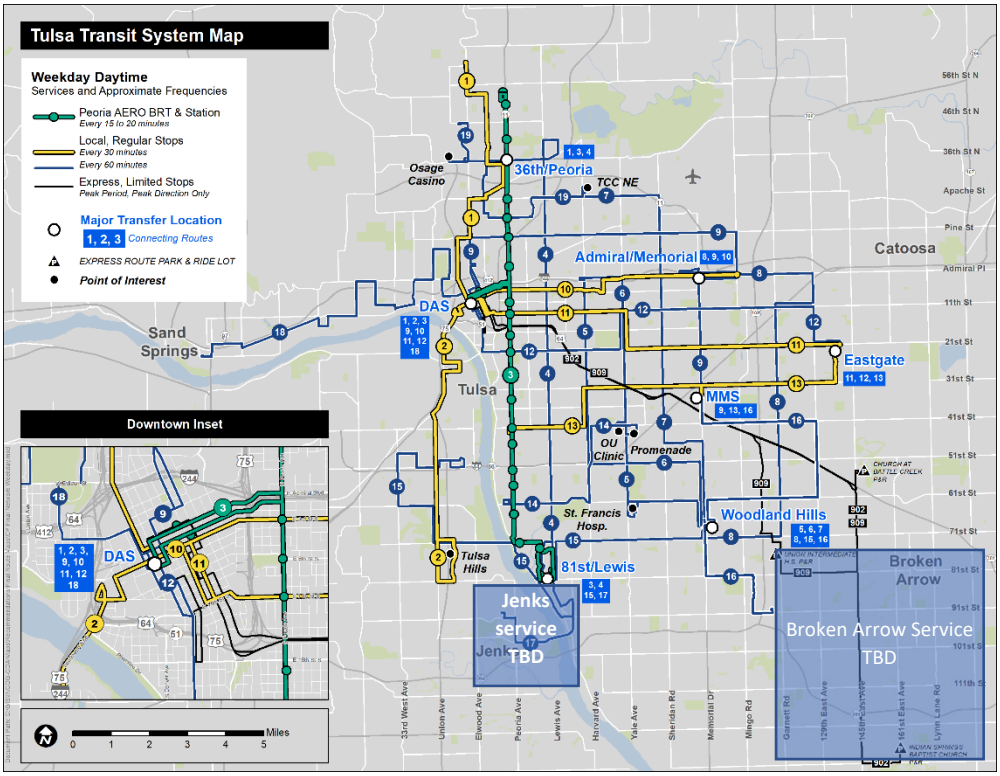


Figure 1-2. Recommended Saturday Daytime Network

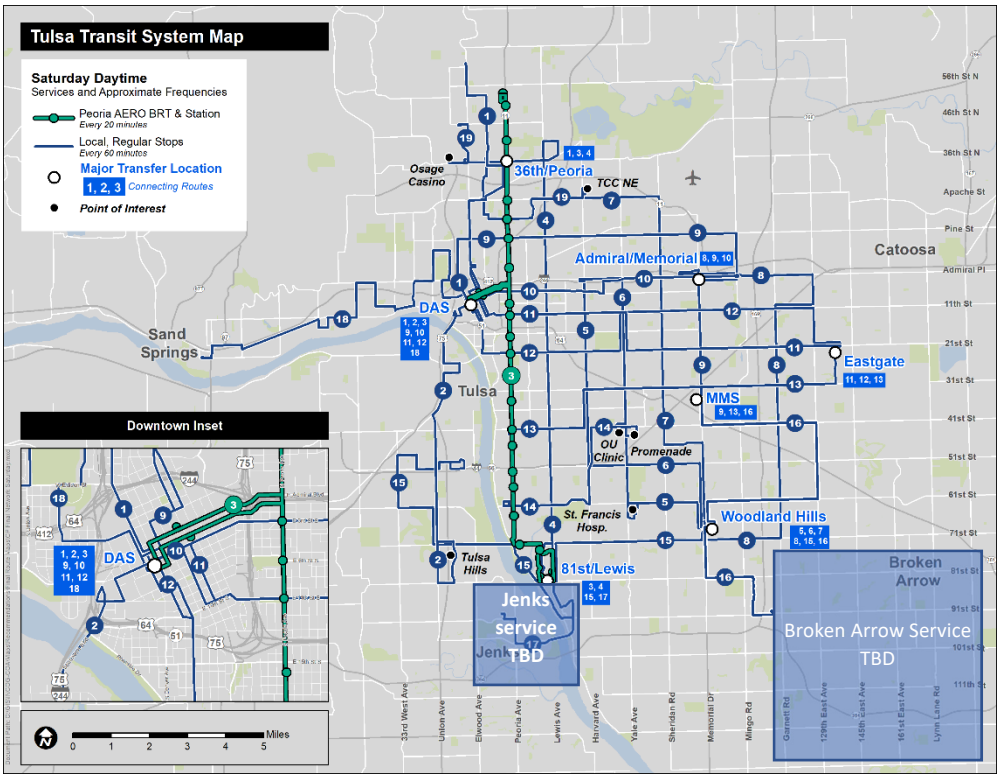


Figure 1-3. Recommended Night/Sunday Network

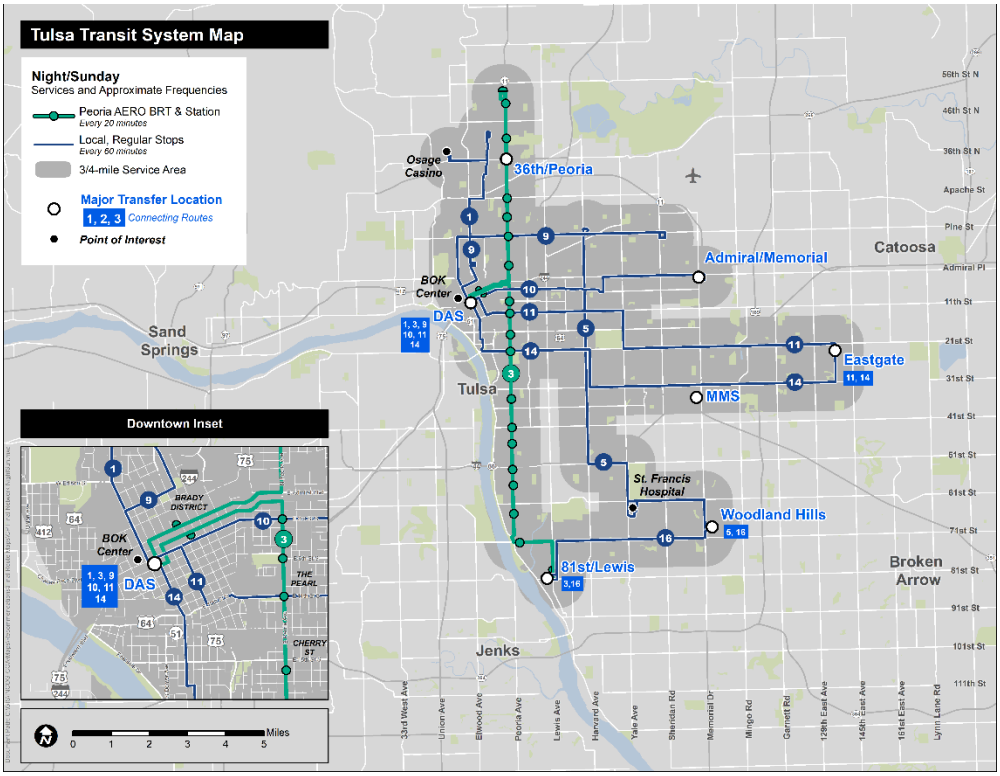


Table 1-1. Daytime Network Summary

Number	Name	Description	Weekday Peak		Weekday Offpeak		Saturday	
			Headway	Span	Headway	Span	Headway	Span
1	MLK	From 61st Street N to DAS	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
2	Southwest Blvd	From DAS to Tulsa Hills	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	15 min	6 hrs	20 min	8 hrs	20 min	13 hrs
4	Lewis	From 36th Street N/Hartford to 81st Street Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
5	Harvard/61st	From Harvard/Admiral to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
6	Yale/51st	From Harvard/Admiral to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
7	Sheridan	From TCC NE to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
8	Garnett	From Admiral/Memorial to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
9	Pine/Memorial	From DAS to MMS	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
12	21st/11th Streets	From DAS to Eastgate	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
13	31st	From 41st/Peoria to Eastgate	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
14	61st/41st	From 61st/Peorial to The Promenade Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
15	West Tulsa/71st Street	From 49th/Jackson to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
16	Southeast Tulsa	From Woodland Hills Mall to St Francis Hosp. South	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
17	Jenks Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
18	Sand Springs	From DAS to Sand Springs Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
19	North Tulsa Circulator	From Dream Center (46th Street N) to TCC NE	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
20	BA Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
902	BA Express	From B.A. to Downtown Tulsa	4 Trips	-	-	-	-	-
909	Union Express	From Union HS to Downtown Tulsa	2 Trips	-	-	-	-	-

Table 1-2. Night/Sunday Network Summary

Number	Name	Description	Weekday Night		Saturday Night		Sunday	
			Headway	Span	Headway	Span	Headway	Span
1	MLK	From 46th Street N to DAS	60	3 hrs	60	3 hrs	60	10 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	20	3 hrs	20	3 hrs	20	14 hrs
5	Harvard/61st	From Harvard/Admiral to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs
9	Pine/Memorial	From DAS to Pine/Sheridan	60	3 hrs	60	3 hrs	60	10 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60	3 hrs	60	3 hrs	60	10 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
13	31st	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
15	71st Street	From 81st Walmart to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs

Mid-Term Plan

The mid-term plan is a list of potential service expansion projects that Tulsa Transit would implement as soon as additional funding is available. The expectation is that these projects would take three to five years to implement.

This expansion list is based on demographics and data analysis along with feedback from the Tulsa Transit working group and Connecting Progress advisory committee. The list of projects is also consistent with public feedback from the community survey.

Potential projects include:

Weekday Daytime

- Improve Route 5 - Harvard to operate with 30-minute headways

Saturday Daytime

- Improve Route 1 - MLK to operate with 30-minute headways
- Improve Route 2 - Southwest Boulevard to operate with 30-minute headways
- Improve Route 10 - Admiral to operate with 30-minute headways

Weekday Night

- Add 2 more hours of service to weekday night network (for routes 1, 3, 5, 9, 10, 11, 13, 15)
- Add routes 6, 7, 12, and 19 to the weekday night network (operating three hours each)

Sunday

- Add routes 6, 7, 12, and 19 to the Sunday network (operating ten hours each)

Each project is projected to cost between $100,000 and $300,000 (in FY17 dollars). These identified projects are all designed to be scalable – meaning they could be implemented individually or in combination, depending on available dollars.

Evaluation of the Recommended Plan

The recommended Connecting Progress Plan is a major change to the network, but one that will result in significant improvement to existing riders, while at the same time attracting new riders to use the system. Improvements include:

- Establishes a set of strategically-located transit subhubs on the periphery of Tulsa Transit's service area to facilitate transfers at locations away from Denver Avenue Station (DAS) and Midtown Memorial Station (MMS). While exact locations and amenities are to be determined, each subhub is presumed to include an off-street waiting area, one or two shelters and benches, and other amenities like lighting, trash receptacle, bicycle parking, and schedule and route information.
- The establishment of subhubs will improve rider travel times by timing transfers in locations other than DAS and MMS and by reducing out of the way travel. The implementation of subhubs is expected to result in an average savings of 16 minutes per one-way trip and removes the need to travel downtown to transfer.
- Provide more continuous corridor-based service on major thoroughfares, including Harvard, Yale, Sheridan, and 31st Street.

- Improves the Saturday network, with all routes proposed to operate every 60 minutes except for Peoria AERO BRT, which is to operate every 20 minutes.
- Adds frequency improvement for weekday service on routes 11 (11th/21st Street) and 13 (31st Street).
- Improves the night network so that routes are same as daytime routes, operating at a consistent 60-minute headway.
- Improves transfers to Peoria AERO BRT, with eleven routes connecting to the Peoria corridor; three of the connecting routes (1, 11, 13) have proposed 30-minute frequency service.
- Establishes Route 11 on alignment of future Route 66 AERO BRT route. This route is proposed to have 30-minute frequency service which can be scaled up with the introduction of BRT service.
- Route-to-route connections outside of subhub locations are spread more evenly throughout the metropolitan area, which substantially cuts down on out-of-direction travel for riders.
- The flag stop policy is recommended to be eliminated, which will give routes greater ability to adhere to their schedules.
- This study considered a variety of non-traditional service delivery approaches, particularly in low-productivity areas of the Tulsa Transit service delivery area.
- This study recommends the use of alternative services in Broken Arrow and Jenks, subject to discussion with each city.

Chapter 2 Public Outreach Process

"I prefer frequency to coverage. 1 hour is too long to wait with children if it's cold."

"Please duplicate daytime routes at night."

"Bidirectional service is preferred to one-way loops."

"We need later bus service. Till 1 am."

""Frequency is critical to more people using it. To all demographics."

"I really like the sub-hubs."

"Are employers open on weekends and evenings being served?"

"Transfers are okay if it improves frequency."

These are some of the thoughts and questions voiced by the ridership of Metropolitan Tulsa Transit Agency (MTTA), as well as potential riders and associated agency representatives.

One of the five goals of the Connecting Progress Plan is to "Improve MTTA's presence in the community through a robust and meaningful public outreach process as well as aligning services with stakeholder goals." This plan sought to achieve meaningful public outreach through a combination of actives including:

- Roundtable discussions with community leaders (defined as *Advisory* and *Stakeholder* committees),
- Two phases of public outreach meetings. The meetings were strategically located across the city to facilitate a diverse representation of attendees. Phases focused on existing conditions and draft recommendations.
- Interviews with Tulsa Transit drivers, supervisors, and call center staff in December 2017
- A route workshop conducted with Tulsa Transit operations and planning staff, INCOG planning staff, and an MTTA board member in April 2018.
- A digital survey and webpage were used to increase reach of public involvement efforts.

It was this goal and these activities that established the feedback necessary to understand how riders utilize existing services, defined present barriers that are inhibiting ridership growth, and establishment of a meaningful connection between the riders and MTTA.

The public outreach component is the foundation of the Connecting Progress Plan itself. Success here is essential if the identified recommendations presented in Chapter 5 are effectively implemented by Tulsa Transit, thereby improving service and advancing the mission of *connecting people to progress and prosperity*.

2.1 Advisory Committee and Stakeholder Groups

During the initial planning stages for public involvement, it was determined that the plan should engage a diverse group of committee leaders, transportation professionals, and social service agency

representatives. An initial list was created and then participants were separated into two groups based on their desired involvement. Table 2-1 presents the initial participation list.

The distinguishing factor between the two groups is that the advisory committee would have increased opportunity to provide feedback on recommendations. Whereas the stakeholder groups were larger audiences to diversify perspectives and gain feedback, the advisory committee was a more defined group with a select number of attendees to ensure thorough group discussions on the overall process, recommendations, and implications of implementation.

Table 2-1. Advisory and Stakeholder Groups

Bama Pie	Growing Together	Tulsa Housing Authority
Bicycle Pedestrian Advisory Committee	Hispanic Chamber of Commerce	Tulsa Hub
BRRX4VETS	INCOG	Tulsa Tech
Center for Individuals with Physical Challenges	Mental Health Association Oklahoma	Tulsa Transit Advisory Board
City of Broken Arrow	MODUS	TYPROS
City of Tulsa	Morton	Women in Recovery
Community Care College	The Parks Authority Board (Conner & Winters)	Workforce Tulsa
Community Health Connection	TPS Transportation	Youth Services of Tulsa
CSC COURTS Program	Tulsa Community College	Zarrow Tulsa City-County Library
CSC Tulsa Reentry One-Stop	Tulsa Health Department	

2.2 Phase 1 Meetings

The purpose of the Phase 1 meetings was to present findings of existing conditions analysis and gain perspectives on what works well and what does not work well within the Tulsa Transit network. Meetings consisted of an advisory committee meeting, three stakeholder committee meetings, and a public open house at Tulsa America Job Center. Advisory and stakeholder committee meetings were conducted at the Center for Family and Children Services. The committee meetings included a presentation on transit planning approach and existing conditions including: individual route performance comparisons, peer review analysis of Tulsa Transit with regional neighbors, and a facilitated group discussion of existing strengths and weaknesses.

Advisory Committee

- Wednesday, February 28, 2018, 10:00 a.m. to 11:30 a.m.

Stakeholders

- Wednesday, February 28, 2018, 3:00 p.m. to 4:30 p.m.
- Thursday, March 1, 2018, 10:00 a.m. to 11:30 a.m.
- Friday, March 2, 2018, 10:00 a.m. to 11:30 a.m.

Public Open House

- Thursday, March 1, 2018, 4:00 p.m. to 6:00 p.m.

Feedback from Phase 1 meetings is presented in Appendix 2A.

2.3 Phase 2 Meetings

The purpose of the Phase 2 meetings was to present a draft recommendation gauge reaction to the changes in the Tulsa Transit network. Phase 2 meetings consisted of one advisory committee meeting,

three optional stakeholder committee meetings before each open house, and three public open house meetings strategically located throughout the city of Tulsa to facilitate a diverse participation of attendees. Meeting times were tailored by location to maximize attendance, and multiple translators were provided for LEP (limited English proficiency) residents.

The overall theme of the Phase 2 meetings was to gain feedback on the CTG draft recommendations which included: two overall options for the route network for weekday daytime, changes to weekday night network, changes to the Saturday daytime network, and changes to the Sunday network. Other concepts discussed were the findings of the digital survey, ridership preferences on transfers and the creation of sub-hubs and the removal of flag stops. The advisory committee meeting was held at INCOG offices, included group discussion, comment periods, etc. The public open house included similar poster boards and materials.

Advisory Committee

- Tuesday, May 22, 2018, 10-11:30am

Stakeholders

- Tuesday, May 22, 2018, 3:30-4:00 p.m.
- Wednesday, May 23, 2018, 5:30-6:00 p.m.
- Thursday, May 24, 2018, 9:30-10:00 a.m.

Public Open Houses

- North Tulsa (Rudisill Public Library) Tuesday, May 22, 2018, 4:00 p.m. to 6:00 p.m.
- Downtown (Denver Avenue Station) Wednesday, May 23, 2018, 11:30 a.m. to 2:30 p.m.
- East Tulsa (Plaza Santa Cecilia) Wednesday, May 23, 2018, 5:00 p.m. to 7:00 p.m.
- West Tulsa (Park View Terrace Apartments) Thursday, May 24, 2018, 10:00 a.m. to 12:00 p.m.

Feedback from Phase 2 meetings is presented in Appendix 2B.

2.4 Community Survey

A digital survey and webpage were used to increase reach of public involvement efforts. A user-friendly online survey (Survey Monkey) was distributed to contacts lists from MTTA, INCOG, and the Community Services Council.

The survey categorized responders by (1) General public transit users (2) General public non-users and (3) Agency representatives. The responders were asked various questions based on chosen category. Questions ranged from trip purpose and transfer locations to preferences in service options (such as *coverage* vs. *frequency* or *one-set rides* vs. *transfers*). The number of survey responses exceeded 500. Additional information on the survey result is presented in Chapter 4 and in Appendix 4A.

Chapter 3 Existing Conditions

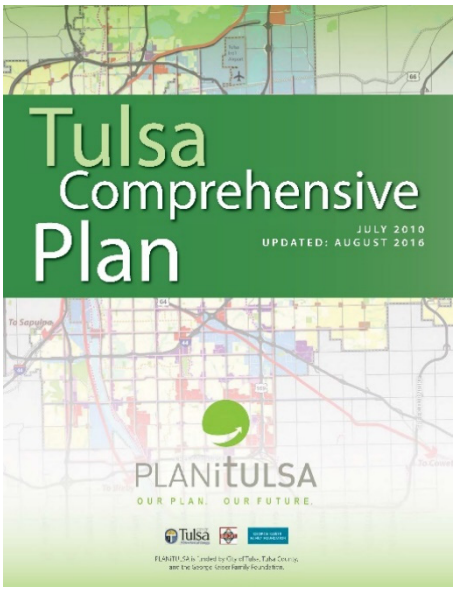
Chapter 3 presents the existing conditions analysis, the first major phase of analysis completed for the Connecting Progress Plan. Demographic data on Tulsa and performance data for the Tulsa Transit network was collected and assessed to establish an understanding of how the city and system are performing, what does well and what is not performing as well. These findings were then used in later phases to inform the final recommendations of the Connecting Progress Plan.

3.1 Review of Relevant Plans

Several recent planning documents in Tulsa have relevance to the Connecting Progress Plan and were reviewed for context to this planning effort, including:

- PLANiTULSA Tulsa Comprehensive Plan,
- Connected 2045 Long Range Transportation Plan,
- Fast Forward Regional Transit Service Plan,
- Peoria Avenue BRT Land Use Framework,
- GO Plan: The Tulsa Region Bicycle and Pedestrian Master Plan, and
- Tulsa Bike Share Strategic Plan.

PLANiTULSA Tulsa Comprehensive Plan



In 2010, *PLANiTULSA* was adopted by the City of Tulsa and was updated in 2016. It is the city's long-range comprehensive plan which guides land use development through a series of goals and policies. Both the City of Tulsa and INCOG maintain and implement aspects of the comprehensive plan and new developments are vetted to ensure they align with the goals and policies documented within the plan. The comprehensive plan is a three-part framework: the comprehensive plan, a strategic plan, and a monitoring program. A strategic plan document was developed to accommodate immediate, short-term developments as well as determine funding sources for projects. The strategic plan has six strategies which assist in implementing the comprehensive plan, of which "Draft and launch a new transportation strategy," is the most pertinent to the Connecting Progress Plan. In response to this strategy, in 2013 Tulsa adopted a Complete Streets Manual which provides an overview of Complete Streets planning and implementation.[2] The monitoring program is *Tulsa 2030*, a way to evaluate the progress of the comprehensive plan, develop and test methodologies to chart progress, assess achievements, and evaluate best practices going forward. A progress report was also released in

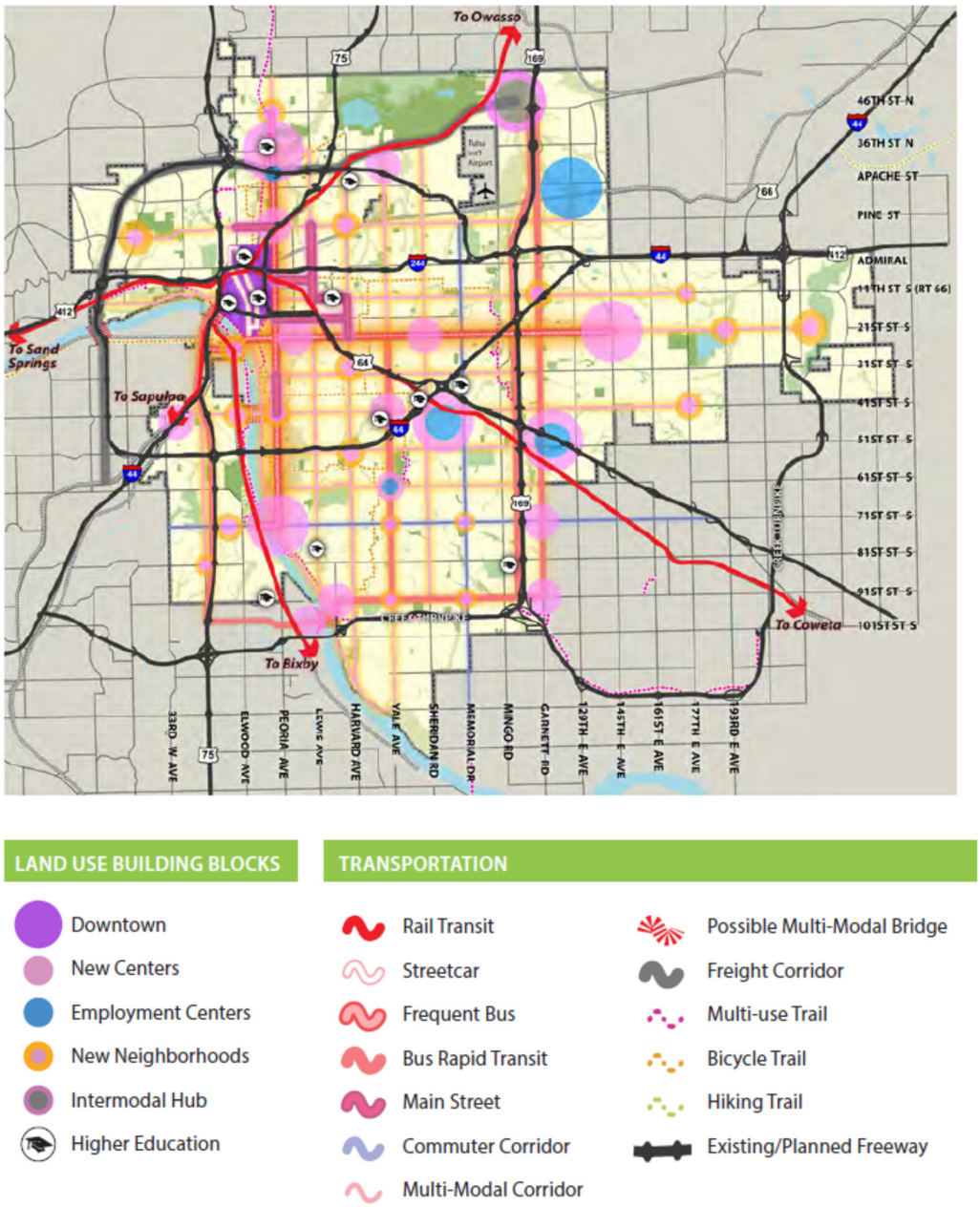
[2] Complete Streets is an idea which provides a greater range of users on a given roadway instead of only automobiles. Context Sensitive Solutions (CSS) seeks to match transportation facilities with the areas they serve, such as incorporating more alternative modes into the transportation network where feasible, and to prioritize the movement of people rather than only automobiles. CSS considers how best to incorporate bicyclists, pedestrians and transit within a transportation facility.

2016 which charted the progress made over the prior five years. The monitoring plan reviews five areas which include land use; transportation; economic development; housing; and parks, trails and open space. The Vision Plan, shown in Figure 3-1. Tulsa Vision Plan, July 2010, summarizes major land use and transportation goals into a single graphic.

Noteworthy specifics within the comprehensive plan with relevance to Connecting Progress include:

- A need to better coordinate land use and transportation planning decisions to target density and residential uses in downtown and centralized new communities built around transit and pedestrian amenities (wider sidewalks, shorter street crossings, bicycle infrastructure, etc.)
- Closely coordinate with Tulsa Transit on transit improvements in high frequency bus, bus rapid transit, streetcar, light rail and commuter rail corridors.
- Priority corridors include Peoria Avenue, 21st Street, 91st Street, Yale Avenue and Garnett Road; design/redesign roads for BRT: Garnett Road, 91st Street, and Yale Avenue.
- Less emphasis on new roadway lane miles, and more emphasis on maintenance and transportation facilities which are oriented more toward pedestrians, bicycles, and transit.
- If goals enacted in Tulsa 2030 are met, transit ridership could increase 600% by 2030 due to increased homes and jobs constructed around transit service.
- The comprehensive plan notes that the growth of Tulsa Transit is "…hampered by automobile-oriented street design, low population density, and the lack of complementary pedestrian and bicycle infrastructure."
- U.S. Highway 169 and the Broken Arrow Expressway see the highest peak hour congestion in the region; rapid transit in these corridors could see decent ridership levels and may be eligible for federal funding.
- High frequency bus would benefit from transit priority improvements (signal changes, bus lanes, etc.), particularly on Peoria Avenue and 21st Street corridors.
- 21st Street and Utica Avenue is a potential location for timed transfers and is a location where Transit Oriented Development is recommended.

Figure 3-1. Tulsa Vision Plan, July 2010



Source: PLANiTULSA

Connected 2045 Long Range Transportation Plan

Connected 2045 is Tulsa's Regional Transportation Plan, released in November of 2017. It is updated every five years and has a 20-year planning horizon. It anticipates the transportation needs of the region based on planning assumptions and modeling estimates and serves as a guide for the investment of regional transportation resources. Because 2045 horizon year is well beyond the planning timeline for the Connecting Progress Plan, the overlap between these two documents is narrow. However, *Connected 2045* addresses transit and pedestrian bicycle infrastructure needs and recommends more

investment in supporting these modes. The *Regional Transit System Plan* was noted to recommend BRT investment on the Peoria Avenue and 11th and 21st Street corridors. As noted in *Connected 2045*, the second phase of BRT service along some combination of 11th and 21st Streets will allow for a decentralized network and will aid in modernizing the system. Further, the plan recommended the use of performance measures to aid in monitoring the performance of the Tulsa Transit system.

Table 3-1. Transit *Performance Measures*

Ridership	Annual ridership should be compared with 2011 Bus Operations Plan and 2017 Route Integration Study. Post BRT-implementation, ridership should be monitored for increase overall and increase in choice riders.
Revenue Service	Revenue service should be compared with 2011 Bus Ops Plan to ensure service grows. (Service was shown to decrease 20% between 2002 and 2009.)
Service Effectiveness	Passengers per revenue mile and revenue hour are two key metrics. Service effectiveness should be measured annually, along with ridership and revenue service to determine overall quality of service.

Source: Summarized from Connected 2045.

Fast Forward Regional Transit System Plan (RTSP or *Fast Forward*)

The RTSP represents the culmination of at least a decade of focused transit planning in the region. Released in 2011, the data-driven and technically-focused plan informed recommendations to guide development of increased regional mobility within the Tulsa transportation management area through year 2035. To determine regional transportation needs, the RTSP incorporated future travel patterns and demand and future population and employment growth.

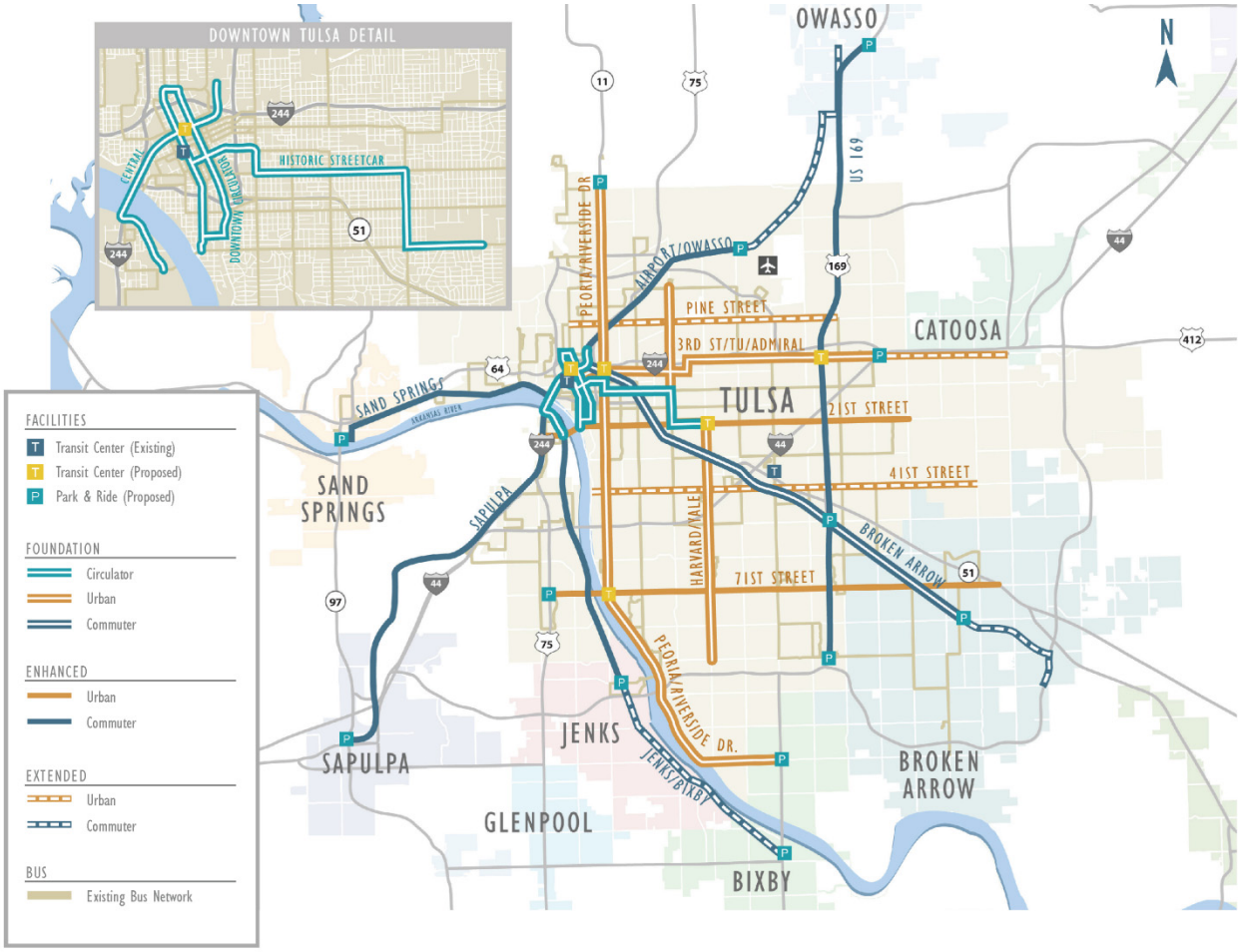
Based on prior reports and studies, twenty-two corridors for improved transit service comprised an initial list of investments. An evaluation process ranked the potential performance of each these corridors, resulting in the highest-ranked corridors or segments. The evaluation process also prioritized which corridors would receive further analysis and potential capital investment in a future Alternatives Analysis study. Corridors were identified as being Foundation, Enhanced, or Extended which prioritizes their further study and likely implementation. Within these groupings, transit corridors were categorized by their level of service needs and transit market characteristics and were considered circulator, urban, or commuter-oriented services.

Recommendations from this process are shown in Figure 3-2. One of the corridors is the future Peoria Avenue AERO BRT which was a Foundation Urban corridor. Tulsa Transit's second AERO BRT corridor will be on a combination of 11th and 21st Streets and was previously identified as portions of a Foundation Circulator and Enhanced Urban service.

This effort also included three reports addressing Tulsa Transit service at a system level: existing service, peer and system analysis, and future near-term and long-term recommendations. The final RTSP incorporated key near-term and long-term recommendations for improving the existing Tulsa Transit system, several of which have already been implemented:

- Use clock headways for bus service (30-, 45-, 60-minute frequencies).
- Implement timed transfers at transit centers.
- Simplify circuitous routing.
- Replace Nightline routes with evening and night service on regular routes.
- Develop detailed downtown transit service map for inclusion in Tulsa Transit *Traveler*.
- Pursue aggressive rebranding, marketing and outreach of the system and its changes.
- Develop "super stop" or "sub-hub" locations (transfer locations besides the existing two at Denver Avenue and Midtown Memorial Stations) and improved information kiosks.
- Provide bus schedule and route information at bus stops.
- Introduce real-time passenger information at key bus stops.

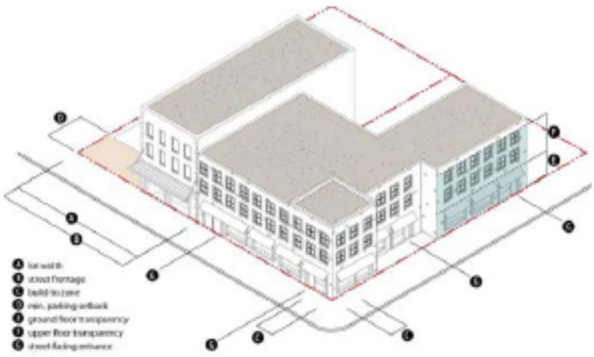
Figure 3-2. Fast Forward Regional Transit System Plan



Source: Fast Forward Regional Transit System Plan*, 2011*

Peoria Avenue BRT Land Use Framework

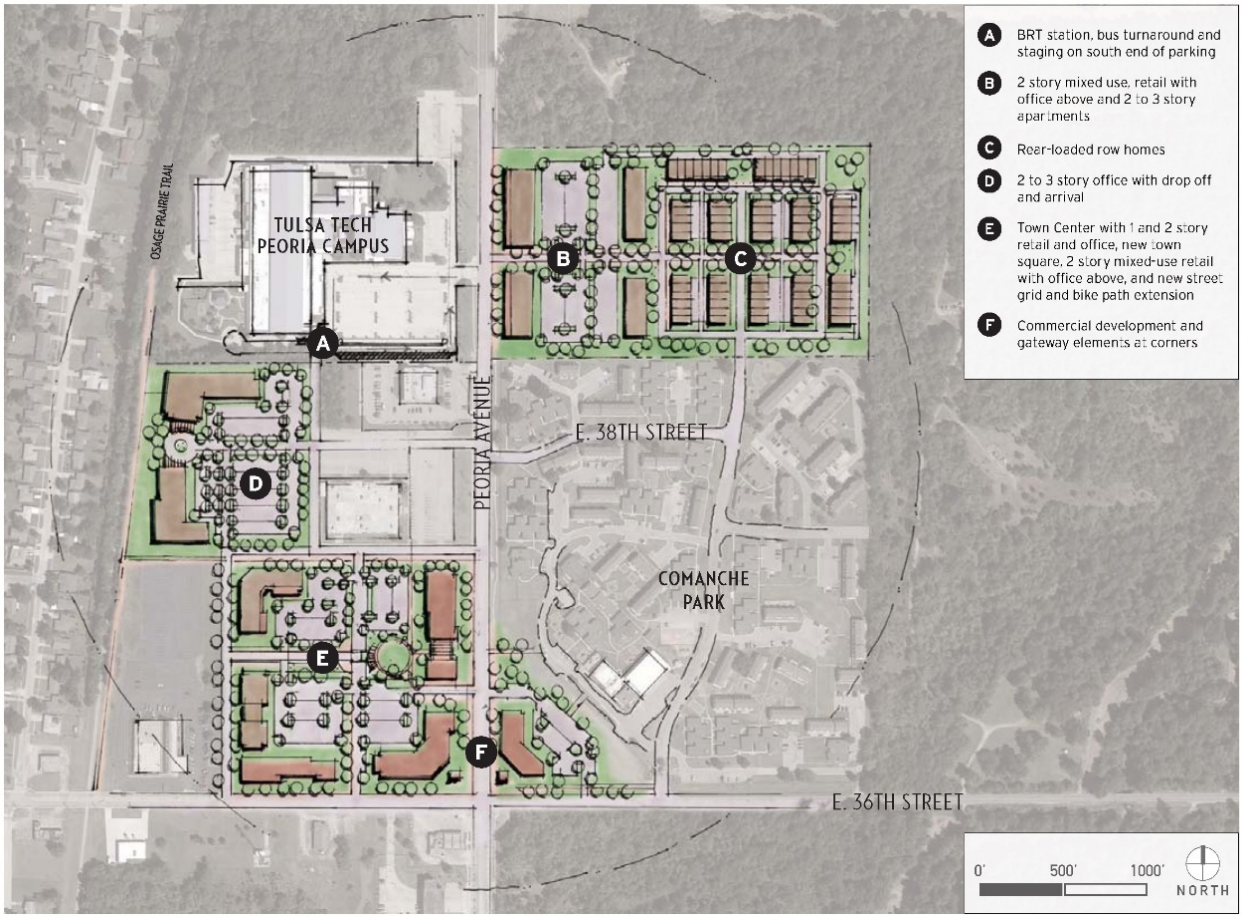
Major transit investments are often associated with land use investments, as the two mutually support one another. To maximize the return on investment of the future Peoria Avenue AERO BRT, the *Peoria Avenue BRT Land Use Framework* was recently developed. This document provides a range of zoning, land use, and street enhancement strategies. These were based on an examination of both the existing physical development along the corridor as well as Tulsa's existing regulatory environment and incorporation of feedback from an extensive public outreach process. Further, eight Small Area Plans were found to be immediately relevant to the Peoria Avenue corridor and were summarized with the document.



MX-Pedestrian (P) character diagram. Source: Tulsa Zoning Code

Overall, the findings and recommendations tailored for the Peoria Avenue corridor could be applicable to the second AERO BRT line on a combination of 11th and/or 21st Streets. Because many areas along the Peoria Avenue corridor are under-developed or were built to accommodate automobile uses, these recommendations focus on providing a friendly environment to the pedestrian or bicyclist, namely those who would likely be using transit. The framework provides recommendations at both the station-area level and the corridor or district level. These include concentration of development into denser, mixed land uses, reduction of parking, bringing building fronts to the edge of the sidewalk as well as incorporation of pedestrian-oriented architecture, addition of street amenities (trees, street furniture, lighting, etc.), consideration for bicycle and pedestrian infrastructure, and a focus on improvements in the top tier of BRT stations (those designated as "enhanced" or those anticipated to see the highest ridership).

Figure 3-3. 38th Street North and Peoria Avenue Station Area Development Concept



Source: Peoria Avenue BRT Land Use Framework, *2017*

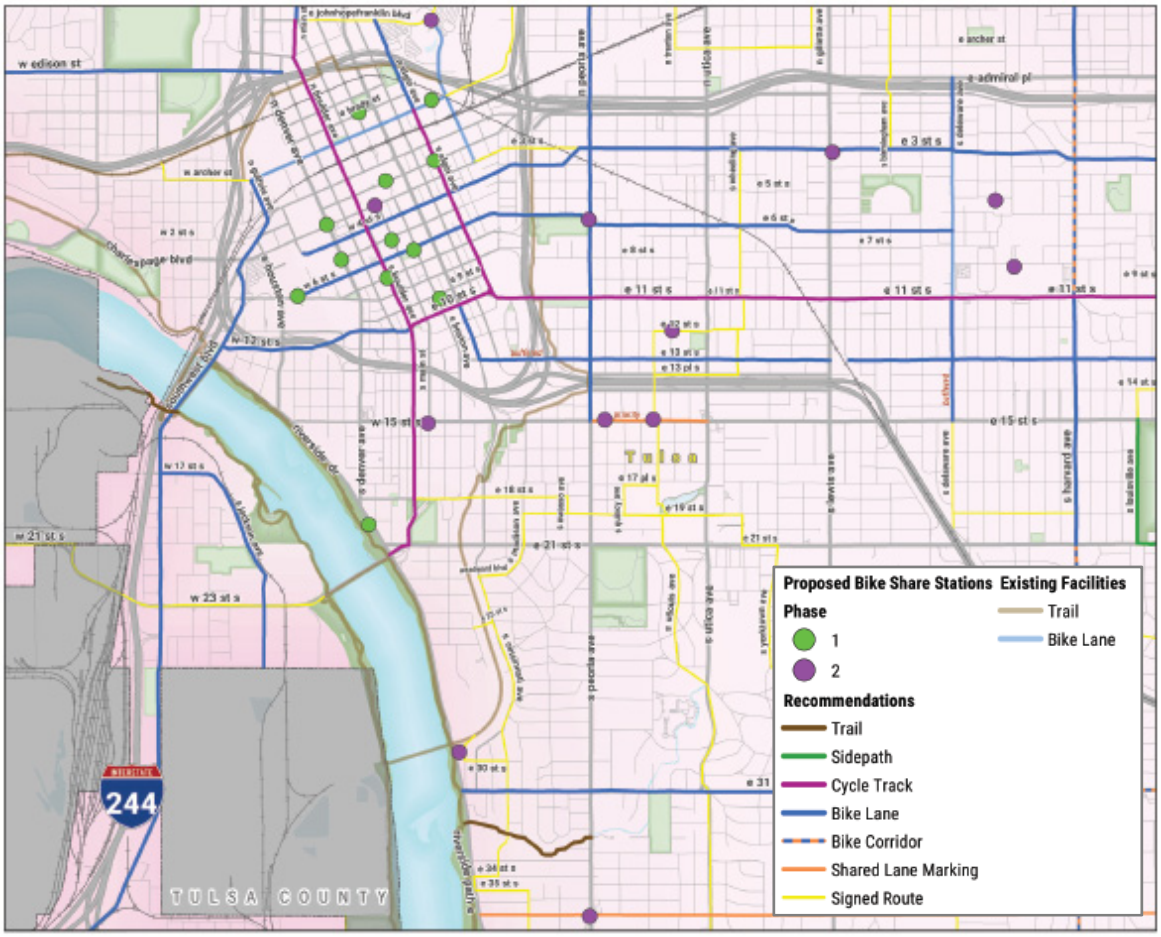
GO Plan: The Tulsa Region Bicycle and Pedestrian Master Plan

In the past several years, bicycle and pedestrian planning has been at the forefront of planning activities for the region. Bicycle and pedestrian activity is highly correlated to transit use because transit riders begin and end their trip as pedestrians. Thus, improvement of these networks will aid in both attracting new riders to transit and providing a safe network that transit riders can utilize. Recently, the City of Tulsa has adopted INCOG's *GO Plan* (2015), the region's very first bicycle and pedestrian master plan. This visionary document builds upon both the *Connections 2045* Regional Transportation Plan and the 1999 *Trails Master Plan* and seeks to improve the bicycling and pedestrian experience in the Tulsa region. Study goals include implementing an interconnected network of bicycle and pedestrian facilities to increase the share of those modes.

Addressing bicycling and pedestrian needs have occurred in several other planning documents, particularly those described previously, but the *GO Plan* lays out concrete goals and objectives so that

the 11 cities in the Tulsa region[3] have the tools to implement aspects of the plan such as the prioritized list of bicycle and pedestrian projects. A comprehensive list of bicycle facility types was provided and a targeted list of pedestrian improvements, particularly those near high schools, was included as recommended improvements.

Figure 3-4. GO Plan Existing and Proposed Facilities



Source: GO Plan

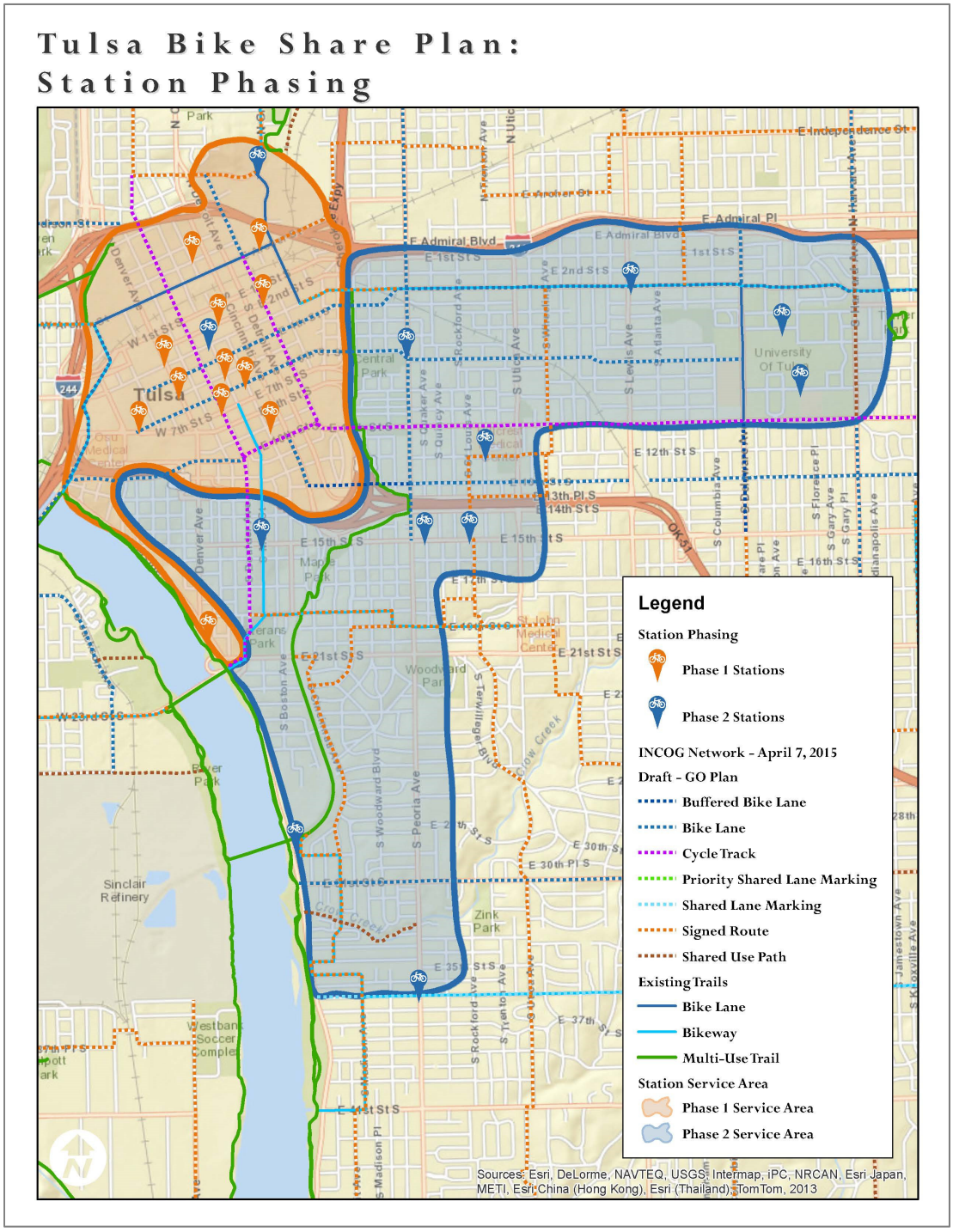
Tulsa Bike Share Strategic Plan

Tulsa will soon also benefit from a bike share program which will be implemented in two phases as funding is secured and planning is finalized: Phase 1 targets the urban core/central business district with 12 initial stations and 108 bicycles; Phase 2 branches out of downtown into the Pearl District area with another 12 stations. Typically, bike share locations are best co-located with transit facilities (such as rail or bus stations) or major activity areas and can bridge the "last mile" gap from origin to destination in many instances. Thus, downtown is logical since this is where much activity occurs and where most of Tulsa Transit's routes connect with one another at Denver Avenue Station.

[3] Bixby, Broken Arrow, Catoosa, Collinsville, Coweta, Glenpool, Jenks, Owasso, Sand Springs, Skiatook, and Tulsa.

As the BRT corridors are implemented, planning should be closely coordinated with INCOG and Tulsa Transit to determine the best high-ridership stations where future bike hubs may be located. These stations may be predetermined based on the scale of station investment (large stations), ends-of-line, or stations where high ridership is generated.

Figure 3-5. Tulsa Bike Share Hub Locations



Source: Tulsa Bike Share

3.2 Market Analysis

This section presents a snapshot of the current demographic and market conditions within the city and county of Tulsa, specifically those correlated to transit ridership. In economic terms, transit is a derived good, meaning people consume it to do something else. Thus, the key to demographic and market analysis is to identify factors that determine transit trip purpose.

Most trips within the Tulsa metropolitan area are completed by automobile. There are many reasons for this, among them urban sprawl, urban freeways, free or inexpensive parking, and low gasoline prices. Much of this trend is due to decades of subsidization from Federal, state, and local governments.[4] People have demonstrated they will choose an alternative mode if the subsidization of auto travel ceases and/or if the alternative mode becomes competitive with auto travel times.

Given the above knowledge, this section reviews data to answer questions about the Tulsa transit market, including where people begin their trip (their origin), where people end their trip (their destination), and what groups of people are most likely to take transit in the city and county. Using these data will assist in understanding where Tulsans are currently using transit and where the transit market has potential to successfully expand.

Study Area and Data Sources

The study area is the area of analysis for all maps presented in this section. The area was defined with assistance from INCOG staff. Consideration included Tulsa Transit's service coverage area (defined as a three-quarter-mile buffer around existing transit routes to match up with the farthest extent of possible ADA coverage) and Tulsa's corporate limits and urbanized area boundary as well as considering which census tracts and census block groups nested within these boundaries. Portions of Catoosa and Sapulpa were included for employment and population considerations. The final proposed study area boundaries contain 402 census block groups for analysis. Figure 3-6 shows the study area boundaries for the market analysis as well as the service coverage of Tulsa Transit routes.

Demographic data was obtained from several sources based on both the origin and destination part of the trip. The American Community Survey 5-year Estimates (2012 – 2016) was used for origin data, while the 2015 Longitudinal Employer-Household Dynamics (LEHD) was used for destination data; both datasets originate from the United States Census Bureau. The principal geographic unit is the census block group for each dataset.

Demographic Review

The demographic review included ten distinct datasets selected because of their correlation to transit ridership. Definitions for each dataset are presented in subsections below.

Specific origin-based data used for this analysis includes:

- Household density
- Minority population
- Population under 25 years of age

[4] Subsidization includes government backed roadway projects, free or reduced parking costs, and low gasoline costs.

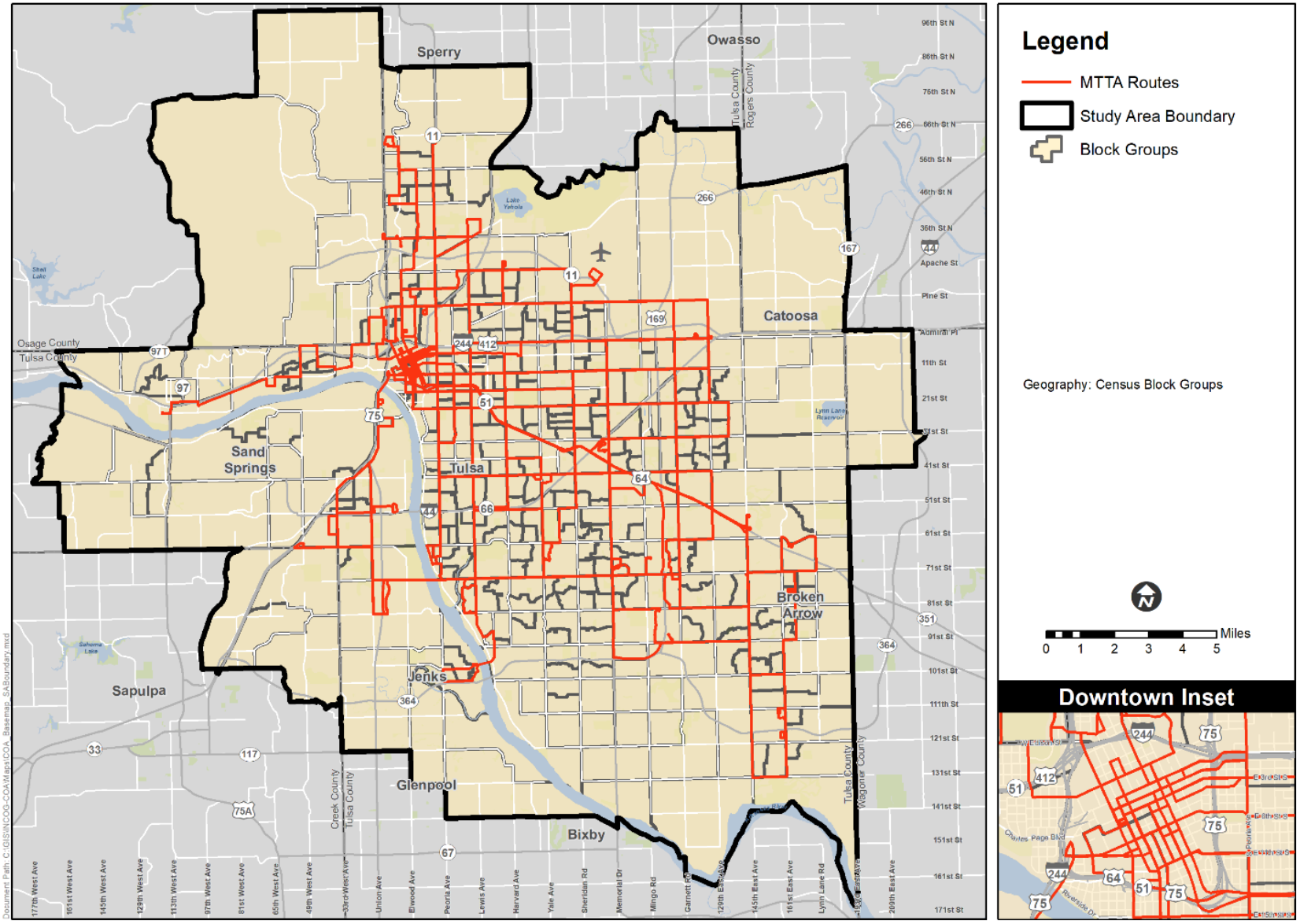
- Population over 65 years of age
- Percentage of households with annual incomes under $30,000
- Unemployment status
- Limited English Proficiency (LEP) households
- Zero-vehicle households
- One-vehicle households

In addition to the origin-based data, a tenth dataset related to the destination part of the trip was aggregated using LEHD Origin-Destination Employment Statistics (LODES) data. A total of eight specific categories were reviewed and used to create a destination index, including:

- Jobs earning less than $1,250 per month
- Jobs earning between $1,250 and $3,333 per month
- Jobs within the retail trade
- Jobs in Healthcare / Social Assistance
- Jobs in Arts, Entertainment, Recreation
- Jobs in Accommodation, Food Service
- Jobs for workers with less than a High School diploma
- Jobs for High School equivalent

The final part of this section is a transit propensity index. Each of the 10 datasets was given a weighted scoring depending on its impact to transit use. Full understanding of the transit market comes by considering all demographics together, which allows to a comprehensive understanding of the transit market in Tulsa.

Figure 3-6. Market Analysis Study Area Boundary



Population Density

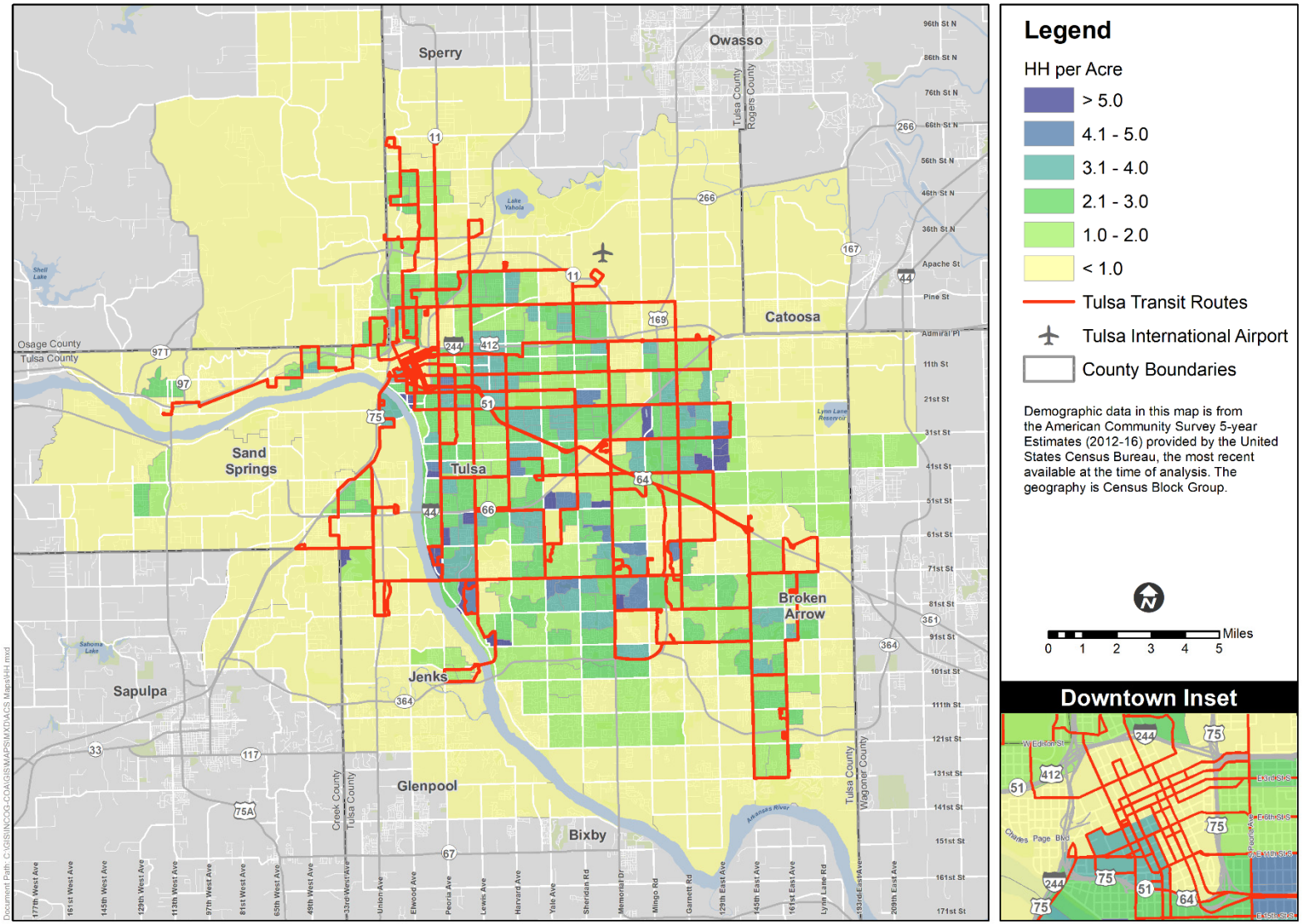
Population density is a significant indicator of where transit origins are occurring. There are two reasons for this. First, density means more people in a smaller geographic area, which in turn means more trips. Second, the density itself means more traffic congestion and more parking constraints, which in turn means more people are likely to choose transit.

The map in Figure 3-7 shows household density within the study area. The areas with the highest household[5] densities are not in the urban core as one might expect, but in areas in the south, southeast, and east sides of the city. One significant reason for this is because Tulsa is comprised mostly of single family homes. Apartments that do exist tend to be auto-oriented developments on the periphery of the metro area.

Areas of noteworthy household density (between 6 and 14 units to an acre) include the neighborhood south of downtown bounded by US Highway 75, the Arkansas River and Main Street; Memorial Drive at 81st Street, multiple locations along South Peoria Avenue and South Lewis Avenue (mostly south of Interstate 44); locations along 51st Street between Yale Avenue and Memorial Drive; Mingo Road between 21st and 31st Streets; and along 129th Avenue between 31st and 41st Streets.

[5] Household is defined as a dwelling unit with one or more adults living in it.

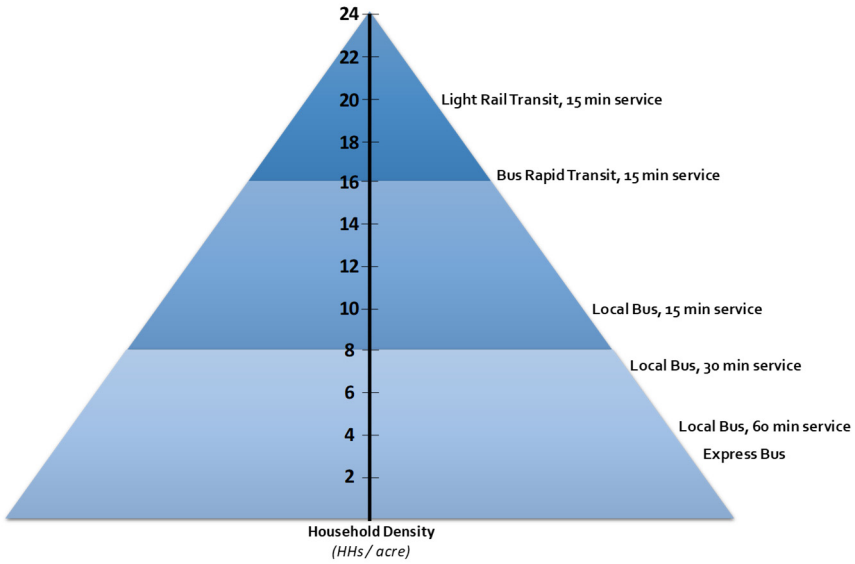
Figure 3-7. Household Density



Study Area median household density: 2.05 HH/acre

Transit service threshold guidelines for various levels of household density, as published by the Transit Cooperative Research Program (TCRP), are shown below in Figure 3-8. Based on the chart, Tulsa's population density suggests that most service should be at 60-minute frequency. However, this is only one factor in many that help determine frequency and service type. Existing ridership, other economic factors, and destination locations are all important before determining frequency for any corridor. As Tulsa continues to develop, particularly if development is channeled towards existing neighborhoods and corridors, higher demand will result in the need for higher frequencies.

Figure 3-8. Transit Thresholds for Household Densities



Source: TCRP 167 Making Effective Fixed Guideway Transit Investments

Minority Population

Minority populations were reviewed in this document to ensure that environmental justice for disadvantaged groups is included as part of the Connecting Progress recommendations. A recent APTA report compiling over 200 passenger survey results across the country noted that while 63% of the population in the United States is considered White/Caucasian, this ethnic group accounts for 40% of transit users. In contrast, other ethnic groups are more likely to have a disproportionately higher proportion of transit users.[6]

The following Census Bureau race and ethnicity categories were included within a combined "minority" population analysis:

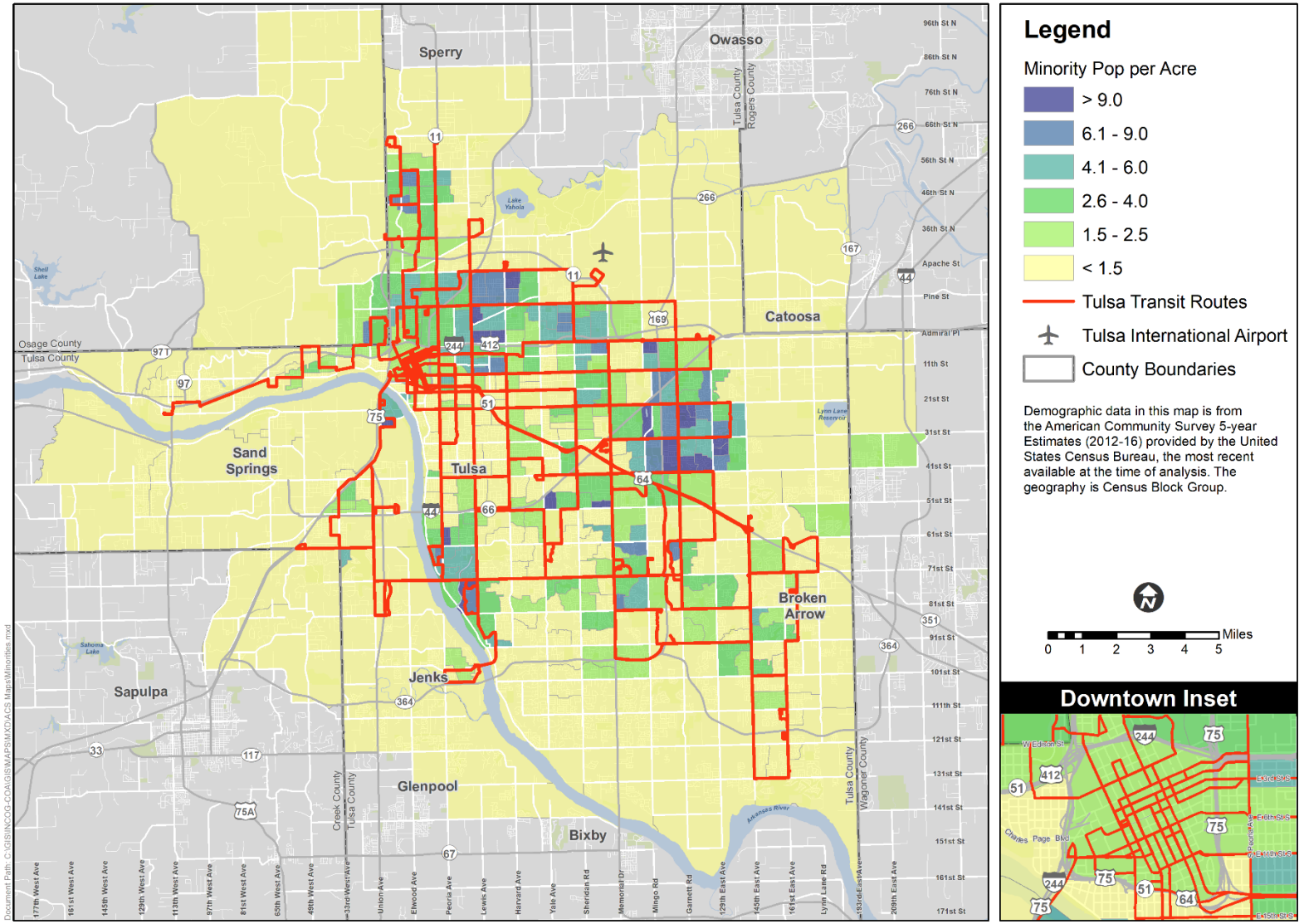
- African American
- Native American
- Asian

[6] American Public Transportation Association. Who Rides Public Transportation, January 2017.

- Asian-Pacific Islander
- Other
- Mixed
- Hispanic Origin

A map of minority population densities is shown in Figure 3-9. Areas with highest minority population densities are located northeast of downtown Tulsa (Apache to 11th Streets and Lewis to Yale Avenues), east of Midtown (areas between 11th and 41st Streets and Mingo Road and 145th Avenue), areas along the South Peoria Avenue corridor (south of 56th Street to 71st Street), and some pockets of higher concentration between southeast Tulsa and Broken Arrow. A general observation is that African Americans live in greater concentrations north and northwest of downtown Tulsa as well as areas of the South Peoria Avenue corridor. Hispanic populations live in greater concentrations in East Tulsa. These areas currently have transit access at least within a half-mile (if not closer) and at varying service levels.

Figure 3-9. Minority Population Density



Study area median Minority Population Density: 1.59 persons/acre

Age

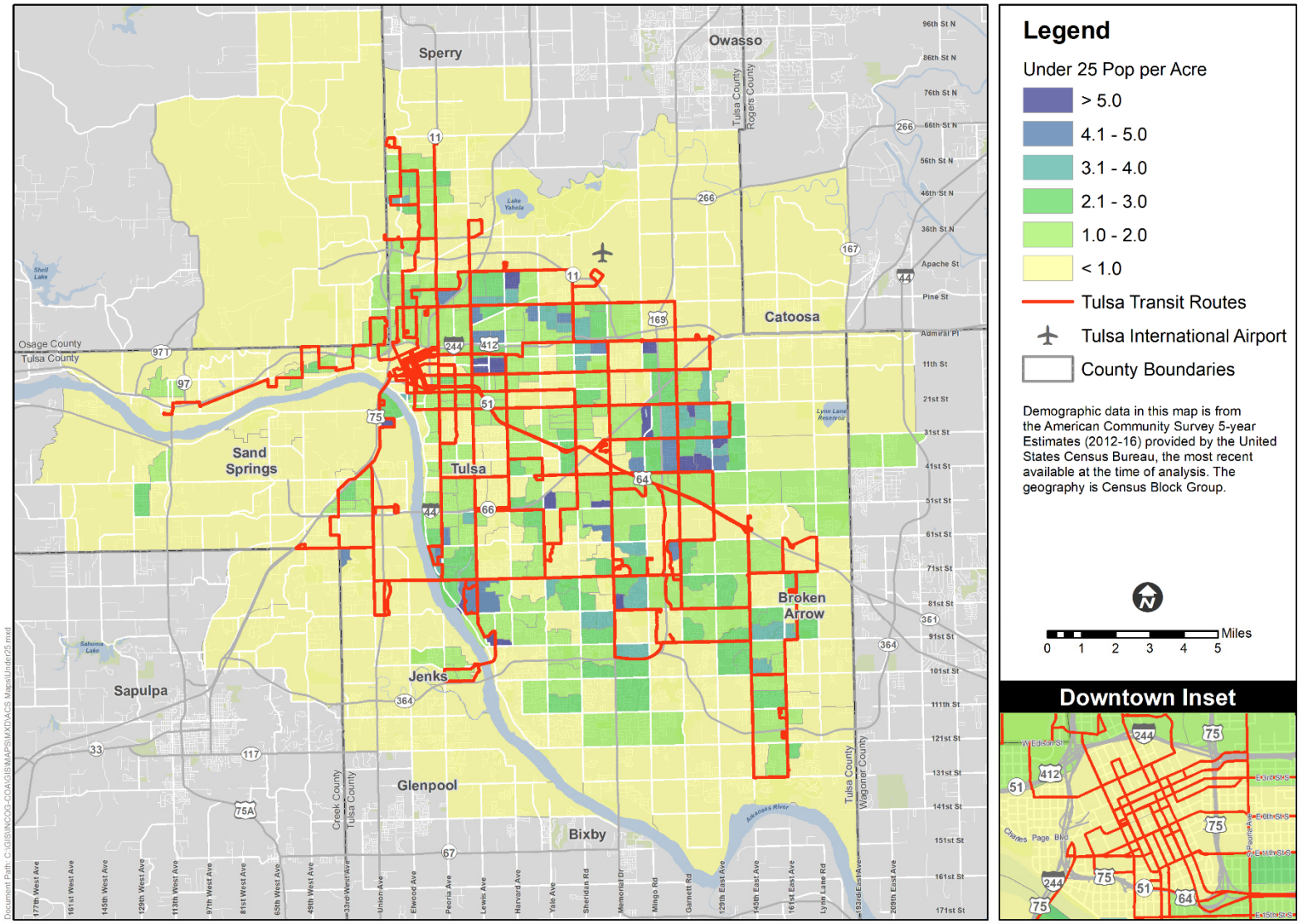
Persons under 25 tend to ride in higher numbers because many are in school or early in their careers and may not have the income to afford an automobile. There are also indicators that Millennials (those born between 1981 and 1997) are not acquiring driver's licenses at the same rate as previous generations.[7]

The under 25 population density in the study area is shown in Figure 3-10. Highest concentrations are the areas around Oral Roberts University and University of Tulsa. East Tulsa also has a higher concentration of persons under 25, likely related to areas with apartment complexes.

Persons over 65 is another population group which tends to utilize transit in higher numbers, either because seniors are on a fixed income (and cannot afford an automobile) or because they have mobility issues related to physical decline. Figure 3-11 shows the over 65 population density within the study area. A large portion of this population resides in the south and southeast sides of the city. This could be due to the age of single family homes in the area, with residents raising children in these neighborhoods in the 1970s and 80s, and now aging in place.

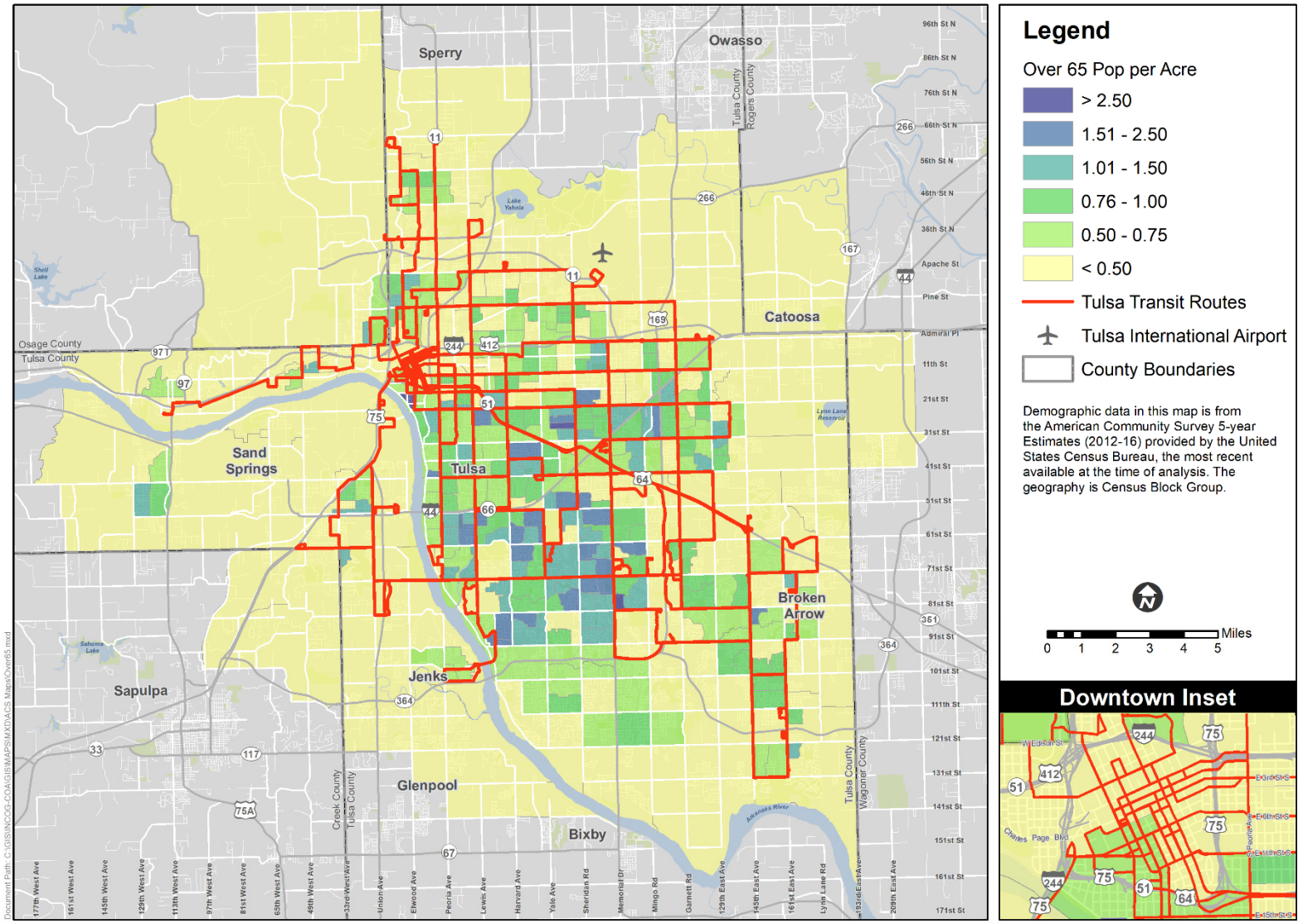
[7] Sivak, Michael. *Has Motorization in the U.S. Peaked? Part 9: Vehicle Ownership and Distance Driven, 1984 to 2015.* February 2017. Sustainable Worldwide Transportation, University of Michigan. http://www.umich.edu/~umtriswt/PDF/SWT-2017-4.pdf

Figure 3-10. Population Under 25 Years of Age Density



Study area median under 25 density: 1.44 persons/acre

Figure 3-11. Population Over 65 Years of Age Density



Study area median over 65 density: 0.60 persons/acre

Income

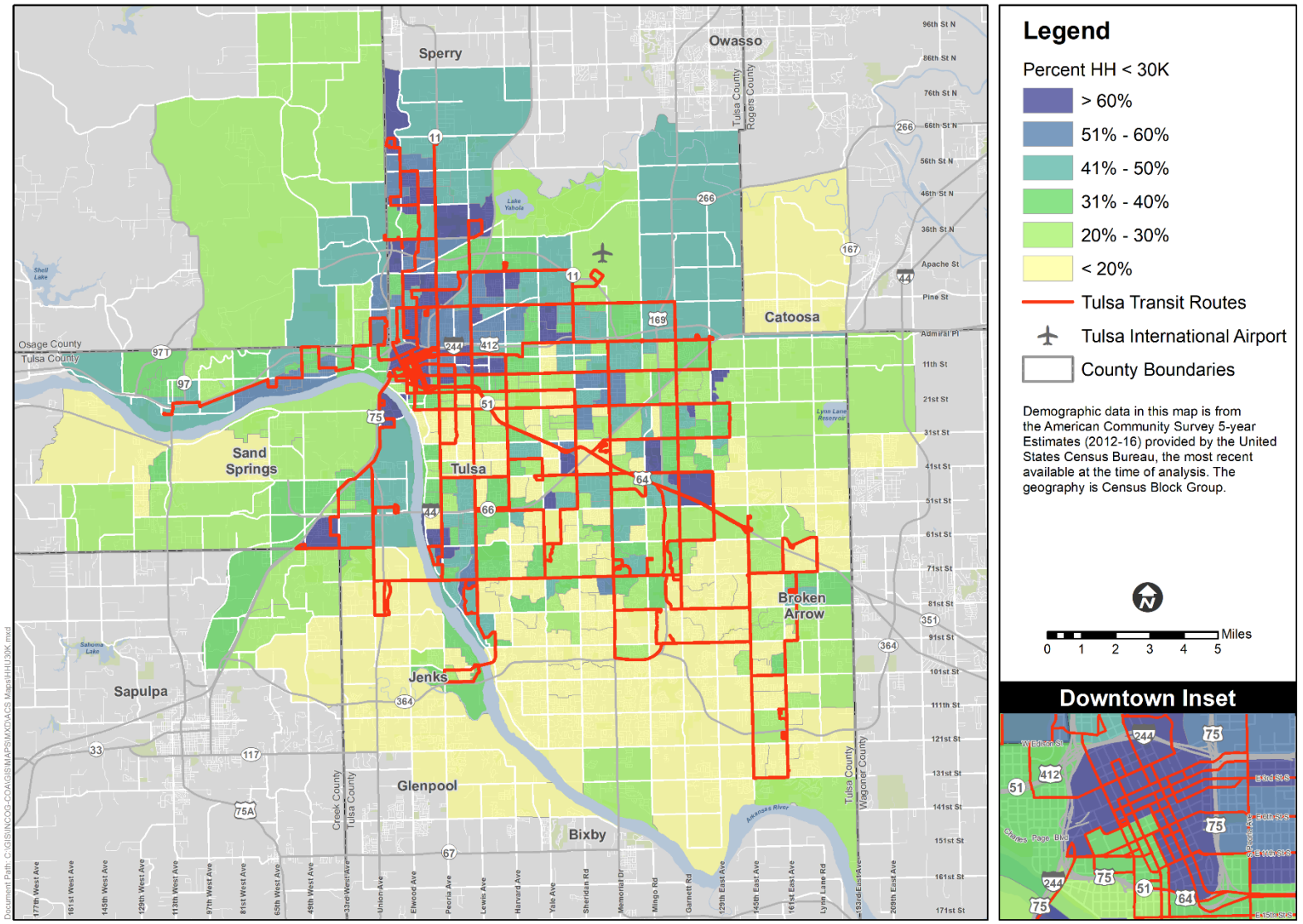
Persons at the lower end of the income scale who cannot afford to own and operate an automobile ride in higher numbers than the population at large. The density of households with annual incomes under $30,000 is mapped in Figure 3-12. Household income and mode choice is a bit difficult to explain with a single metric. A 1-person household with income of $30,000 is above the poverty line and may own an automobile, while a household with one working adult and four children with the same income is below the poverty line and more likely to not own an automobile. As a result, household income must be combined with other demographics to best understand the transit market.

Census blocks with more than 60 percent of households earning annual incomes under $30,000 are concentrated mostly in the north and northeast neighborhoods of Tulsa, with a few zones located south, southeast, and east. The map also shows a distinctive pattern of zones surrounding an "island" of higher income neighborhoods in midtown Tulsa.

Unemployment Density

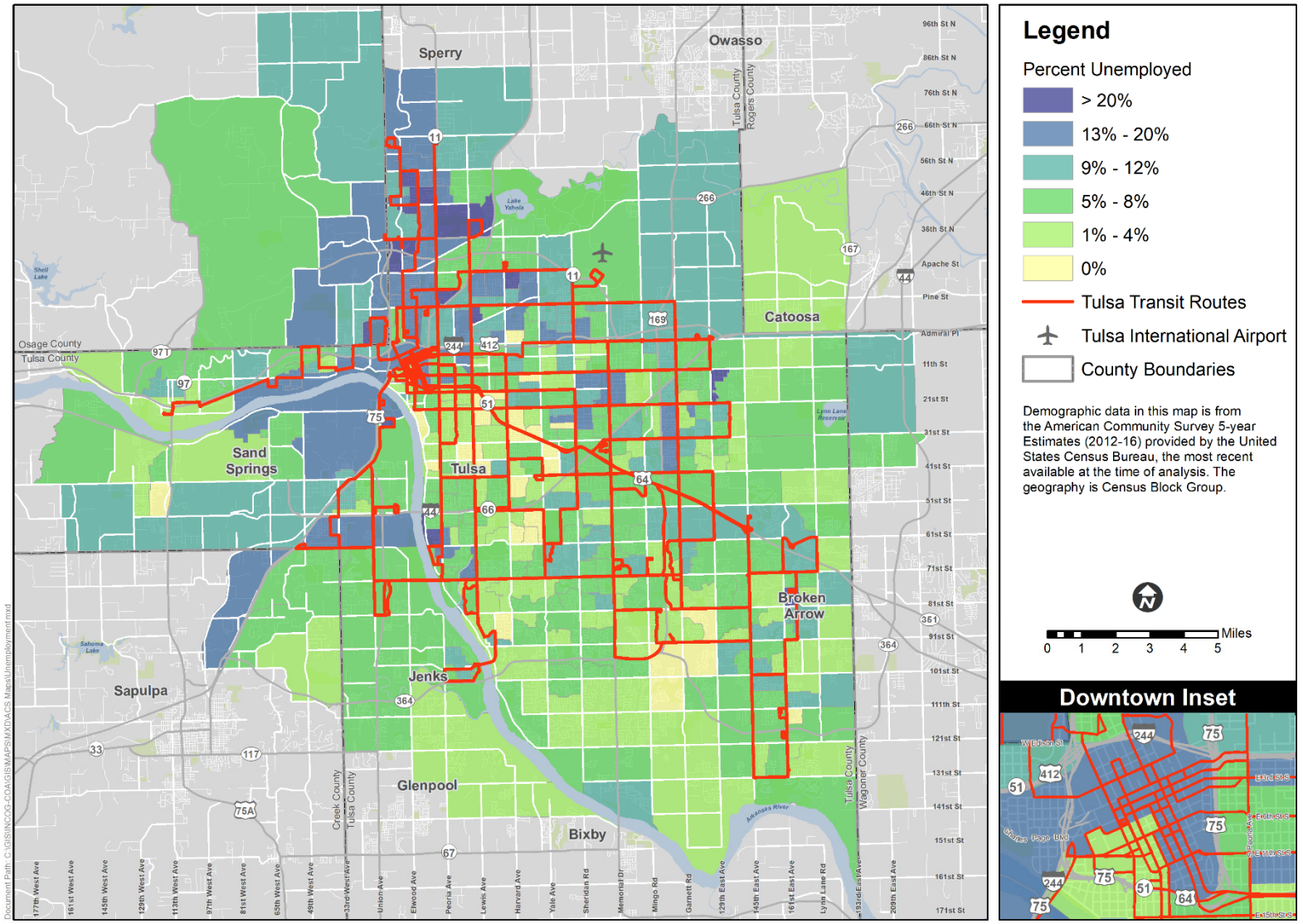
Unemployment density, like household income, can indicate the presence of transit riders because the unemployed likely cannot afford to own and operate an automobile. A scoring of block groups with the percent of the labor force (those 16 years and over) unemployed is shown in Figure 3-13. While unemployment can fluctuate with the economy, this map is instructive to show the parts of the study area with greatest average concentrations of unemployment. It would be desirable to ensure these areas are served by transit, since lack of access to jobs would be a barrier to employment. Concentrations of unemployment at levels above 12 percent of the labor force include much of north and northeast Tulsa, along the Arkansas River west to Sand Springs, West Tulsa, pockets along South Peoria Avenue at 61st Street, and along 129th Avenue at 11th Street.

Figure 3-12. Percent of Households with Annual Incomes Below $30,000



Study area median percentage with household income under $30,000: 28.7%

Figure 3-13. Percent of Labor Force (16 and Over) Unemployed Scores



Study area median percent unemployment: 6.1%

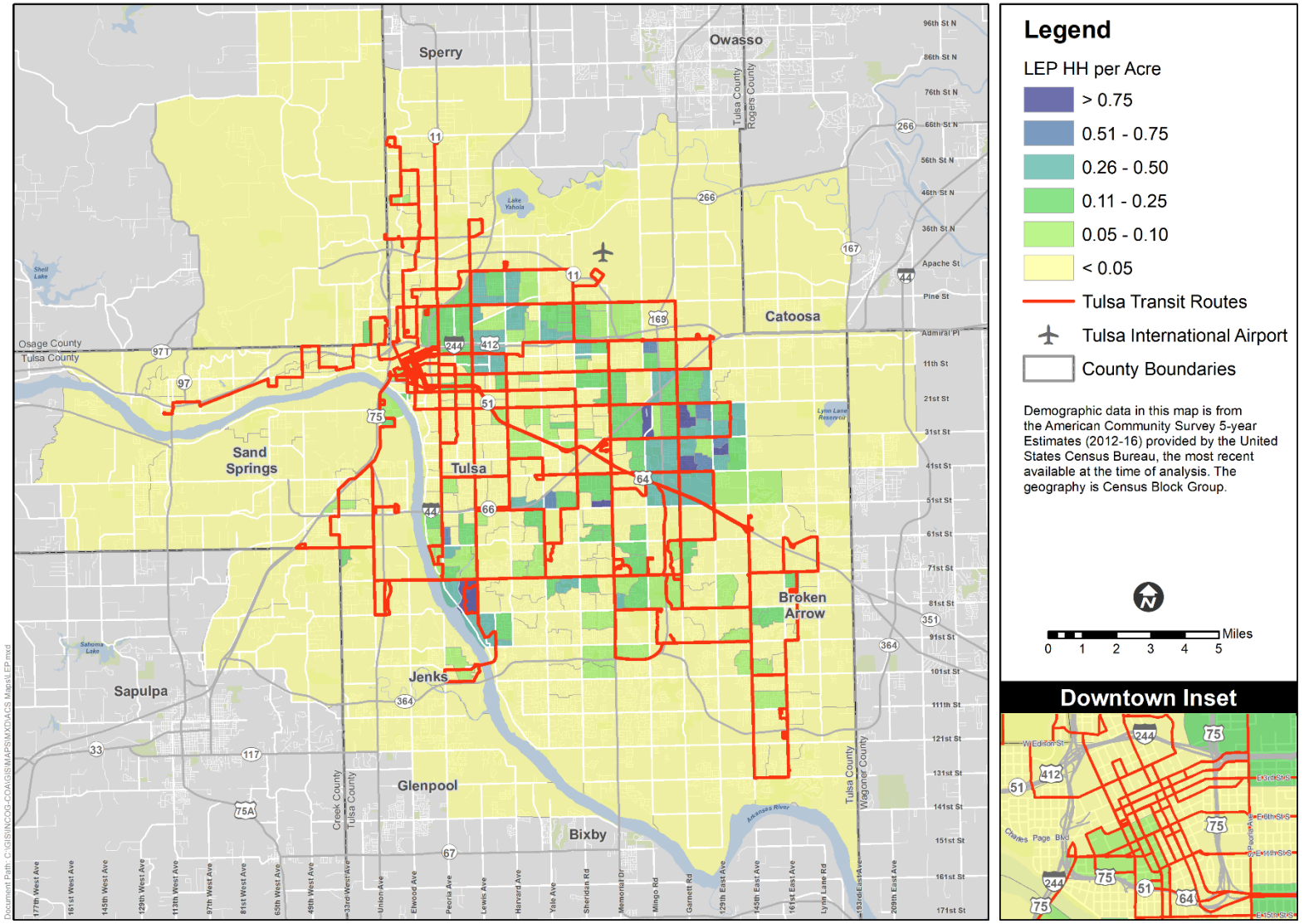
Limited English Proficiency (LEP) Households

Limited English Proficiency (LEP) households are an indicator that residents are new to the United States. That could mean a reliance on low-skill and low-wage jobs, which in turn results in the need for transit services. Many LEP residents have emigrated from counties where public transportation is a primary means of travel, and they are comfortable using transit to access jobs and services. Older Latino and Asian communities often make up the largest share of local populations with LEP households and the largest share of LEP transit riders.[8]

A map of LEP household density is shown in Figure 3-14. The map indicates that LEP households are generally located in East Tulsa, which corresponds to the predominantly Hispanic neighborhoods between Mingo Road and 145th Avenue and 21st and 41st Streets. The map also shows LEP household concentrations along South Peoria Avenue and 71st to 81st Streets.

[8] Community Transportation Association of America. *Transportation for Persons with Limited English Proficiency*. FTA Circular 4702.1A. http://www.ctaa.org/webmodules/webarticles/articlefiles/LEP.pdf

Figure 3-14. Limited English Proficiency Households Density

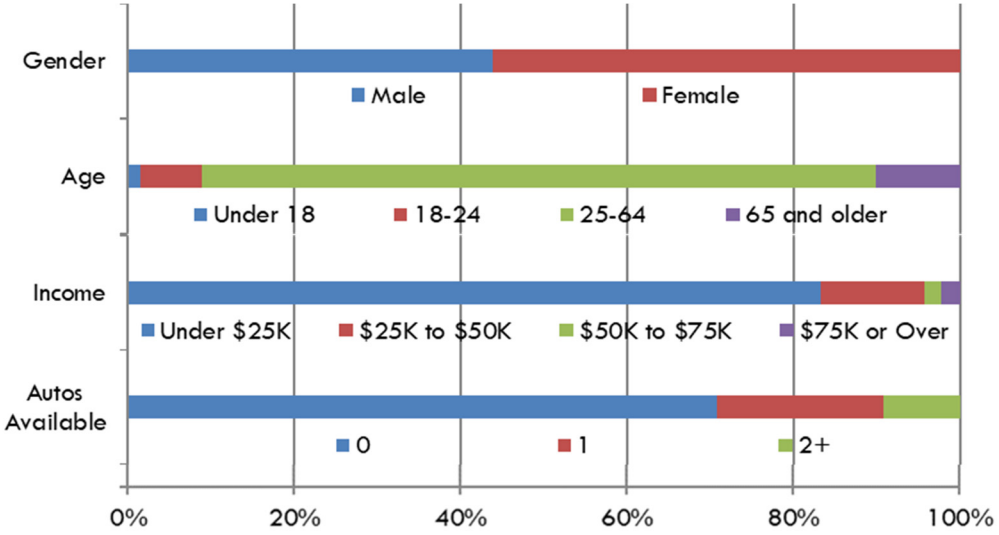


Study area median LEP HH density: 0.01 HH/acre

Automobile Ownership

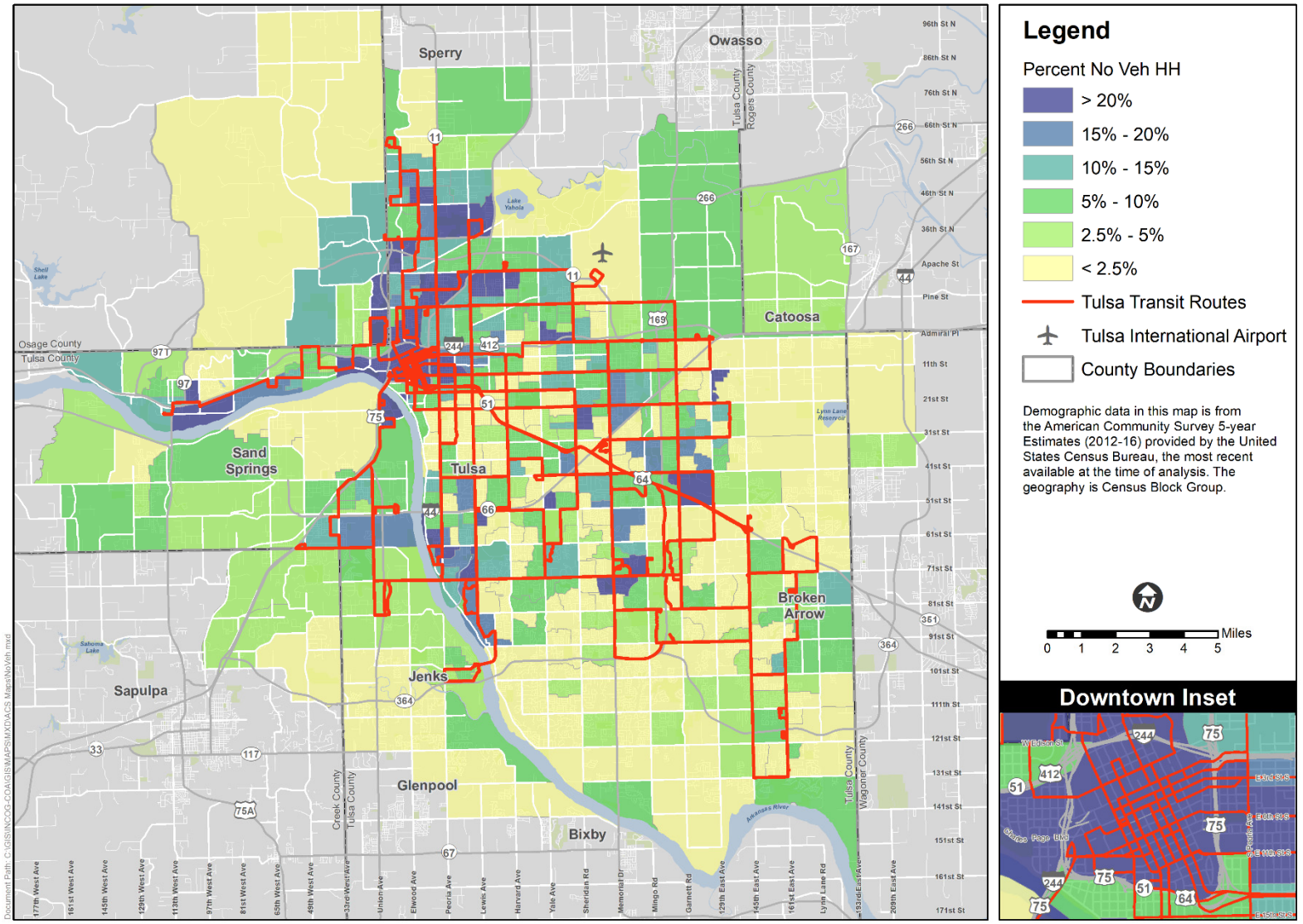
Automobile ownership (or lack thereof) is a major indicator of transit use; low automobile ownership is associated with higher transit use. A 2017 Tulsa Transit rider survey indicated that 2 in 3 riders live in a zero-vehicle household, and almost 75% of riders have no automobile available to them. Thus, automobile ownership is a vital factor driving transit ridership in Tulsa.

Figure 3-15. Rider Characteristics from 2017 Tulsa Transit Survey



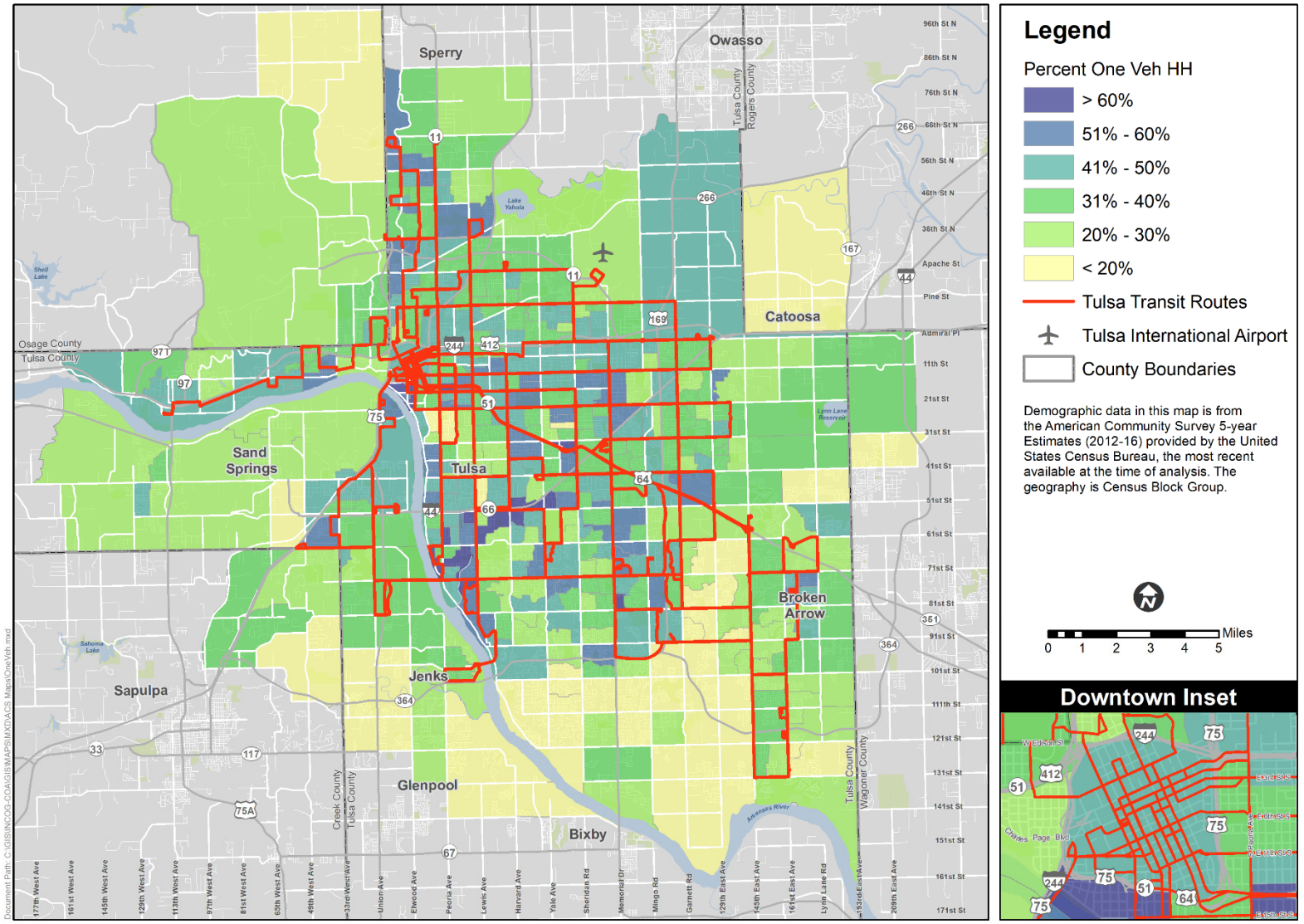
Zero and one-vehicle households were mapped in Figure 3-16 and Figure 3-17, respectively. These maps echo the income density map, which is logical since income is the primary resource required for auto ownership. Overall, zero vehicle households are concentrated in north Tulsa, west to Sand Springs, and South Peoria Avenue between 61st and 81st Streets. One vehicle households are spread more evenly across the entire metro area, with concentrations in south and southeast Tulsa. Depending on household size, one car households may or may not indicate a potential for transit ridership.

Figure 3-16. Percent of Zero Vehicle Households



Study area median percentage zero vehicle households: 4.9%

Figure 3-17. Percent of One Vehicle Households



Study area median percentage one vehicle households: 37.7%

LEHD Origin-Destination Employment Statistics Data

Data from the Census Bureau's 2015 Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) provides information on employment characteristics, including information on income, industry, and education level. This data can be used to determine zones of employment with the most potential for transit riders.

Two distinct maps were created to review employment statistics in Tulsa. Figure 3-18 shows total employment within the study area along with transit coverage within ¼ mile of each route alignment. Two trends are apparent in this map. First, downtown Tulsa has the highest concentration of jobs within the study area, which is consistent with other data in this document. Second, there is a large spread of jobs in the southeast corner of the study area, roughly from Yale to Garnett and from 41st to 71st streets. This area is a major destination for many trips in the metropolitan area.

A second, more in depth analysis focused on characteristics that represent low-income employment (thus reflecting a greater propensity for transit ridership in Tulsa), including:

- Income characteristics:
  - Jobs earning less than $1,250 per month
  - Jobs earning between $1,250 and $3,333 per month
- Jobs within certain industries:
  - Retail trade
  - Healthcare / Social Assistance
  - Arts, Entertainment, Recreation
  - Accommodation, Food Service
- Jobs for certain educational attainment levels:
  - Jobs for workers with less than a High School diploma
  - Jobs for High School equivalent

The densities of these employment characteristics (jobs per acre) were given weighted scores and then aggregated into a total score. The weights applied to each LODES metric are listed in the table below.

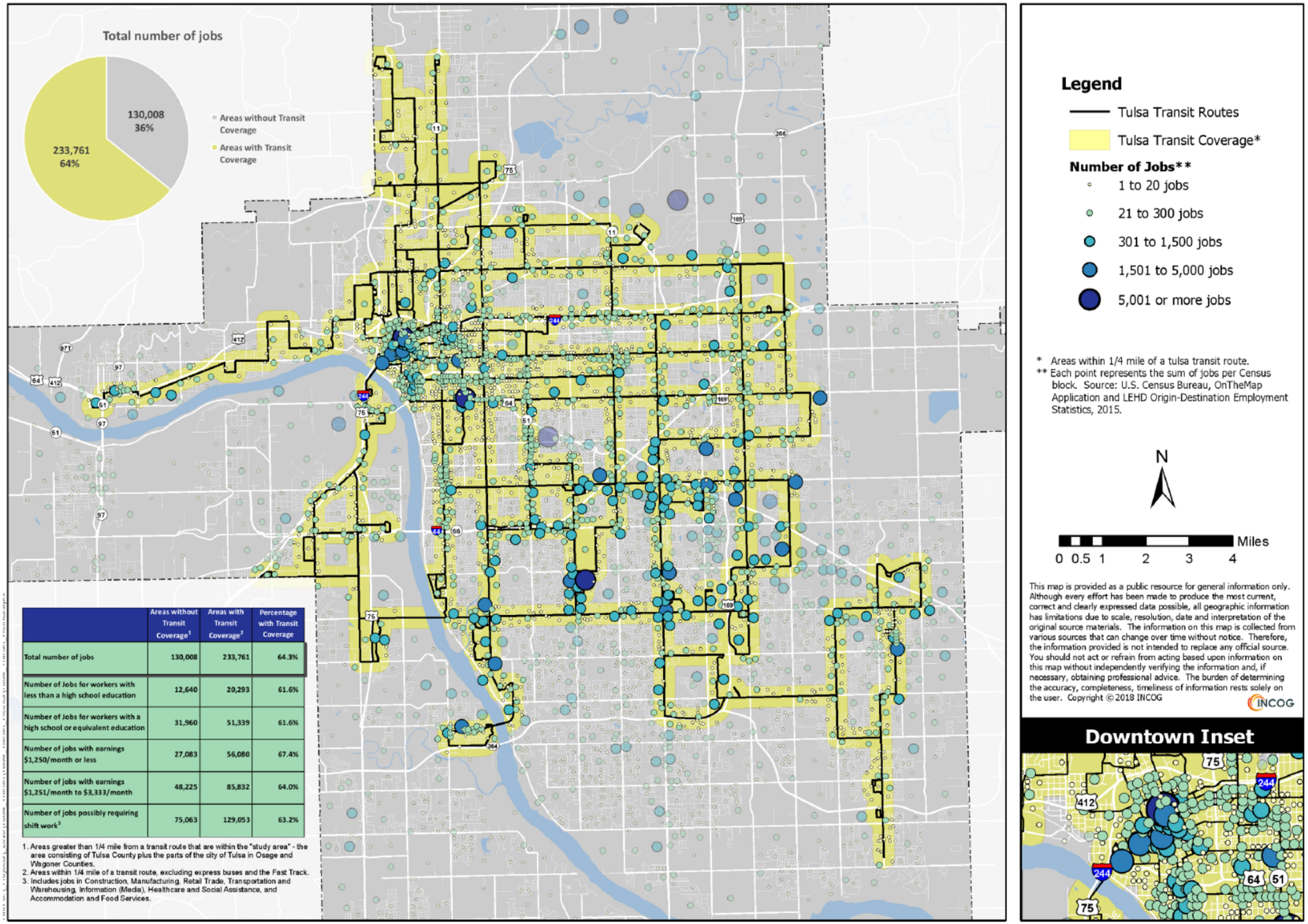
Table 3-2. LODES Metric Weighted Scores

LODES Metric	Weighted Score Range
Jobs earning <$1,250 per month	0 - 1
Jobs earning $1,251 to $3,333 per month	0 - 0.5
Jobs in Retail Trade	0 - 0.25
Jobs in Health Care-Social Assistance	0 - 0.5
Jobs in Arts-Entertainment-Recreation	0 - 0.25
Jobs in Accommodation-Food Services	0 - 0.25
Jobs for Workers with less than H.S. Diploma	0 - 1
Jobs for High School Equivalent	0 - 1
Total Weighted Score Range	**0 - 4.75**

A map of the aggregate scoring is presented in Figure 3-19. Generally, the map indicates areas of high potential as a transit destination. These areas include downtown Tulsa, the Pearl District, the Cherry

Street corridor, Harvard Avenue at 31st Street, areas around the Southroads Shopping Center and the Tulsa Promenade mall, St. Francis Hospital and the block it sits within (Yale Avenue, 61st and 71st Streets, and Sheridan Road), and Memorial Drive between 61st and 71st Streets which includes Woodland Hills Mall and the many establishments surrounding it. It should be noted that much of the transit ridership potential is in the central business district as well as in south and southeast Tulsa.

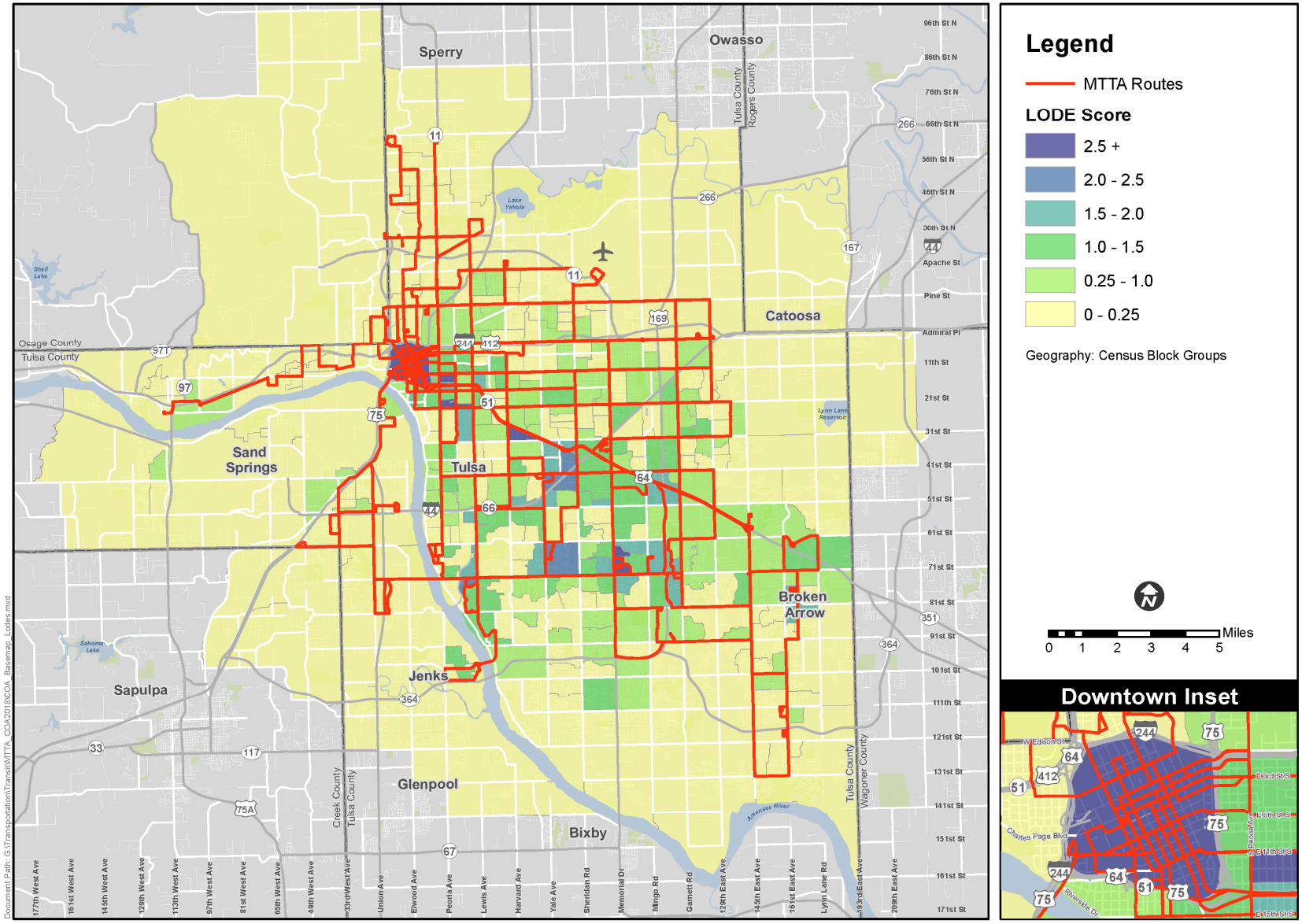
Figure 3-18. Total Employment



	Areas without Transit Coverage[1]	Areas with Transit Coverage[2]	Percentage with Transit Coverage
Total number of jobs	130,008	233,761	64.3%
Number of Jobs for workers with less than a high school education	12,640	20,293	61.6%
Number of Jobs for workers with a high school or equivalent education	31,960	51,339	61.6%
Number of jobs with earnings $1,250/month or less	27,083	56,080	67.4%
Number of jobs with earnings $1,251/month to $3,333/month	48,225	85,832	64.0%
Number of jobs possibly requiring shift work[3]	75,063	129,053	63.2%

1. Areas greater than 1/4 mile from a transit route that are within the "study area" - the area consisting of Tulsa County plus the parts of the city of Tulsa in Osage and Wagoner Counties.
2. Areas within 1/4 mile of a transit route, excluding express buses and the Fast Track.
3. Includes jobs in Construction, Manufacturing, Retail Trade, Transportation and Warehousing, Information (Media), Healthcare and Social Assistance, and Accommodation and Food Services.

Figure 3-19. Employment Zones with Highest Transit Ridership Potential



Transit Propensity

The demographics presented above each provide a piece of Tulsa's potential transit market. Combining these individual pieces into a single index gives us a reasonable assessment of the likely transit market. Therefore, a transit propensity index was created. This score includes both an origin score (how likely someone would use transit at their origin) and destination score (how likely someone would use transit to get to their destination). Both scores are comprised of weighted scores of their respective datasets.

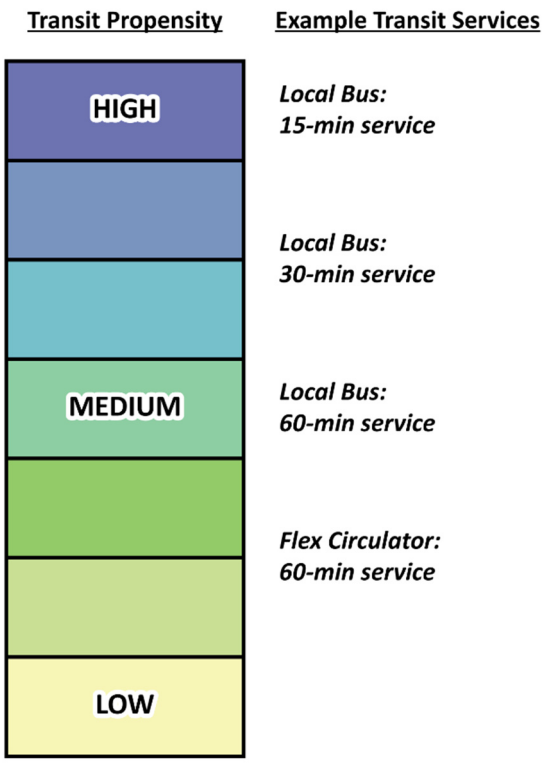
The origin score incorporated data included the following:

- Household density
- Minority populations
- Population under 25 years of age
- Population over 65 years of age
- Percentage of households with annual incomes under $30,000
- Unemployment status
- Density of Limited English Proficiency (LEP) households
- Zero-vehicle households
- One-vehicle households

For the destination score, incorporated data included the following:

- Jobs earning less than $1,250 per month
- Jobs earning between $1,250 and $3,333 per month
- Jobs within the retail trade
- Jobs in Healthcare / Social Assistance
- Jobs in Arts, Entertainment, Recreation
- Jobs in Accommodation, Food Service
- Jobs for workers with less than a High School diploma
- Jobs for High School equivalent

Figure 3-20. Transit Propensity and Example Transit Services



Source: TCRP 167 and CTG

The destination-end scores (LODES scores) were previously presented in Table 3-2. The origin scores are listed in Table 3-3 below.

Table 3-3. Origin-End Data and Weighted Score Ranges

Metric	Data Range	Max. Value	Score Range
Population Density			
Minority	0 - 9+	17.6	0 - 1
Under 25	0 - 5+	10.4	0 - 1
Over 65	0 - 2.5+	4.6	0 - 1
Household Density			
Household Density	0 - 5+	13.9	0 - 5
LEP Households	0 - 0.75+	1.32	0 - 1
Percentages			
% Unemployed	0 - 20%+	34.1%	0 - 1
Household % <$30k	0 - 60%+	93%	0 - 1
Zero-veh. Households	0 - 20%+	54%	0 - 2
One-veh. Households	0 - 60%+	78%	0 - 1
Maximum Score Range			**0 - 14**

The imbalance between origin and destination data is because the Census Bureau reports much more information on where people live than where they work. Nevertheless, the index includes enough information on both the origin and destination part of the trip to make desired conclusions.

The transit propensity scoring from high scores to low scores is shown in Figure 3-20, alongside modes of transit most likely to be served with each level for the Tulsa service area. A transit network with 60-minute frequency is viable when the transit propensity score is medium or better. Increased frequency generally becomes more viable with a medium-high score (30-minute frequency) or high score (15-minute frequency).

The daytime transit network was overlaid on results from the transit propensity analysis in Figure 3-21 and the nightline services were overlaid in Figure 3-22. The maps show a ring of high scoring adjacent to downtown Tulsa, with other high scoring zones located on the south, southeast, and east sides of the city. Interestingly, only a single zone on the north side of Tulsa scores a high in the transit propensity index, but there are many continuous zones that score the second highest level. Thus, many continuous zones of medium high score provides more transit riders than a single zone of high scoring.

Altogether, the transit propensity index shows a core centered on downtown Tulsa with enough blue zones to potentially support a few 15-minute frequency corridors connecting areas north, east and south of downtown. The transit propensity score in most other areas indicate a 30- to 60-minute frequency network is more appropriate.

Figure 3-21. Daytime Transit Network Overlaid on Results from Transit Propensity Analysis

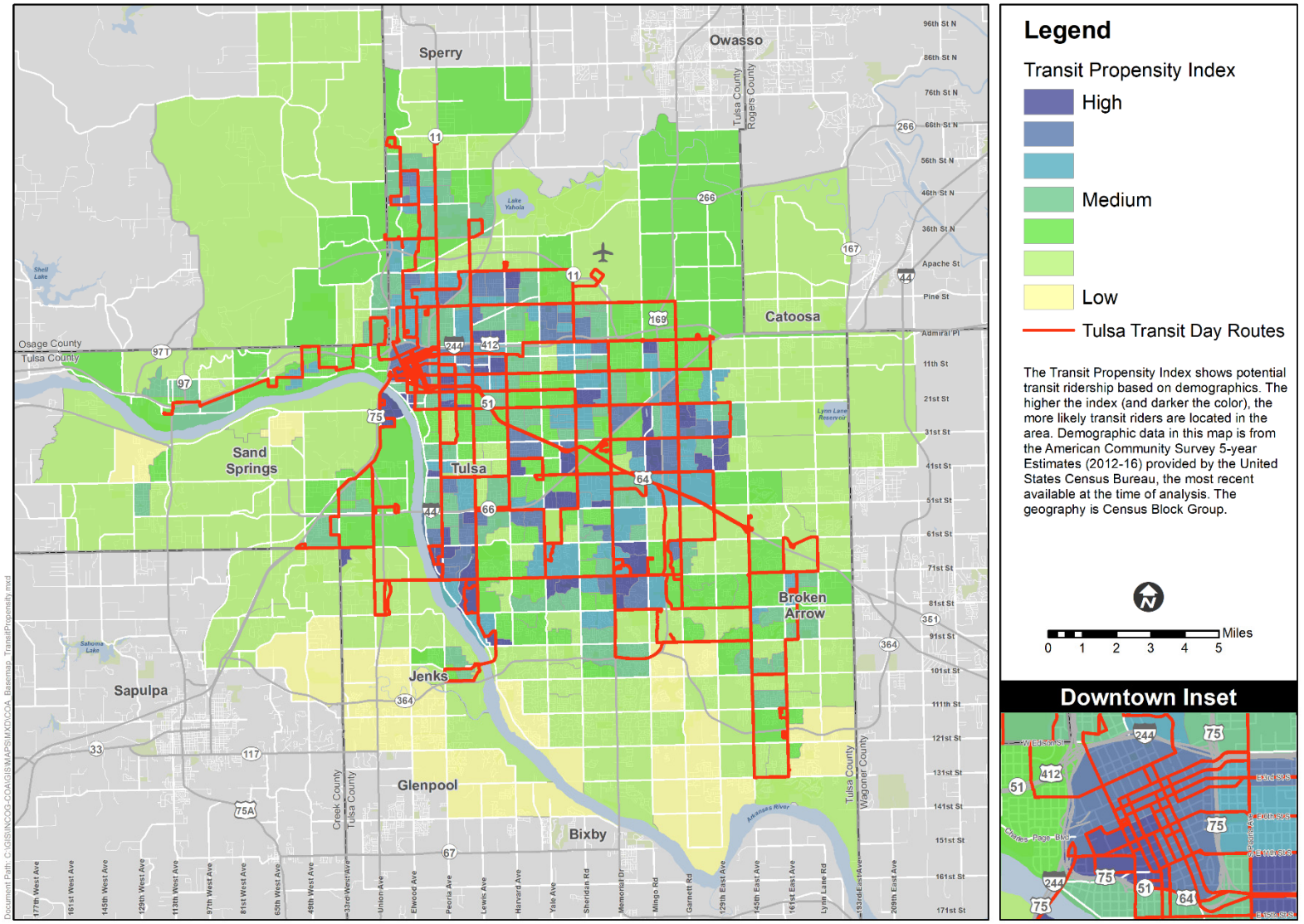
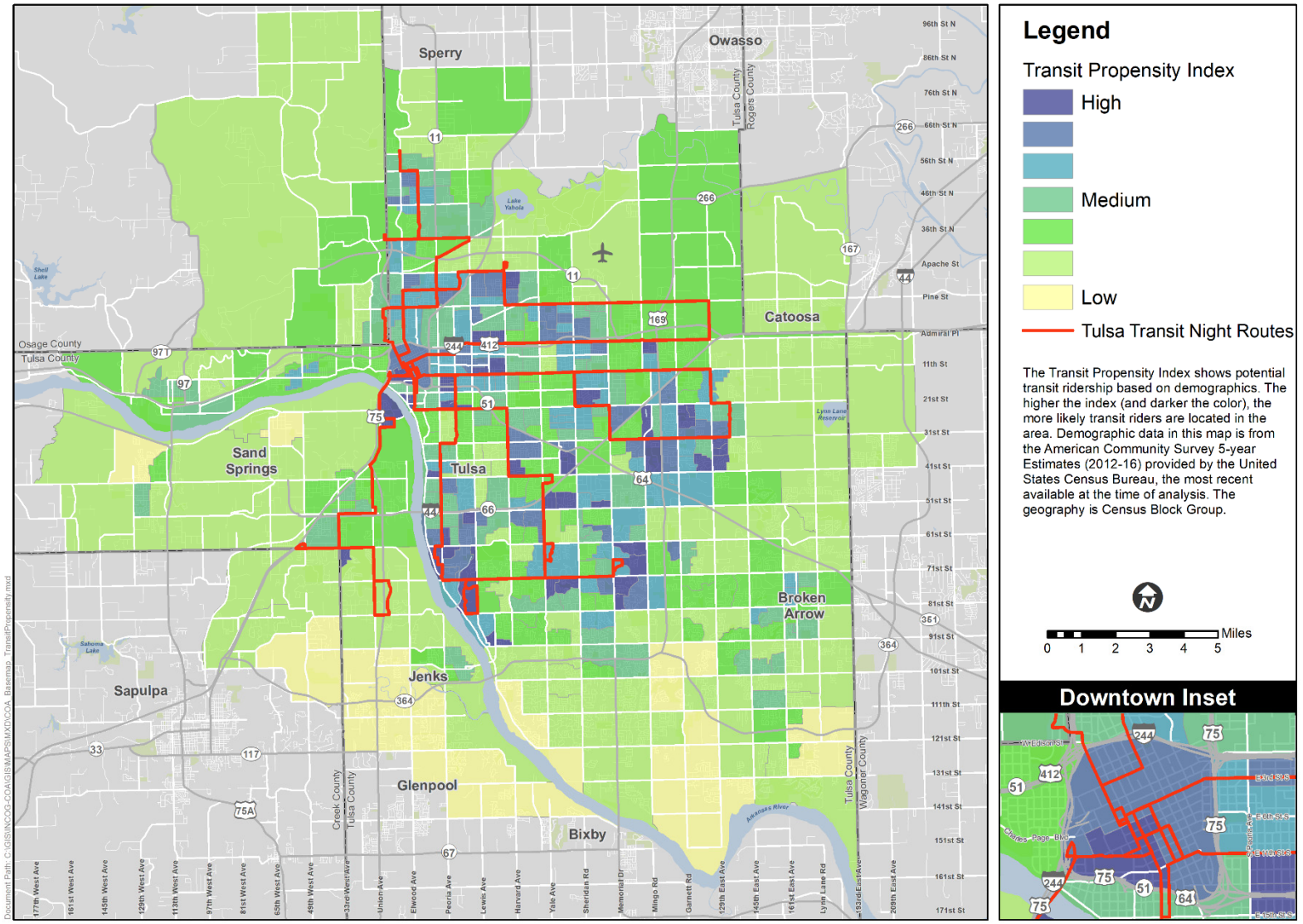


Figure 3-22. Night Transit Network Overlaid on Results from Transit Propensity Analysis



3.3 Peer Analysis

Analysis in this section focuses on the performance of the Tulsa Transit network and how the agency compares to other service providers. A peer analysis was conducted to provide context for Tulsa Transit's recent service delivery as well as how the agency compares to others of similar size. A trend analysis was also conducted using National Transit Database (NTD) data for the years 2011 through 2015, which was the most recent data included with the software that was used to select peers.

A peer analysis provides the means to compare various system wide metrics for Tulsa Transit against other agencies of similar size and operation. Transit agencies provide annual reporting of operational and financial data to the Federal Transit Administration (FTA) which in turn records this data within the National Transit Database (NTD). FTA reviews and confirms the accuracy of the information received and publishes a final report after a reporting transit system successfully responds to all comments and inquiries. The NTD has strict reporting requirements and, as such, provides a uniform, consistent, and reliable database.

Peer Selection Process

The peers for comparison with Tulsa Transit were selected from a list generated by the Florida Transit Information System (http://www.ftis.org). Their Integrated National Transit Database for urban transit systems (Urban iNTD) allows for selection of peer agencies based on a target agency. With Tulsa Transit identified as the target agency, a list of peers was generated based on service area population, population density, service area size, revenue hours and peak vehicles in operation.

Based on this initial list, CTG and Tulsa Transit selected five agencies that are of similar size and are also located in the same region of the country. Peers selected are mapped in Figure 3-23, and include:

- Colorado Springs, Colorado (Mountain Metro Transit)
- Little Rock, Arkansas (Rock Region Metro)
- Oklahoma City, Oklahoma (Embark)
- Omaha, Nebraska (Metro)
- Wichita, Kansas (Wichita Transit)

Figure 3-23. Location of Peer Agencies

Table 3-4 and Table 3-5 summarize the service area and service, service effectiveness and service efficiency metrics, respectively. As the tables show, the peer list contains cities that are close to Tulsa's size as well as two cities that are larger (Oklahoma City) and smaller (Little Rock) to give a sense of scale. Tulsa's service area population of just over 490,000 ranks it about in the middle of its peers, just over the peer average of 457,359. Tulsa is also about in the middle of this pack in terms of average service area population density, with approximately 2,501 people per square mile (3.9 people per acre).

In terms of service provided, Tulsa is again close to the peer average. In 2015, Tulsa Transit operated 51 vehicles for fixed route peak service compared to the peer average of 58. Tulsa's nearly 177,000 revenue hours compare closely with the average of just over 175,000; Omaha operated the most hours (285,537) and Wichita and Colorado Springs ran less. Annual revenue miles show a similar trend. Over 2.9 million trips were made in 2015 on Tulsa Transit buses. This compares with 2.87 million as the peer average. Colorado Springs (just over 3 million) and Oklahoma City (3.09 million) handled slightly more trips and Omaha carried much more (3.78 million).

Among service effectiveness measures, two key ratios include revenue hours per capita (how much service is provided to citizens) and trips per service hour or mile (how much the service is being utilized). Tulsa Transit operates 0.36 revenue hours per capita, compared to 1.06 in Little Rock and 0.51 in Omaha, both strong performing peers. In terms of passenger trips per revenue hour, Tulsa Transit is at 16.6 trips per hour, which is where most of the peers sit. Outliers include Colorado Springs with the highest at 23.0 trips per revenue hour and Omaha the lowest at 13.2 trips per revenue hour.

Service efficiency ratios measure the level of service provided by the operating budget, or the cost of providing the service for each revenue unit. In 2015, Tulsa Transit's operating budget was just under $13.5 million compared with a peer average of $15.8 million. While the agency is spending less than its peers on service, cost efficiencies are better than average. Tulsa's operating expense per capita was $27.53 compared with the peer average of $41.13, and its operating expense per revenue hour was $76.38 compared to the peer average of $90.76. Hence, Tulsa is more efficient with the dollars being spent than peer agencies.

Table 3-6 details the six-year trend (expressed as percent change) in key metrics across the peer agencies. Overall, Tulsa Transit operates an efficient system compared to similar peers and has maintained these efficiencies even as its operations have grown. For instance, while operating budget and revenue hours have both grown 8 percent, passenger trips have increased 18 percent. Thus, productivity has increased over the six years. Only Colorado Springs has shown a similar increase in productivity, with all other peers seeing a decrease in productivity. Because these numbers are from 2015 and national trends show ridership losses in almost every system, it is unclear whether service productivity remains above the peer average.

Additional charts with peer information are in Appendix 3A. Additional graphs of Tulsa Transit's six-year performance trends are in Appendix 3B.

Table 3-4. Urbanized Area and Service Area Statistics Summary

Numbers	Omaha, NE Metro	Oklahoma City, OK Embark	Wichita, KS Wichita Transit	Little Rock, AR METRO	Colorado Springs, CO Mountain Metro	Tulsa, OK Tulsa Transit
Service Area						
Population	561,920	650,221	382,386	164,972	527,294	490,195
Size (square miles)	178	244	159	97	257	196
Population Density	3,157	2,665	2,405	1,701	2,052	2,501

Table 3-5. Service and Service Metrics Summary

Numbers	Omaha, NE Metro	Oklahoma City, OK Embark	Wichita, KS Wichita Transit	Little Rock, AR METRO	Colorado Springs, CO Mountain Metro	Tulsa, OK Tulsa Transit
Service Operated						
Vehicles Operated in Maximum Service	98	48	38	49	35	51
Revenue Hours	285,537	174,955	111,056	174,303	130,696	176,672
Revenue Miles	3,979,913	2,684,935	1,719,897	2,434,063	1,787,192	2,651,980
Passenger Trips	3,780,468	3,085,663	1,886,498	2,573,938	3,009,500	2,940,575
Service Effectiveness						
Revenue Hours per Capita	0.51	0.27	0.29	1.06	0.25	0.36
Revenue Miles per Capita	7.08	4.13	4.50	14.75	3.39	5.41
Revenue Hours per Square Mile	1,604	717	698	1,797	509	901
Revenue Miles per Square Mile	22,359	11,004	10,817	25,093	6,954	13,531
Revenue Hours per Peak Vehicle	2,914	3,645	2,923	3,557	3,734	3,464
Revenue Miles per Peak Vehicle	40,611	55,936	45,260	49,675	51,063	52,000
Passenger Trips per Capita	6.7	4.8	4.9	15.6	5.7	6.0
Passenger Trips per Revenue Mile	1.0	1.2	1.1	1.1	1.7	1.1
Passenger Trips per Revenue Hour	13.2	17.6	17.0	14.8	23.0	16.6
Service Efficiency						
Total Operating Expense	$24,311,195	$20,224,843	$9,400,841	$14,002,229	$11,508,698	$13,494,700
Operating Expense Per Capita	$43.26	$31.10	$24.58	$84.88	$21.83	$27.53
Operating Expense Per Peak Vehicle	$248,073	$421,351	$247,391	$285,760	$328,820	$264,602
Operating Expense Per Passenger Mile	$1.69	$1.21	$1.02	$0.97	$0.89	$0.84
Operating Expense Per Revenue Hour	$85.14	$115.60	$84.65	$80.33	$88.06	$76.38
Operating Expense Per Revenue Mile	$6.11	$7.53	$5.47	$5.75	$6.44	$5.09
Operating Expense Per Passenger Trip	$6.43	$6.55	$4.98	$5.44	$3.82	$4.59
Farebox Recovery (%)	18%	13%	19%	14%	23%	20%

Table 3-6. Percent Change for Selected Metrics, Fiscal Years 2010 through 2015

Operator	Change, FY2010-15							
	Revenue Hours	Revenue Miles	Passenger Trips	Trips per Capita	Trips per rev mi	Trips per rev hr	Operating Cost	Cost per Rev Hr
Tulsa, OK (MTTA)	8%	6%	18%	-4%	12%	10%	8%	0%
Omaha, NE (Metro)	-5%	-2%	-10%	-7%	-8%	-5%	6%	13%
Oklahoma City, OK (Embark)	14%	11%	14%	14%	3%	-1%	24%	8%
Little Rock, AR (METRO)	10%	6%	9%	6%	2%	-1%	23%	12%
Colorado Springs, CO (Mountain Metro Transit)	10%	-15%	19%	-1%	39%	7%	5%	-5%
Wichita, KS (Wichita Transit)	2%	14%	-15%	-14%	-25%	-16%	-3%	-4%

3.4 System Wide Performance Analysis

The system wide performance section presents ridership information recently obtained through a comprehensive data collection effort using automatic passenger counters (APCs) and analyzes this information to show where and when ridership activity is occurring. Ridership data was collected at the stop level on all Tulsa Transit routes for weekday, Saturday and Sunday service. Data outputs from the APCs were then formatted and analyzed for visual production. Ridership data (boardings and alightings) were parsed at the route, trip, time point segment and stop levels, including various combinations of these stratifications.

The last system wide on-board survey was conducted in 2010/2011. This allowed an origin- destination analysis as provided in the *Fast Forward Regional Transit System Plan*. In April 2017, a targeted on-board survey was conducted for Route 105 as part of the initial work for the *Peoria Bus Rapid Transit Route Integration Study* which allows an updated understanding of origins and destinations on the Peoria corridor. Results of this survey can be found in the *Peoria Avenue BRT Route Integration Study*.

The CTG team also conducted three days of in-field observations to gain a thorough understanding of the Tulsa Transit system and the surrounding metropolitan area. This allowed our team to refresh our understanding of the transit system and operating environment.

Data collected from APCs was used to assess the systemwide performance of the Tulsa Transit network. The APC data collection effort was conducted by a subcontractor, UTA, using temporarily-installed counters on Tulsa Transit buses from October through December of 2017. Buses were then rotated through routes, trips, and time periods, resulting in a statistically valid ridership average for weekday, Saturday, Sunday and night service. These data included route, ridership and geographic information, among others. Data was not collected for Route 508 because a vehicle with a passenger counter was not available. Instead its ridership was assessed through recent farebox figures provided by Tulsa Transit.

System wide Stop Activity

Daily ridership activity (boardings plus alightings) was aggregated by stop for the entire Tulsa Transit system for multiple periods, including weekday daytime, weekday night, Saturday daytime, and Sunday daytime time periods. Activity averages from the APC data collection effort were used for the following figures, and combined activity at Denver Avenue Station was excluded so that its activity would not dwarf (and thus cover up, as mapped) all other stops.

Weekday Daytime Stop Activity

Figure 3-24 below shows the average ridership activity by stop for the weekday daytime network. Generally, most of the system wide stops serve 15 or fewer passengers per weekday. However, several locations accommodate more than 75 daily riders. Denver Avenue Station is obviously the best performing location in the system, due mainly to transfers between routes. Beyond DAS, many high performing stops are located on Routes 101 and 105, two of the top routes for ridership in the system. Another top performing stop is at the Midtown Memorial Station where riders can transfer to several other routes.

Several other noteworthy locations carry between 40 and 75 passengers per day and these are scattered throughout the system at major transfer locations (Routes 101 and 105 along 36th Street, Routes 101

and 112, Routes 117 and 418, and Routes 100 and 203), major shopping and retail employment destinations (Walmart locations and Woodland Hills Mall) and major employment or service centers (St. Francis Hospital, Eastgate Metroplex, Turley Correction Center, etc.).

Weekday Night Stop Activity

Weekday Nightline service was reviewed, shown in Figure 3-25 shows stop-level ridership activity. Top performers were on the south end of Tulsa, at the 81st Street Walmart and at 61st Street and Peoria Avenue. A few other stops were also noteworthy for the nightline service: 36th Street at the Osage Casino on Route 840, Tulsa Community College on Route 850, and the Southroads Shopping Center and Tulsa Promenade Mall stop at 41st Street and Yale Avenue and at the stop just south of there on 51st Street and Yale Avenue on Route 860.

Saturday Daytime Stop Activity

The Saturday daytime stop activity map is shown in Figure 3-26. The map shows similar patterns as weekday daytime, with major stop activity on routes 101 and 105 in the north and route 105 in the south. East and south stops with high activity include Midtown Memorial Station, Woodland Hills Mall, and the end of route 100 at Admiral/129th Street.

Sunday Daytime Stop Activity

The Sunday daytime stop activity is shown in Figure 3-27. Overall the activity is like the weekday night map, but with more overall activity because the service is in the daytime and has longer service span. Like other time periods, top performers include the 81st Street Walmart, 61st Street and Peoria Avenue, 36th Street and Hartford Avenue, Osage Casino, the Southroads Shopping Center, the Admiral Place Walmart, 21st Street and Memorial Drive, St Francis Hospital, and Eastgate.

Figure 3-24. Weekday Average Ridership Activity, Daytime Service

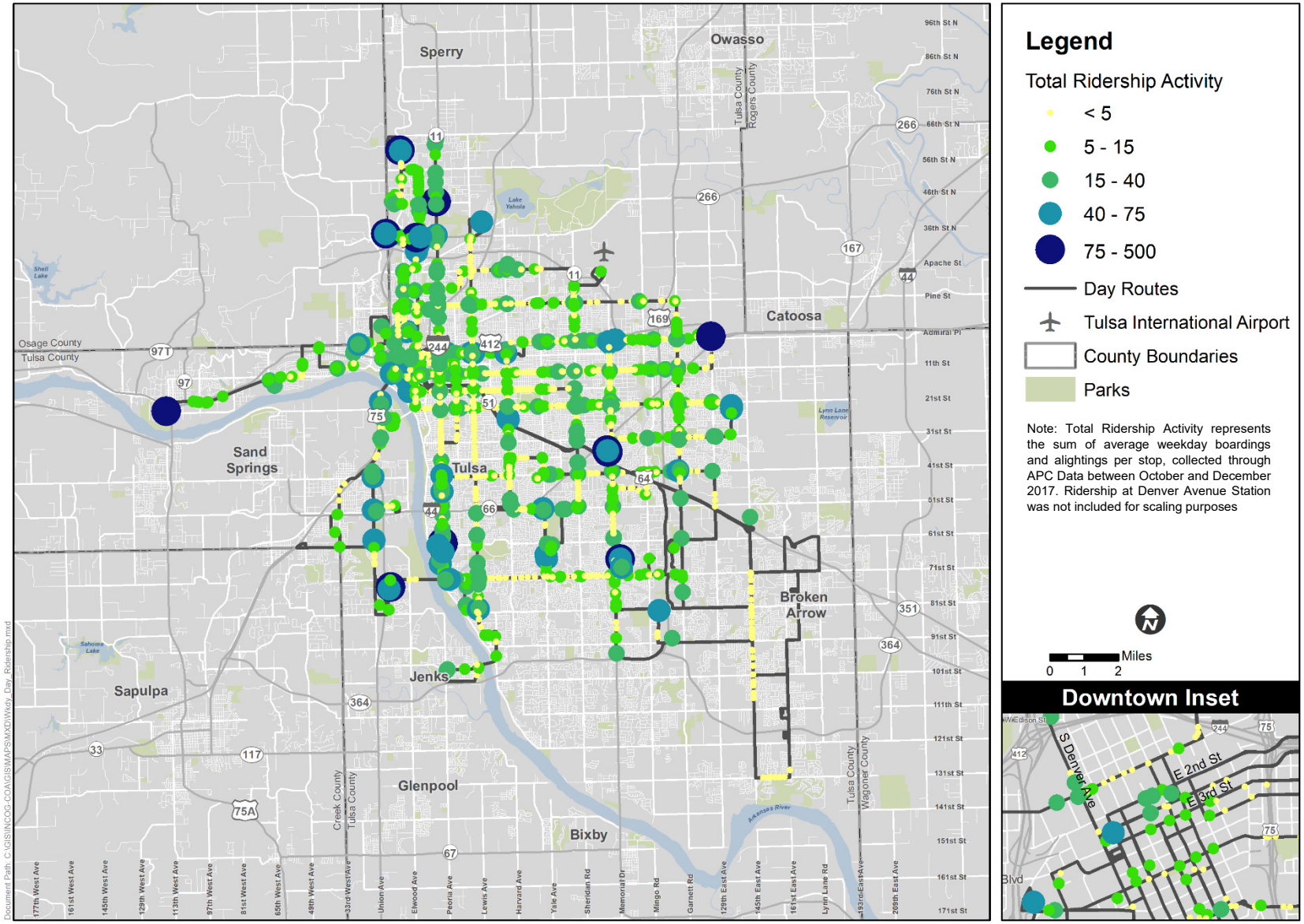


Figure 3-25. Weekday Average Ridership Activity, Nightline Service

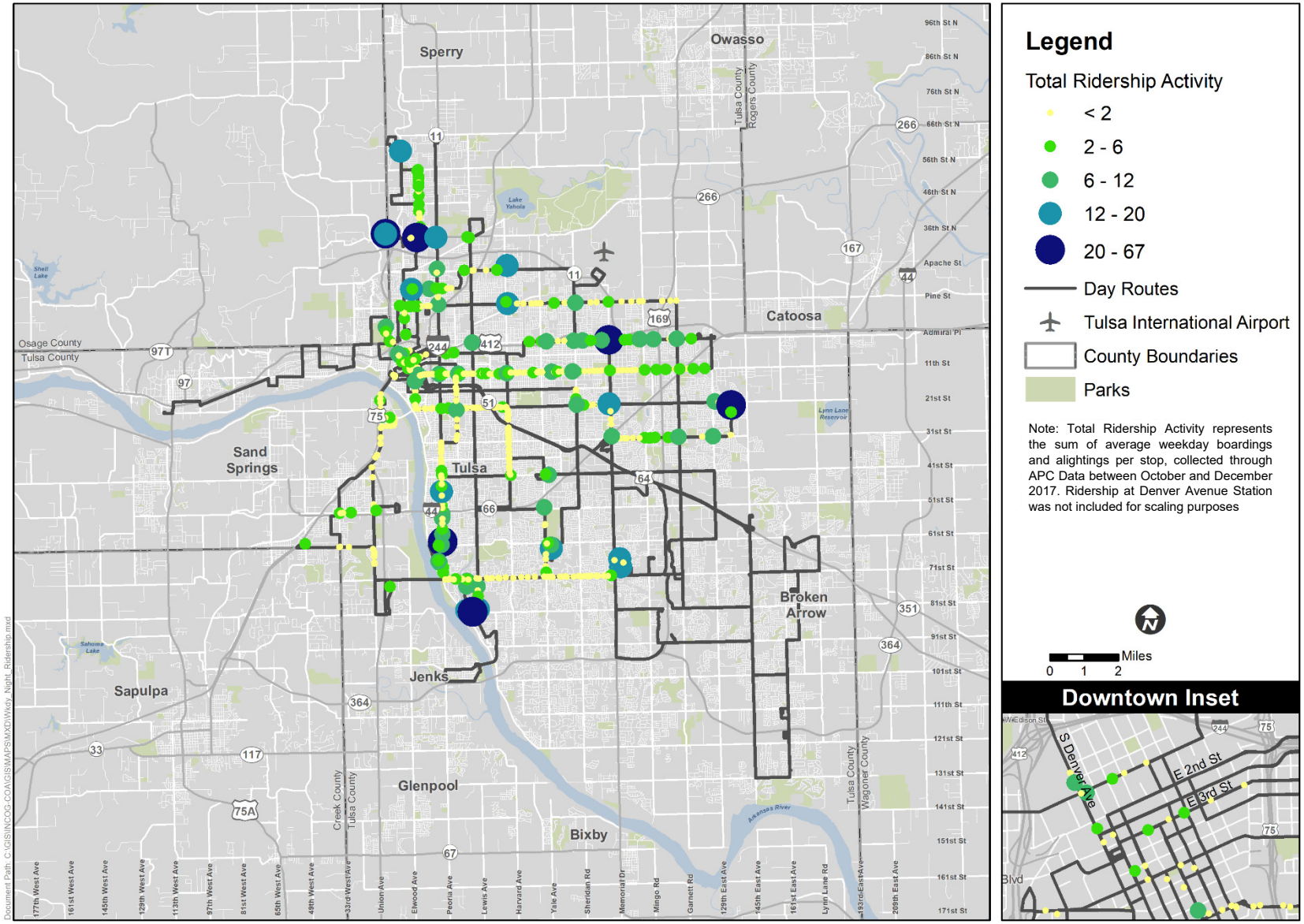


Figure 3-26. Saturday Average Ridership Activity, Daytime Service

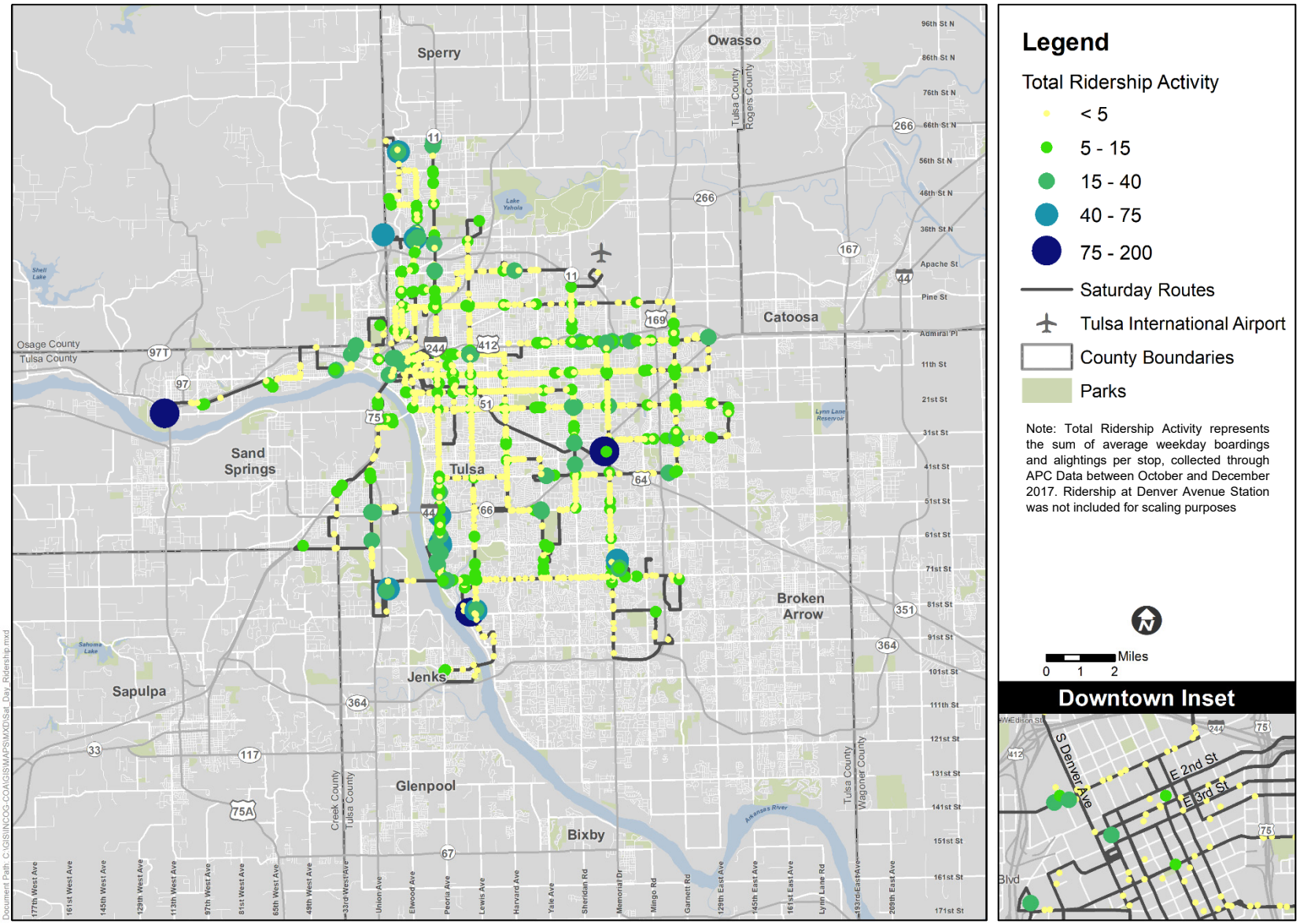
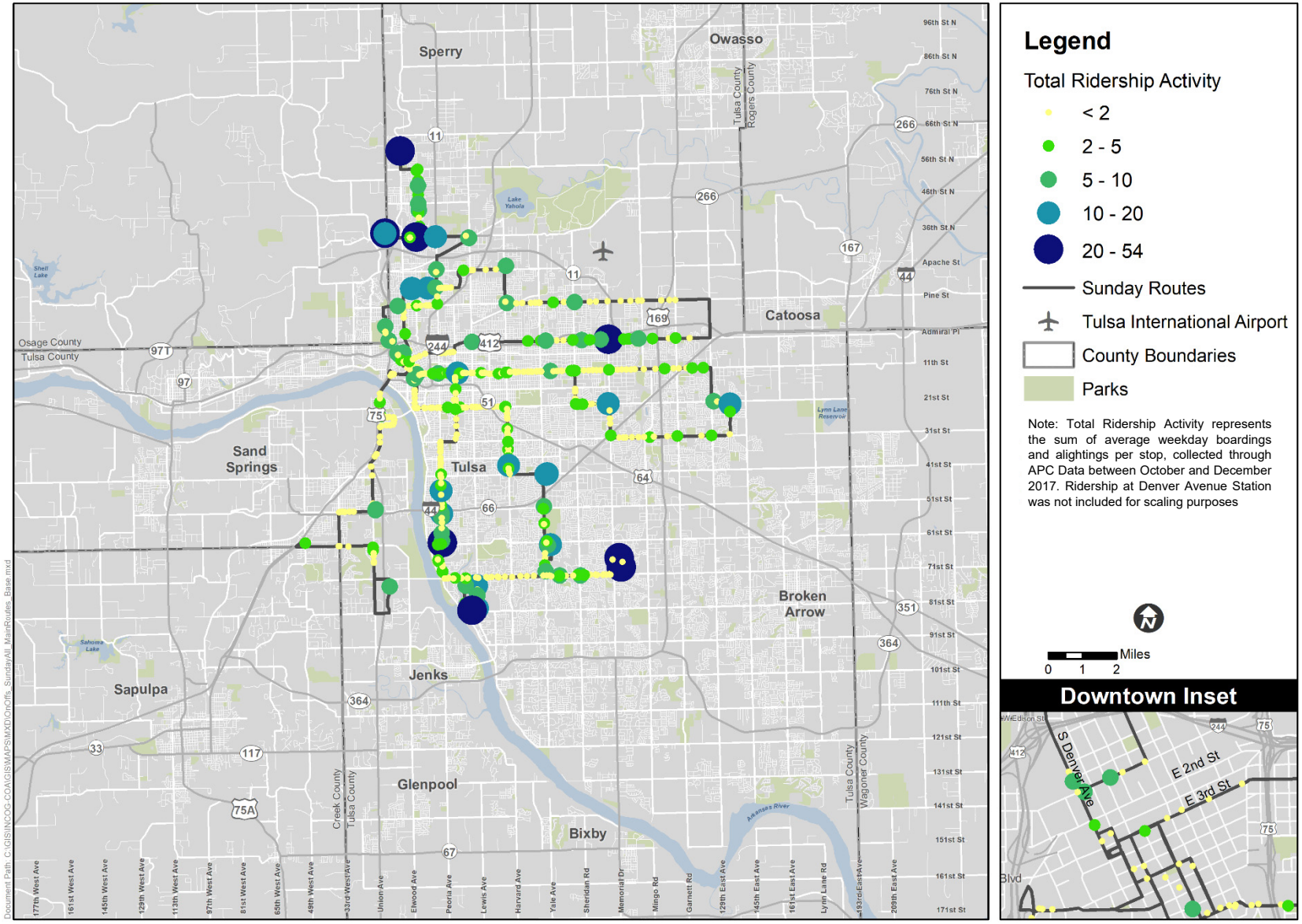


Figure 3-27. Sunday Average Ridership Activity



Segment Analysis

A segment-level analysis was conducted utilizing the collected APC data. The data was analyzed by route, day, and direction at the segment level; segments were defined by Tulsa Transit's scheduled timepoints. This level of detail is helpful to understand the parts of each route that do best. For example, route 114 has two productive segments (Sand Springs and Northwest Tulsa), with a lower performing segment in between on Charles Page Boulevard. This uneven productivity can help make decisions on whether to adjust the route alignment, and what parts of the route are best candidates to make a change.

Weekday Daytime Productivity Analysis

The maximum passenger load and average passenger activity by revenue hour and revenue mile were examined for weekday routes. Figure 3-28 shows the maximum passenger load by route segment, Figure 3-29 shows the average passengers per revenue hour, and Figure 3-30 shows average passengers per revenue mile. The segments with strongest performance include parts of Route 101, the southern half of Route 105, the easternmost segment of Route 114, Route 251, and segments close to Midtown Memorial station.

Beyond the above routes and route segments, it is also noteworthy that many segments within Midtown Tulsa also have productive segments. This is a somewhat denser part of the city which results in higher productivities. Conversely, the outer parts of south and southeast Tulsa show lower productivity despite having many transit riders. This is because lower densities result in routes traveling farther to pick up passengers compared to the Midtown area.

Weekday Daytime On Time Performance

On time performance was examined for weekday daytime routes and results are presented in Figure 3-31. The dataset calculated the average actual travel time (collected from APC data) and compared it to the scheduled time. Segments were color coded from early (yellow) to late (dark blue). The map shows early arrivals for segments on routes 101, 114, 210, 251, 418 and 471. For the most part, these may be built-in allowances in the schedule to allow for traffic conditions. Nevertheless, these are routes where timetables could be updated, or drivers will need to better adhere to scheduled timepoints to ensure no early arrivals to improve the customer experience.

Regarding late-performing segments, portions of Routes 100, 101, 105, 117, 210, and 318 average between two and four minutes behind schedule. The only route segment consistently more than four minutes behind schedule is Route 101 along 46th Street. Route 251 is consistently early traveling between Midtown Memorial Station and Denver Avenue Station.

Figure 3-28. Maximum Passenger Load by Segment

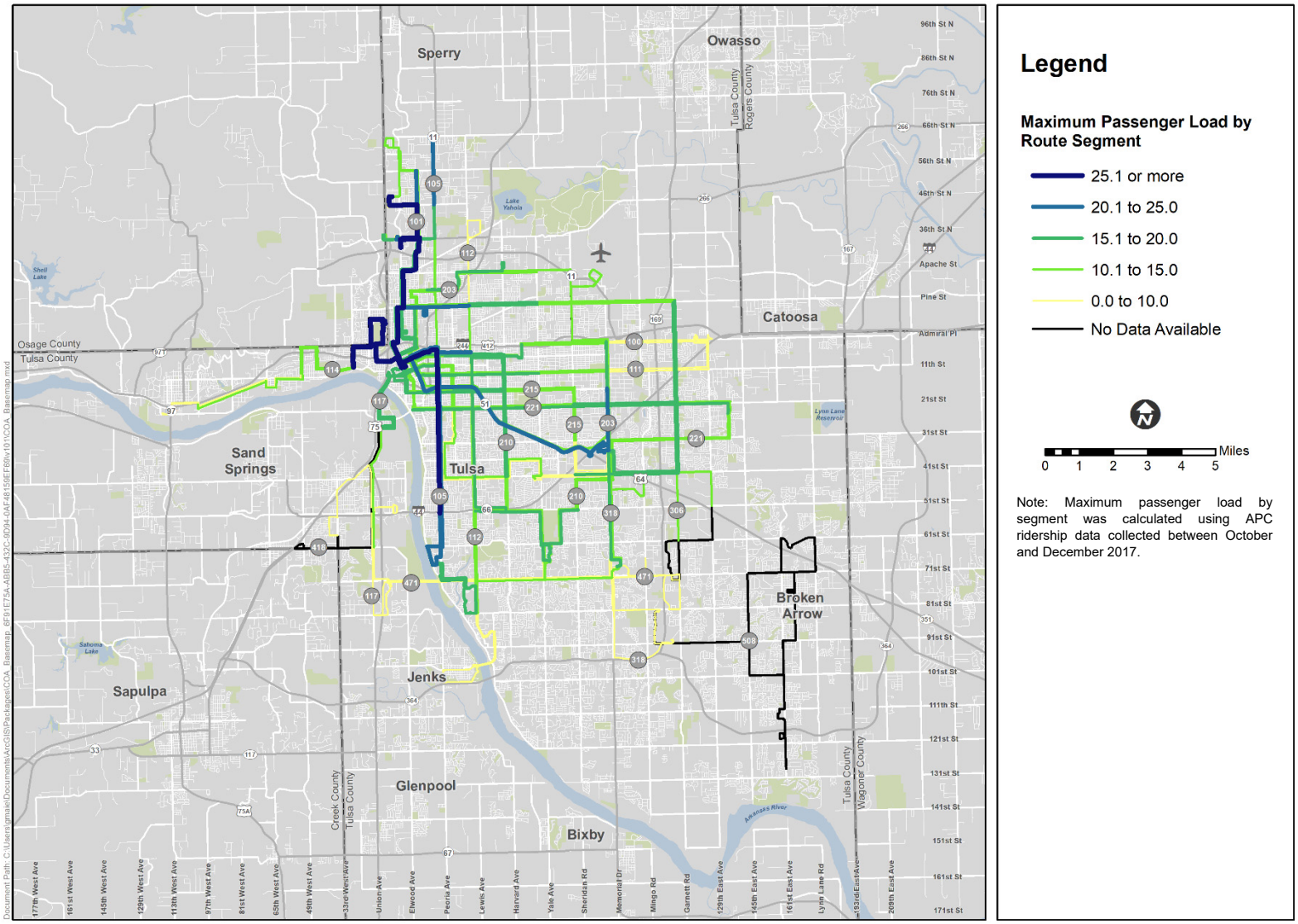


Figure 3-29. Average Passengers per Revenue Hour by Segment

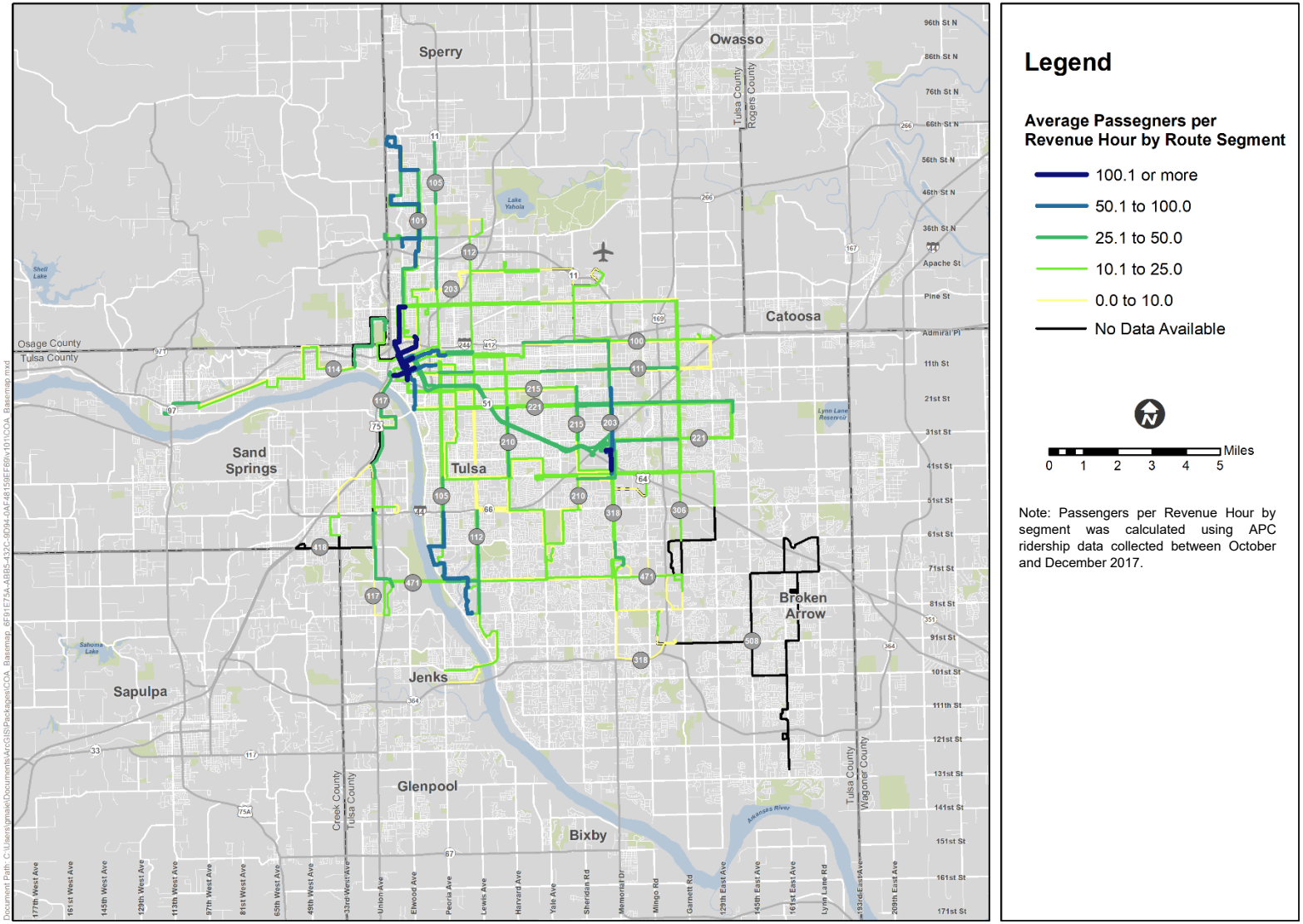


Figure 3-30. Average Passengers per Revenue Mile by Segment

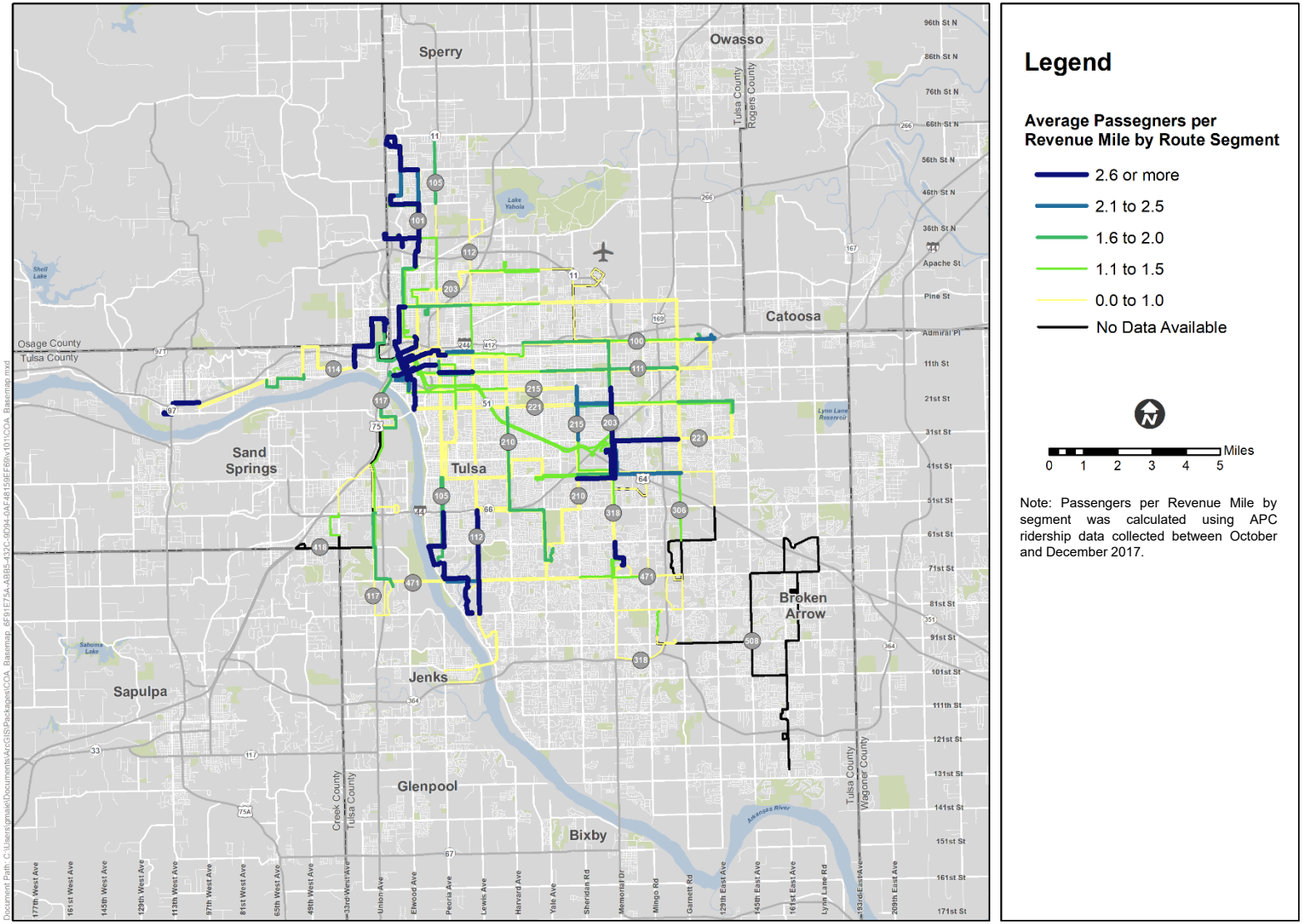
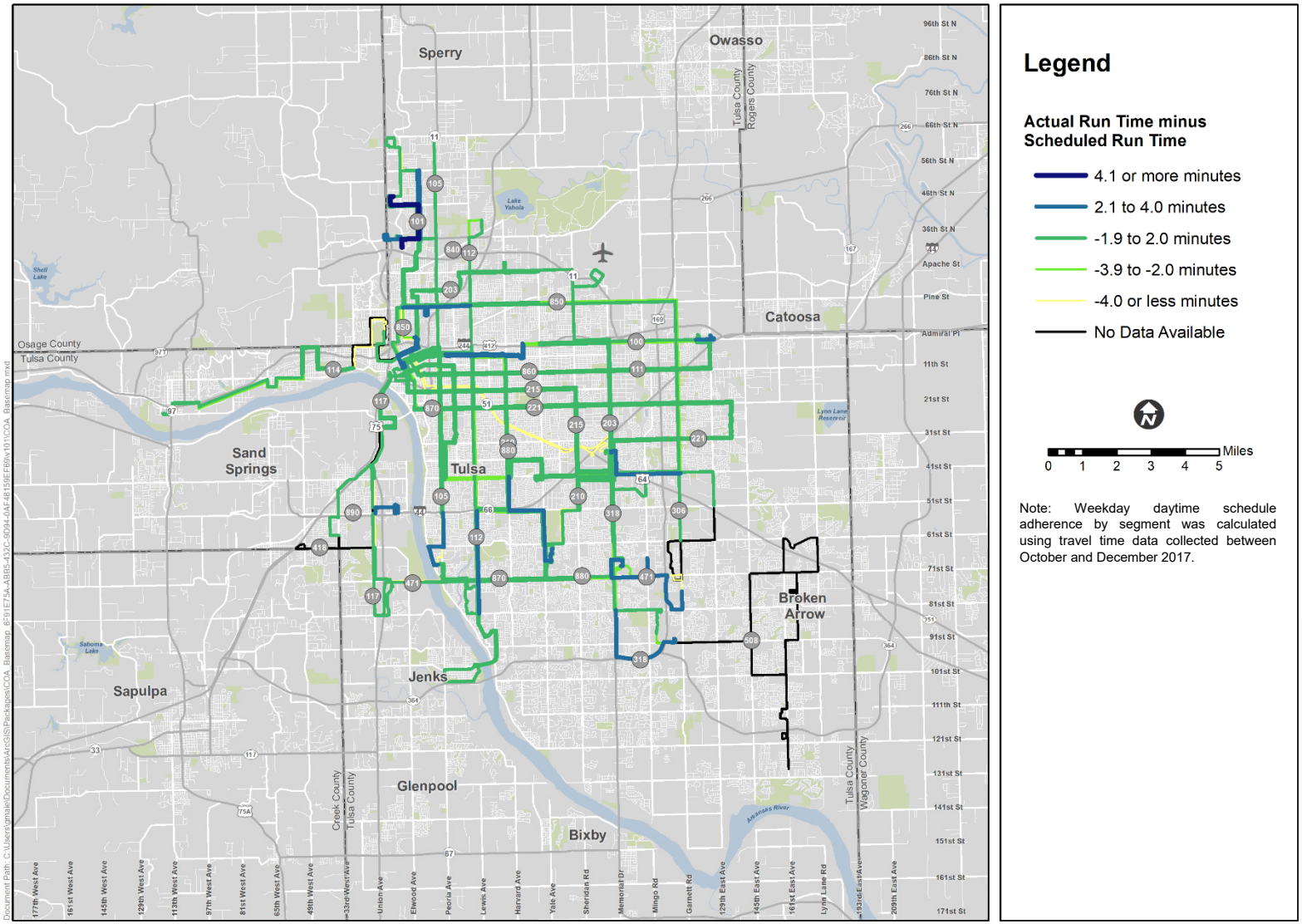


Figure 3-31. Weekday Schedule Adherence by Segment



Weekday Night Productivity Analysis

Segment productivity analysis was also conducted for the six nighttime routes (800-series Nightlines) operated for coverage after 8:00 pm on weekday evenings. Like the weekday daytime routes, the analysis includes maximum passenger loads as well as passenger activity by revenue hour and revenue mile. Overall, system loads and passenger activity appears like daytime routes (albeit with smaller numbers) where there is overlap in route coverage, such as portions of Route 840/850 (daytime route 101) and Route 870 (daytime route 105).

Maximum passenger loads are shown in Figure 3-32, while Figure 3-33 shows passengers per revenue hour, and Figure 3-34 shows passengers per revenue mile. Each map tells a similar story – productivity is highest in the central core of Tulsa, which is logical considering the density and demographic advantages of this area. Outer parts of Route 870 (along Peoria Avenue), Route 860 (along 11th Street); and Route 880 (along 71st Street) have higher than average productivity at night. These findings are strongly correlated with daytime segment productivities presented from Figure 3-28 to Figure 3-30.

Weekday Night On Time Performance

Overall, weekday night routes are adhering to their scheduled run times. Nightline schedule adherence is shown in Figure 3-35. One segment of Route 890 (51st Street), one segment of Route 860 (31st Street between Mingo Road and 129th Avenue), and one segment of 870 (71st Street) are 4 or more minutes behind schedule. Otherwise, most other night segments are scheduled appropriately.

Figure 3-32. Maximum Passenger Load by Segment (Night Service)

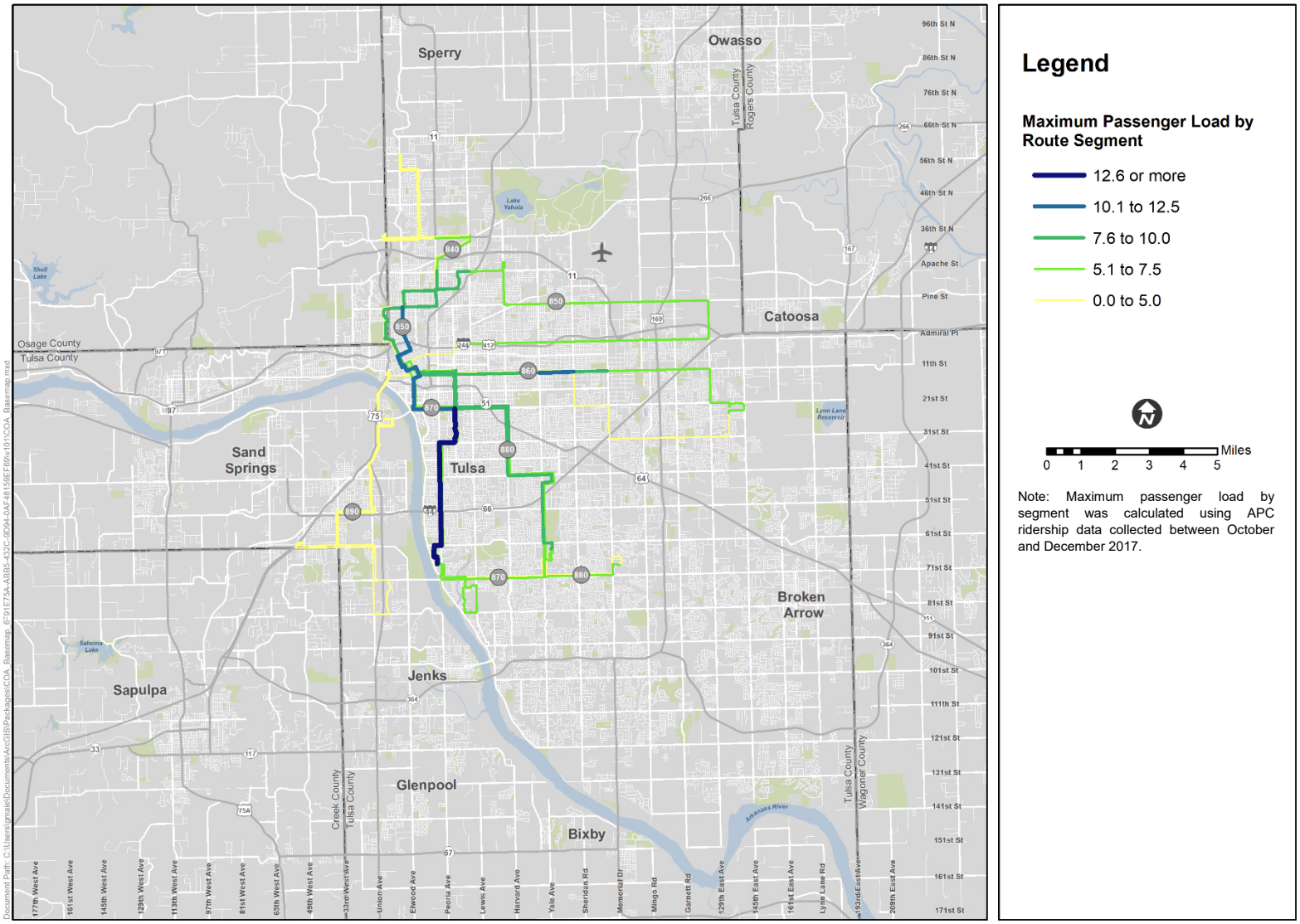


Figure 3-33. Average Passengers per Revenue Hour by Segment (Night Service)

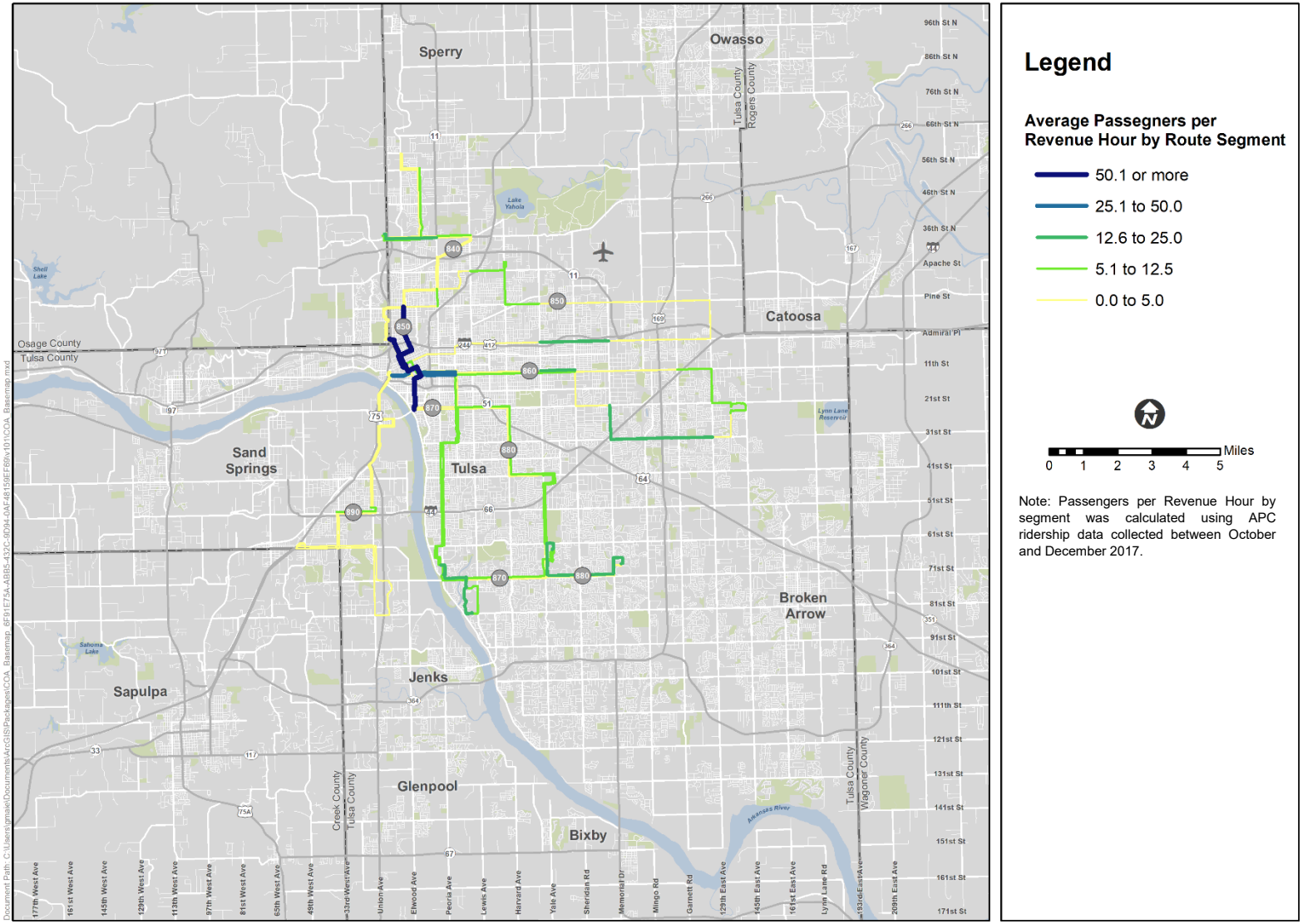


Figure 3-34. Average Passengers per Revenue Mile by Segment (Night Service)

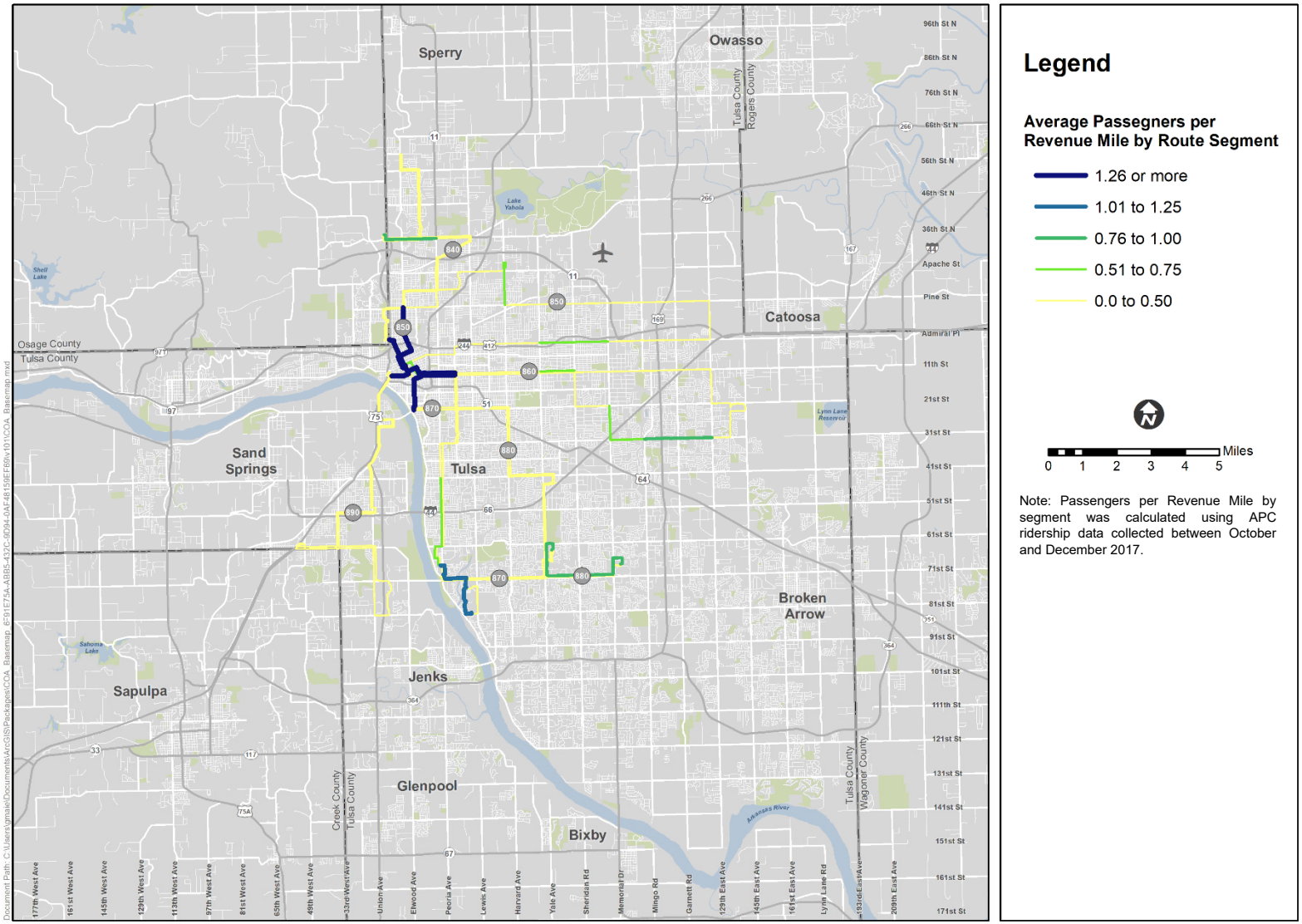
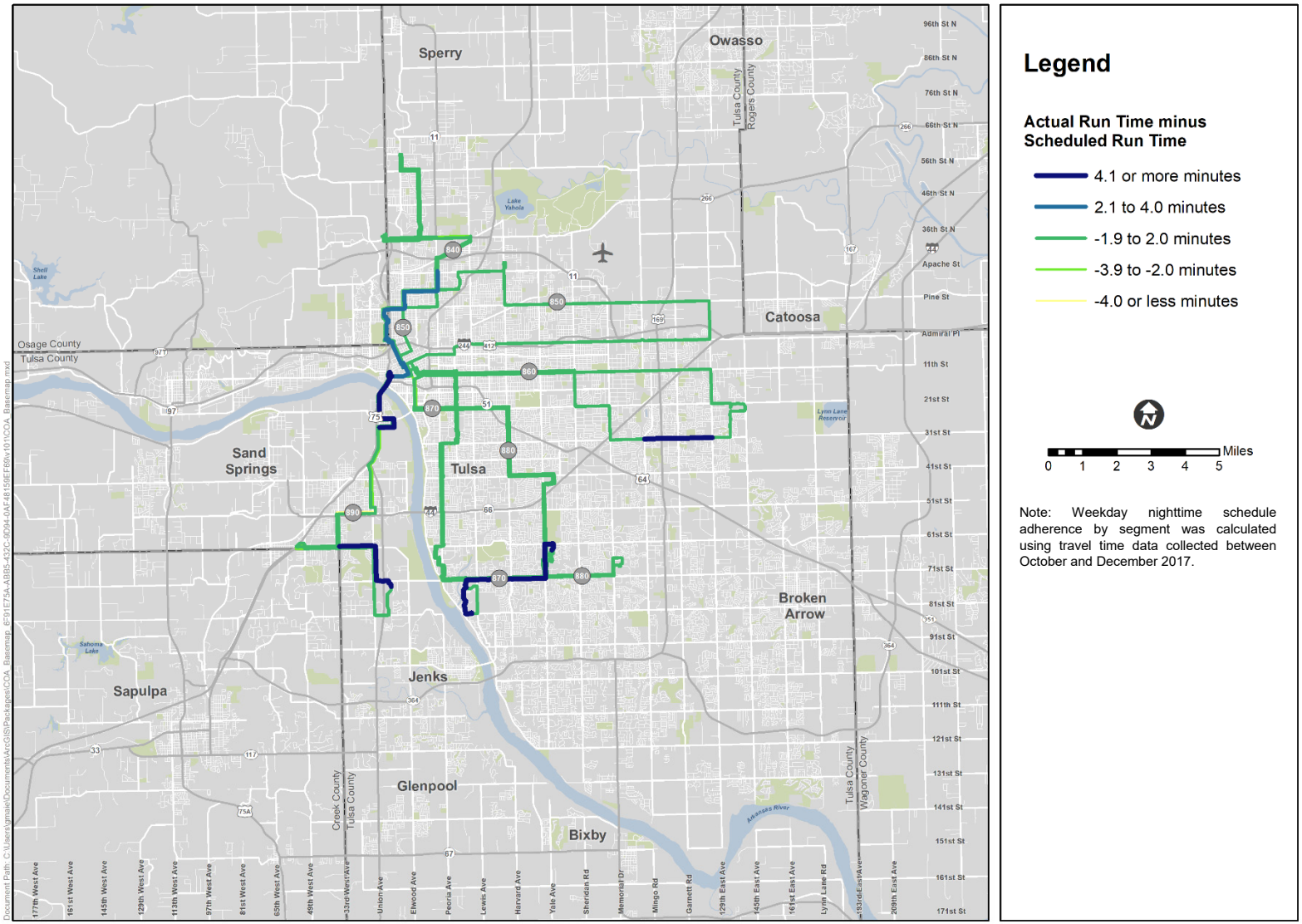


Figure 3-35. Schedule Adherence by Segment (Night Service)



Flag Stop Analysis

Tulsa Transit allows for flag stops, allowing passengers to board or alight the vehicle anywhere along the route alignment regardless of the presence of an official stop. Official agency policy stipulates these locations should be at least one city block away from a marked stop. In reality, flag stops are utilized by passengers in many places, some just feet from marked locations as was determined by the APC data collected in late 2017. While access is improved, flag stops are detrimental in other ways, primarily because they require time in the schedule of each route to accommodate unexpected stops and create greater travel time variability.

A high-level analysis on the impact of flag stops was completed based on data collected in late 2017, shown in Table 3-7. The analysis found that flag stops comprise 31 percent of the total stops and 15 percent of the daily ridership.

Table 3-7. Ridership Activity by Stop Type, 2017

STOP TYPE	TOTAL STOPS	BOARDINGS
Fixed Stop	1,627	5,843
Flag	718	1,748
Total	2,345	7,591
% Flag	31%	23%

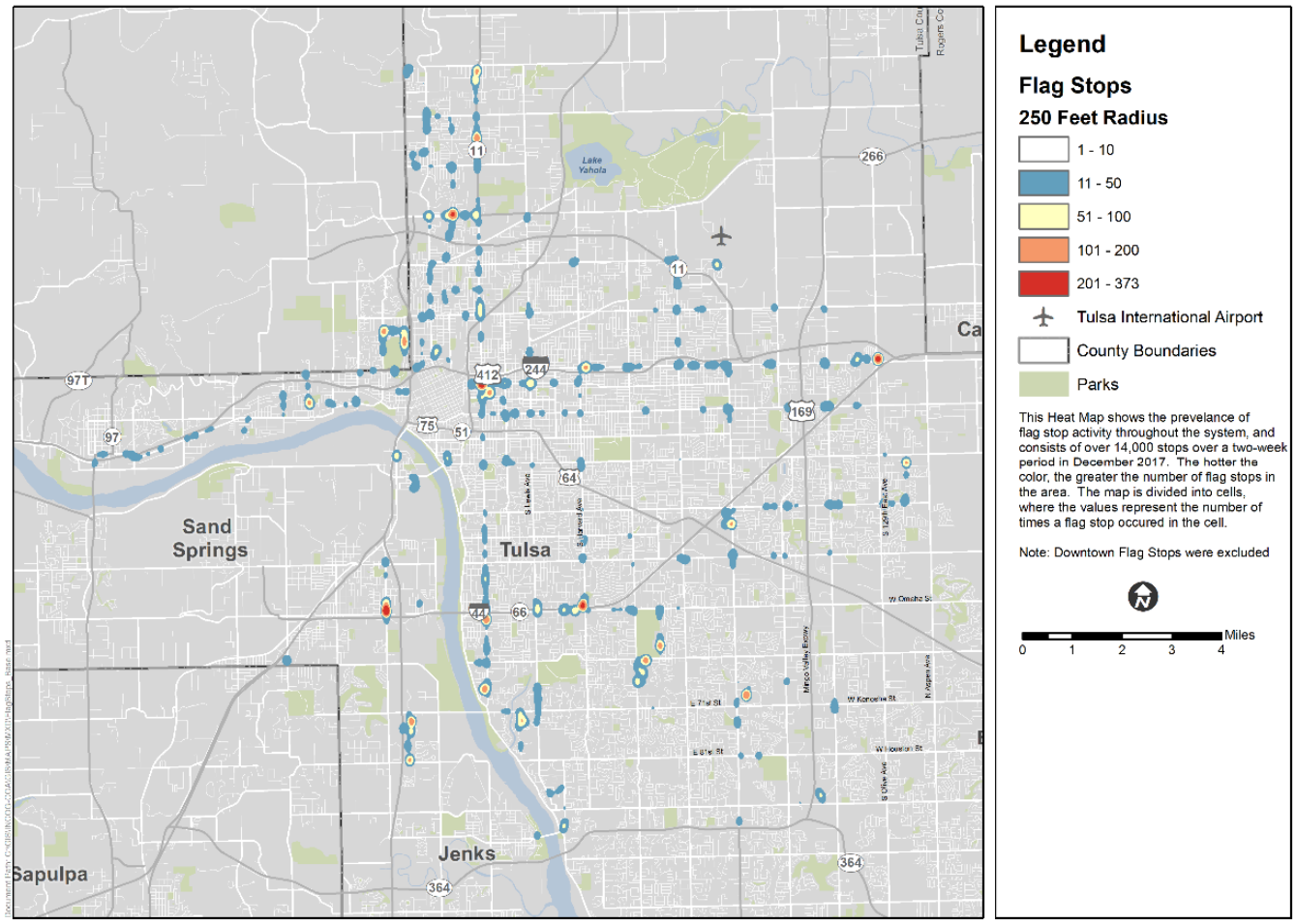
Note: boardings analysis removes activity at DAS and MMS

The 2017 APC data collection effort was able to provide greater detail regarding flag stop usage. Figure 3-36 shows that flag stop activity is prevalent across the system, particularly in locations indicated in red. These locations include:

- Along North 36th Street between Martin Luther King, Jr. Boulevard and Hartford Avenue (Routes 101/105)
- Route 105: end-of-lines, near McLain Village shopping center, at 6th Street, south of Skelly Drive, Inhofe Plaza area, and at 73rd Street
- Route 100: Admiral Place east of Harvard Avenue and at end-of-line
- Route 112: along Lewis Avenue around 71st Street
- Route 114: on the top end of Tulsa Country Club and across from Ziegler Park
- Route 117: Union Avenue at 51st Street
- Route 210: Harvard Avenue at 51st Street
- Route 471: within Tulsa Hills Shopping Center
- Other locations include Woodland Hills Mall, Eastgate Metroplex and just outside the Midtown Memorial Station along Memorial Drive

Most of the places with a concentration of flag stops are already served by one or more marked stops. Flags occur in these places due to sprawl (the location is so large that people choose the most convenient place to be picked up), mobility issues, or unwillingness to walk to the nearest stop.

Figure 3-36. Flag Stop Analysis Heat Map



3.5 Route Level Performance

The ridership data collected in late 2017 allows for a deeper review of ridership, operations and finance performance at the route level. Detailed route profiles have been developed for each of Tulsa Transit's routes and are presented as Appendix 3C of this document. These profiles include a summary table which lists the following key information of each route:

- Operational characteristics by day of week
  - Span of service
  - Peak frequency
  - Peak Buses
- Operating statistics by day of week
  - One-way trips
  - Revenue hours and revenue miles
- On-Time Performance summary
  - Percentage of trips early, on-time or late by day and period (AM Peak, Midday, PM Peak)
- Service Productivities and ranking

    - Average daily riders
    - Riders per revenue hour, revenue mile and trip
- Financial performance and ranking
    - Daily operating cost
    - Cost per rider
    - Farebox recovery ratio
    - Subsidy per rider
- Economic performance and ranking
    - Average daily revenue
    - Revenue per revenue hour, revenue mile and trip
- Weekday ridership by fare type analysis
- Flag stop analysis summary
- A map depicting the current alignment and transit propensity by Census block group of surrounding area

A summary of Tulsa Transit's 26 routes is shown in Table 3-8. Tulsa Transit provides service from approximately 5 am to midnight weekdays, 6:30 am to midnight Saturday, and 8:30 am to 7 pm Sunday and was currently operates 53 vehicles in the weekday peak period.

Table 3-8. Tulsa Transit Route Operational Characteristics

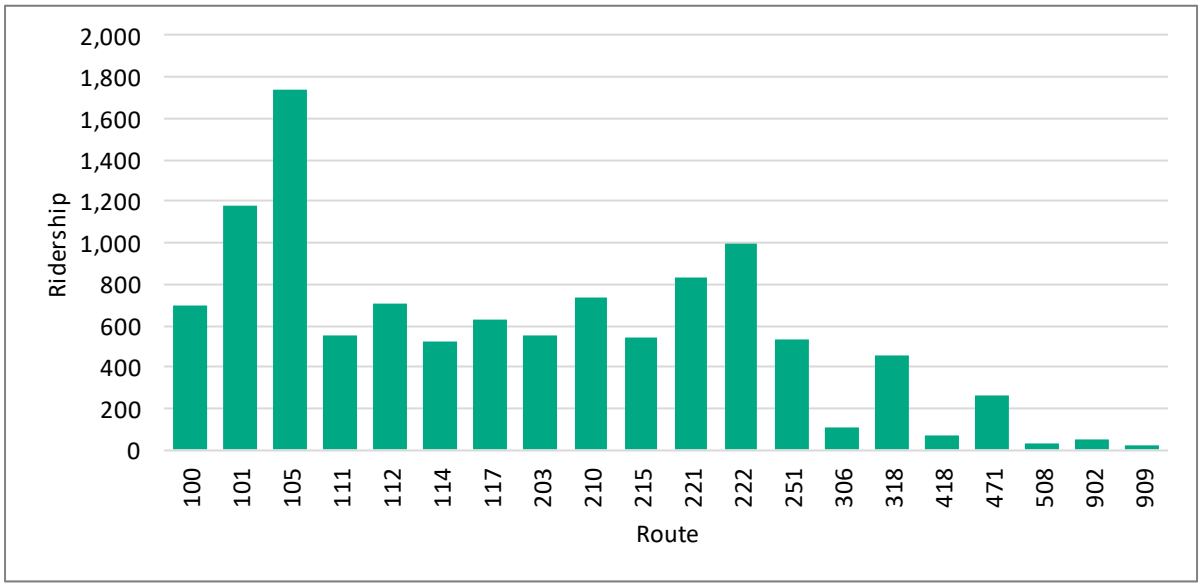
		Weekday			Saturday			Sunday		
Route	Route Name	Span of Service	Headway	Peak Bus	Span of Service	Headway	Peak Bus	Span of Service	Headway	Peak Bus
100	Admiral	5:46 am - 6:45 pm	30	3	7:01 am - 6:05 pm	90	1	-	-	-
101	Suburban Acres	4:47 am - 7:50 pm	30	3	6:47 am - 7:00 pm	45	2	-	-	-
105	Peoria	5:25 am - 8:08 pm	30	6	6:35 am - 6:23 pm	45	3	-	-	-
111	11th Street	5:29 am - 6:10 pm	45	2	6:44 am - 6:04 pm	90	1	-	-	-
112	Lewis/Jenks	5:43 am - 6:39 pm	45	4	7:08 am - 6:07 pm	90	2	-	-	-
114	Charles Page/Sand Springs	5:15 am - 7:10 pm	60	2	6:24 am - 7:04 pm	120	1	-	-	-
117	Union/SW Blvd	5:30 am - 7:08 pm	30	3	7:45 am - 6:30 pm	90	1	-	-	-
203	Airport	5:00 am - 8:00 pm	45-60-75	3	6:54 am - 7:11 pm	60-75	2	-	-	-
210	Harvard	5:10 am - 6:55 pm	30-45	4	7:00 am - 7:10 pm	135	1	-	-	-
215	15th Street	6:00 am - 7:28 pm	45	2	7:00 am - 6:48 pm	90	1	-	-	-
221	21st Street/Eastgate	5:25 am - 7:55 pm	45	3	7:15 am - 5:48 pm	75	2	-	-	-
222	Pine/41st Street	5:15 am - 7:50 pm	45	6	7:00 am - 6:21 pm	60-75	4	-	-	-
251	Fast Track	5:15 am - 7:10 pm	30	2	7:15 am - 6:30 pm	45	1	-	-	-
306	Southeast Industrial	6:30 am - 7:48 pm	75	1	-	-	-	-	-	-
318	Memorial	5:40 am - 7:02 pm	30-45	2	7:00 am - 6:02 pm	90	1	-	-	-
418	West Connector Loop	6:15 am - 6:55 pm	45	1	7:00 am - 6:10 pm	45	1	-	-	-
471	71st Street	5:25 am - 6:25 pm	60	2	7:00 am - 5:25 pm	75-100	2	-	-	-
508	BA Connection	5:55 am - 6:20 pm	60-80	2	-	-	-	-	-	-
902	Broken Arrow Express	Peak Only	3 IB / 3 OB	1	-	-	-	-	-	-
909	Union Express	Peak Only	1 IB / 1 OB	1	-	-	-	-	-	-
840	North	8:00 pm - 12:10 am	2.5 RTs	1	7:40 pm - 12:00 am	2.5 RTs	1	8:45 am - 6:25 pm	45	2
850	Northeast	8:15 pm - 12:15 am	3.0 RTs	1	7:30 pm - 11:40 pm	3.0 RTs	1	8:30 am - 6:55 pm	45	2
860	East	8:15 pm - 11:52 pm	2.5 RTs	1	7:30 pm - 11:50 pm	3.0 RTs	1	8:30 am - 6:03 pm	45 - 60	2
870	South	8:00 pm - 12:27 am	4.0 RTs	2	7:13 pm - 12:27 am	4.5 RTs	2	8:30 am - 6:40 pm	45 - 60	2
880	Southeast	8:05 pm - 12:34 am	2.5 RTs	1	7:40 pm - 12:04 am	2.5 RTs	1	8:30 am - 6:53 pm	45 - 60	2
890	West	8:00 pm - 12:10 am	2.5 RTs	1	7:30 pm - 11:40 pm	2.5 RTs	1	8:30 am - 6:50 pm	45 - 60	2

Note: RTs = round trips

Average Daily Ridership

Route level ridership data from the data collection effort was compiled by day of week. Average daily ridership was charted for all three service days. Eighteen local and two express routes were included in the weekday analysis, the results of which are presented below in Figure 3-37. The top four routes by average daily ridership (in order) are Routes 105, 101, 222, and 221. Routes 306, 418, and 508 carry the least number of riders.

Figure 3-37. Weekday Average Daily Ridership



Note: Route 508 ridership data assessed from December 2016 figures.

Sixteen local routes operate on Saturdays; Routes 306 and 508 do not operate nor do the two 900-series express services. Figure 3-38 below shows average daily ridership for Saturday routes. Route 105 is again the top performer, carrying an average of 913 daily Saturday riders. However, on Saturday Route 222 carries about 50 more riders than Route 101 with both routes carrying over 500 daily riders. Average Saturday ridership drops by an average of 50 percent compared to weekdays, with the sharpest decline of 74 percent occurring on Route 210. Several other routes see reductions of over 60 percent, including Routes 100, 111, 117, 215, 221, and 251. Because Saturday operates less than 50 percent of the weekday service, the drop in ridership is commiserate with service levels.

Six routes (the 800-series) operate on Weekday nights, Saturday nights, and Sundays. Night service is provided Monday through Saturday generally for two to three hours from 8 pm until 11 pm. Sunday service is comparatively more robust, with service between 8:30 am until 6:30 pm. Figure 3-39 charts the average daily ridership for the 800-series for the time periods noted above. Route 870 carries the most weekday nightline riders, followed by Routes 860, 840, and 880 with roughly half the ridership. On Saturdays Routes 870 and 840 carry the most riders. And Sunday service sees the most riders on Routes 870 and 880 followed by Route 860.

Figure 3-38. Saturday Average Daily Ridership

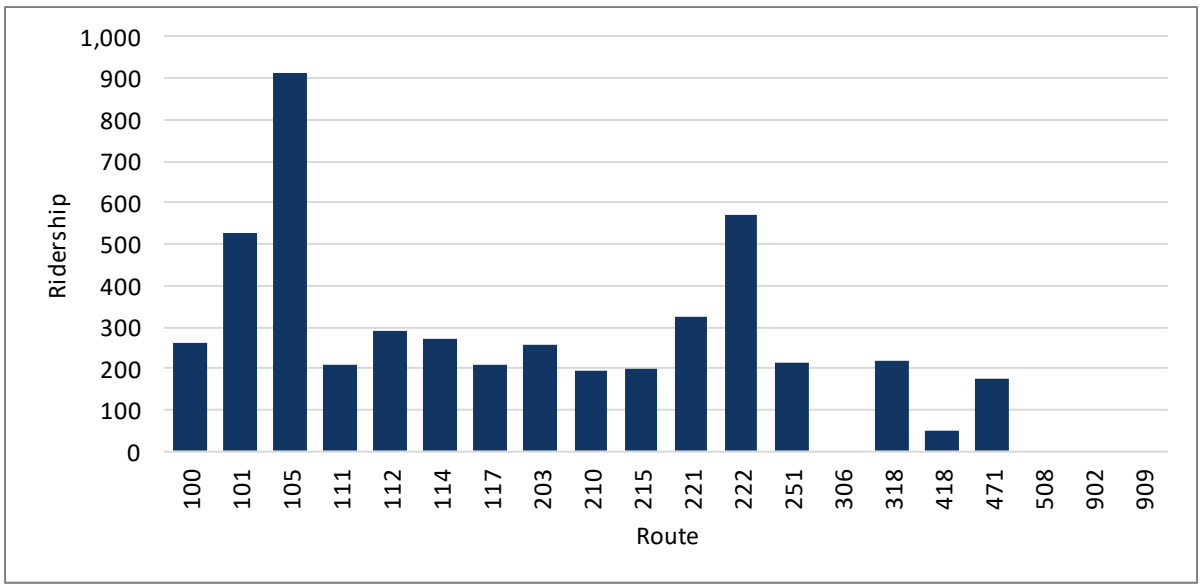
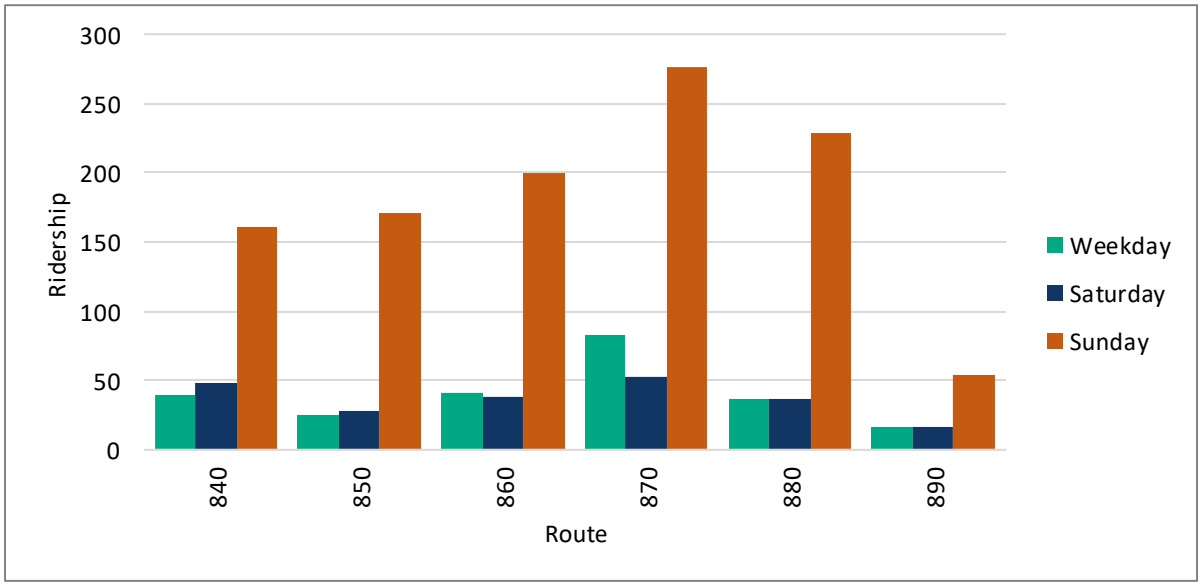


Figure 3-39. Average Nightline Ridership for Weekday Night, Saturday Night, and Sunday



Note: Sunday operates all day, while Weekday and Saturday nights are only a couple hours of service

Ridership Productivity

Although average daily ridership is a good metric for examining overall route performance, controlling for other factors like frequency and route length can provide context beyond average daily ridership. Three common measures used to evaluate route performance are riders per revenue hour, riders per revenue mile, and riders per trip. Table 3-9 summarizes these measures by route for the twenty local and express routes and six nightline routes. The top four and bottom four routes in the daytime routes, and the top two and bottom two for the nightline routes, have been highlighted for each measure.

As the table shows, routes 101 and 105 still rank high on productivity measures. However, routes 221 and 222, which rank high in average daily ridership, perform much lower in riders per revenue hour. These routes benefit from their length, which adds a lot of riders, but requires a lot of resources to operate. Routes 111 and 251 are ranked high on productivity measures.

Routes 306, 318, 418 and 471 tend to perform the lowest of weekday daytime routes for productivity measures. All these routes operate on the lower density periphery of Tulsa and none connect to the Denver Avenue Station downtown. It is important to note that these routes have been developed to serve low density areas with the knowledge that productivity will likely be low. For example, Route 508 operates as a flex route circulator providing lifeline service across the lower density Broken Arrow community. Based on service area and design, it will naturally be less productive than the rest of the local system.

Overall, routes 101, 105, 111, and 221 rank highest when combining ranks; routes 306, 418, 508, and 909 end up at the bottom of average rankings.

Among the nightline routes, 860 and 870 are the top performers in this set while 890 is ranked last in all measures. This is likely due to land use and population density reasons: 890 operates in a lower density and more sparsely populated area of the metro area compared to Routes 860 and 870. Overall, routes 860 and 870 perform the best, and because the other routes tie in average rankings, 850 was ranked lowest with 890 due to its low number of riders.

Saturday and Sunday services were similarly ranked. Only sixteen routes operate on Saturday because Routes 306 and 508 and the two express routes operate weekdays only; Sunday service only includes the 800 series routes.

Table 3-9. Weekday Route Productivities, October-December 2017

Route	Avg. Daily Riders	Rank	Riders per Hour	Rank	Riders per Mile	Rank	Riders per Trip	Rank	Avg. Rank
Weekday Local									
100	696	**7**	21.8	**7**	1.4	**6**	13.6	**11**	**5**
101	1,178	**2**	30.4	**1**	1.8	**1**	21.0	**4**	**2**
105	1,742	**1**	24.9	**3**	1.6	**2**	31.1	**1**	**1**
111	551	**9**	24.9	**2**	1.5	**3**	16.2	**9**	**4**
112	703	**6**	15.3	**13**	1.0	**12**	20.1	**5**	**9**
114	520	**13**	20.6	**8**	1.2	**10**	18.6	**7**	**11**
117	633	**8**	20.2	**9**	1.2	**8**	12.2	**12**	**10**
203	548	**10**	17.0	**12**	1.0	**13**	17.7	**8**	**12**
210	740	**5**	18.3	**11**	1.2	**9**	19.5	**6**	**5**
215	541	**11**	22.4	**6**	1.4	**5**	15.0	**10**	**7**
221	831	**4**	22.6	**5**	1.5	**4**	23.1	**3**	**3**
222	993	**3**	13.4	**15**	0.9	**14**	28.4	**2**	**8**
251	536	**12**	23.4	**4**	1.1	**11**	9.7	**18**	**13**
306	112	**16**	10.7	**18**	0.7	**16**	11.2	**16**	**17**
318	456	**14**	19.5	**10**	1.3	**7**	11.4	**15**	**14**
418	74	**17**	6.5	**19**	0.4	**19**	4.4	**19**	**19**
471	266	**15**	11.3	**17**	0.7	**15**	10.2	**17**	**16**
508	28	**19**	1.5	**20**	0.1	**20**	1.6	**20**	**20**
Weekday Express									
902	47	**18**	15.2	**14**	0.6	**17**	11.8	**13**	**15**
909	23	**20**	13.1	**16**	0.6	**18**	11.5	**14**	**18**
Sys. Avg.	***561***		***17.7***		***1.1***		***15.4***		
Weekday Night									
840	39	**3**	4.5	**6**	0.6	**3**	7.8	**4**	**3**
850	25	**5**	7.1	**4**	0.3	**5**	8.3	**2**	**3**
860	41	**2**	12.6	**1**	0.7	**1**	8.2	**3**	**2**
870	83	**1**	10.9	**2**	0.6	**2**	10.4	**1**	**1**
880	37	**4**	9.1	**3**	0.5	**4**	7.4	**5**	**3**
890	16	**6**	4.8	**5**	0.2	**6**	3.2	**6**	**6**
NL Avg.	***40***		***8.2***		***0.5***		***7.6***		

Table 3-10. Saturday Route Productivities, October-December 2017

Route	Avg. Daily Riders	Rank	Riders per Hour	Rank	Riders per Mile	Rank	Riders per Trip	Rank	Avg. Rank
Saturday Local									
100	262	**7**	27.9	**2**	1.7	**1**	17.5	**6**	**2**
101	525	**3**	23.7	**4**	1.4	**4**	16.4	**7**	**3**
105	913	**1**	30.5	**1**	1.6	**2**	31.5	**1**	**1**
111	207	**12**	21.2	**8**	1.3	**7**	13.8	**11**	**10**
112	293	**5**	14.4	**12**	0.9	**12**	18.3	**4**	**8**
114	271	**6**	26.9	**3**	1.4	**6**	20.8	**3**	**3**
117	210	**11**	23.3	**6**	1.4	**5**	14.0	**10**	**7**
203	257	**8**	11.7	**15**	0.7	**15**	12.2	**13**	**14**
210	193	**14**	16.7	**10**	1.1	**9**	17.5	**5**	**10**
215	200	**13**	19.2	**9**	1.2	**8**	12.5	**12**	**12**
221	323	**4**	16.4	**11**	1.0	**10**	16.2	**8**	**8**
222	571	**2**	13.9	**13**	0.9	**11**	28.6	**2**	**6**
251	212	**10**	21.2	**7**	0.8	**14**	7.1	**15**	**13**
306	-	**-**	-	**-**	-	**-**	-	**-**	
318	218	**9**	23.4	**5**	1.6	**3**	14.5	**9**	**5**
418	51	**16**	5.1	**16**	0.3	**16**	3.4	**16**	**16**
471	177	**15**	12.3	**14**	0.8	**13**	11.8	**14**	**15**
508	-	**-**	-	**-**	-	**-**	-	**-**	
Sys. Avg.	***305***		***19.2***		***1.1***		***16.0***		
Saturday Night									
840	48	**2**	12.8	**1**	0.7	**1**	9.6	**1**	**1**
850	28	**5**	8.0	**4**	0.4	**4**	9.3	**2**	**4**
860	38	**3**	9.6	**2**	0.5	**2**	6.3	**4**	**2**
870	52	**1**	6.1	**5**	0.4	**5**	5.8	**5**	**5**
880	36	**4**	8.8	**3**	0.5	**3**	7.2	**3**	**3**
890	17	**6**	5.1	**6**	0.2	**6**	3.4	**6**	**6**
NL Avg.	***37***		***8.4***		***0.5***		***6.9***		

Table 3-11. Sunday Route Productivities, December 2017

Route	Avg. Daily Riders	Rank	Riders per Hour	Rank	Riders per Mile	Rank	Riders per Trip	Rank	Avg. Rank
Sunday									
840	161	**5**	8.8	**5**	0.6	**4**	8.1	**5**	**5**
850	171	**4**	9.3	**4**	0.5	**5**	13.2	**2**	**4**
860	200	**3**	11.7	**3**	0.8	**2**	9.5	**4**	**3**
870	277	**1**	14.7	**1**	1.0	**1**	15.4	**1**	**1**
880	229	**2**	12.2	**2**	0.7	**3**	10.0	**3**	**2**
890	54	**6**	2.9	**6**	0.2	**6**	2.3	**6**	**6**
Avg.	***182***		***9.9***		***0.6***		***9.7***		

Financial Productivity

This section provides an analysis of financial metrics for Tulsa Transit routes by examining revenues and costs on a per route basis as well as ratios to determine which routes bring in more revenue and which routes cost more to operate.

Metrics included in this analysis include revenue per rider, cost per rider, farebox recovery ratio, and subsidy per rider. Ridership and route ranking, as before, is also included for reference. Revenue per rider estimates the income generated on a per passenger basis based on the average daily revenues and average daily boardings. Revenue comes from fiscal year 2017 fare revenue data supplied by Tulsa Transit. Cost per rider uses an estimated aggregated cost which is determined from estimated cost per mile and cost per hour unit costs as well as a daily administrative cost.[9] Farebox recovery is the ratio of revenue compared to the cost of the route. Finally, subsidy per rider is the difference between cost per rider and revenue per rider.

The following three tables summarize the four financial metrics of each route for weekday, Saturday, and Sunday service. Top and bottom overall rankings are similarly colored as with the route productivities tables: the top four routes are highlighted green while the bottom four are highlighted red; Nightline and Sunday services highlight the top two and bottom two routes. For weekday service, the routes with the highest revenue per rider were Routes 508, 306, 471, and 222. The lowest were Route 418, 251, and the two express routes. In terms of cost per rider, recovery ratio, and subsidy per rider, the top performers in each ratio were Routes 100, 101, 105 and 221 while the bottom four performers were Routes 418, 508 and the two express routes.

Saturday service saw some shifting in rankings compared with weekday service. Routes 112, 203, 221, and 100 brought in the most revenue per rider while Routes 418, 251, and 318 brought in the least. Routes 100, 101 and 105 were again top performers in the other metrics, but Route 114 ranked higher than Route 221 in terms of cost per rider and subsidy per rider.

[9] These costs are derived from 2016 National Transit Database information with a 2017 inflation factor.

Table 3-12. Weekday Financial Performance by Route

Route	Avg. Daily Riders	Rank	Revenue per Rider	Rank	Cost per Rider	Rank	Recovery Ratio	Rank	Subsidy per Rider	Rank	Avg. Rank
Weekday Local											
100	696	**7**	$0.40	**7**	$3.61	**4**	11.1%	**2**	$3.21	**4**	**2**
101	1,178	**2**	$0.26	**16**	$2.51	**1**	10.3%	**4**	$2.25	**2**	**4**
105	1,742	**1**	$0.41	**6**	$2.62	**2**	15.5%	**1**	$2.22	**1**	**1**
111	551	**9**	$0.37	**9**	$3.63	**5**	10.1%	**5**	$3.26	**5**	**5**
112	703	**6**	$0.44	**5**	$4.63	**12**	9.4%	**6**	$4.19	**12**	**6**
114	520	**13**	$0.39	**8**	$4.20	**10**	9.2%	**8**	$3.82	**9**	**10**
117	633	**8**	$0.28	**15**	$3.95	**8**	7.0%	**12**	$3.68	**8**	**11**
203	548	**10**	$0.37	**10**	$4.73	**13**	7.8%	**10**	$4.37	**14**	**12**
210	740	**5**	$0.31	**13**	$3.95	**7**	7.7%	**11**	$3.65	**7**	**8**
215	541	**11**	$0.31	**12**	$3.84	**6**	8.1%	**9**	$3.53	**6**	**9**
221	831	**4**	$0.36	**11**	$3.32	**3**	10.8%	**3**	$2.96	**3**	**2**
222	993	**3**	$0.45	**4**	$4.76	**14**	9.4%	**7**	$4.31	**13**	**6**
251	536	**12**	$0.16	**18**	$4.05	**9**	3.9%	**15**	$3.89	**10**	**15**
306	112	**16**	$0.47	**2**	$11.94	**16**	3.9%	**16**	$11.47	**16**	**16**
318	456	**14**	$0.30	**14**	$4.42	**11**	6.7%	**13**	$4.12	**11**	**14**
418	74	**17**	$0.12	**20**	$18.88	**17**	0.6%	**19**	$18.77	**17**	**19**
471	266	**15**	$0.45	**3**	$7.87	**15**	5.7%	**14**	$7.42	**15**	**13**
508	28	**19**	$0.66	**1**	$63.38	**20**	1.0%	**18**	$62.73	**20**	**17**
Weekday Express											
902	47	**18**	$0.22	**17**	$20.50	**18**	1.1%	**17**	$20.27	**18**	**18**
909	23	**20**	$0.13	**19**	$37.62	**19**	0.3%	**20**	$37.50	**19**	**20**
Avg.	***561***		***$0.34***		***$10.72***		***7.0%***		***$10.38***		
Weekday Night											
840	39	**3**	$0.16	**5**	$9.61	**6**	1.7%	**5**	$9.45	**6**	**5**
850	25	**5**	$0.05	**6**	$6.00	**4**	0.9%	**6**	$5.94	**4**	**5**
860	41	**2**	$0.32	**1**	$3.39	**1**	9.4%	**1**	$3.08	**1**	**1**
870	83	**1**	$0.32	**2**	$3.92	**2**	8.1%	**2**	$3.60	**2**	**2**
880	37	**4**	$0.25	**4**	$4.72	**3**	5.3%	**3**	$4.47	**3**	**3**
890	16	**6**	$0.31	**3**	$8.91	**5**	3.4%	**4**	$8.61	**5**	**4**
Avg.	***40***		***$0.23***		***$6.09***		***4.8%***		***$5.86***		

Table 3-13. Saturday Financial Performance by Route

Route	Avg. Daily Riders	Rank	Revenue per Rider	Rank	Cost per Rider	Rank	Recovery Ratio	Rank	Subsidy per Rider	Rank	Avg. Rank
Saturday Local											
100	262	**7**	$0.47	**4**	$4.85	**3**	9.6%	**2**	$4.38	**3**	**2**
101	525	**3**	$0.32	**13**	$3.81	**2**	8.3%	**3**	$3.49	**2**	**3**
105	913	**1**	$0.43	**6**	$2.76	**1**	15.4%	**1**	$2.34	**1**	**1**
111	207	**12**	$0.43	**5**	$6.30	**9**	6.9%	**8**	$5.87	**9**	**8**
112	293	**5**	$0.52	**1**	$6.43	**10**	8.0%	**6**	$5.92	**10**	**7**
114	271	**6**	$0.39	**10**	$5.04	**4**	7.7%	**7**	$4.65	**4**	**6**
117	210	**11**	$0.38	**11**	$5.99	**8**	6.3%	**9**	$5.61	**8**	**9**
203	257	**8**	$0.48	**2**	$7.79	**14**	6.2%	**10**	$7.31	**14**	**10**
210	193	**14**	$0.39	**9**	$7.15	**13**	5.4%	**12**	$6.76	**13**	**13**
215	200	**13**	$0.36	**12**	$6.64	**11**	5.4%	**11**	$6.28	**11**	**12**
221	323	**4**	$0.47	**3**	$5.70	**6**	8.2%	**4**	$5.23	**6**	**3**
222	571	**2**	$0.42	**7**	$5.16	**5**	8.2%	**5**	$4.74	**5**	**5**
251	212	**10**	$0.18	**15**	$6.82	**12**	2.6%	**15**	$6.64	**12**	**14**
306	-	**-**	-	**-**	-	**-**	-	**-**	-	**-**	
318	218	**9**	$0.31	**14**	$5.71	**7**	5.4%	**13**	$5.40	**7**	**11**
418	51	**16**	$0.12	**16**	$25.91	**16**	0.5%	**16**	$25.79	**16**	**16**
471	177	**15**	$0.39	**8**	$8.58	**15**	4.5%	**14**	$8.19	**15**	**15**
508	-	**-**	-	**-**	-	**-**	-	**-**	-	**-**	
Avg.	***305***		***$0.38***		***$7.16***		***6.8%***		***$6.79***		
Saturday Night											
840	48	**2**	$0.17	**5**	$3.35	**1**	5.0%	**3**	$3.18	**1**	**2**
850	28	**5**	$0.03	**6**	$5.35	**4**	0.5%	**6**	$5.33	**4**	**5**
860	38	**3**	$0.31	**2**	$4.45	**2**	7.1%	**1**	$4.14	**2**	**1**
870	52	**1**	$0.48	**1**	$7.04	**5**	6.8%	**2**	$6.56	**5**	**3**
880	36	**4**	$0.23	**4**	$4.85	**3**	4.8%	**4**	$4.62	**3**	**4**
890	17	**6**	$0.25	**3**	$8.39	**6**	2.9%	**5**	$8.14	**6**	**6**
Avg.	***37***		***$0.24***		***$5.57***		***4.5%***		***$5.33***		

Table 3-14. Sunday Financial Performance by Route

Route	Avg. Daily Riders	Rank	Revenue per Rider	Rank	Cost per Rider	Rank	Recovery Ratio	Rank	Subsidy per Rider	Rank	Avg. Rank
Sunday											
840	161	**5**	$0.00	**5**	$4.88	**5**	0.03%	**5**	$4.87	**5**	**6**
850	171	**4**	$0.00	**6**	$4.61	**4**	0.00%	**6**	$4.61	**4**	**5**
860	200	**3**	$0.01	**3**	$3.67	**3**	0.15%	**2**	$3.66	**3**	**2**
870	277	**1**	$0.01	**2**	$2.92	**1**	0.38%	**1**	$2.91	**1**	**1**
880	229	**2**	$0.00	**4**	$3.51	**2**	0.13%	**4**	$3.51	**2**	**1**
890	54	**6**	$0.02	**1**	$14.91	**6**	0.15%	**3**	$14.89	**6**	**1**
Avg.	***182***		***$0.01***		***$5.75***		***0.14%***		***$5.74***		

3.6 Conclusions

Major takeaways for the existing conditions analysis include the following:

Market Analysis

Demographic datasets showed that Tulsa has areas of low-income and minority households on the north, far south, and east sides, all of which surround an affluent and less diverse population in the midtown area of the city. A Transit Propensity Index combines these datasets into an aggregate score with areas scoring highest (greatest transit propensity) on the far east and south parts of Tulsa. These demographics have not changed drastically over the past decade and have been repeated in prior studies, particularly the *Fast Forward Regional Transit System Plan* and prior work by CTG. This outer "doughnut" of demographics is comprised of a population that is generally more apt to utilize transit. Already, Tulsa Transit does an admirable job of broad coverage across the majority of Tulsa's corporate limits, but some areas may need more coverage, higher frequency, or both, based on the findings of the transit propensity index.

Peer Agency Review

Tulsa Transit was compared with five other agencies that were determined to be of similar size, similar service provision, and close geographic proximity. The cities (and transit agencies) selected were Colorado Springs, Colorado (Mountain Metro Transit); Little Rock, Arkansas (Rock Region Metro); Oklahoma City, Oklahoma (Embark); Omaha, Nebraska (Metro); and Wichita, Kansas (Wichita Transit).

Of this selected group of similar peers, the peer analysis found Tulsa Transit to be performing quite well in terms of service delivery. Following drastic cuts to its system early this decade leading out of the recession, since 2011 Tulsa Transit has seen increased revenue hours and decreasing costs per revenue hour as well as steady growth in ridership. However, ridership has stalled in recent years which mirrors what has happened nationwide following steady growth in employment and low gas prices. Tulsa Transit has added operating costs due to additional service and it has seen a marked increase in passengers carried compared to other systems which have also had more costs but not as much ridership growth. Only Colorado Springs saw more growth with less operating cost increases. Overall, Tulsa Transit runs a lean, efficient system and delivers more service to more people than similar systems, which sets it up well for future growth.

System wide Performance

System wide, ridership performance was examined for productivity and schedule adherence. Except for the obvious high passenger volumes at Denver Avenue Station and Midtown Memorial Station, routes 101 and 105 have stops with the highest stop activity in the system.

Routes were also examined at the segment level. Segments with the highest passenger loads were on Route 101 and the south half of Route 105. Moderately high loading can be seen on several east-west routes such as 100, 111, 215, 221, and 210 and the 251 crosstown. Segment analysis of passengers per revenue hour saw similar information but was more oriented to east-west route segments, and on a passenger per revenue mile basis, highest-performing segments were portions of Route 101, 105, 112, 111, 114, 215, 203, and 221. On time performance was also examined. Most routes adhered to scheduled times well. However, some routes may have more slack than necessary. These included Routes 101, 114, 251, and 471. No routes had trips that were measured as later than 4 minutes.

Flag stops were also examined, defined as locations more than 200 feet from a marked stop. A heat map was produced which showed areas of high flag stop activity which included areas along Routes 100, 101, 105, 117, and 210. Elimination of flag stops may address on time performance or safety issues as well as potentially shorter travel times and/or more time for end-of-line recovery or route extensions.

Route Level Performance

Every one of Tulsa Transit's 26 routes (20 daytime and express and 6 Nightline routes) were examined individually in terms of operating characteristics, service productivities (passengers per unit of service delivered), and financial performance as well as ranked against each other. The analysis found that routes 101, 105, and 111 tend to perform the best almost across the board. Different metrics found some shifting of these rankings, but these routes tend to carry the most people for the least amount of resources. Other top performers include routes 251, 221, and 222. The lowest performing routes tend to be the 400-series (westside and 71st Street routes not anchored to a transfer facility), 500-series (Broken Arrow), and 900-series (express) routes. The exception was in revenue per rider where routes 471 and 508 excelled.

The top four routes in terms of:

- Passengers/revenue hour: 101, 105, 111, 251
- Passengers/revenue mile: 101, 105, 111, 221
- Passengers/trip: 101, 105, 221, 222
- Revenue/rider: 222, 306, 471, 508
- Cost/rider, recovery ratio, and subsidy/rider: 100, 101, 105, 221

The bottom four routes in terms of:

- Passengers/revenue hour: 306, 418, 471, 508
- Passengers/revenue mile: 418, 508, 902, 909
- Passengers/trip: 251, 418, 471, 508
- Revenue/rider: 251, 418, 902, 909
- Cost/rider, recovery ratio, and subsidy/rider: 418, 508, 902, 909

Chapter 4 Analysis and Draft Recommendations

Chapter 4 uses the information and feedback from Chapter 2 (Outreach) and Chapter 3 (Existing Conditions) to conduct analysis on the transit system redesign. Section 4.1 provides results from a public community survey which sought feedback on the current transit network as well as on potential improvements. Section 4.2 outlines the overarching restructuring philosophy used for the draft recommendation.

A draft recommendation for restructuring the network is presented in Section 4.3. This section includes two alternatives developed for the Daytime network and a recommendation for the night/Sunday network. Section 4.3 also includes metrics used in evaluation of the draft network.

Finally, Section 4.4 discusses additional analyses important to the operations of Tulsa Transit, including analyses of flag stops, stop amenities, and service performance standards.

4.1 Community Survey Results

An online survey was created to solicit feedback on what transit improvements were most desired and what issues might affect transit users. The survey accepted feedback for a month between March 13 and April 13 and collected 517 surveys. Questions asked respondents to rank improvements such as frequency versus coverage, determine preferences on flag stops versus designated stops, and indicate their impediments to transit use. It was hypothesized that feedback would differ depending on if the respondent was a regular transit user, someone who may be familiar with transit but doesn't utilize it often or someone who knows or is aware of clients or constituents who utilize transit. As such, the survey was set up to allow respondents to indicate whether they were riders, non-riders or representatives of transit stakeholder agencies. Similarly, the questions posed to each of these groups were tailored to their specific needs. For instance, questions on trip type and transfer information were more pertinent to regular users, whereas questions directed at agency representatives examined issues facing their constituents or clients.

Questions on Transit Usage

General public transit users indicated their trip type and whether and where they make transfers. The most common trip purpose was for work (43%) followed by errands (20%). Almost a third of users had no transfers on their trips, 46% had one transfer and the remaining 22% had two or more transfers. The transfer locations were overwhelmingly at Denver Avenue Station (DAS) (43%), with 22% at Midtown Memorial Station (MMS) and 20% elsewhere such as on-street between routes. The survey also inquired whether transit users generally utilized flag stops (16%) or designated stops (84%) and users' predilection for flag stops: if users were forced into an all-designated stop system how would they respond? Nearly 90% of users stated they would be willing to use a designated stop instead of a flag stop but 58% of those said there would be some sort of difficulty in transitioning to a designated stop; around 12% explicitly stated they would not be willing to use a designated stop.

General public non-transit users were also queried on their motivations for using transit. Non-users gave multiple reasons when they would use transit: if it was somehow like driving, such as with comparable trip times (58%), followed by lack of car ownership (48%), more bus amenities/safer (35%) and if there was an economic benefit to them (30%). Non-users also gave multiple factors that were

important to them in choosing transit: convenience (77%), competitive travel times (60%), frequency (52%), safety/security (43%), economic (35%) and passenger comfort (18%).

Agency representatives were polled on what issues they thought their clients or constituents faced. Multiple reasons were allowed and included routes not going where needed (45%), inadequate weekend service (36%), long waits (35%), service ending prematurely (34%), infrequency (30%), slow travel times (20%) and stop amenities/safety (17%).

Tradeoff Questions

Because funding for transit is limited, it is vital to understand what Tulsans desire out of their transit system to prioritize improvements. All users were queried on tradeoffs – a series of questions that gave two choices and asked respondents to choose which one they preferred. Figure 4-1 through Figure 4-7 display the results. Highlights include:

- When comparing frequency versus coverage, existing transit users seemed to value coverage a bit more than non-users who seemed to value frequency slightly more. Agency representatives valued coverage much more.
- When comparing improved frequency to improved span of service, all groups overwhelmingly chose a better span of service, which seems to indicate a desire for either earlier or later service.
- When polling about a preference to improve either weekday or weekend service, users indicated a desire for better weekend service (64% compared to 36%), but non-users and agency representatives were evenly split, possibly indicating a desire to improve both.
- When asking whether improvements should be made to the Nightline 800-series routes or the core weekday network, all groups indicated a preference for the core network, with 68% of users indicating their preference for core network improvements.
- When comparing flag stops to designated stops, 57% of transit users thought flag stops should be allowed but the non-user and agency representative groups were slightly more in favor of designated stops.
- When comparing a hypothetical one-seat ride with transfers but with more frequency, all groups thought transfers were fine if it included more frequency. Over three-quarters of transit users thought transfers with more frequency was okay, compared to 54% of non-users and 58% of agency representatives.
- When addressing bi-directional service compared to large one-way loops, two-thirds of users and nearly as many non-users preferred bi-directional service but agency representatives were evenly split.

Overall, the desired improvements from the survey appear to request extending the span of service; extend daytime routes into evening service, replacing the existing Nightlines; allow for transfers as long as it improves frequency of service; and move toward bidirectional service instead of one-way loops. Some results were mixed, however: there was no clear mandate for either frequency or coverage; improvements could be made to both weekday or weekend service; and the removal of flag stops was not clear based on survey feedback, although it seems there is willingness to eliminate them. Additional details on the community survey results can be found in Appendix 4A.

Figure 4-1. Frequency vs Coverage Trade Off Survey Results

Figure 4-2. Frequency vs Span Trade Off Results

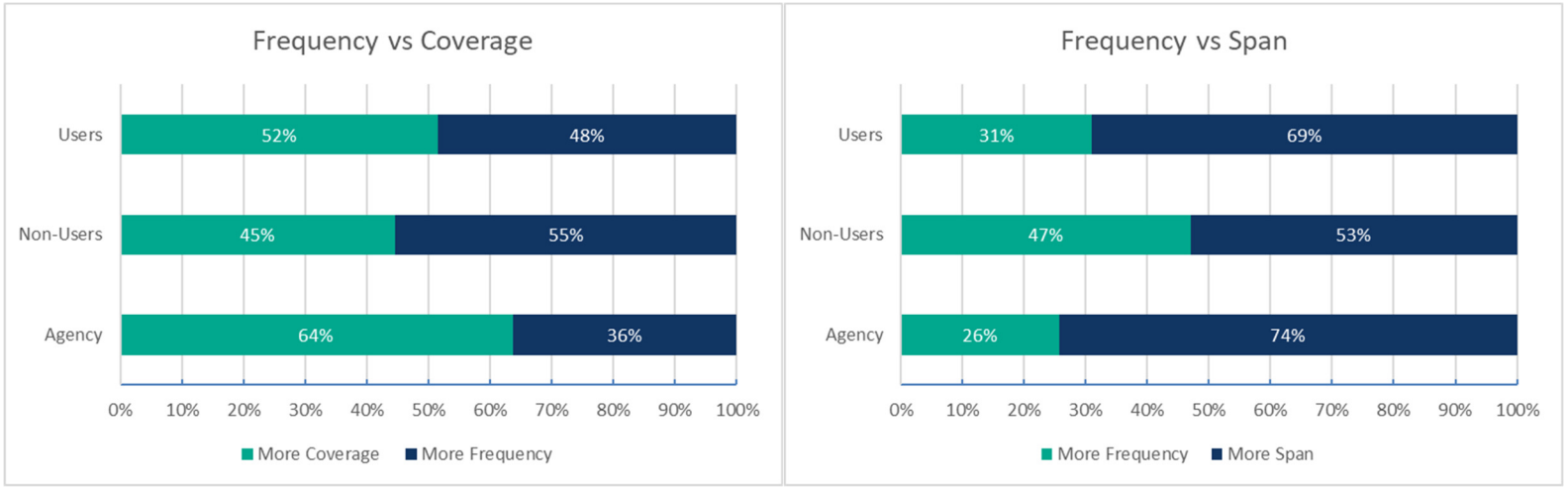


Figure 4-3. Weekday vs Weekend Trade Off Survey Results

Figure 4-4. 800-series Routes vs Daytime Network for Nighttime Service Trade Off Results

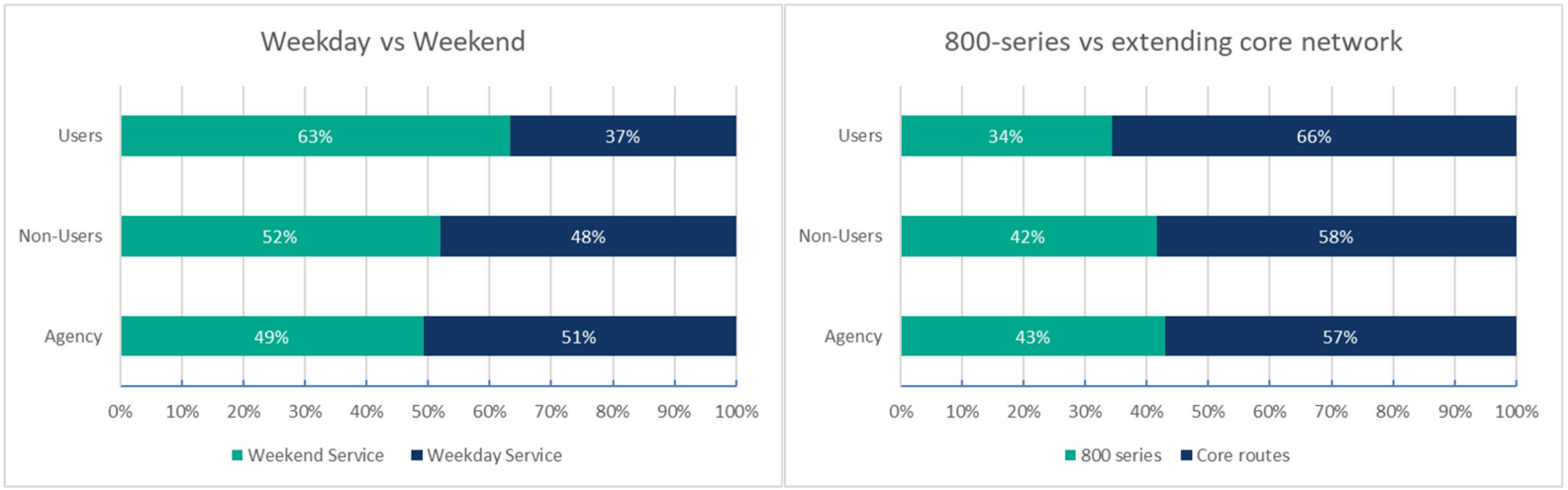
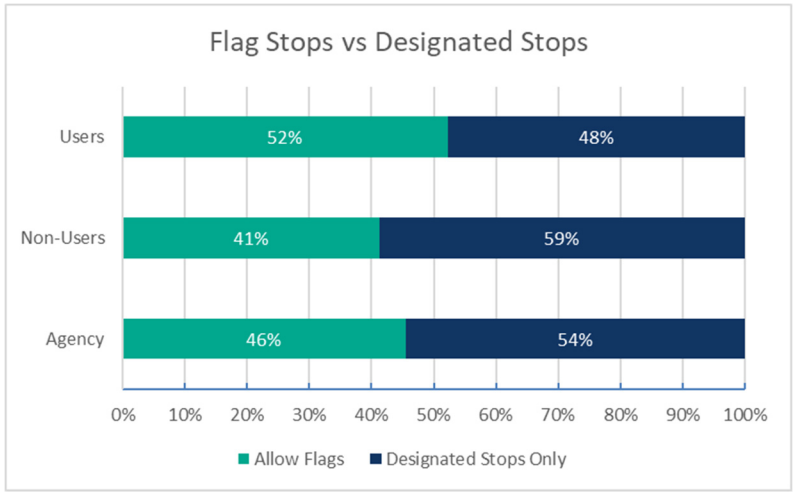


Figure 4-5. Flag Stops vs Designated Stops Trade Off Survey Results

Figure 4-6. One-seat Ride vs Transfers Trade Off Results



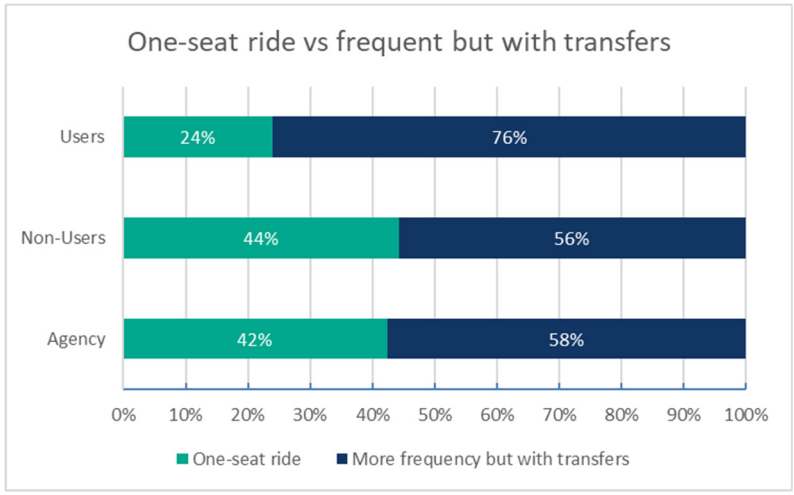
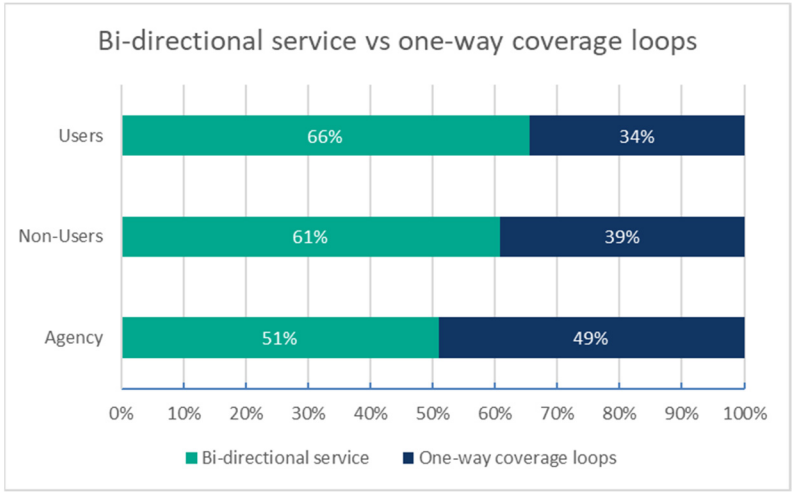


Figure 4-7. Bi-directional Service vs Coverage Loops Trade Off Survey Results



4.2 Restructuring Philosophy

Several topics are important to the overall goals of restructuring the existing Tulsa Transit network to provide more efficient service. These included the format or structure of the network of routes and the purpose behind their reconfigured alignments, use of regular clockface headways for the time between bus arrivals, utilizing the forthcoming AERO BRT service as a foundation for a new Tulsa Transit network, exploration of creative approaches to providing service in lower productivity areas and defining priorities for building a new network. These topics are described in more detail below.

Clean Route Structure

Overall, Tulsa Transit routes should be easy to understand and take advantage of Tulsa's grid network, where possible. While there are multiple ways to structure routes, three main ways are:

- **Radial**: system is designed to converge at a single point, usually in downtown core at a transfer facility. This allows for a single, convenient location for transfers.
- **Grid:** system is designed using north-south or east-west alignments, and connections occur in a regular pattern at main intersections. Routes will not be timed to meet up at every intersection, meaning high service frequency is necessary to facilitate movement across the network.
- **Hybrid Grid**: system is designed to have long north-south or east-west alignments (like a grid), but routes deviate to meet at designated transfer locations which help with negate issues with frequencies and transfers. While hubs can be operated on-street, this route network is best when capital investments allow for off-street hubs to be constructed.

Based on Tulsa Transit's grid, travel patterns, and limited resources, a hybrid grid was determined to be the desired route structure for a revised Tulsa Transit network.

Clockface headways (30 or 60 minutes)

Tulsa currently provides service at varying headways, including routes operating with 30, 45, and 60-minute intervals during weekday daytimes. During nights and Saturdays some routes operate at even higher headways, including 75, 90, and 120-minute intervals.

The headway variance can cause confusion among passengers and requires a schedule in some cases because buses come at different times each hour with a 45, 75, or 90-minute headway.

Clockface headways are frequencies that are divide evenly into the hour (such as every 30 or every 60 minutes). These headways are preferable from a customer standpoint, since schedules will maintain consistent arrival or departure times from hour to hour. For Tulsa Transit operations, clockface headways of 30 or 60 minutes are recommended wherever possible. Not only will this reduce customer confusion, but it will also improve connections because routes will be able to meet at hubs at synchronized intervals.

Peoria AERO BRT service as foundation

The Peoria AERO BRT is a high frequency corridor that will improve connectivity both on Peoria Avenue and the rest of the Tulsa Transit network.

Peoria BRT is proposed to have 15-minute service during peak periods and 20-minute service all other times. While details of the service plan are still being finalized, it will be the first of possibly several corridors with frequent, premium service.

As this network redesign is completed, efforts should be made to connect at many routes as possible to Peoria AERO BRT to take advantage of the benefits of the newly implemented service.

Consider New Ways to Deliver Service in Low Density Areas

Low density areas tend to be less productive with transit service compared to the core of the region. While low density sprawl can include trip generators, they are typically surrounded by large areas with few riders. As a result, buses travel through low ridership areas to reach the high ridership generator.

Creative approaches to continuing to serve these areas are necessary because they free up Tulsa Transit resources for the more productive parts of the network. New service delivery opportunities include partnerships with TNCs (transportation network companies) such as Lyft or Uber, on-demand services that are contracted to a private carrier (purchased transportation), or flexible routing which allows for deviated fixed route service or a flex-service zone.

Redesign Priorities

Based on the above results from both the community survey, the public outreach process including stakeholder review, and a comprehensive route workshop involving Tulsa Transit staff completed in April 2018, priorities for a reorganized transit network include:

- Connect routes to Peoria AERO BRT to take advantage of the speed and frequency improvements in the Peoria Avenue corridor.
- Consider opportunities to move toward a hybrid grid, including the use of hubs at locations other than Denver Avenue Station and Midtown Memorial Station.
- Consider the development of a hierarchy of service types as Tulsa Transit transitions toward an agency providing multiple services: premium BRT, local, express and zone-based services.
- Focus on crosstown trip patterns particularly between areas of high residential density or need and key destinations such as areas of high employment, grocery stores and retail amenities, medical facilities and institutional destinations.
- Provide a balance of coverage in terms of repurposing revenue service from lower to higher productivity areas as well as investing in frequency improvements along key corridors.
- Consider the wholesale elimination of flag stops to reduce safety issues and increase both average vehicle speeds and on-time performance.

4.3 Draft Recommended Networks

Following the public input process and incorporation of study goals as well as close coordination with agency staff, recommendations were developed to revise the Tulsa Transit network, including revised weekday daytime, Saturday daytime, and night/Sunday networks. Network structure was intended to be consistent across all time periods to improve customer understanding and reliability. Alternative service delivery was also considered, particularly for Jenks and Broken Arrow, two lower density destinations on the edge of the metropolitan area.

Weekday Daytime

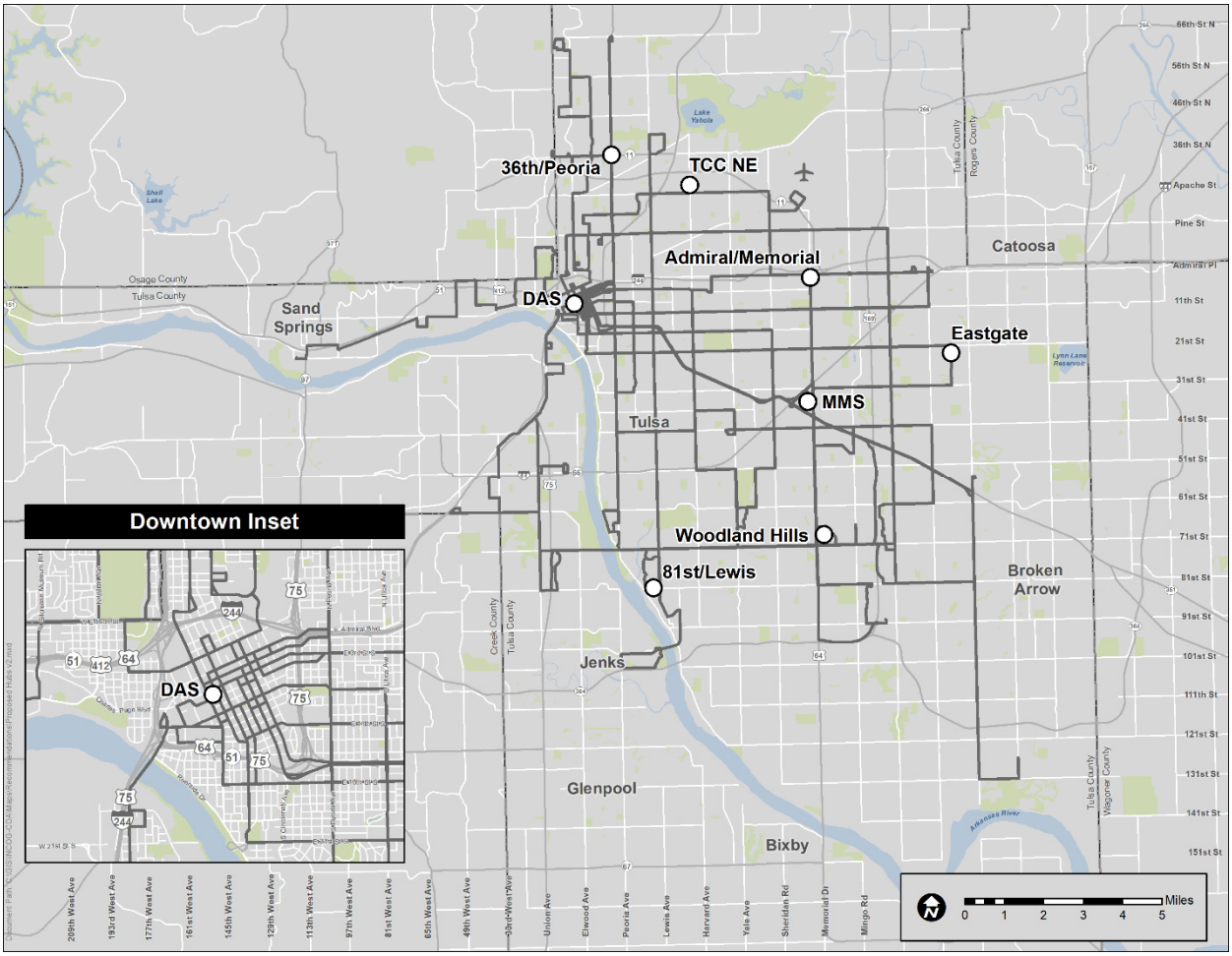
Based on the review of the existing Tulsa Transit weekday network and the restructuring philosophy presented in section 4.2, it was determined that the weekday daytime network should be redesigned.

During the route workshop, staff identified the hybrid grid as the desired route structure. A series of subhubs were identified outside of Denver Avenue and Midtown Memorial stations for potential connections. Those subhubs – strategic locations near desired destinations – include the following:

- 36th Street N and Peoria Avenue
- TCC Northeast (Harvard Avenue and Apache Street)
- Admiral Walmart (Admiral Place and Memorial Drive)
- Eastgate (21st Street N and 137th Avenue)
- Woodland Hills (71st Street S and Memorial Drive)
- 81st Street Walmart (81st Street S and Lewis Avenue)

While exact locations and amenities are to be determined, each subhub is presumed to include an off-street waiting area, one or two shelters and benches, and other amenities like lighting, trash receptacle, bicycle parking, and schedule and route information. Figure 4-8 shows the proposed subhubs within the context of the existing Tulsa Transit network.

Figure 4-8. Proposed Subhubs Within Tulsa



Although an overhaul was desired, certain aspects of the existing network were important to retain. For example, service along key arterials and to major destinations were to be incorporated into the new

design. Locations such as Tulsa Public High Schools, local technical colleges and institutions are expected to continue to be served in the redesigned network. These structural constraints mean alignments often had to remain in some segments but still allowed some flexibility in other locations.

Structural constraints aside, the socioeconomic-demographic data from Chapter 3 indicates service could be reallocated to better serve existing transit riders. For example, frequent (30-minutes or better) east-west service is missing from the existing network between Admiral Place and 71st Street. Additionally, matching service levels to demand was another consideration. As documented in the community survey results, the public indicated a desire to strike a balance between coverage and frequency to best facilitate movement through the network.

The revised network includes the following highlights:

- North Tulsa has been reorganized into two services with a slightly more direct, 30-minute service route (Route 1) providing a connection to the Peoria AERO BRT along with a neighborhood circulator (Route 19) that provides connections to social services, the Osage Casino, the Peoria AERO BRT and TCC NE. Route 1 is also through-routed (interlined) along Southwest Boulevard to serve West Tulsa;
- Service on the Pine and Apache corridors has been reorganized so that North Tulsa has better access to the Admiral/Memorial Walmart, MMS, and Woodland Hills Mall.
- A new route (Route 11) is proposed to follow 11th Street to Yale Avenue and then 21st Street to Eastgate. This alignment follows the proposed Route 66 AERO BRT corridor.
- The 31st Street route (Route 13) would make a direct connection from Peoria AERO BRT to Eastgate subhub while also serving a new social services complex planned for Legacy Plaza (31st Street/Hudson Avenue).
- East-west service (Route 14) connecting Peoria AERO BRT to the Promenade Mall at 41st Street S and Yale Avenue is added.
- Corridor-based service for the Harvard, Yale, Sheridan, and 31st Street corridors is added or enhanced.

Additionally, route structures were simplified or reorganized throughout the network, resulting in the desired hybrid grid network. The new network fosters timed connections at identified subhub locations, allowing for easier movement throughout Tulsa.

During the staff route workshop in April 2018 there was some debate on placement of resources within the network. As a result, two proposed transit networks evolved during the draft recommendations phase: Alternative A Frequency and Alternative B Coverage. Both networks have the same revised base network described above. The major difference is the allocation of resources. Alternative A Frequency puts resources into frequency improvements on key corridors while Alternative B Coverage puts resources into covering new territory in Tulsa. Each alternative is described in more detail below.

Alternative A Frequency

The Alternative A Frequency network prioritizes east-west mobility by creating 30-minute headways on two routes, Route 11 and Route 13. To accomplish this, routes 5 and 6 connect to each other at the Harvard/Admiral intersection. Table 4-1 shows the proposed weekday daytime network for Alternative A.

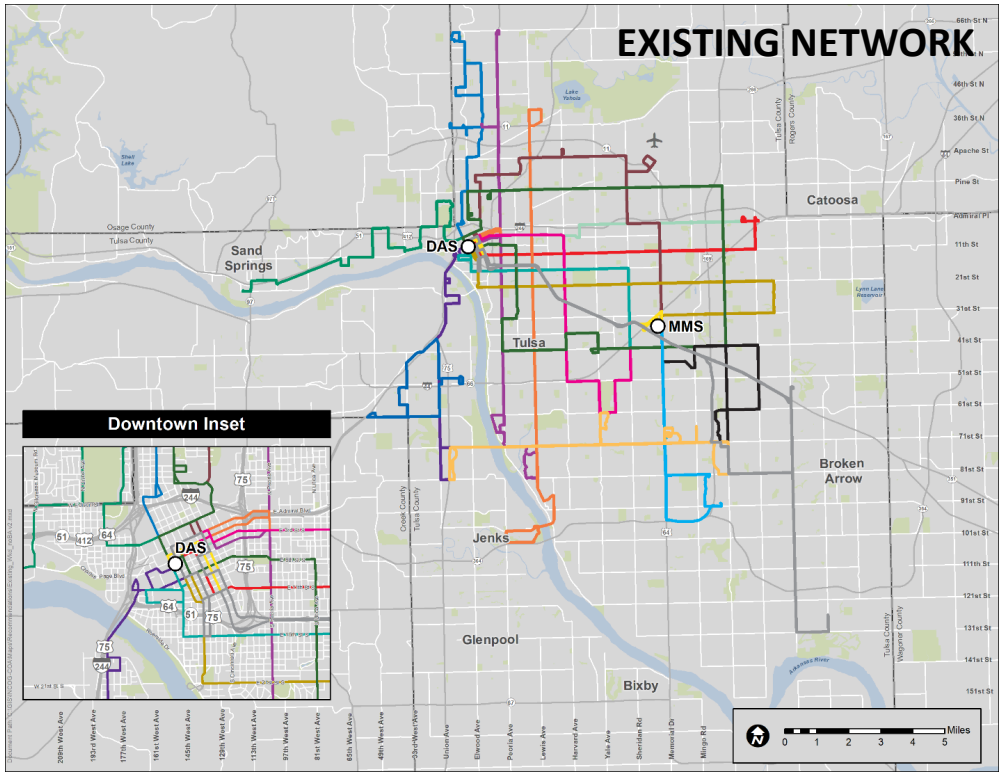
Table 4-1. Alternative A Frequency Route Summary

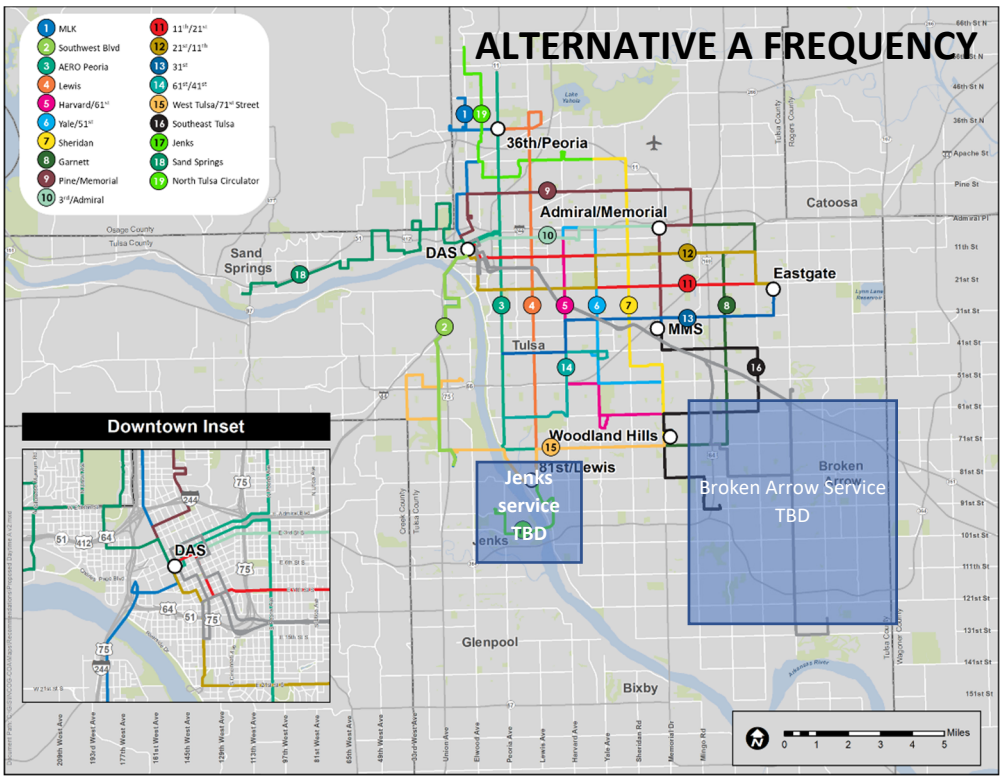
			Weekday Peak		Weekday Offpeak		Saturday	
Number	Name	Description	Headway	Span	Headway	Span	Headway	Span
1	MLK	From Dream Center (46th Street N) to DAS	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
2	Southwest Blvd	From DAS to Tulsa Hills	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	15 min	6 hrs	20 min	8 hrs	20 min	13 hrs
4	Lewis	From 36th Street N/Hartford to 81st Street Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
5	Harvard/61st	From **Harvard/Admiral** to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
6	Yale/51st	From **Harvard/Admiral** to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
7	Sheridan	From TCC NE to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
8	Garnett	From Admiral/Memorial to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
9	Pine/Memorial	From DAS to MMS	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	**30 min**	6 hrs	**30 min**	8 hrs	60 min	13 hrs
12	21st/11th Streets	From DAS to Eastgate	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
13	31st	From 41st/Peoria to Eastgate	**30 min**	6 hrs	**30 min**	8 hrs	60 min	13 hrs
14	61st/41st	From 61st/Peorial to The Promenade Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
15	West Tulsa/71st Street	From 49th/Jackson to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
16	Southeast Tulsa	From Woodland Hills Mall to St Francis Hosp. South	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
17	Jenks Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
18	Sand Springs	From DAS to Sand Springs Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
19	North Tulsa Circulator	From 61st Street N to TCC NE	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
TBD	BA Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
902	BA Express	From B.A. to Downtown Tulsa	4 Trips	-	-	-	-	-
909	Union Express	From Union HS to Downtown Tulsa	2 Trips	-	-	-	-	-

*Descriptions in **red** are different than Alternative B*

A comparison of the existing and Alternative A networks is shown in Figure 4-9.

Figure 4-9. Comparison of Existing Weekday Daytime and Alternative A Frequency





Alternative B Coverage

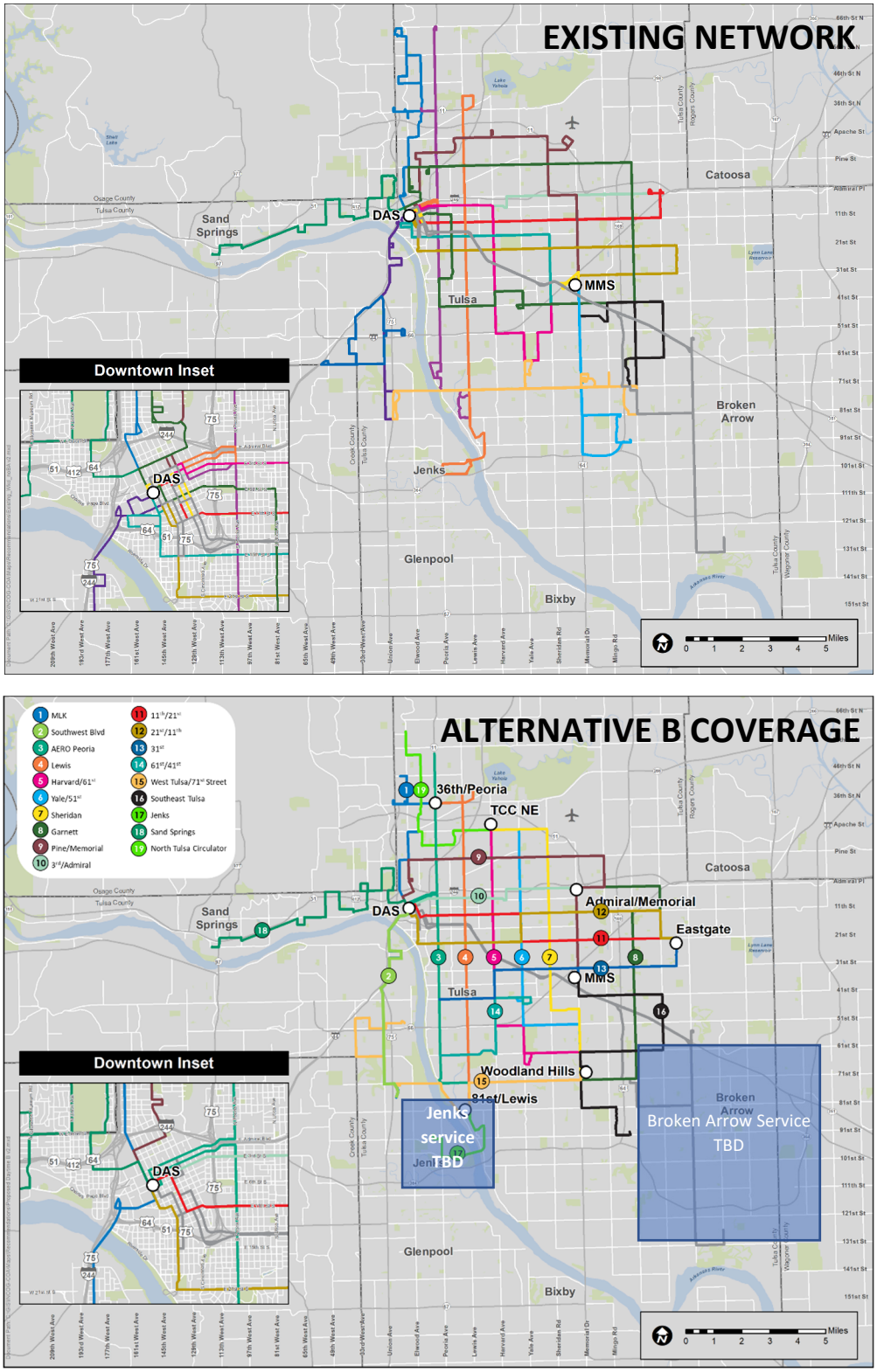
The Alternative B Coverage network prioritizes coverage by extending the Harvard and Yale routes north to TCC Northeast. This establishes a new hub at TCC NE where four routes would meet (routes 5, 6, 7, and 19). To accomplish this, routes 11 and 13 would each have a 60-minute headway. Table 4-2 shows the proposed weekday daytime network for Alternative B.

Table 4-2. Alternative B Coverage Route Summary

			Weekday Peak		Weekday Offpeak		Saturday	
Number	Name	Description	Headway	Span	Headway	Span	Headway	Span
1	MLK	From Dream Center (46th Street N) to DAS	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
2	Southwest Blvd	From DAS to Tulsa Hills	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	15 min	6 hrs	20 min	8 hrs	20 min	13 hrs
4	Lewis	From 36th Street N/Hartford to 81st Street Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
5	Harvard/61st	From **TCC NE** to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
6	Yale/51st	From **TCC NE** to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
7	Sheridan	From TCC NE to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
8	Garnett	From Admiral/Memorial to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
9	Pine/Memorial	From DAS to MMS	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	**60 min**	6 hrs	**60 min**	8 hrs	60 min	13 hrs
12	21st/11th Streets	From DAS to Eastgate	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
13	31st	From 41st/Peoria to Eastgate	**60 min**	6 hrs	**60 min**	8 hrs	60 min	13 hrs
14	61st/41st	From 61st/Peorial to The Promenade Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
15	West Tulsa/71st Street	From 49th/Jackson to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
16	Southeast Tulsa	From Woodland Hills Mall to St Francis Hosp. South	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
17	Jenks Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
18	Sand Springs	From DAS to Sand Springs Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
19	North Tulsa Circulator	From 61st Street N to TCC NE	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
TBD	BA Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
902	BA Express	From B.A. to Downtown Tulsa	4 Trips	-	-	-	-	-
909	Union Express	From Union HS to Downtown Tulsa	2 Trips	-	-	-	-	-

A comparison of the existing and Alternative B networks is shown in Figure 4-10.

Figure 4-10. Comparison of Existing Weekday Daytime and Alternative B Coverage



Saturday Daytime

The proposed Saturday daytime network is based on the weekday daytime network and will have consistent headways across all routes. Current Saturday service headways vary from 45 to 120 minutes. The proposed network will operate all routes at 60-minute headways except for the Peoria AERO BRT, which is assumed to operate every 20 minutes[10]. During the draft recommendations stage the Saturday daytime network was assumed to be Alternative A Frequency. However, a final determination of this network was made with the final recommendation (see Chapter 5).

Night/Sunday

The existing night/Sunday network had several large, one direction loops which are generally inefficient particularly from a customer mobility standpoint. Additionally, these routes only had a few trips and did not generally reflect the same service during the daytime.

The public overwhelmingly supported the idea that the night/Sunday network should reflect the daytime route structure instead of changing to the different routes (the 800-series routes). Using daytime routes has the benefit of making the night/Sunday network easier to understand as riders do not have to memorize a new set of routes to travel at night and on Sundays.

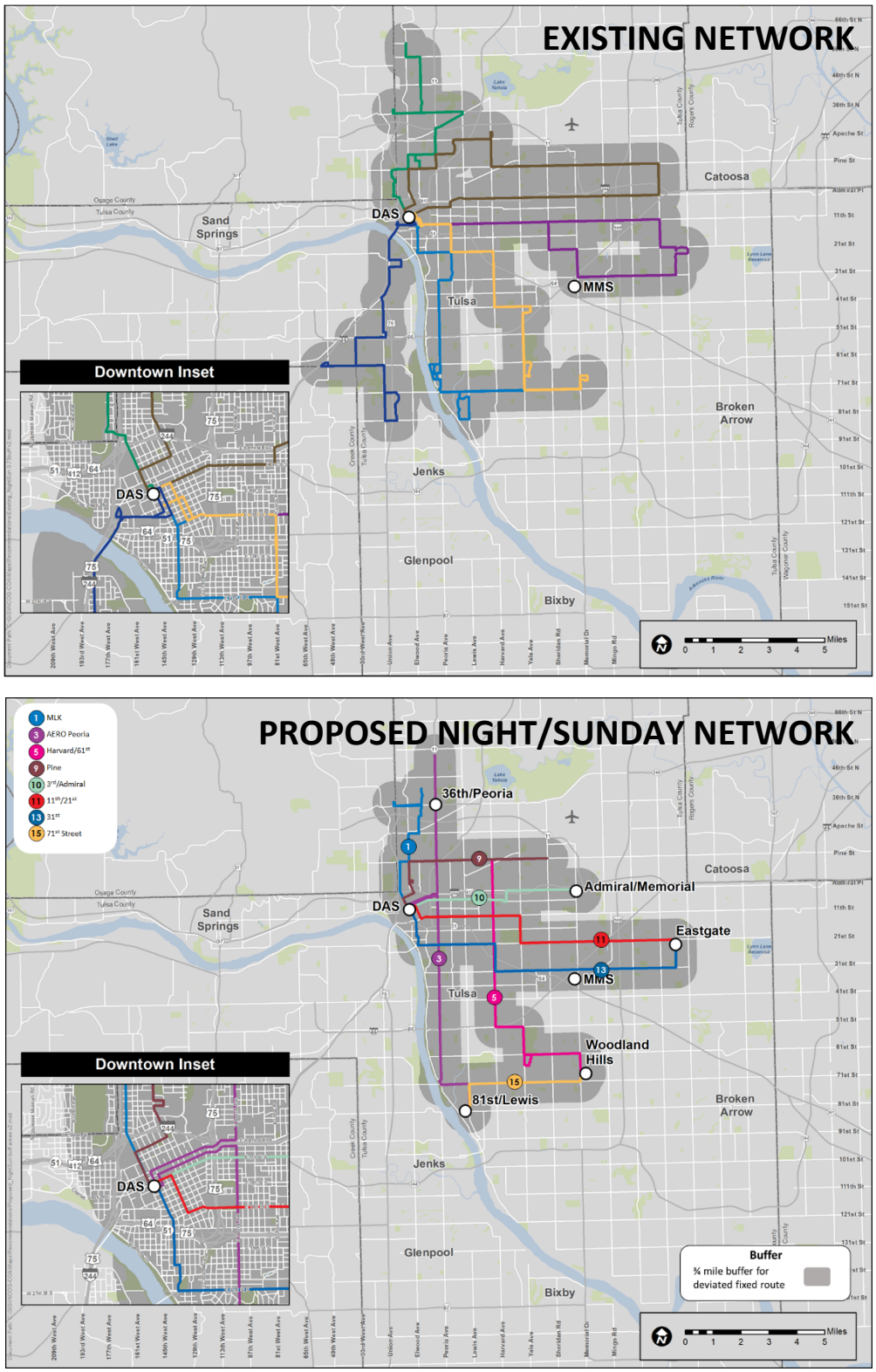
As a result, the revised night/Sunday network uses a limited set of daytime routes, including routes 1, 3, 5, 9, 10, 11, 13, and 15. The proposed network is centered around the new Peoria AERO BRT which will run into the evening with 20-minute frequency service. The remaining routes would operate once an hour for three trips each evening. Users can depend on the same routing at night and on Sundays as they do during other days and times of the week. Further, these routes will now have consistent headways throughout the evening. Finally, the proposed network can scale up with more routes as additional funding is identified. Thus, a long-term goal of Tulsa Transit would be to grow the night/Sunday network to mirror the full daytime network.

Table 4-3. Night/Sunday Route Summary

			Weekday Night		Saturday Night		Sunday	
Number	Name	Description	Headway	Span	Headway	Span	Headway	Span
1	MLK	From Dream Center (46th Street N) to DAS	60	3 hrs	60	3 hrs	60	10 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	20	3 hrs	20	3 hrs	20	14 hrs
5	Harvard/61st	From Harvard/Admiral to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs
9	Pine/Memorial	From DAS to Pine/Sheridan	60	3 hrs	60	3 hrs	60	10 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60	3 hrs	60	3 hrs	60	10 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
13	31st	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
15	71st Street	From 81st Walmart to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs

[10] Some frequencies for Peoria AERO BRT are yet to be determined. An assumption was made for this document, but it could change as Tulsa Transit gets closer to implementation.

Figure 4-11. Comparison of Existing and Proposed Night/Sunday Network

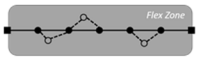
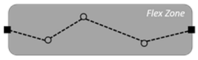
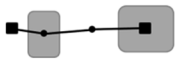
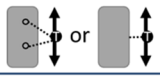
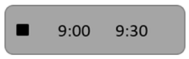
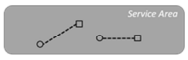
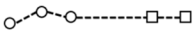
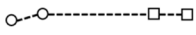


Alternative Service Delivery Options

A review of existing service productivities (see Chapter 3) show some routes on the edge of the metropolitan area suffer from low utilization, particularly in Broken Arrow and Jenks. While these areas are important to serve, the question is whether alternative service delivery beyond fixed route service is possible.

To that end the study team took a detail look at alternative service delivery options, as summarized in Table 4-4. Service to Jenks and Broken Arrow could potentially be satisfied using one or more of the options outlined in the table. Each city pays Tulsa Transit to operate service. Therefore, any change or recommendation to serve these areas would require discussion with local decision makers. As such, no draft recommendations are made within this section of the Connecting Progress Plan.

Table 4-4. Alternative service delivery options

Delivery Model	Illustration	Description
Deviated Fixed Route		Regular schedule operating along path, with or without marked bus stops, deviating to serve on-demand zone
Point Deviation		Serves on-demand requests in a zone, but also serves a small number of stops in the zone, following no regular path
Flexible Route Segments		Conventional fixed route, fixed schedule, but switches to on-demand operation for a limited portion of route
Demand Response Connector		On-demand mode within a zone, with one or more scheduled transfer points to a fixed-route network or rail station
Zone Route		Operates in on-demand mode within a zone with established departure and arrival times at one or more established locations.
Taxi / TNC / Dial-a-Ride		Provides point-to-point on-demand service within a defined zone with no fixed timepoints. Can be operated as sequential or concurrent trip sharing.
Private Shuttles / Microtransit		Traditional private shuttles provide limited stops, only picking up specified riders. Microtransit provides pooled on-demand service within defined zone using dynamic routing based on demand.
Vanpools / Ridesharing / Ridesplitting		Passengers share private trip from common origins to common destinations. Ridesplitting incorporates mobile app to match drivers to passengers.

Evaluation Measures

Once a draft recommendation was identified, the study team evaluated the proposal using several measures to determine how it compares with the existing Tulsa Transit network. These measures included the number of route connections, route frequencies, travel time comparisons, service area coverage and demographic measures.

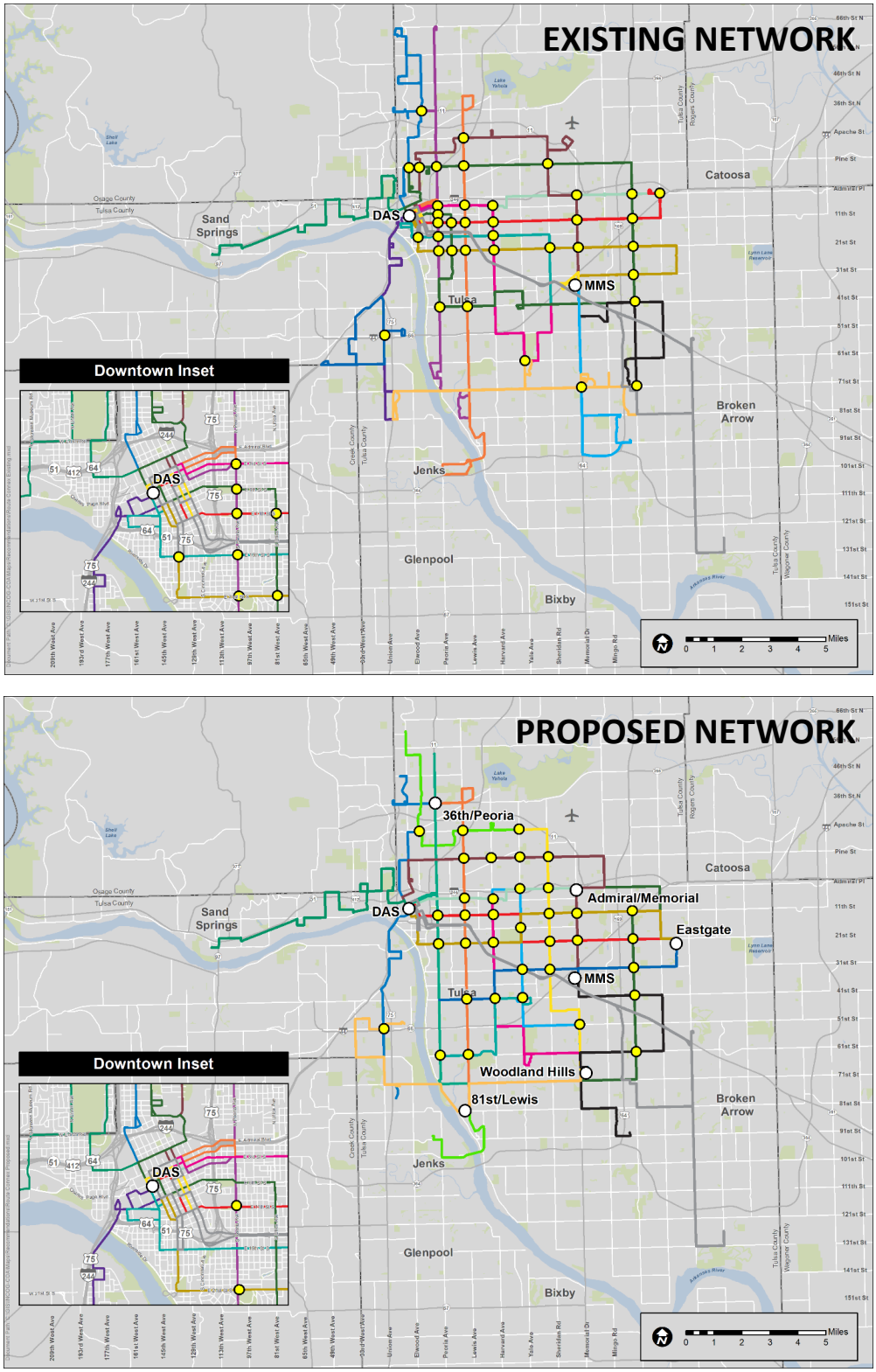
Route Connections

One of the potential benefits of the proposed network alternatives is a decentralized network of connections to other routes possible because of the simplified restructuring of routes along corridors. While most of transfers will occur at DAS, MMS, or one of the other subhubs due to timed connections, the ability to transfer at an intersection will be important to facilitate movement throughout the city.

A comparison of the distribution of transfer locations between existing and proposed can be seen with Figure 4-12. Overall the same number of connections is featured in the existing and proposed networks. The big difference is in location. Route connections for the existing network are grouped primarily in Midtown/Pearl District area of Tulsa because of the number of routes concentrated in this area. So even if riders want to transfer outside of DAS, they still must travel very close to downtown to connect in the existing system.

Conversely, connections for the proposed network (for this evaluation Alternative A is used), are dispersed more evenly and at regular intervals along major arterials. This distribution means riders can be more efficient in their transfer instead of traveling close to downtown, an obvious improvement over existing.

Figure 4-12. Comparison of Existing and Proposed Route Connections



Frequency

Frequency is one of the primary indicators of a rider's ability to move successfully through the network since it determines how soon one can catch a bus or make a connection. The existing weekday daytime network is shown in Figure 4-13. Most of the routes have peak frequencies of every 45 minutes, with routes 100, 101, 105 and 251 operating every 30 minutes.

Frequencies for the proposed weekday daytime networks are shown in Figure 4-14 for Alternative A Frequency and Figure 4-15 for Alternative B Coverage. While most routes have shifted to every 60 minutes (instead of every 45 minutes), the change allows for timed connections at the subhubs and allows for some of the savings to be reallocated into improvements elsewhere in the network.

Existing Saturday daytime frequencies are shown in Figure 4-16 below. Most routes operate with varying frequency (the blue 75-minute to 135-minute category). It is particularly problematic because there is no standard frequency, meaning routes rarely connect in a timed fashion. The highest frequency routes are 101, 105, 418 and 251, each operating every 45-minutes.

Saturday daytime frequencies are proposed to be every 60 minutes across all routes except for the Peoria AERO BRT. This would be a large improvement from existing, providing consistency and timed connections across the network. The proposed Saturday daytime frequency is shown in Figure 4-17 (for Alternative A). Alternative B would have identical Saturday frequency improvements but a slightly different route structure with extensions of the Harvard and Yale routes to TCC Northeast instead of Admiral Place.

Figure 4-13. Peak Frequency for Existing Weekday Daytime Network

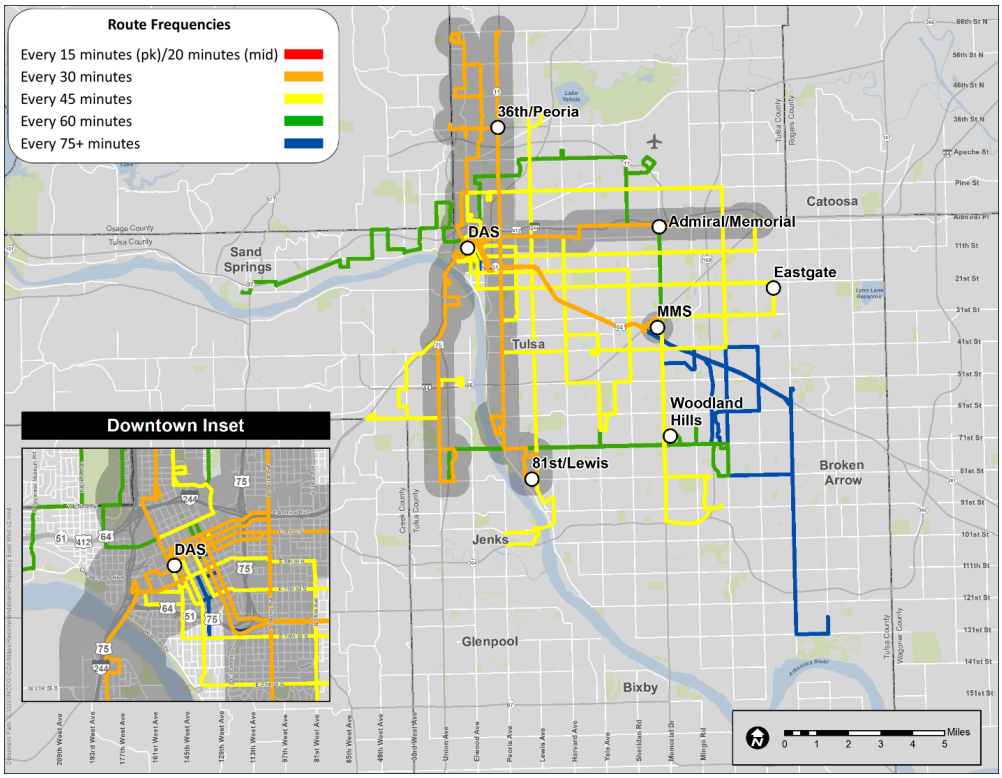


Figure 4-14. Peak Frequency for Proposed Alternative A Frequency Daytime Network

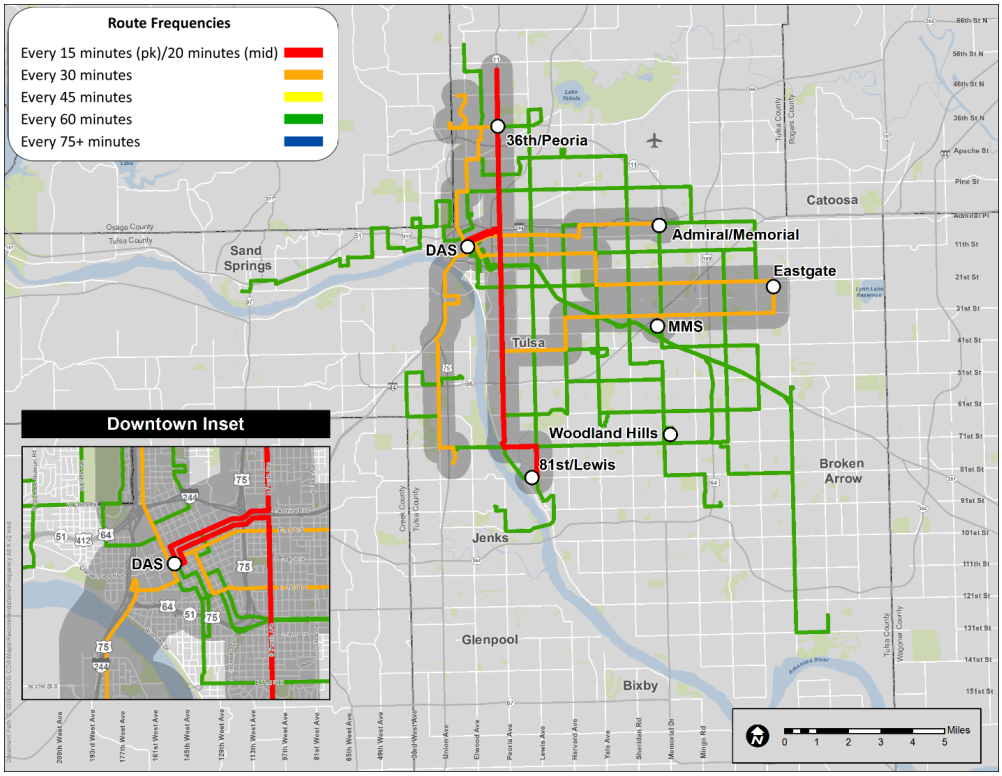


Figure 4-15. Peak Frequency for Proposed Alternative B Coverage Daytime Network

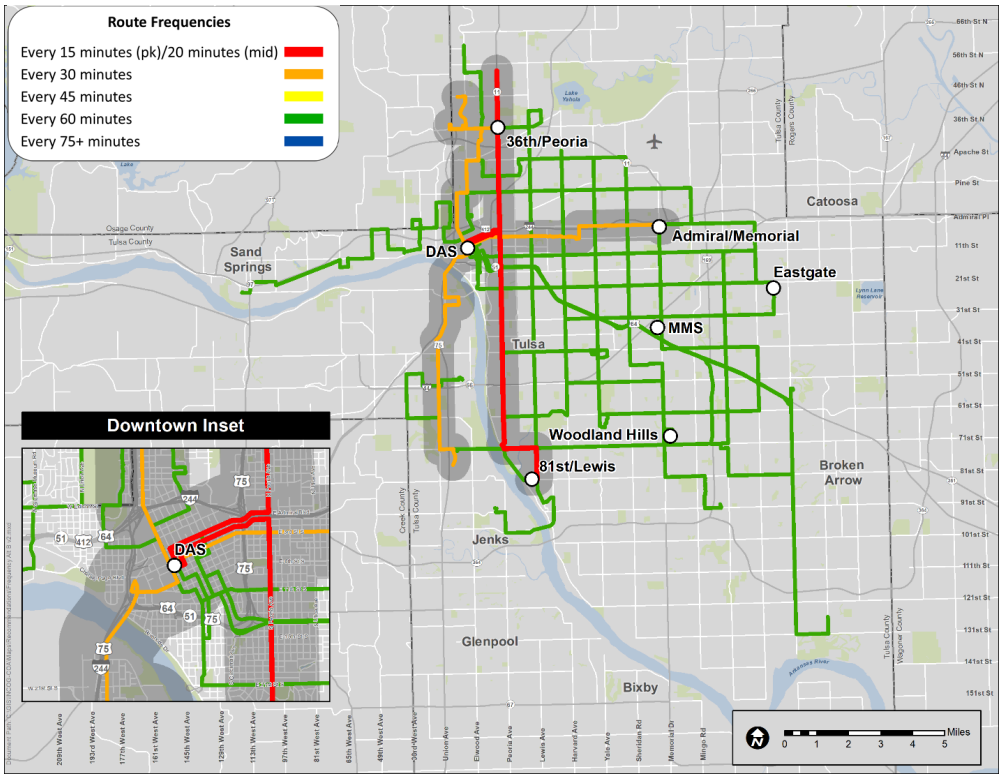


Figure 4-16. Frequency for Existing Saturday Daytime Network

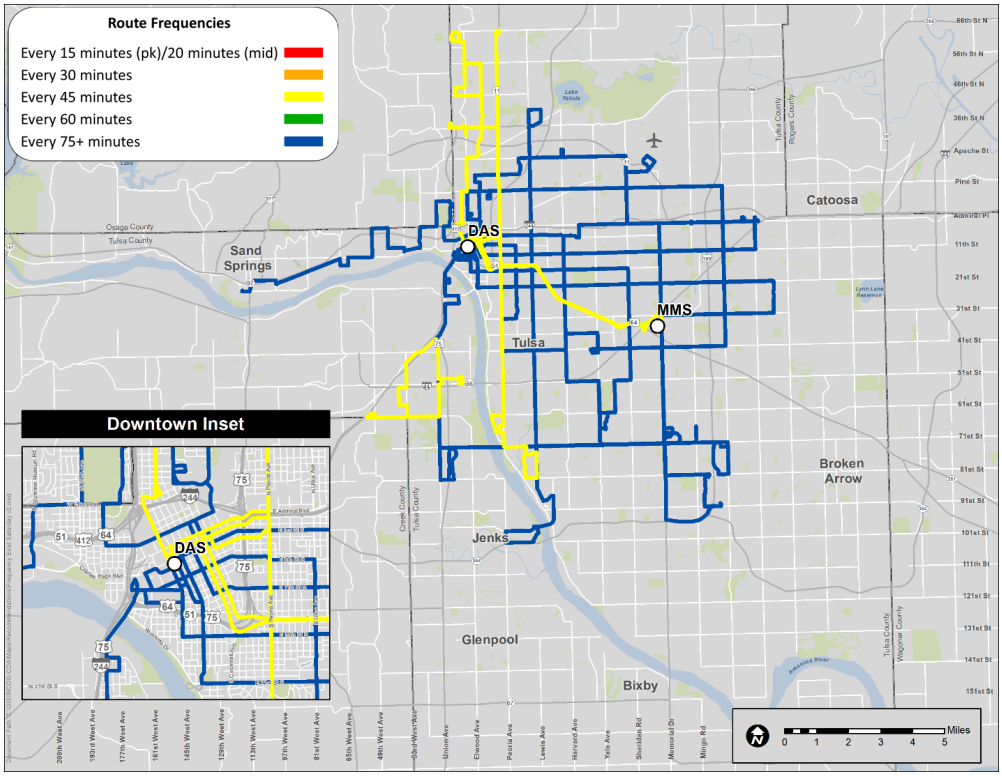
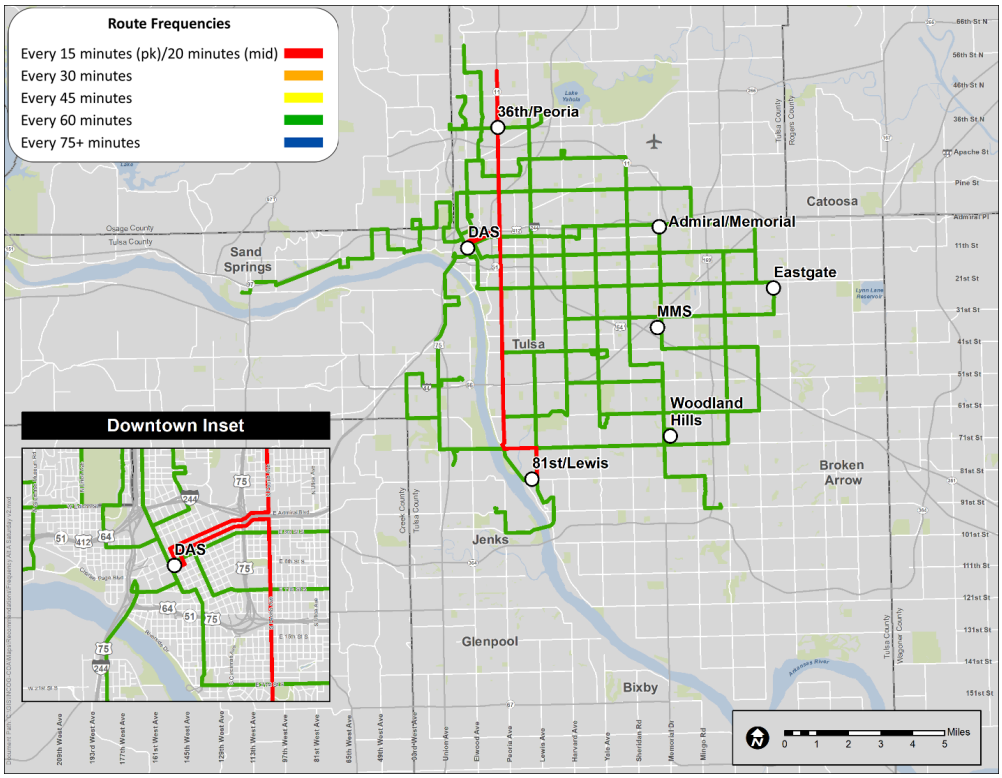


Figure 4-17. Frequency for Proposed Saturday Daytime Network



Note: Alternative A used for this map. Alternative B has the same proposed Saturday daytime frequencies by route.

Travel Time Comparisons

One of the benefits of the restructured network is improvements to frequency and connectivity, which in turn should result in travel time savings for riders. To evaluate this improvement, the study team selected ten important locations (five origins and five destinations) in Tulsa, including:

Origins	Destinations
E. 46th St. N. / Martin Luther King, Jr. Blvd.	E. Admiral Pl. / S. Memorial Dr.
N. Lewis Ave. / E. Pine St.	E. 41st St. / S. Yale Ave.
E. 21st St. / S. Garnett Rd.	Woodland Hills Mall
E. 61st St. / S. Peoria Ave.	E. 11th St. / S. Utica Ave.
W. 61st St. / S. Union Ave.	Tulsa Hills Shopping Center

Travel times were estimated for both existing and proposed conditions to determine the difference and expected improvement with the recommended network. Existing travel times between these locations were determined using Google Maps directions since Tulsa Transit headways and scheduled times are available online and wait and walk times are built into the directions. An 11 a.m. travel time was assumed for existing directions.

For the proposed networks, additional assumptions had to be made to estimate future times. The assumptions included:

- All travel occurs at 11 a.m. on a weekday
- No wait time occurs at beginning (i.e., rider uses schedule before leaving house)
- Average travel speeds were used for in-vehicle travel
- Wait times were assumed to be half of the proposed headway at intersections and 5 minutes for timed transfers at DAS/MMS/subhubs.

A total of 25 combinations were evaluated using all pairs of the origins and destinations listed above. Of the 25 pairs, 22 resulted in travel time savings while three did not. Table 4-5 shows the existing, proposed and difference in travel times for both daytime alternatives. Alternative A Frequency saves 388 total minutes, an average of 16 minutes per one-way trip. Alternative B Coverage is slightly worse (due to less frequent east-west service on 11th/21st and 31st corridors). Nevertheless, Alternative B has a very good improvement over existing, with 358 total minutes saved and an average of 14 minutes per one-way trip.

Service Coverage

Besides service frequency, service coverage is another important issue because riders must be able to connect to destinations in all parts of the metropolitan area. To evaluate the amount of coverage between existing and the proposed networks, a half-mile buffer was created around existing and proposed networks, and the result was mapped. Figure 4-18 and Figure 4-19 show proposed weekday daytime and night/Sunday service coverage areas, respectively. The color scheme shows areas that will continue to be served with the new network (purple), areas that will gain service (blue), and areas that will lose service (red). A fourth color (yellow) represents area served in Alternative B Coverage but not in Alternative A Frequency.

The weekday comparison shows that most of the lost area is on the far fringes of the service area, while gains tend to be along 61st Street, where additional service is added as part of the hybrid grid scheme employed by the daytime network.

The night/Sunday map uses the same color scheme. The night/Sunday network is proposed to lose service area in a few places. West Tulsa would lose service on Southwest Boulevard and Union Avenue, while eastern parts of Pine Avenue and Admiral Plan are also part of lost area. Areas gained include parts of 21st and 31st streets. Because the night and Sunday networks will feature bi-directional service (instead of long one-way segments) the recommended network is expected to be more reliable, consistent for existing and potential riders.

Table 4-5. Travel Time Evaluation

Existing		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	60 min	104 min	84 min	76 min	74 min
	Lewis/Pine	45 min	58 min	66 min	31 min	59 min
	21st/Garnett	34 min	36 min	59 min	41 min	107 min
	61st/Peoria	57 min	56 min	40 min	30 min	49 min
	61st/Union	87 min	85 min	96 min	58 min	9 min

Existing		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	60 min	104 min	84 min	76 min	74 min
	Lewis/Pine	45 min	58 min	66 min	31 min	59 min
	21st/Garnett	34 min	36 min	59 min	41 min	107 min
	61st/Peoria	57 min	56 min	40 min	30 min	49 min
	61st/Union	87 min	85 min	96 min	58 min	9 min

Alt A Frequency		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	85 min	61 min	83 min	43 min	61 min
	Lewis/Pine	25 min	56 min	62 min	28 min	51 min
	21st/Garnett	20 min	51 min	26 min	25 min	58 min
	61st/Peoria	54 min	20 min	38 min	34 min	28 min
	61st/Union	53 min	62 min	45 min	37 min	7 min

Alt B (Coverage)		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	85 min	61 min	83 min	43 min	61 min
	Lewis/Pine	25 min	56 min	62 min	28 min	51 min
	21st/Garnett	20 min	51 min	26 min	25 min	58 min
	61st/Peoria	54 min	20 min	38 min	49 min	28 min
	61st/Union	53 min	77 min	45 min	37 min	7 min

Difference (Alt A - Existing)		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	25	(43)	(1)	(33)	(13)
	Lewis/Pine	(20)	(2)	(4)	(3)	(8)
	21st/Garnett	(14)	15	(33)	(16)	(49)
	61st/Peoria	(3)	(36)	(2)	4	(21)
	61st/Union	(34)	(23)	(51)	(21)	(2)

Difference (Alt B - Existing)		Destination				
		Admiral/ Memorial	41st/ Yale	Woodland Hills	11th/ Utica	Tulsa Hills
Origin	46th/MLK	25	(43)	(1)	(33)	(13)
	Lewis/Pine	(20)	(2)	(4)	(3)	(8)
	21st/Garnett	(14)	15	(33)	(16)	(49)
	61st/Peoria	(3)	(36)	(2)	19	(21)
	61st/Union	(34)	(8)	(51)	(21)	(2)

Figure 4-18. Service Coverage Change for Weekday Daytime

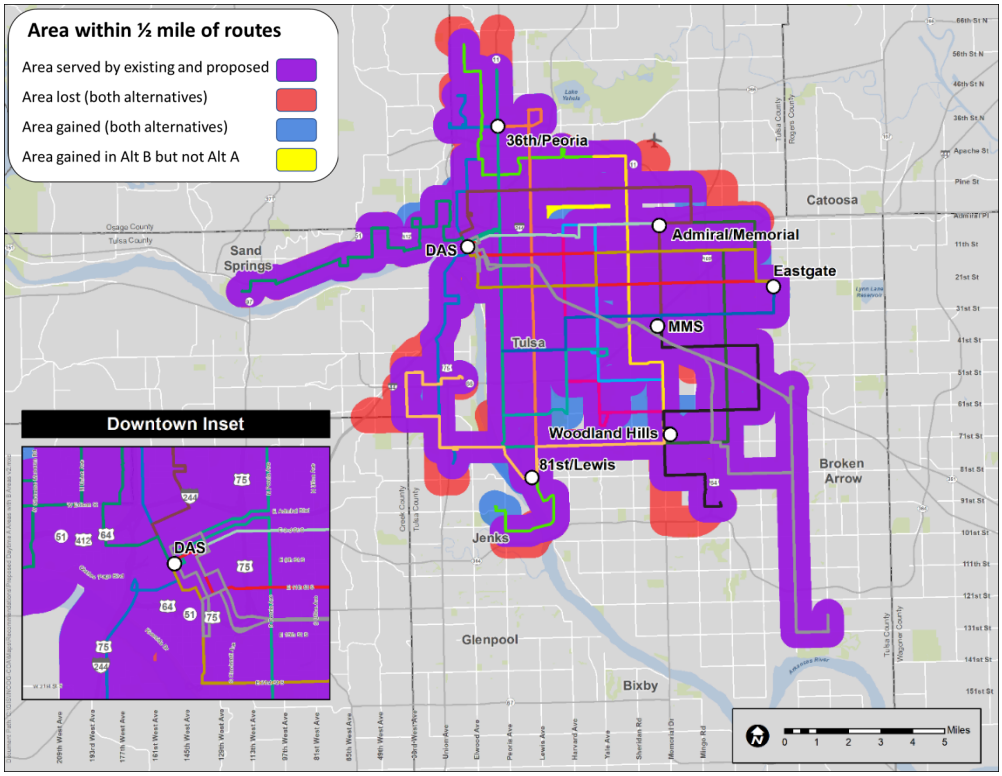
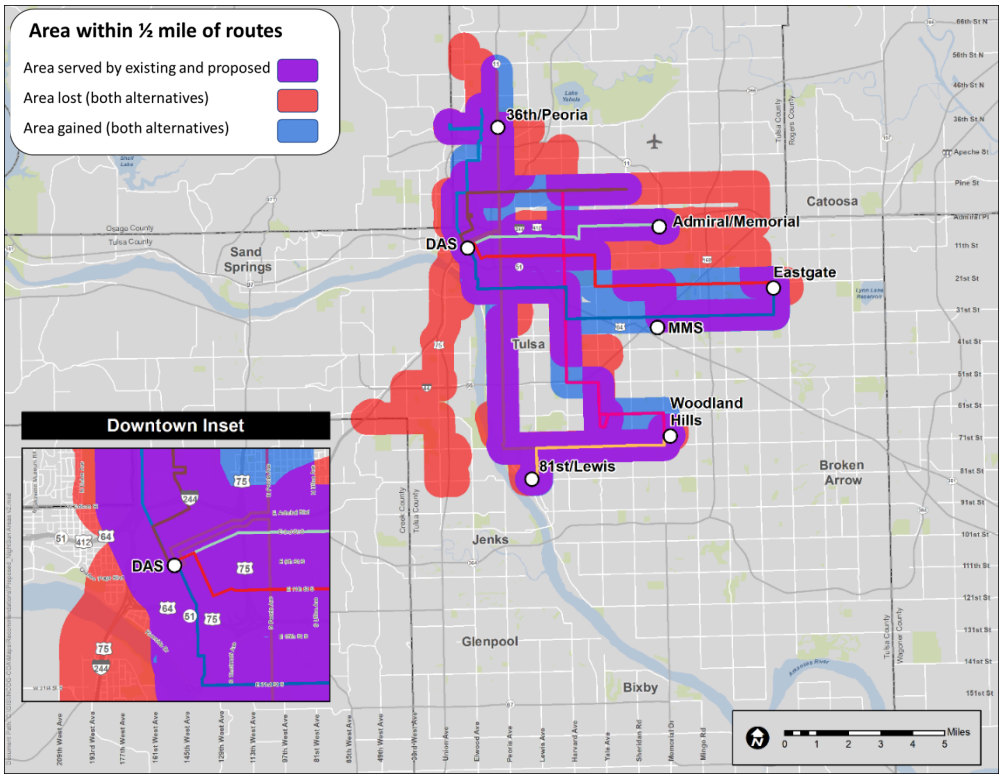


Figure 4-19. Service Coverage Change for Night/Sunday



Evaluation Tables

Evaluation measures (including those discussed in the preceding sections) were assembled into tables to summarize the differences between the existing and proposed networks. Measures included population, employment, service area coverage, ridership served (based on the APC data collection effort of 2017), and the number of corridors with improved frequencies.

Weekday daytime evaluation measures are compiled in Table 4-6. The evaluation shows the draft networks (both Alternative A Frequency and Alternative B Frequency) compare favorably to the existing. While most measures are slightly lower than existing, population, employment, coverage area, and existing ridership still serve 95% or greater of existing. Coupled with the advantages in connectivity and travel time improvement, and the weekday daytime network is an improvement for Tulsa Transit users.

Night/Sunday measures are shown in Table 4-7. The night/Sunday measures show a decrease over existing. While the proposed network only covers 73% of the existing service area, 92% of population is served and 89% of employment is served. As with daytime, the benefits of the revised network coupled with these evaluation measures indicate this network is an improvement for Tulsa Transit users.

Table 4-6. Weekday Daytime Evaluation Summary

		Alt A Frequency		Alt B Coverage	
Weekday Daytime	Existing	Measure	Change from existing	Measure	Change from existing
Service Area (sq mi)	145	138	95%	138	95%
Route Miles	222	214	96%	219	98%
Daily Ridership Served	16,203	16,052	99%	16,052	99%
Total Population Served	372,788	369,043	99%	370,323	99%
Total Employment Served	281,649	273,718	97%	274,021	97%
Average travel time (25 trip pairs)	60 min	44 min	-27%	46 min	-23%
Corridors with 30-minute or better frequency	4	6	50%	4	0%
Population within 1/2 mile of 30-minute or better corridor	106,733	165,071	55%	94,856	-11%

Table 4-7. Night/Sunday Evaluation Summary

Night/Sunday	Existing	Proposed	Change from existing
Service Area (sq mi)	80	59	73%
Route Miles	95	80	84%
Daily Ridership Served	313	256	82%
Total Population	222,568	203,873	92%
Total Employment	174,871	155,798	89%

4.4 Other Analyses

Three related topics – performance standards, flag stops, and stop amenities – were addressed in conjunction with the goals of the study. These topics are examined in this section. Policy recommendations are included in section 5.3 of Chapter 5.

Performance Standards

Transit performance standards help establish a measure of efficiency as well as the level of demand for service that is provided. These standards will help inform Tulsa Transit when making decisions – both to invest in additional service on productive routes or to remove service from routes deemed inefficient or unpopular.

The data that forms the initial baseline performance standards come from the APC data collection effort in late 2017. Five metrics were identified for this analysis. Three are indicators of service productivity, including passengers per revenue hour, passengers per revenue mile, and passengers per trip. The other two, net cost per passenger and farebox recovery, indicate financial productivity.

Each metric was calculated by first taking the average across all routes, then calculating the standard deviation. The identified performance standard is one standard deviation removed from the average. By using this method, the performance measures consider clustering of data. Thus, any route that falls below the identified standard is truly an outlier that needs consideration.

The metrics have been calculated by day and by time, as shown in Table 4-8. Further discussion of a performance standard policy is discussed in Chapter 5.

Table 4-8. Tulsa Transit Proposed Performance Standards

	Weekday Daytime	Saturday Daytime	Weekday Night	Saturday Night	Sunday
Passengers per Revenue Hour	12.9	12.4	4.9	5.7	5.9
Passenger per Revenue Mile	0.79	0.75	0.32	0.28	0.35
Passengers per Trip	9.8	9.1	5.2	4.6	5.2
Net Cost per Passenger	$9.57	$12.37	$8.71	$7.41	$10.29
Farebox Recovery	5.0%	3.8%	2.2%	2.7%	-

Flag Stop Analysis

Current Tulsa Transit policy is that flag stops are allowed. That is, passengers can board or alight the vehicle anywhere along the alignment regardless of the presence of an official designated stop, simply by waving down the approaching bus. Official agency policy stipulates flag stops should be located at least one city block away from a marked stop. In reality flag stops are utilized by passengers in many places, some just feet from marked locations.

A flag stop analysis was performed using ridership data collected in late 2017 and documented in Chapter 3. This data collected included the time bus doors were open as well as the geographic coordinates of each stop. This allowed the consultant team to review the average time doors were open at designated stops as well as at locations more than 250 feet away from a stop which indicated a likely flag stop.

The flag stop heat map for the entire Tulsa Transit service area is shown in Figure 4-20. Downtown Tulsa was excluded from the visualization of this data since flag stops were found to be unusually prevalent in the downtown core.

The evaluation of the flag stop policy is one of access versus operational and safety improvement. The currently policy certainly improves rider access because riders can get on and off closest to their desired location. However, all other arguments are against the policy. First, the policy requires additional time in the schedule of each route to accommodate unexpected stops. Relatedly, flag stops also add greater travel time variability. Flag stops place additional safety demands on operators. Operators must look for flag stop riders (among their other duties). When a flag stop is requested the operator must then find a safe place to stop. There is also the consideration of trailing vehicles who may not be paying attention when the bus halts for a flag stop.

Eliminating the use of flag stops would have the potential benefits of improved driver and customer safety, a more predictable and streamlined customer experience, improved scheduling of bus routes and better on-time performance. An official policy recommendation is part of Chapter 5 of this document.

Stop Amenity Analysis

Tulsa Transit currently has approximately 283 shelters deployed across the service area. As ridership has shifted, some stops may now have underutilized shelters and others may be overwhelmed. Knowing where these locations are will help Tulsa Transit redeploy shelters to where they are most needed, particularly at subhubs expected to have timed transfers.

An analysis on shelter locations and their associated ridership was conducted by matching ridership data with the stop amenity database provided by Tulsa Transit. The result of this analysis is shown in Table 4-9. Stops were divided into six categories using ridership thresholds found in Chapter 3. The analysis shows that the highest ridership stops tend of have shelters, but this percentage decreases with each lower threshold. For example, 94% of stops with more than 75 daily boardings have shelters, but this number drops to 64% for stops with 40-74 daily boardings. Thus, Tulsa Transit and riders could benefit from targeting higher use stops for shelters and removing shelters from stops with fewer than five boardings per day.

Figure 4-21 displays stops with shelters for those stops seeing daily boardings higher than 15 people and Figure 4-22 shows stops with shelters with fewer than 15 daily boardings. Each map shows the distribution of shelters throughout the existing network. An official policy recommendation for shelters is part of Chapter 5 of this document.

Table 4-9. Shelter Analysis by Stop Boardings

Boardings	Shelter	No Shelter	Total	Percentage with Shelter
>75	17	1	18	94%
40-74	7	4	11	64%
15-39	57	49	106	54%
5-14	71	211	282	25%
<5	85	740	825	10%
0	46	691	737	6%

Source: Tulsa Transit, CTG

Figure 4-20. Flag stop heat map analysis

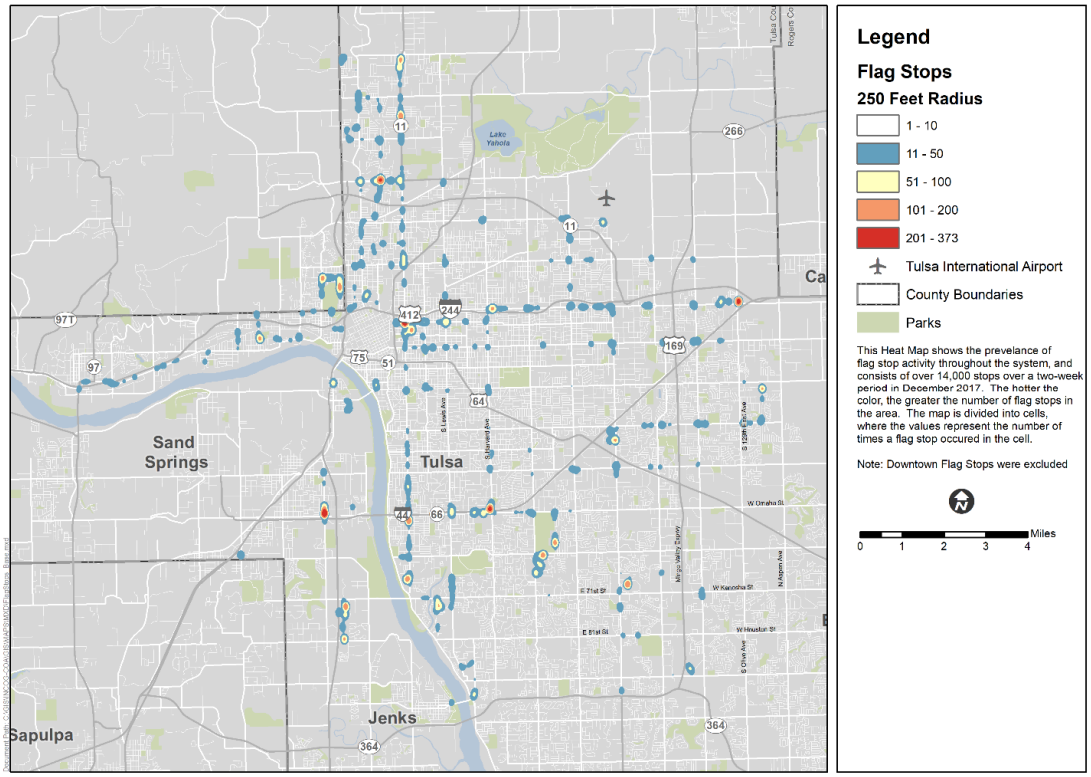


Figure 4-21. Existing shelter locations for stops with 15 or more average daily boardings

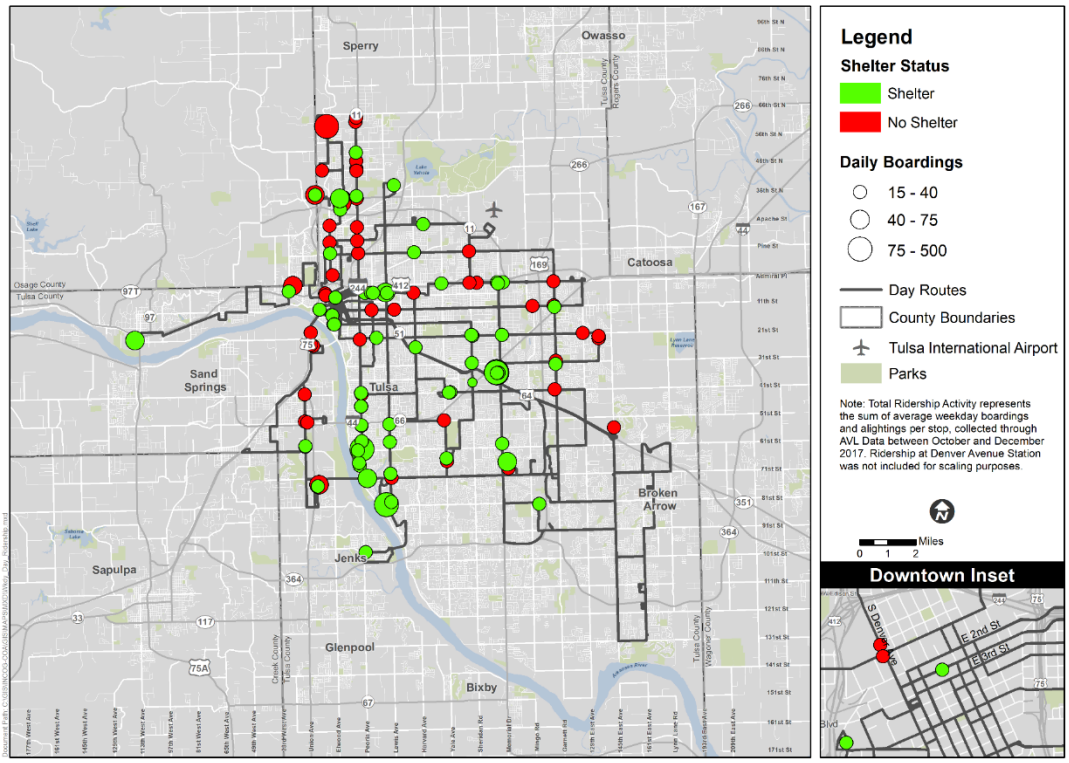
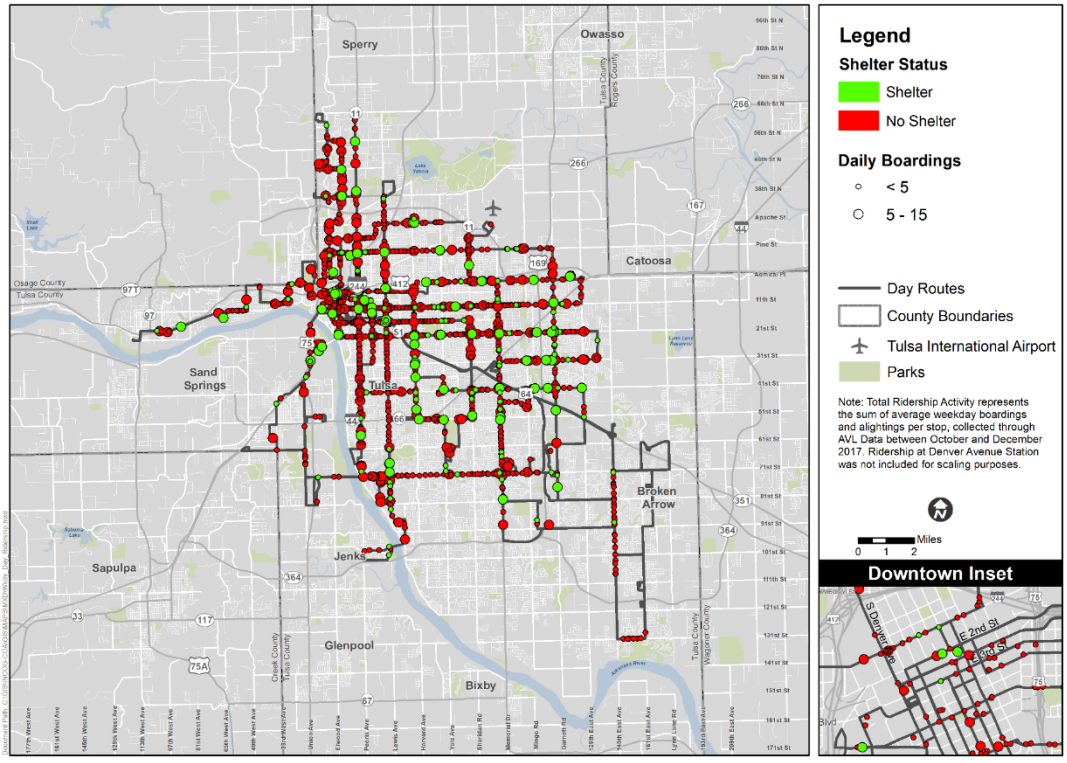


Figure 4-22. Existing shelter locations for stops with 14 or fewer average daily boardings



Chapter 5 Recommended Plan

Chapter 5 presents the Connecting Progress recommended plan for restructuring the Tulsa Transit bus network. The recommendations herein are based on the analysis work completed in Chapter 4 and include updates to recommendations based on public and staff comments. This work led to two main recommendations for the plan: a cost-neutral short-term plan to restructure the route network to be implemented in 2019, and a mid-term service expansion plan to be implemented as funding becomes available. A third section of the recommended plan is additional policy recommendations.

5.1 Short-Term Plan

The short-term plan is the recommended restructuring of the Tulsa Transit network. This plan is cost-neutral, that is, it will cost the same to operate as the existing network. Sections below describe the weekday daytime, Saturday daytime, and night/Sunday recommendations.

Weekday Daytime

After careful review of all public comments, Tulsa Transit staff recommends the final weekday daytime network based on Alternative A Frequency. The ability to provide 30-minute headways on the 11th/21st and 31st corridors was important to the study team and public comments favored this alternative as well. The recommended network will improve travel times for many people traveling east-west within the system.

One adjustment was made to the network for the short-term plan. Alignments for Route 1 MLK and Route 19 North Tulsa Circulator were swapped to make Route 1 more direct, with the circulator picking up the connection to the Dream Center and Route 1 operating on MLK to 61st Street.

Figure 5-1 and Table 5-1 summarize the recommended weekday daytime network. Appendix 5A presents individual route maps for the recommended daytime network.

Saturday Daytime

The Saturday daytime network is based on the weekday daytime network, but with 60-minute headways for all routes except Peoria AERO BRT, which would operate every 20 minutes. The headways are a major improvement over existing Saturday service, as is the operation of all routes, which provides consistency to passengers who are used to Saturday service being a lower priority in the operation. Figure 5-2 and Table 5-1 summarize the recommended Saturday daytime network.

Figure 5-1. Recommended Weekday Daytime Network

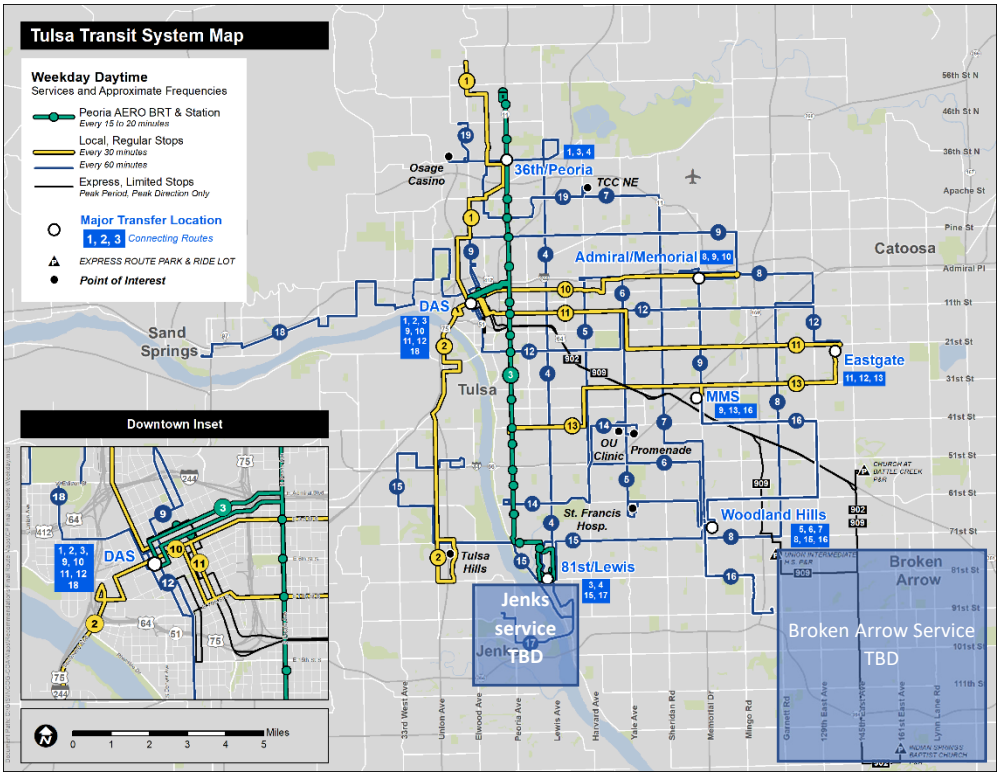
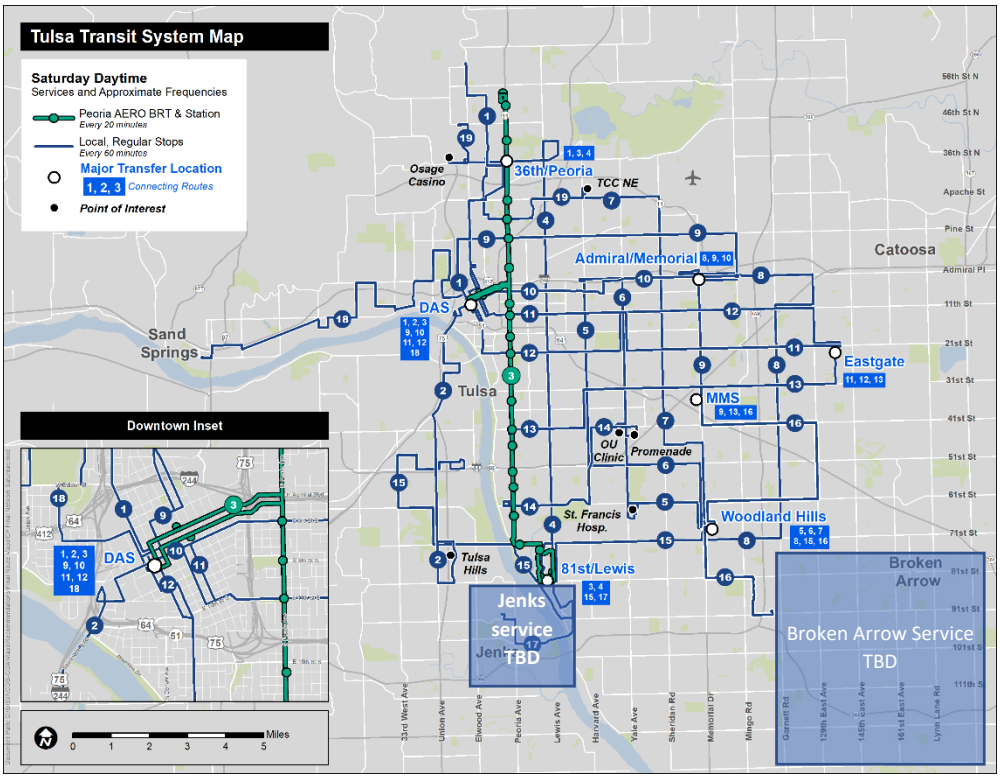


Figure 5-2. Recommended Saturday Daytime Network



Night/Sunday

The recommended night/Sunday network is proposed to operate a limited set of daytime routes in the night and Sunday time periods. Feedback from the public overwhelmingly supported this approach instead of the current operation of different routes (i.e., the Nightline or 800-series routes). The proposed night/Sunday network would operate at 60-minute headways for three hours each weekday and Saturday night, and at 60-minute headways for 10 hours each Sunday. Peoria AERO BRT will serve as a spine throughout all service periods, operating at a higher frequency and facilitating north-south movement through the system.

There are two minor changes to the routes that are different than their daytime counterparts:

- Route 9 would terminate at Pine/Sheridan instead of continuing to MMS
- Route 13 would operate to DAS via 21st Street and Cheyenne/Boulder pair into and out of downtown Tulsa. In addition, Route 13 would not stop at MMS at night because there would be no connecting routes at this location.

Figure 5-3 shows the proposed system map for night/Sunday, while Table 5-2 details the headways and span for each time period.

Figure 5-3. Recommended Night/Sunday Network

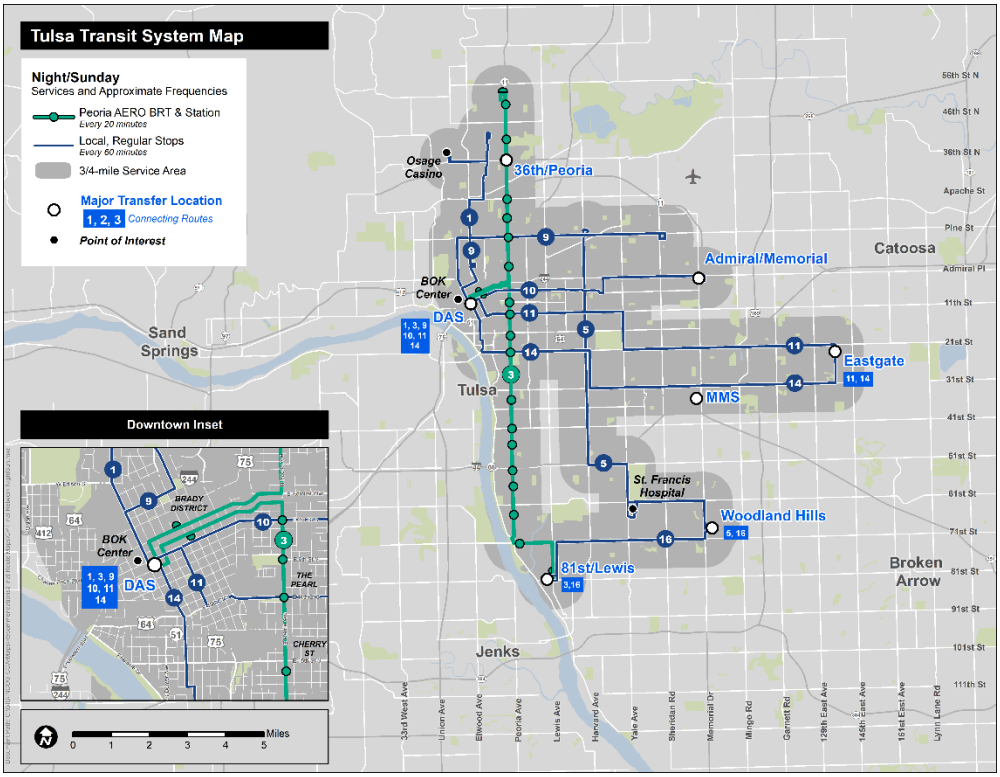


Table 5-1. Daytime Network Summary

Number	Name	Description	Weekday Peak		Weekday Offpeak		Saturday	
			Headway	Span	Headway	Span	Headway	Span
1	MLK	From 61st Street N to DAS	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
2	Southwest Blvd	From DAS to Tulsa Hills	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	15 min	6 hrs	20 min	8 hrs	20 min	13 hrs
4	Lewis	From 36th Street N/Hartford to 81st Street Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
5	Harvard/61st	From Harvard/Admiral to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
6	Yale/51st	From Harvard/Admiral to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
7	Sheridan	From TCC NE to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
8	Garnett	From Admiral/Memorial to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
9	Pine/Memorial	From DAS to MMS	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
12	21st/11th Streets	From DAS to Eastgate	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
13	31st	From 41st/Peoria to Eastgate	30 min	6 hrs	30 min	8 hrs	60 min	13 hrs
14	61st/41st	From 61st/Peorial to The Promenade Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
15	West Tulsa/71st Street	From 49th/Jackson to Woodland Hills Mall	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
16	Southeast Tulsa	From Woodland Hills Mall to St Francis Hosp. South	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
17	Jenks Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
18	Sand Springs	From DAS to Sand Springs Walmart	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
19	North Tulsa Circulator	From Dream Center (46th Street N) to TCC NE	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
20	BA Circulator	TBD	60 min	6 hrs	60 min	8 hrs	60 min	13 hrs
902	BA Express	From B.A. to Downtown Tulsa	4 Trips	-	-	-	-	-
909	Union Express	From Union HS to Downtown Tulsa	2 Trips	-	-	-	-	-

Table 5-2. Night/Sunday Network Summary

Number	Name	Description	Weekday Night		Saturday Night		Sunday	
			Headway	Span	Headway	Span	Headway	Span
1	MLK	From 46th Street N to DAS	60	3 hrs	60	3 hrs	60	10 hrs
3	Peoria AERO BRT	From 56th Street N to 81st Walmart	20	3 hrs	20	3 hrs	20	14 hrs
5	Harvard/61st	From Harvard/Admiral to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs
9	Pine/Memorial	From DAS to Pine/Sheridan	60	3 hrs	60	3 hrs	60	10 hrs
10	3rd/Admiral	From DAS to Admiral Walmart	60	3 hrs	60	3 hrs	60	10 hrs
11	11th/21st Steets (future BRT)	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
13	31st	From DAS to Eastgate	60	3 hrs	60	3 hrs	60	10 hrs
15	71st Street	From 81st Walmart to Woodland Hills Mall	60	3 hrs	60	3 hrs	60	10 hrs

Span for Table 5-1 and Table 5-2 are generally assumed to be the following:

- Weekday Peak: 6:00 – 9:00 a.m.; 4:00 – 7:00 p.m.
- Weekday Offpeak: 5:00 – 6:00 a.m.; 9:00 a.m. – 4:00 p.m.
- Saturday Daytime: 6:00 a.m. – 7:00 p.m.
- Weekday Night: 7:00 – 10:00 p.m.
- Saturday Night: 7:00 – 10:00 p.m.
- Sunday: 8:00 a.m. – 6:00 p.m.

Outer Area Alternative Service Delivery

Two areas were identified as being prime candidates for alternative service delivery – Jenks and Broken Arrow. A final recommendation for either is not made within this document because it will ultimately require additional discussion and sign-off from each city. Thus, each is discussed below as a potential recommendation.

Jenks

Route 112 currently serves Jenks , which extends south from the 81st/Lewis Walmart into Jenks. During this study, Tulsa Transit staff indicated a desire to separate Jenks service from the rest of the Lewis corridor. This change would then allow Tulsa Transit to tailor the service to better match Jenks land use and destinations by potentially operating as a deviated fixed route service. Therefore, the proposed service is the Jenks Circulator (Route 17), which would start at the 81st/Lewis Walmart and travel south into the city, across Main Street, and end at the Tulsa Tech Riverside Campus. Additional discussion with

Jenks will be required before a change to service would occur. Jenks pays $27,152 annually for its FY2019 service.

Broken Arrow

Service in Broken Arrow is currently provided by Route 508, a weekday-only deviated fixed route service composed of a bidirectional loop route around central Broken Arrow with three different trip patterns throughout the day as well as a 41-square mile flex zone. This route has low ridership and it struggles to maintain on-time service due to the large area in the flex zone. Another issue is that the route is calculated to cost Tulsa Transit approximately $400,000 annually, but Broken Arrow only provides $232,000 in subsidy.

Therefore, a revised service plan is necessary to improve connections both to and through Broken Arrow. Three options for service include:

- Deviated Fixed Route Service
- Demand Response Zone
- TNC-subsidized service

In addition, Tulsa Transit is recommended to only operate service that matches the subsidy provided by Broken Arrow. A $200,000 annual subsidy is equal to operating one bus for weekdays only at a 60-minute headway for 14 hours a day. Broken Arrow's large service area means one bus would not cover all areas. Therefore, Broken Arrow must decide whether to keep the subsidy as is and cover a smaller area or expand the subsidy and the service area. These details are expected to be worked out after the adoption of the Connecting Progress final plan.

Service options are shown in Table 5-3. All services are expected to connect to the rest of the Tulsa Transit network at St Francis Hospital South, where riders could connect to Route 16 Southeast Tulsa.

Table 5-3. Broken Arrow Options

B.A. Options	Route Miles	Area	Days of operation	Headway	Span	Cost
Fixed Route (1 bus)	7.5	-	255	60 min	14 hrs	$200,000
Fixed Route (2 buses)	15.5	-	255	60 min	14 hrs	$400,000
Call-a-Ride Zone (1 bus)	-	6.0 sq mi	255	60 min	14 hrs	$200,000
Call-a-Ride Zone (2 bus)	-	12.0 sq mi	255	60 min	14 hrs	$400,000
TNC subsidy	-	-	255	-	-	$200,000

Cost Analysis

Because additional funds are not available to expand the network, the short-term plan must be cost-neutral. Thus, it can only cost as much as Tulsa Transit currently has to operate the network. There are caveats to this, though. Peoria AERO BRT is to be funded through a combination of existing Tulsa Transit funds and Vision Tulsa funds. Therefore, the cost-neutral approach assumes Peoria AERO BRT is funded separately.

The cost summary for the short-term plan is shown in Table 5-4. Based on existing operating statistics and reported costs, Tulsa Transit's existing network costs $15,038,000 to operate. By removing the cost of the existing route 105 (which will be used to operate the Peoria AERO BRT) and the Broken Arrow contribution (which will be used as part of a revised Broken Arrow service), the total funds available to Tulsa Transit for the revised network is $13,485,000.

Table 5-4. Short-Term Plan O&M Cost Summary

	Daily Weekday	Daily Saturday	Daily Sunday	Totals	Difference	
					Cost	Percentage
Existing	$51,407	$29,968	$7,126	$15,038,000		
Route 105	$4,651	$2,601	$0	($1,321,000)		
Broken Arrow Contribution				($232,000)		
Baseline Cost				$13,485,000		
Recommended Network	$44,935	$35,239	$5,038	$13,553,000	$68,000	0.504%

Note: all costs shown in FY17 dollars

The operating statistics for the recommended network are shown on the following page in Table 5-5. The daily Weekday, Saturday, and Sunday operations and maintenance (O&M) costs were estimated using a three-variable cost model that was estimated based on FY 2017 reporting to the National Transit Database. Based on those costs, the following unit costs were developed:

- Cost per revenue hour of $33.58
- Cost per revenue mile of $1.33
- Administrative cost per route per day of service (applicable to Weekday and Saturday routes): $853.34

Using the above unit costs and operating statistics, the following formula was used to determine costs:

(revenue hours x cost per revenue hour) + (revenue miles x cost per revenue mile) + (route days x administrative cost per route day of service)

After factoring out the Peoria AERO BRT service, the recommended network is expected to cost $13,553,000, or $68,000 above existing. The small increase in cost (approximately 0.5% above existing) can be considered within the margin of error. Because the cost model assumes all driver blocks operate through the entirety of the time period, it is likely the 0.5% difference will be absorbed once scheduling of the network occurs before implementation.

Table 5-5. Final Network Operating Statistics Summary

WEEKDAY						EARLY				PEAK				OFFPEAK				NIGHT					SUMMARY			
Number	Route Name	One-way Distance [miles]	Speed [mph]	R/T Time [min]	Lay-over [percent]	Cycle Time [min]	Head-way [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	One-way Distance [miles]	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Total One-way Trips	Revenue Hours	Daily Revenue Miles	O&M Cost
1+2	MLK/Southwest	17.7	17.1	124	21%	120	60	1	2.0	150	30	6	5.0	150	30	7	5.0	7.4	60	60	3	1.0	30	70.0	1062.0	$3,762
3	Peoria AERO BRT	16.6	17.4	115	18%	140	20	1	7.0	135	15	6	9.0	140	20	7	7.0	16.6	140	20	3	7.0	57	131.0	1892.4	$6,915
4	Lewis	13.6	15.7	104	15%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0						14	28.0	380.8	$1,446
5	Harvard/61st	11.9	16.5	87	4%	120	60	1	2.0	90	60	6	1.5	90	60	7	1.5	12.2	120	60	3	2.0	17	27.5	404.6	$1,461
6	Yale/51st	10.0	16.5	73	24%	120	60	1	2.0	90	60	6	1.5	90	60	7	1.5						14	21.5	280.0	$1,094
7	Sheridan	11.1	15.0	89	2%	120	60	1	2.0	90	60	6	1.5	90	60	7	1.5						14	21.5	310.8	$1,135
8	Garnett	13.3	17.2	93	29%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0						14	28.0	372.4	$1,435
9	Pine/Memorial	14.9	17.2	104	15%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0	7.4	60	60	3	1.0	17	31.0	506.6	$1,714
10	3rd/Admiral	7.5	16.4	55	9%	120	60	1	2.0	60	30	6	2.0	60	30	7	2.0	7.5	60	60	3	1.0	30	31.0	450.6	$1,640
11	11th/21st Steets (future B	11.0	18.0	73	23%	120	60	1	2.0	90	30	6	3.0	90	30	7	3.0	11.0	120	60	3	2.0	30	47.0	660.0	$2,456
12	21st/11th Streets	12.9	15.5	100	20%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0						14	28.0	361.2	$1,420
13	31st	11.3	16.0	85	42%	120	60	1	2.0	120	30	6	4.0	120	30	7	4.0	12.5	120	60	3	2.0	30	60.0	678.0	$2,916
14	61st/41st	6.0	15.0	48	25%	60	60	1	1.0	60	60	6	1.0	60	60	7	1.0						14	14.0	168.0	$693
15	West Tulsa/71st Street	15.1	18.1	100	20%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0	5.6	60	60	3	1.0	17	31.0	513.4	$1,724
16	Southeast Tulsa	14.0	16.4	103	17%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0						14	28.0	392.0	$1,461
17	Jenks Circulator	4.7	17.1	33	81%	60	60	1	1.0	60	60	6	1.0	60	60	7	1.0						14	14.0	132.2	$646
18	Sand Springs	14.1	17.1	99	22%	120	60	1	2.0	120	60	6	2.0	120	60	7	2.0						14	28.0	394.8	$1,465
19	North Tulsa Circulator	9.6	17.1	67	33%	120	60	1	2.0	90	60	6	1.5	90	60	7	1.5						14	21.5	268.8	$1,079
902	BA Express																							3.1	77.0	$206
909	Union Express																							1.8	40.0	$112
DAILY GA COST																										$17,067
TOTALS w/ PEORIA BRT																										$51,850
TOTALS w/o PEORIA BRT																										$44,935

SATURDAY						EARLY				PEAK				OFFPEAK				NIGHT					SUMMARY			
Number	Route Name	One-way Distance [miles]	Speed [mph]	R/T Time [min]	Lay-over [percent]	Cycle Time [min]	Head-way [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	One-way Distance [miles]	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Total One-way Trips	Revenue Hours	Daily Revenue Miles	O&M Cost
1+2	MLK/Southwest	16.6	17.1	117	54%	120	60		2.0	180	60	6	3.0	180	60	7	3.0	7.4	60	60	3	1.0	16	42.0	531.2	$2,117
3	Peoria AERO BRT	16.6	17.4	115	22%	140	20		7.0	140	20	6	7.0	140	20	7	7.0	16.6	140	20	3	7.0	48	112.0	1593.6	$5,880
4	Lewis	13.6	15.7	104	15%	120	60		2.0	120	60	6	2.0	120	60	7	2.0						13	26.0	353.6	$1,343
5	Harvard/61st	10.8	15.5	84	8%	120	60		2.0	90	60	6	1.5	90	60	7	1.5	12.2	120	60	3	2.0	16	25.5	345.6	$1,316
6	Yale/51st	10.6	15.5	82	10%	120	60		2.0	90	60	6	1.5	90	60	7	1.5						13	19.5	275.6	$1,021
7	Sheridan	11.1	15.0	89	2%	120	60		2.0	90	60	6	1.5	90	60	7	1.5						13	19.5	288.6	$1,038
8	Garnett	13.3	17.2	93	29%	120	60		2.0	120	60	6	2.0	120	60	7	2.0						13	26.0	345.8	$1,333
9	Pine/Memorial	14.9	17.2	104	15%	120	60		2.0	120	60	6	2.0	120	60	7	2.0	7.4	60	60	3	1.0	16	29.0	476.8	$1,608
10	3rd/Admiral	7.1	16.4	52	15%	60	60		1.0	60	60	6	1.0	60	60	7	1.0	7.1	60	60	3	1.0	16	16.0	227.2	$839
11	11th/21st Steets (future B	11.0	18.0	73	64%	120	60		2.0	120	60	6	2.0	120	60	7	2.0	11.0	120	60	3	2.0	16	32.0	352.0	$1,542
12	21st/11th Streets	12.9	15.5	100	20%	120	60		2.0	120	60	6	2.0	120	60	7	2.0						13	26.0	335.4	$1,319
13	31st	11.3	16.0	85	42%	120	60		2.0	120	60	6	2.0	120	60	7	2.0	12.5	120	60	3	2.0	16	32.0	361.6	$1,555
14	61st/41st	6.0	15.0	48	25%	60	60		1.0	60	60	6	1.0	60	60	7	1.0						13	13.0	156.0	$644
15	West Tulsa/71st Street	15.1	18.1	100	20%	120	60		2.0	120	60	6	2.0	120	60	7	2.0	5.6	60	60	3	1.0	16	29.0	483.2	$1,616
16	Southeast Tulsa	14.0	16.4	103	17%	120	60		2.0	120	60	6	2.0	120	60	7	2.0						13	26.0	364.0	$1,357
17	Jenks Circulator	4.7	17.1	33	81%	60	60		1.0	60	60	6	1.0	60	60	7	1.0						13	13.0	122.7	$600
18	Sand Springs	14.1	17.1	99	22%	120	60		2.0	120	60	6	2.0	120	60	7	2.0						13	26.0	366.6	$1,360
19	North Tulsa Circulator	9.3	17.1	65	38%	120	60		2.0	90	60	6	1.5	90	60	7	1.5						13	19.5	241.8	$976
DAILY GA COST																										$13,653
TOTALS w/ PEORIA BRT																										$41,118
TOTALS w/o PEORIA BRT																										$35,239

SUNDAY						EARLY				PEAK				OFFPEAK				NIGHT					SUMMARY			
Number	Route Name	One-way Distance [miles]	Speed [mph]	R/T Time [min]	Lay-over [percent]	Cycle Time [min]	Head-way [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	One-way Distance [miles]	Cycle Time [min]	Headway [min]	Span [hrs]	Driver Blocks	Total One-way Trips	Revenue Hours	Daily Revenue Miles	O&M Cost
1	MLK	7.4	17.1	52	15%					60	60	6	1.0	60	60	4	1.0						10	10.0	148.4	$533
3	Peoria AERO BRT	16.6	17.4	115	22%					140	20	6	7.0	140	20	4	7.0	16.6	140	20	2	7	36	84.0	1195.2	$4,410
5	Harvard/61st	12.2	15.5	95	27%					120	60	6	2.0	120	60	4	2.0						10	20.0	244.0	$996
9	Pine/Memorial	7.4	17.2	52	16%					60	60	6	1.0	60	60	4	1.0						10	10.0	148.0	$533
10	3rd/Admiral	7.1	16.4	52	15%					60	60	6	1.0	60	60	4	1.0						10	10.0	142.0	$525
11	11th/21st Steets (future B	11.0	18.0	73	64%					120	60	6	2.0	120	60	4	2.0						10	20.0	220.0	$964
13	31st	12.5	15.5	97	24%					120	60	6	2.0	120	60	4	2.0						10	20.0	250.0	$1,004
15	West Tulsa/71st Street	5.6	18.1	37	62%					60	60	6	1.0	60	60	4	1.0						10	10.0	111.6	$484
DAILY GA COST																										
TOTALS w/ PEORIA BRT																										$9,448
TOTALS w/o PEORIA BRT																										$5,038

5.2 Mid-Term Expansion Plan

The mid-term plan is a list of potential service expansion projects that Tulsa Transit would implement as soon as additional funding is available. The expectation is that these projects would take three to five years to implement. Improvements identified for future consideration include:

Weekday Daytime

- Improve Route 5 - Harvard to operate with 30-minute headways

Saturday Daytime

- Improve Route 1 - MLK to operate with 30-minute headways
- Improve Route 2 - Southwest Boulevard to operate with 30-minute headways
- Improve Route 10 - Admiral to operate with 30-minute headways

Weekday Night

- Operate routes 6, 7, 12, and 19 for three hours on weekday night network
- Add West Tulsa Call-a-Ride zone for three hours on weekday night network
- Add 2 more hours of service to weekday night network (specifically routes 1, 3, 5, 9, 10, 11, 13, 15)

Sunday

- Operate routes 6, 7, 12, and 19 for ten hours on Sunday network
- Add West Tulsa Call-a-Ride zone for ten hours on Sunday network

The above improvements do not include upgrading Route 11 to high frequency Route 66 AERO BRT service. It is assumed this would be funded separately from the Mid-Term Service Expansion plan.

Using the O&M unit costs from the previous section, costs were estimated for each of the above projects, as shown in

Table 5-6. When additional funding is identified, these projects are recommended for incorporation into the Tulsa Transit network.

Table 5-6. Mid-Term Plan O&M Cost Summary

	Annual Revenue Hours	Annual Revenue Miles	Additional Peak Vehicles	Annual O&M Cost
Improve Route 5 Harvard to every 30 minutes on weekdays (includes keeping Route 6 Yale at 60-minute headway)	19,125	240,924	1	$318,000
Improve Route 1 MLK, Route 2 Southwest Blvd, and Route 10 to 30-minute headways on Saturdays	5,044	74,797	-	$113,000
Night West Tulsa Call-a-Ride service	765	15,300	-	$47,000
Add 2 more hours to night service	8,670	140,454	-	$291,000
Add additional daytime routes to night network	6,120	67,167	-	$295,000
Add additional daytime routes to Sunday network	3,380	45,656	-	$175,000
Sunday West Tulsa Call-a-Ride service	2,550	51,000	-	$32,000
Totals	**45,654**	**635,298**	**1**	**1,271,000**

5.3 Policy Recommendations

Based on analysis completed in Chapter 4, three distinct policies are suggested as part of the recommended plan.

Performance Standard Policy

Performance of individual fixed route services operating in the MTTA network should be examined on a regular basis using identified standards. These standards will help identify when routes are underperforming and determine a course of action to monitor, adjust, or eliminate the route.

Five performance metrics are included in the policy:

- Passengers per Revenue Hour
- Passenger per Revenue Mile
- Passengers per Trip
- Net Cost per Passenger
- Farebox Recovery

Based on review of existing data, the following performance standards have been identified:

	Weekday Daytime	Saturday Daytime	Weekday Night	Saturday Night	Sunday
Passengers per Revenue Hour	12.9	12.4	4.9	5.7	5.9
Passenger per Revenue Mile	0.79	0.75	0.32	0.28	0.35
Passengers per Trip	9.8	9.1	5.2	4.6	5.2
Net Cost per Passenger	$9.57	$12.37	$8.71	$7.41	$10.29
Farebox Recovery	5.0%	3.8%	2.2%	2.7%	-

As shown above, these standards are divided into five operational periods. Each period should be monitored individually to allow MTTA flexibility in determining updates and a course of action for each route. In addition, the above service standards should be refreshed with new data at least once every five years.

Monitoring Program

A route-level report is proposed to be generated twice a year for review by the MTTA Board of Trustees. Reports will be provided in January (covering July through December) and July (covering January through June). Each route report will include performance metrics averaged over the time period for the five standards identified in the policy. The report will include five operational time periods for all routes, as applicable since not all routes operate on nights and Sundays.

The report will highlight which reported statistics fall below the adopted performance standard by route and by time period. The report will also note what stage of the monitoring program (if any) the route is in.

A new route is exempt from the monitoring program for two years to build a travel market, although its statistics will be reported for review and comparison purposes.

If a route underperforms in three out of five measures, then it enters the monitoring program, which has three stages:

- **Supervision**: routes that fall below standards after not doing so in the previous reporting period enter the supervision phase. No changes to the route are expected in this phase, but MTTA staff would use the following six months to gather evidence on how to improve performance on the route.
- **Adjustment**: routes that fall below standards in two consecutive reporting periods enter the adjustment phase. MTTA staff will present ridership and farebox data on the route to the Board and include a recommended course of action to update the alignment, frequency, or span, to improve route performance.
- **Resolution**: routes that fall below standards in three consecutive reporting periods enter the resolution phase. At this point the Board of Trustees will determine a course of action for the individual route. Staff is expected to make a recommendation on action for the Board to discuss. Action could include:
    - **Elimination:** the MTTA Board decides to eliminate the route (or the time period of operation) from the network
    - **Continued adjustment**: The MTTA Board leaves it up to MTTA staff to improve the route. For this option the Board would determine how many additional review periods until the route is placed back into the monitoring program.
    - **Exemption**: The MTTA Board determines the route is a valuable part of the MTTA network and should be exempt from performance standards. The Board can make this a permanent or temporary exemption. A temporary exemption should include the number of review periods until the route is placed back into the monitoring program.

Flag Stop Elimination Policy

Based on operational and safety evidence, along with the judgment of MTTA planning staff, supervisors, and drivers, the following policy is proposed for potential adoption by the MTTA Board of Trustees:

Flag stops for boardings or alightings will no longer be served by MTTA buses on [to be determined].

Upon adoption of this policy MTTA staff will work to determine all route alignments that do not currently have regularly established stop locations. Regular stops will be established in these segments with spacing approximately 1,320 feet (1/4 mile) apart, depending on the ability to safely locate each stop. Each new stop shall include a MTTA stop pole and sign. Efforts will be made by MTTA staff to locate all new stops at or near a sidewalk connection.

Shelter Policy

Based on review of existing ridership and shelter data, the MTTA Board of Trustees adopts the following policy for shelters:

MTTA shall provide shelters at all stops with more than 15 daily boardings provided the right-of-way and general topography can accommodate the shelter. Analysis in the Connecting Progress Plan identified 54 locations with greater than 15 boardings without a shelter. MTTA staff shall investigate all 54 locations by [to be determined] and present a progress report to the Board on which locations are available for a shelter.

Conversely, all locations with fewer than 15 boardings are eligible to have shelters removed and reallocated to higher ridership locations within the network.

Stop-level ridership information shall be collected once every two years resulting in an update to the shelter amenity analysis. A report to the Board of Trustees shall be provided once every year on the progress of shelters throughout the system.

5.4 Review of Connecting Progress Goals

Five goals were outlined at the beginning of this study. This section reviews these goals and answers how the recommended plan addresses each one.

Goal 1: Help Tulsa Transit determine how to improve service frequencies and reduce rider travel time without additional operating costs. The recommended plan:

- ✓ Reduces rider travel time by strategic placement of transit subhubs that allow additional timed transfers outside of DAS. Timed connections at these "on-street" or route-to-route transfers results in an average savings of 16 minutes per one-way trip and removes the need to travel downtown to transfer.
- ✓ Provide more continuous corridor-based service (e.g., along Harvard, Yale, and 31st). This results in riders more efficiently being able to access destinations without needing to double back or transfer.
- ✓ Improves the Saturday network, with all routes proposed to operate every 60 minutes.
- ✓ Adds frequency improvement for weekday service on routes 11 (11th/21st Street) and 13 (31st Street).
- ✓ Improves the night network so that routes operate every 60 minutes.

Goal 2: Build network off the Peoria AERO BRT in the short term and Route 66 AERO BRT in the intermediate term. The proposed network:

- ✓ Improves transfers to Peoria AERO BRT, with eleven routes connecting to the Peoria corridor; three of the connecting routes (1, 11, 13) have proposed 30-minute frequency service.
- ✓ Establishes Route 11 on alignment of future Route 66 AERO BRT route. This route is proposed to have 30-minute frequency service which can be scaled up with the introduction of BRT service.

Goal 3: Improve Tulsa Transit's presence in the community through a robust and meaningful public outreach process as well as aligning services with stakeholder goals.

- ✓ A technical advisory committee meeting was established during the beginning of the study and two meetings were held during existing conditions and draft recommendations phases of the study.
- ✓ Stakeholders were identified during the beginning of the study and three stakeholder meetings were held during the existing conditions phase of the work.
- ✓ Open houses were held throughout the study. One open house was held during the existing conditions phase of work. Four more open houses were held during the draft recommendations phase.
- ✓ A community survey was conducted during March/April 2018 to determine desired improvements to the network.

Goal 4: Make recommendations related to Tulsa Transit's "hub and spoke" design while also addressing schedule adherence issues. The proposed network:

- ✓ Established a set of strategically-located transit subhubs on the periphery of Tulsa Transit's service area to facilitate transfers at locations away from DAS. These subhubs decentralize the need for connection at Denver Avenue Station and Midtown Memorial Station.
- ✓ Beyond the subhubs, route-to-route connections are spread more evenly throughout the metropolitan area, which substantially cuts down on out-of-direction travel for riders.
- ✓ The flag stop policy is recommended to be eliminated, which will give routes more time to adhere to their schedules.

Goal 5: Recommend other non-traditional service delivery approaches like private providers, TNCs, and demand response zones, as appropriate.

- ✓ This study considered a variety of non-traditional service delivery approaches, particularly in low-productivity areas of the Tulsa Transit service delivery area.
- ✓ This study recommends the use of alternative services in Broken Arrow and Jenks, subject to discussion with each city.

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