



*Peoria/Riverside Corridor Alternatives Analysis*

# Evaluation of Alternatives Memo

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## Introduction

### Background

The Indian Nations Council of Governments (INCOG), the Metropolitan Planning Organization for the greater Tulsa metropolitan Transportation Management Area (TMA), recently completed its *Fast Forward* Regional Transit System Plan (RTSP). The plan institutes a comprehensive, long-range and realistic system of transit corridors to help meet the region's transportation needs over the next 25 years

The RTSP identified and prioritized corridors within the TMA which are suitable candidates for high capacity, rapid transit service. Local consensus was attained that identified the Peoria/Riverside Corridor (PRC) as the first to undergo a detailed Alternatives Analysis (AA) evaluation of transit options to determine the most appropriate transit mode, alignment and service operating parameters for the corridor.

Through the AA process, INCOG, together with the Metropolitan Tulsa Transit Authority (Tulsa Transit) will identify corridor problems, develop alternatives, analyze costs and benefits, and select a Locally Preferred Alternative (LPA) for implementation.

### Study Area Description

The Peoria/Riverside Corridor (PRC) contains approximately 56,000 residents (1 in 7 of the city's population) and over 52,000 jobs (1 in 5 of the city's jobs). Of the 41,700 trips into and out of downtown Tulsa, 13 percent (5,700) trips either originate or end in the PRC. The corridor also includes more than 30 regional activity centers and is home to significant portions of the TMA employment and transit dependent population.

The PRC extends north to south across the TMA for a distance of approximately 20.2 miles. Beginning at Peoria Avenue and 66<sup>th</sup> Street North, near the City of Tulsa boundary, it spans the length of the city predominantly along Peoria Avenue and Riverside Drive/Parkway, before heading east at approximately 121<sup>st</sup> Street South and terminating at Memorial Drive in Bixby, as shown in **Error! Reference source not found.**

The PRC is one of the most regionally significant arterial thoroughfares in the greater Tulsa TMA. It is one of the primary north-south arterial roadway corridors in Tulsa County east of the Arkansas River, and the only one connecting directly to the central business district (CBD). The only other highway alternative parallel to the PRC is US Highway 75, which is located on the west side of the Arkansas River south of Downtown. As a result, the PRC serves as a primary regional thoroughfare providing access to residential, employment, educational, commercial and activity centers across the area. Comparison between the TMA, City of Tulsa and PRC study areas' demographics is illustrated in **Table 1**.

Transit opportunities within the PRC may be improved through various means and combinations of improvements to the existing transit service level, infrastructure, and/or technologies implemented. A local preference will have to be determined for each of the transit system components of the eventual preferred alternative. Each component will have several implementation options which will be evaluated through this Alternatives Analysis (AA) study.

**Figure 1: PRC Corridor Study Area**



**Table 1: Comparison of PRC, City of Tulsa and Transportation Management Area (TMA) Demographics**

	PRC	City of Tulsa		TMA	
		Total	PRC %	Total	PRC %
<b>Population*</b>	56,450	391,906	14.40%	778,051	7.26%
<b>Jobs**</b>	52,627	259,914	20.25%	376,954	13.96%
<b>Zero Car Households***</b>	1,188	5,548	21.41%	7,749	15.33%

\* Source: U.S. Census Bureau, 2010 Census

\*\* U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2010). All jobs all workers.

\*\*\* U.S. American Community Survey and INCOG

## Purpose and Need for Transit Improvements

The purpose of the Alternatives Analysis (AA) study is to evaluate and determine a cost-effective transit mode and alignment that significantly improves transit services and access within the PRC. The need for improved transit service within the corridor is documented within the RTSP needs assessment analysis categorized into four goals:

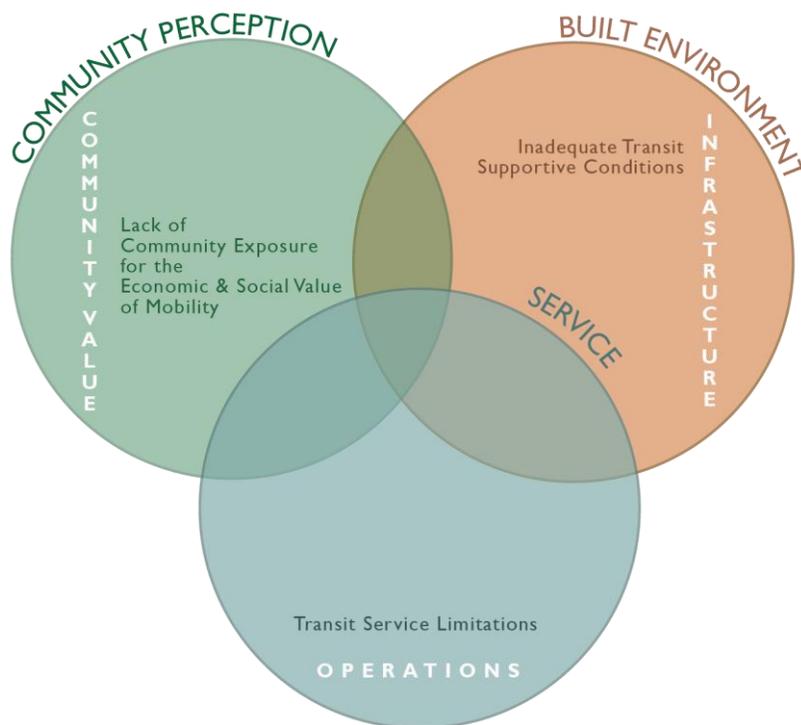
- ▶ Mobility & Accessibility
- ▶ Efficiency & Safety
- ▶ Environmental Benefits
- ▶ Economic Development

The challenges posed to the community for the AA study cluster into three basic categories:

- ▶ Lack of Community Exposure to Economic and Social Value of Mobility
- ▶ Existing Transit Service Limitations
- ▶ Inadequate Transit Supportive Conditions

Each of these issues is inter-dependent and have compounded upon one another to further degrade the transit service and service potential within the corridor. The (historically) negative community perception, paired with recent economic challenges creates an environment that discourages community support for capital and operational investment. The constraints of the built environment and urban development patterns also limit the opportunities for improved facilities and efficient services. The deficiency in funding support has led to inadequate infrastructure, amenities and transit service availability to support the existing and (potential) future patronage. The subsequent sections briefly describe these three problems and how they contribute to an overall need for improved transit services within the corridor.

Figure 2: PRC Challenges to Transit Improvements



## Alternatives Analysis Framework

The evaluation of proposed alternatives was conducted to assess each alternative's ability to meet the goals established for the AA within the constraints identified by INCOG and Tulsa Transit, as well as citizens, stakeholders and potential partnering agencies participating through the AA public engagement process.

### Goals and Objectives

The goals and objectives of the PRC AA study are identified below:

#### Goal 1: Improve Transit Access and Regional Mobility

- ▶ Provide competitive alternative transportation options
- ▶ Improve service efficiency for transit riders
- ▶ Appeal to non-transit dependent commuters
- ▶ Provide access to major destinations within the corridor

#### Goal 2: Support Economic Development

- ▶ Capitalize on opportunities for joint development
- ▶ Provide job accessibility for low income and transit dependent population
- ▶ Support local investment and development policies

#### Goal 3: Invest in Low-Cost, High-Impact Transit Infrastructure

- ▶ Maximize effectiveness of transit through land use strategies
- ▶ Maximize Return on Investment (ROI) and minimize recurring maintenance costs
- ▶ Minimize parking and property displacements

#### Goal 4: Build Community Support for the Value of Transit

- ▶ Improve transit system visibility and public perception of utility
- ▶ Incorporate stakeholder input to address community transit needs
- ▶ Facilitate local commitment to future transit improvements and funding

The detailed evaluation of alternatives, presented within this document, was conducted following the development of all technical analyses and public outreach activities throughout the course of this AA study. Building from results from the preliminary screening process, study of potential impacts and financial feasibility, the evaluation utilized numerous indicators to determine a transportation solution best fit for the Tulsa region.

### PRC Alternatives for Detailed Evaluation

This AA will feature *BRT* and *Enhanced Bus* alternatives operating in a variety of potential technology and service deployment schemes or accompanied by a range of supporting infrastructure improvements. The alternatives are proposed to operate in mixed traffic and will include all the elements of the Tulsa Transit system planned as part of the No-Build/Baseline alternative plus deployment of additional service, infrastructure and technology improvements. These Build Alternatives, described below, would enhance and complement existing fixed route bus service within the corridor, without diminishing existing service.

#### No-Build/Baseline Alternative

The No-Build/Baseline Alternative consists of existing fixed route bus transit service and committed transportation improvements within the PRC, as identified by the City of Tulsa (Tulsa Transit) and included in the fiscally

constrained Transportation Improvement Program (TIP) of INCOG. The No-Build/Baseline Alternative establishes a foundation, or reference, condition from which the Build Alternatives are developed and evaluated.

For comparison against proposed alternatives, the existing Tulsa Transit route 105 is identified as the baseline transit operating condition for the PRC. It services North and South Tulsa, operating from approximately 66<sup>th</sup> Street North to 81<sup>st</sup> Street South and Lewis Avenue. Existing facilities along route 105 and its current service operating parameters are described below:

- ▶ Currently operates approximately 15 hours daily, from approximately 5:30 am to 8:30pm (M-F) and from 6:30 am to 6:30 pm on Saturday
- ▶ Current headway is 30 minutes all day, with an off peak period of 45 minute frequency from approximately 10:30 am to 1 pm. (Average Tulsa Transit system-wide headways are approximately 45 to 50 minutes)
- ▶ Fixed route local service with flag-stop operations, allowing passengers to board and alight at any safe stopping location along the corridor by alerting the vehicle operator.
- ▶ Transit shelters and amenities are available only at a few locations within the corridor.

### **Improved Local Service (“Tulsa Plus”) Build Alternative**

This alternative will maintain the existing flag-stop operations of the fixed route 105 service along the same limits of the PRC, but offer service modifications in response to public demand for increased frequency and hours of operation, including:

- ▶ 17 hours service operating span (approximately 6am to 11pm) Monday thru Saturday
- ▶ Continuous 30 minute headways all day
- ▶ Traffic signal prioritization at all PRC signalized intersections
- ▶ Significant transit shelters and amenities at end of line or major destinations / activity centers only; minimal transit amenities installed at major arterial intersections or multimodal transfer points

### **Enhanced Local Service (“Tulsa Enhanced”) Build Alternative**

This alternative will replace the existing fixed route 105 service along the PRC and modify the current flag-stop service operating procedure to a traditional, fixed-route local service stopping only at Tulsa Transit designated locations. Alternative features include:

- ▶ 17 hours service operating span (approximately 6am to 11pm) Monday thru Saturday
- ▶ Traditional fixed route stop patterns (average every 2 to 3 blocks) from 38<sup>th</sup> Street North to 81<sup>st</sup> Street South and Lewis Avenue.
  - A local circulator bus will be added to the end of the alignment to maintain service in between 38<sup>th</sup> and 66<sup>th</sup> Streets.
- ▶ Continuous 20 minute headways all day
- ▶ Traffic signal prioritization at all PRC signalized intersections
- ▶ Branding of vehicles and transit amenities
- ▶ Significant transit shelters and amenities at end of line or major destinations / activity centers only; minimal transit amenities installed at major arterial intersections or multimodal transfer points
- ▶ Real time arrival information and passenger information media at shelters
- ▶ Pedestrian crossing protection and sidewalk repair/installation at stations adjacent to major arterial intersections or multimodal transfer points

### **Limited Stop Service (“Fast Bus”) Build Alternative**

This alternative is proposed to operate in mixed traffic, overlaid on top of the existing route 105 service within the PRC to a ‘limited stop’ service while maintaining a 30 minute continuous headway. Alternative features include:

- ▶ 17 hours service operating span (approximately 6am to 11pm) Monday thru Saturday
- ▶ Continuous 30 minute headways all day
- ▶ Limited stop frequency ranging from approximately every ½ mile to 1½ miles
- ▶ Traffic signal prioritization at all PRC signalized intersections
- ▶ Branding of vehicles and transit amenities
- ▶ Significant transit shelters and amenities at end of line or major destinations / activity centers, major arterials intersections and multimodal transfer points. Minimal transit shelters and amenities will be installed at other selected stations.
- ▶ Real time arrival information and passenger information media at shelters
- ▶ Pedestrian crossing protection and sidewalk repair/installation at stations adjacent to major arterial intersections or multimodal transfer points
- ▶ Automated ticket vending and pedestrian lighting fixtures along sidewalk approaches to stations adjacent to major arterial intersections or multimodal transfer points

### **Corridor-Based BRT Light (“BRT 10/15” & “BRT 15/20”) Build Alternatives**

These alternatives are proposed to operate in mixed traffic, replacing the existing route 105 service within the PRC. Two BRT scenarios were devised in order to compare cost efficiency of operating at a 10 minute/15 minute or at a 15 minute/20 minute peak versus off peak service frequency. Infrastructure and technology improvements are the same between alternatives. BRT Alternative features include:

- ▶ 15 hours service operating span (approximately 6am to 9pm) Monday thru Sunday (BRT 10/15) OR Monday thru Saturday (BRT 15/20)
- ▶ 10 minutes peak / 15 minutes off-peak daily service frequency OR 15 minutes peak / 20 minutes off-peak daily service frequency
- ▶ Limited stop frequency ranging from approximately every ½ mile to 1½ miles from 38<sup>th</sup> Street North to 81<sup>st</sup> Street South and Lewis Avenue.
  - A local circulator bus will be added to the end of the rapid bus alignment to maintain service in between 38<sup>th</sup> and 66<sup>th</sup> Streets.
- ▶ Traffic signal prioritization at all PRC signalized intersections
- ▶ Branding of vehicles and transit amenities
- ▶ Significant transit shelters and amenities at end of line or major destinations / activity centers, major arterials intersections and multimodal transfer points. Minimal transit shelters and amenities will be installed at other selected stations.
- ▶ Real time arrival information and passenger information media at shelters
- ▶ Pedestrian crossing protection and sidewalk repair/installation at stations adjacent to major arterial intersections or multimodal transfer points
- ▶ Automated ticket vending and pedestrian lighting fixtures along sidewalk approaches to stations adjacent to major arterial intersections or multimodal transfer points
- ▶ Dedicated transit lanes deployed in select locations (only as appropriate)

## Evaluation of Alternatives

### Methodology

Developed based on the goals and needs established during the PRC project, a set of criteria were developed to comparatively evaluate the final set of alternatives. **Table 2** highlights the ranging attributes of the proposed transit alternatives which led to the respective high and low scores of each. Evaluation criterion included:

- ▶ Travel Time;
- ▶ Transit Visibility and Perception;
- ▶ Comfort and Reliability;
- ▶ Safety;
- ▶ Support Economic Development;
- ▶ Capital Cost;
- ▶ Incremental Operating and Maintenance; and
- ▶ Percent of Current Tulsa Transit Operating Budget

Each evaluation criteria was supported by multiple attributes, which were scored qualitatively, low to high, based (comparatively) on positive attributes (benefits) offered by an alternative’s proposed scope of improvements. The respective rating values are composite, determined by assessing the combined impact potential of an alternative’s service, infrastructure and technology improvements. The rating gradient established for this detailed evaluation of alternatives is as follows:

- (1 – 0) – Low benefit; potential negative impacts
- (2 – 1) – Medium-Low benefit; potential negative impacts
- (3 – 2) – Medium potential benefit
- (4 – 3) – Medium-High potential benefit
- (5 – 4) – High potential benefit

Scores range from one (1 – 0), representing a perceived negative impact, to five (5 – 4), representing a perceived positive impact. The scores evaluated for each criterion were summed to produce a relative ranking of the alternatives’ construction impacts.

**Table 2: Factors Attributing to High and Lows Scores of each Evaluation Criterion**

Evaluation Criteria	Factors Attributing to Low Score	Factors Attributing to High Score
Travel Time	<ul style="list-style-type: none"> <li>● Longer Travel Time</li> <li>● Mixed Traffic</li> <li>● Frequent Stops</li> </ul>	<ul style="list-style-type: none"> <li>● Shorter Travel Time</li> <li>● Dedicated Travel Lanes</li> <li>● Less Frequent Stops</li> <li>● Traffic Signal Priority</li> </ul>
Perception and Visibility	<ul style="list-style-type: none"> <li>● Few Passenger Amenities</li> <li>● Variable Wait Times</li> <li>● Minimal Passenger Information</li> </ul>	<ul style="list-style-type: none"> <li>● Branded Service</li> <li>● Landmark Stations with Passenger Amenities</li> <li>● Prompt Service</li> <li>● Multi-Media Information Technology</li> </ul>
Comfort and Reliability	<ul style="list-style-type: none"> <li>● Few Passenger Amenities</li> <li>● Variable Wait Times</li> <li>● Minimal Passenger Information</li> <li>● Limited Access to Stations</li> </ul>	<ul style="list-style-type: none"> <li>● Branded Service</li> <li>● Landmark Stations with Passenger Amenities</li> <li>● Prompt Service</li> </ul>

Evaluation Criteria	Factors Attributing to Low Score	Factors Attributing to High Score
		<ul style="list-style-type: none"> <li>• Pedestrian Accessibility Improvements</li> <li>• Multi-Media Information Technology</li> </ul>
Safety	<ul style="list-style-type: none"> <li>• Limited Pedestrian Improvements</li> </ul>	<ul style="list-style-type: none"> <li>• Sidewalk Enhancement</li> <li>• Pedestrian Street Crossings</li> <li>• Lighting at Stations</li> </ul>
Support Economic Development	<ul style="list-style-type: none"> <li>• Property impacts or acquisitions during or after construction</li> <li>• Additional investment needed to achieve transit/mobility vision</li> </ul>	<ul style="list-style-type: none"> <li>• Improve travel times and intermodal connectivity</li> <li>• Improved job accessibility and expanded labor pool</li> <li>• Joint development opportunities</li> </ul>
Capital Cost	<ul style="list-style-type: none"> <li>• Significant investment in high cost construction scope items such as: station improvements, vehicles and pedestrian improvements</li> </ul>	<ul style="list-style-type: none"> <li>• Minimal high cost construction scope items such as: station improvements, vehicles and pedestrian improvements</li> </ul>
Incremental PRC O&M Cost (from rte 105)	<ul style="list-style-type: none"> <li>• Significant increase to annual operational budget needed to maintain proposed PRC transit alternative</li> </ul>	<ul style="list-style-type: none"> <li>• Low or minimal change in annual operational budget needed to maintain proposed PRC transit alternative</li> </ul>
Feasibility – Percent of Tulsa Transit Annual Operating Budget	<ul style="list-style-type: none"> <li>• High percentage indicating significant shifts in existing resources necessary to continually operate proposed project</li> </ul>	<ul style="list-style-type: none"> <li>• Low percentage indicating minor or non-existing shifts in resources necessary to continually operate proposed project</li> </ul>

## Transit Operations Impact Evaluation

The transit operations impact criteria considered would result in direct and tangible impacts to the existing transit operations or infrastructure within the PRC. These criteria were:

- ▶ Travel Time;
- ▶ Perception & Visibility;
- ▶ Comfort & Reliability; and
- ▶ Safety

### Travel Time

Attributing factors used to evaluate *Travel Time* performance included service operating or infrastructure improvements that would directly influence a passenger’s in-vehicle travel time.

Implementation of *dedicated transit lanes* would offer transit (and other approved vehicles) a dedicated roadway to utilize at designated times to avoid potential congestion related queues or delays. Potential negative effects include reduction in roadway capacity for automobiles and increased congestion for non-transit vehicles.

Implementation of *traffic signal prioritization (tsp)* technologies increases green time of traffic signals for approaching transit vehicles traveling along the mainline of the PRC. This reduces the delay experienced due to queuing for traffic signal cycles.

The *number of 1-way stops* that the proposed alternative may have direct impacts on the in-vehicle passenger travel time because of the added dwell time for boarding and alighting at on-line bus stops or passenger-requested flag stops.

The *1-way travel time* projected for each alternative utilized the baseline travel time of the No Build Alternative and estimated the time savings for each alternative through a series of assumptions attributed to service, infrastructure or technology improvements of each. For more detail on 1-way travel time value assumptions, refer to the *Peoria/Riverside Corridor Alternatives Analysis Operating Cost Report (rev. 3/13/13)* for further information.

**Table 3: Travel Time Benefit Evaluation**

Alternative	Dedicated Lanes	Traffic Signal Priority	# of 1-way Stops	1-way travel time	Rating	
NO BUILD	NO	NO	70-75	75	0	1
TULSA (+) PLUS	NO	YES	70-75	65	1	2
TULSA ENHANCED	NO	YES	40	60	2	3
FAST BUS	NO	YES	22	50	3	4
BRT Light (15/20)	NO	YES	22	50	3	4
BRT Light (10/15)	NO	YES	22	50	3	4

Through the course of this AA, the implementation of dedicated transit lanes was analyzed at a conceptual planning level. However, the PRC currently experiences only minor congestion and projections of future traffic demands on the facility do not suggest that the implementation of a dedicated transit lane would not add significant benefit to 1-way transit vehicle travel time. The only segment of the PRC identified with sufficient existing roadway capacity and alternative routing for automobiles to accommodate the removal of a mixed-use traffic lane for a dedicated transit lane is available is within Downtown Tulsa.

The *No Build* Alternative consists of the existing route 105 service operating on the PRC. There are currently no dedicated transit lanes, nor traffic signals outfitted with TSP along the route. As this alternative is the baseline established for evaluation, no appreciable benefits are proposed, resulting in a **Low** rating.

The *Tulsa Plus* Alternative maintains the current route 105 local & flag-stop operating parameters, but introduces TSP technology to improve 1-way travel speeds. An improved 1-way travel time of approximately 10 minutes was projected, resulting in a **Medium-Low** Rating.

The *Tulsa Enhanced* Alternative implements TSP technologies as well as reduces the amount of 1-way stops and total dwell time by removing the flag-stops of the 105 and transitioning to a fixed-route stop

pattern of every 2-3 blocks along the route. An improved 1-way travel time of approximately 15 minutes was projected, resulting in a **Medium** Rating.

The *Fast Bus* Alternative implements TSP technologies as well as reduces the amount of 1-way stops and total dwell time by replacing local and flag-stop operations with a “Limited” service, stopping at major activity centers and intermodal transfer points every ½ mile to 1 ½ miles within the PRC. An improved 1-way travel time of approximately 20 minutes was projected, resulting in a **Medium-High** Rating.

The *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives implement the same TSP and Limited Stop improvements to improve 1-way travel time as the Fast Bus Alternative. An improved 1-way travel time of approximately 20 minutes was projected, resulting in a **Medium-High** Rating for both.

### Perception and Visibility

Attributing factors used to evaluate *Perception and Visibility* performance included service, infrastructure or technology improvements that would improve the visibility and perceived image of Tulsa Transit within the community as a viable and attractive transportation alternative.

The deployment of *branded vehicles and stations* would distinguish new, high-capacity and/or high frequency services from the existing fixed routes by using branded vehicles and station shelters equipped with improved passenger amenities and technologies.

The installation of *dedicated transit lanes* would give drivers, pedestrian and transit users a consistent visual and operational reminder to consider transit within daily transportation related activities. Such improvements may help reinforce that transit is an integrated part of the overall transportation system and has been given a more prominent role in the Tulsa community

The deployment of *passenger technologies* includes posted transit system and connecting bus route information (PI), real-time vehicle arrival information via variable message signs (VMS), and off board fare collection via automated ticket-vending machines (TVMs) at designated stations.

Extending *daily hours of operation* to provide high-frequency passenger service beyond the peak evening commute times gives access to potential transit users who may work later or staggered shifts, or those who may want to travel to non-business destinations after work and still be able to complete their return trip home.

**Table 4: Perception & Visibility Evaluation**

Alternative	Branded Vehicles / Stations	Dedicated Lanes	Passenger Technologies	Daily Hours of Operation (M-F)	Rating	
NO BUILD	NO	NO	N/A	15	0	1
TULSA (+) PLUS	NO	NO	PI	17	1	2
TULSA ENHANCED	YES	NO	PI, VMS	17	2	3
FAST BUS	YES	NO	PI, TVM, VMS	17	3	4
BRT Light (15/20)	YES	NO	PI, TVM, VMS	17	3	4

BRT Light (10/15)	YES	NO	PI, TVM, VMS	15	2	3
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As stated in the evaluation of 1-way Travel Time improvements, the implementation of dedicated lanes was considered a non-essential improvement and dismissed from final alternatives.

The *No Build* Alternative consists of the existing route 105 service operating on the PRC. There are currently no branded shelter or vehicles, dedicated transit lanes, or passenger information technologies installed along the route. These attributes resulted in a **Low** rating for the alternative.

While the *Tulsa Plus* Alternative does include extended night service hours and transit system PI, it does not offer deployment of branded vehicles, station shelters, TSP or VMS technologies, resulting in a **Medium-Low** rating.

The *Tulsa Enhanced* Alternative deploys branded vehicles and station shelters; as well as PI and VMS technology improvements at designated stations; and extended night service hours, resulting in a **Medium** rating.

The *Fast Bus* Alternative deploys branded vehicles and station shelters; as well as PI, VMS and TVM technology improvements at designated stations; and extended night service hours, resulting in a **Medium-High** rating.

The *BRT Light (15/20)* Alternative deploys branded vehicles and station shelters; as well as PI, VMS and TVM technology improvements at designated stations; and extended night service hours, resulting in a **Medium-High** rating.

The *BRT Light (10/15)* Alternative deploys branded vehicles and station shelters; as well as PI, VMS and TVM technology improvements at designated stations. The alternative does not, however, extend the hours of operation to include night service, resulting in a **Medium** rating.

### **Comfort and Reliability**

Attributing factors used to evaluate *Comfort and Reliability* performance included service, infrastructure or technology improvements that would provide potential transit users with a comfortable waiting facility and refuge from severe weather; furnished with pedestrian amenities and decision making tools to instill confidence in trip planning capability.

The deployment of *passenger/pedestrian amenities* would only be deployed at stations designated for “Improved” and “Enhanced” improvements. Existing Tulsa Transit stops that are not coincident with the proposed PRC “Improved” and “Enhanced” stations will not be improved by shelters or significant passenger information upgrades. Alternatives proposed to continue local service stop frequency within segments of the PRC may improve additional fixed route stops with “Local” station enhancements.

Increasing service *frequency* would decrease passenger wait times, allowing for more effective timing of intermodal transfers with fixed routes. Greater trip planning reliability is also provided for passengers new to the Tulsa Transit system, knowing that the next PRC transit vehicle will be no more than 30 minutes away from arrival, whenever they arrive at a PRC station.

Improvements contributing to *on-time performance reliability* include: increased service frequency; projected 1-way travel time and real-time vehicle arrival (VMS) information. The perceived benefits or impacts to this attribute were evaluated on a low-medium-high gradient based on a comparison of all improvements deployed within an alternative.

The assessment of *accessibility* benefits includes factors impacting pedestrian walk access to station areas, including station spacing intervals and presence of sidewalk facilities. The perceived benefits or impacts to this attribute were evaluated on a low-medium-high gradient based on a comparison of all improvements deployed within an alternative.

**Table 5: Comfort & Reliability Evaluation**

Alternative	Amenities	Frequency	On-Time Performance Reliability	Accessibility	Rating
NO BUILD	Existing Conditions	30-45	LOW	HIGH	0 1
TULSA (+) PLUS	6 enh; 16 imp; 16 local	30	LOW	HIGH	1 2
TULSA ENHANCED	10 enh; 22 imp; 16 local	20	MEDIUM	MEDIUM	2 3
FAST BUS	10 enh; 22 imp; 4 local	30 (15 w/route 105)	HIGH	MEDIUM	3 4
BRT Light (15/20)	10 enh; 22 imp; 4 local	15-20	HIGH	LOW	2 3
BRT Light (10/15)	10 enh; 22 imp; 4 local	10-15	HIGH	LOW	2 3

The *No Build* Alternative consists of the existing route 105 service operating on the PRC. There are currently only sparse passenger shelters or amenities in place within the corridor. Intermodal transfers are infrequent due to extended headways on supporting fixed routes, making the system difficult for passengers to use efficiently. These contributing attributes led to a **Low** alternative rating.

The *Tulsa Plus* Alternative proposes implementation of approximately twenty-two (22) “Enhanced” and “Improved” stations with amenities throughout the PRC and maintains the existing walk accessibility of local stops and flag-stops utilized by route 105. However, the lack of significantly improved service frequency, to improve intermodal connectivity and a lessened deployment of significant stations with amenities, when compared with other alternatives, led to a **Medium-Low** rating.

The *Tulsa Enhanced* Alternative proposes implementation of approximately thirty-two (32) “Enhanced” and “Improved” stations with amenities throughout the PRC. By replacing the route 105, however, the pedestrian walk accessibility is weakened by the removal of flag-stops and the 2-3 block minimum local stop spacing within the corridor. Evaluation of these attributing factors led to a **Medium** rating.

The *Fast Bus* Alternative proposes implementation of approximately thirty-two (32) “Enhanced” and “Improved” stations and amenities within the PRC. It also includes maintaining the existing route 105

service within the PRC, offering a combined frequency of 15-minutes and allowing pedestrians to utilize local service stops within the corridor to access transit and transfer to high-frequency stations as desired. Evaluation of these attributing factors led to a **Medium-High** rating.

The *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives proposes implementation of approximately thirty-two (32) “Enhanced” and “Improved” stations and amenities within the PRC. It also provides the most frequent service of all proposed alternatives (10 minutes to 20 minutes) and seeks to deploy the most comprehensive package of infrastructure and technology improvements to raise confidence in reliable trip planning. However, both eliminate local fixed-route stops and modify station spacing within the PRC to every ½ mile to 1½ mile. Typical pedestrian walk radius to and from transit stations are up to approximately ½ mile. The proposed additional spacing between stations may be perceived as a deterrent to potential transit users. As a result, these alternatives received a **Medium** rating.

### Safety

Attributing factors used to evaluate *Safety* performance primarily included infrastructure improvements that installed ADA compliant pedestrian facilities (including sidewalks and curb ramps), or features to increase pedestrian or passenger visibility and protection.

The construction of *sidewalks and ADA facilities* would make the PRC more walkable to pedestrians seeking to access transit or multimodal facilities such as the City’s extensive trail system.

The installation of *pedestrian illumination* would occur around Enhanced and Improved PRC stations only. The additional illumination gives passengers additional security during night hours and reinforces Tulsa Transit facilities as designated “safe areas” for pedestrian refuge.

The installation of *pedestrian crossing protection* would occur at the nearest signalized intersection to proposed PRC “Enhanced”, “Improved”, and “Local” stations to facilitate the safe pedestrian arrival and circulation about the station areas, nearby activity centers and intermodal facilities.

**Table 6: Safety Impact Evaluation**

Alternative	Sidewalks / ADA	Pedestrian Illumination	Pedestrian Crossing Protection	Rating	
NO BUILD	NO	NO	NO	0	1
TULSA (+) PLUS	NO	NO	NO	0	1
TULSA ENHANCED	YES	NO	YES	2	3
FAST BUS	YES	YES	YES	3	4
BRT Light (15/20)	YES	YES	YES	3	4
BRT Light (10/15)	YES	YES	YES	3	4

The *No Build* and *Tulsa Plus* Alternatives consists of the existing pedestrian infrastructure within the PRC. The current condition of the PRC presents an inconsistent deployment of sidewalk, ADA compliant

pedestrian access to stations and crossing protection at nearby intersections. The lack of improvements to these attributes resulted in a **Low** rating.

The *Tulsa Enhanced* Alternative introduces pedestrian crossing protection and sidewalk repair/installation at stations adjacent to major arterial intersections or multimodal transfer points. The investment in safety infrastructure resulted in a **Medium** rating.

The *Fast Bus*, *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives adds moderate pedestrian illumination fixtures at the platform areas of “Enhanced” and “Improved” stations. Pedestrian crossing protection and sidewalk repair/installation at stations adjacent to major arterial intersections or multimodal transfer points will also be implemented within these alternatives, resulting in a **Medium-High** rating for each.

### Summary

Each of the Transit Service Impact evaluation criteria identified were comprised of several attributes which qualitatively assessed an alternative’s recommended service operations, infrastructure and technology deployment. Each alternative was attributed with a comparative rating of its perceived benefits to the PRC corridor according to the established criteria. The PRC transit alternative with the most perceived benefits was the *Fast Bus* Alternative; followed closely by the *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives. A composite rating summary of the proposed PRC Alternatives’ construction and operating impacts is shown in **Table 7** and a summary of the applied ratings is provided below.

**Table 7: Transit Service Impact Evaluation Summary**

Criteria	NO BUILD		TULSA (+) PLUS		TULSA ENHANCED		FAST BUS		BRT Light (15/20)		BRT Light (10/15)	
Travel Time	0	1	1	2	2	3	3	4	3	4	3	4
Perception & Visibility	0	1	1	2	2	3	3	4	3	4	2	3
Comfort & Reliability	0	1	1	2	2	3	3	4	2	3	2	3
Safety	0	1	0	1	2	3	3	4	3	4	3	4
<b>Total</b>	<b>4</b>		<b>7</b>		<b>12</b>		<b>16</b>		<b>15</b>		<b>14</b>	

The *No Build* Alternative represents the existing condition of the level of transit supportive services, infrastructure and technology deployed within the PRC. It is the baseline by which all Alternatives proposed by this study were evaluated and consists of the existing route 105 transit service; as well as pedestrian and roadway facilities operating on the PRC. There are currently no dedicated transit lanes, nor traffic signals outfitted with TSP along the route. There is a non-continuous sidewalk, with inconsistent ADA compliant pedestrian facilities, pedestrian safety and information systems deployed throughout.

The *Tulsa Plus* Alternative provides minimal benefits to the PRC by introducing traffic signal prioritization (TSP) for improved travel times and investment in several significant transit shelters at key activity centers and intermodal locations along the corridor. Minor service improvements are also recommended to improve service during a brief off-peak window of diminished service currently operated by route 105.

The *Tulsa Enhanced* Alternative replaces the route 105 and introduces changes to the existing local and flag-stop operations found on Tulsa Transit's fixed route services, as well as improving service frequency by  $\frac{1}{3}$  and extending hours of service further into evenings. It also builds on the infrastructure and technology improvements proposed within the Tulsa Plus Alternative by adding real time vehicle arrival information and pedestrian facility improvements around selected station areas.

The *Fast Bus* Alternative adds an overlapping, Limited or Skip-stop ( $\frac{1}{2}$  mile to  $1\frac{1}{2}$  mile) service operating at a continuous 30 minute frequency to the existing 105 to provide maximum flexibility in trip planning for passengers. It contains all of the infrastructure and technology improvements of the Tulsa Enhanced Alternative, with additional locations for construction of significant transit shelters and including automated ticket vending capabilities as well as pedestrian illumination at new station shelters.

The *BRT Light (15/20)* Alternative contains all infrastructure and technology improvements identified by the Fast Bus Alternative, but proposed replacement of the existing 105 service for implementation of Limited or Skip-stop service within the study area operating at a 15 minute peak and 20 minute off-peak frequency.

The *BRT Light (10/15)* Alternative offers all of the infrastructure and technology improvements proposed by the BRT Light (15/20) Alternative, but increases service frequency by five (5) minutes and decreases hours of service by two (2) hours on weekdays.

## Financial Impact Evaluation

One of the stated goals of the PRC AA study is to develop a low-cost, high-impact solution for implementation within the study area. The evaluation of financial impacts of deployment was a necessary and proper evaluation based on the Tulsa Transit's historic funding capacity for capital improvement projects as well as maintaining and expanding existing fixed route service. Evaluation criteria used for Financial Impact evaluation were:

- ▶ Support for Economic Development
- ▶ Capital Cost
- ▶ Incremental O&M Cost
- ▶ Percentage of Current Tulsa Transit Operating Budget

## Support for Economic Development

Attributing factors used to evaluate *Support for Economic Development* included potential property impacts to community stakeholders, accessibility to jobs and labor pools, and magnitude of investment supporting further development.

The *commercial and residential property impacts* caused by construction of stations and pedestrian amenities may include (temporary or permanent) acquisition of right-of-way (ROW) and modifications to traffic circulation or access, which could disrupt businesses or residents.

Community *access to jobs and labor markets* would be expanded by more frequent service, shorter travel times and longer hours of operation, enabling greater utilization of transit for work-based trips.

Improvements that contribute to the PRC vision of *supporting further economic development* include improving pedestrian accessibility, implementing sustainable community development principles and investing in station areas with potential for joint development opportunities.

**Table 8: Economic Development Support Evaluation**

Alternative	Property Impacts	Access to Jobs and Labor	Support Further Development	Rating	
NO BUILD	HIGH	LOW	LOW	1	2
TULSA (+) PLUS	MEDIUM	LOW	LOW	0	1
TULSA ENHANCED	LOW	MEDIUM	MEDIUM	2	3
FAST BUS	LOW	HIGH	HIGH	3	4
BRT Light (15/20)	LOW	MEDIUM	HIGH	2	3
BRT Light (10/15)	LOW	MEDIUM	HIGH	2	3

The *No Build* Alternative does not involve construction of any new infrastructure within the corridor or modifying the existing service operating parameters, thus having a null impact on economic development within the corridor. The lack of construction does not present any adverse property impacts, however, resulting in a **Medium-Low** rating.

The *Tulsa Plus* proposes minimal investment in capital improvements to install more robust station shelters only at selected locations within the corridor, and maintains the current service operating profile of the existing route 105. Without significant improvement to pedestrian facilities, service frequency or hours of operation the alternative received a **Low** rating.

The *Tulsa Enhanced* Alternative modifies the service operating profile within the corridor to improve frequency by 33% over the No Build as well as extending the hours of operation by two hours. It also includes a greater number of significant station platform locations and adds pedestrian infrastructure around proposed platforms; making strides to improve the corridor vision for transit accessibility, but causing additional property impacts. The combined attributes of the alternative resulted in a **Medium** rating.

The *Fast Bus* Alternative extends the current service hours and provides the most operating flexibility and accessibility of the proposed alternative since users may access the existing local service of route 105 or the limited stop service of the Fast Bus throughout the corridor. It proposes the most significant station platform and amenity construction, contributing to corridor economic development potential, but increasing the likelihood of property impacts. The combined attributes of the alternative resulted in a **Medium-High** rating.

The *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives improve service frequencies by a minimum of 33% to 50% over the No Build, while installing the most significant station platform and pedestrian accessibility improvements among all alternatives. Although the BRT Light (10/15) Alternative has a

greater service frequency, it does not propose extending the hours of operation as the BRT Light (15/20) Alternatives does. The As a result, the alternatives each received **Medium** ratings.

### Capital Cost

The projected capital costs of alternatives was a critical aspect of this alternatives analysis in order to shape the development of capital funding strategies to be pursued by the City of Tulsa and Tulsa Transit. Capital cost projections are presented in year of expenditure (YOE) dollars. These figures include all applied construction, design, unallocated contingencies as well as an escalation factor to account for any changes in market pricing of construction materials and labor between the time of the estimate and the proposed beginning date of revenue operations. Further information on development of capital cost figures will be included in the final Peoria/Riverside Corridor Alternatives Analysis Report.

- (1 - 0) - \$20 M or greater
- (2 - 1) - \$15 M to \$20M
- (3 - 2) - \$10M to \$15M
- (4 - 3) - \$5 M to \$10M
- (5 - 4) - Less than \$5M

**Table 9: PRC Alternative Capital Cost Estimates**

Criteria	NO BUILD		TULSA (+) PLUS		TULSA ENHANCED		FAST BUS		BRT Light (15/20)		BRT Light (10/15)	
Projected Capital Cost	\$0		\$12.20 M		\$17.19 M		\$16.39 M		\$18.65 M		\$20.53 M	
Rating	4	5	2	3	1	2	1	2	1	2	0	1

### Incremental Operations & Maintenance Cost

the projection of incremental increase to the existing Tulsa Transit annual operating & maintenance (O&M) budget is a critical tool in the public involvement and local decision making process, as policy makers, City of Tulsa administrative staff, and potential local funding partners must determine the amount of additional revenues that must be raise in order to support the continued operations of Tulsa Transit at levels required by implementing the proposed alternatives. The rating of Alternatives' incremental O&M cost was evaluated as follows:

- (1 - 0) - \$2 M or greater increase
- (2 - 1) - \$1.5 M to \$2M increase
- (3 - 2) - \$1M to \$1.5M increase
- (4 - 3) - \$0.5 M to \$1M increase
- (5 - 4) - Less than \$0.5M increase

**Table 10: PRC Alternative Incremental O&M Cost**

Criteria	NO BUILD		TULSA (+) PLUS		TULSA ENHANCED		FAST BUS		BRT Light (15/20)		BRT Light (10/15)	
Projected O&M Cost	\$1.3 M		\$1.55 M		\$2.57 M		\$2.65 M		\$2.33 M		\$3.11 M	
Incremental Cost (above No Build)	\$0		\$0.25 M		\$1.27 M		\$1.35 M		\$1.03 M		\$1.81 M	
Rating	4	5	4	5	2	3	2	3	2	3	1	1

**Percentage of Current Tulsa Transit Operating Budget**

A useful tool in evaluation and selection of a proposed alternative is the relative long term financial commitment of agency O&M budget needed to maintain alternatives’ proposed service profiles. **Table 11** highlights the amount of resources that would be dedicated towards continued deployment of the new service versus known expense of existing route 105 annual revenue operations. Alternatives were rated based on the calculated proportion of the existing Tulsa Transit budget required for operations (as a percentage of the current total O&M budget of approximately \$18 M).

- (1 – 0) – Greater than 20% of current budget
- (2 – 1) – 15% to 20% of current budget
- (3 – 2) – 10% to 15% of current budget
- (4 – 3) – 5% to 10% of current budget
- (5 – 4) – 0% to 5% of current budget

**Table 11: PRC Alternative O&M Cost as Percent of Existing Tulsa Transit Operating Budget**

Criteria	NO BUILD		TULSA (+) PLUS		TULSA ENHANCED		FAST BUS		BRT Light (15/20)		BRT Light (10/15)	
Projected O&M Cost	\$1.3 M		\$1.55 M		\$2.57 M		\$2.65 M		\$2.33 M		\$3.11 M	
% of Existing Budget	7.2%		8.6%		14.3%		14.7%		13.0%		17.3%	
Rating	3	4	3	4	2	3	2	3	2	3	1	2

**Summary**

Financial evaluation ratings were assessed based on comparison of the incremental level of financial commitment required by each alternative to deploy and maintain service operations at the prescribed levels. Those alternatives with the lowest initial capital investment requirements and lowest annual operating expense increase were rated

highest in feasibility. As a result, the *No Build* Alternative was assessed as the least impactful (most financially beneficial) alternative. A composite rating summary of the proposed PRC Alternatives' capital and O&M cost impacts is shown in **Table 12** and a summary of the applied ratings is provided below. It should be noted that economic development potential of alternative implementation was not able to be assessed at this point due to lack of industry guidelines for and inconclusive empirical evidence of direct investment or redevelopment attributable to bus transit projects.

**Table 12: Financial Impact Evaluation Summary**

Criteria	NO BUILD	TULSA (+) PLUS	TULSA ENHANCED	FAST BUS	BRT Light (15/20)	BRT Light (10/15)
Support Economic Development	1 2	0 1	2 3	3 4	2 3	2 3
Capital Cost	4 5	2 3	1 2	1 2	1 2	0 1
Incremental O&M Cost	4 5	4 5	2 3	2 3	2 3	1 2
% of Current O&M Budget	3 4	3 4	2 3	2 3	2 3	1 2
<b>Total</b>	<b>16</b>	<b>13</b>	<b>11</b>	<b>12</b>	<b>11</b>	<b>8</b>

As the existing, baseline condition, the *No Build* Alternative would not require any additional capital expenditure or incur any additional annual operating and maintenance expenses for continuing operation of route 105. As such, it was assessed to be the least fiscally impactful alternative amongst those proposed.

Intuitively, it can be inferred that the greatest increment in capital or operating expense lies in implementing any alternative above the No Build alternative, as there is no assumed additional funding, above the committed, to continue current operations. In observance of the incremental difference in alternative O&M costs, any significant increase in service frequency above the existing 30 to 45 minute frequency (i.e. - 20 minute frequency = 33%; 15 minute frequency = 50%; 10 minute frequency = 66% minimum improvement, respectively) results in corollary significant O&M funding needs.

Beyond the initial capital investment above the No Build Alternative however, it may be observed that the greatest incremental increase in capital expense is found between the proposed scopes of the Tulsa Plus and Enhanced Bus Alternatives. This may also be attributed largely to the additional vehicles required to conduct service at the significantly increased frequencies, as the cost of clean-fuel vehicles largely outweighs costs due to increases in the scope of pedestrian infrastructure and technologies deployed.

The *Tulsa Plus* Alternative maintained much the same service operations as the No Build Alternative, but introduced the first level of capital investment for infrastructure and technologies. The capital cost implications of new vehicles and moderate bus shelters is reflected in the capital cost impact ratings of this alternative.

The *Tulsa Enhanced* Alternative increases service frequency in the PRC, as evident in the O&M cost impact ratings, and built upon the low-level investment in infrastructure and technologies to include additional vehicles, station amenities, and pedestrian enhancements at designated station areas.

Capital Cost differences between the *Fast Bus*, *BRT Light (15/20)* and *BRT Light (10/15)* Alternatives is primarily due to the amount of rolling stock required to operate the service at the prescribed frequencies. All infrastructure and technology deployments are consistent among alternatives. Similarly, the variation in proposed frequencies between the Fast Bus (30 minutes continuously), BRT Light (15 minute peak/20 minute of peak) and BRT Light (10 minute peak/15 minute of peak) is the driving factor behind the differences in projected operating cost of the alternatives. The higher frequency operating scenarios require additional vehicles (incurring maintenance costs) and additional labor (operators) to staff the vehicles in revenue service.

## Results

As stated within the Purpose and Need of this AA, the primary goals of this study are to identify a set of Low-Cost, High Impact transportation improvements that may be used to meet the mobility, accessibility, safety needs of the study area; as well as support the economic development potential and community vision for the PRC. The evaluation of construction impacts comparatively measure the alternatives’ respective mobility benefits to the PRC, but to effectively compare their ability to meet the stated goal of Low-Cost, High-Impact also requires inspection of incremental capital and operating costs to successfully deploy and operate the Recommended Alternative.

Each Construction Impact evaluation criteria identified within this document was supported by three to four indicators which were rated qualitatively, high to low, based on its ability to meet each criterion. Scores ranges from one (1 – 0), representing a perceived negative impact, to five (5 – 4), representing a perceived positive impact. The total scores for each evaluation criteria were summed to produce a relative technical ranking of the alternatives. Two alternatives surfaced as the best at meeting the needs and goals of the corridor, the **Fast Bus** and the **BRT 15/20**. A summary of the evaluation criteria ratings attributed to each alternative is shown in **Table 13** and discussed below.

**Table 13: PRC Alternative Evaluation Results**

Evaluation Criteria	No Build	Tulsa Plus	Tulsa Enhanced	Fast Bus	BRT 15/20	BRT 10/15
Travel Time	0	1	2	3	3	3
Transit Visibility & Perception	0	1	2	3	3	2
Comfort & Reliability	0	1	2	3	2	2
Safety	0	0	2	3	3	3
Support Economic Development	1	0	2	3	2	2
Capital Cost	4	2	1	1	1	0
Incremental Operating & Maintenance Cost	4	4	2	2	2	1
Feasibility – Percent of Current Tulsa Transit Operating Budget	3	3	2	2	2	1
<b>TOTAL SCORE</b>	<b>20</b>	<b>20</b>	<b>23</b>	<b>28</b>	<b>26</b>	<b>22</b>

Rating Scale: (1 – 0), (2 – 1), (3 – 2), (4 – 3), (5 – 4)

One of the more resounding conclusions to be drawn from the detailed impact evaluation of alternatives is that there appears to be a threshold to the scope of proposed service, infrastructure and technology improvements that combines optimal potential benefits with pragmatic investment. The **Fast Bus** and the **BRT 15/20** alternatives recommended by this evaluation propose scenarios of best fit to significantly improve service frequency, public perception and pedestrian accommodations of the public transportation system.

The Alternative recommendation and adoption process concluding this Alternatives Analysis study will include technical evaluations as well as review and feedback of public stakeholders, including the PRC Steering

Committee. The PRC Steering Committee will utilize the technical findings as information as they confirm a final recommendation for implementation.