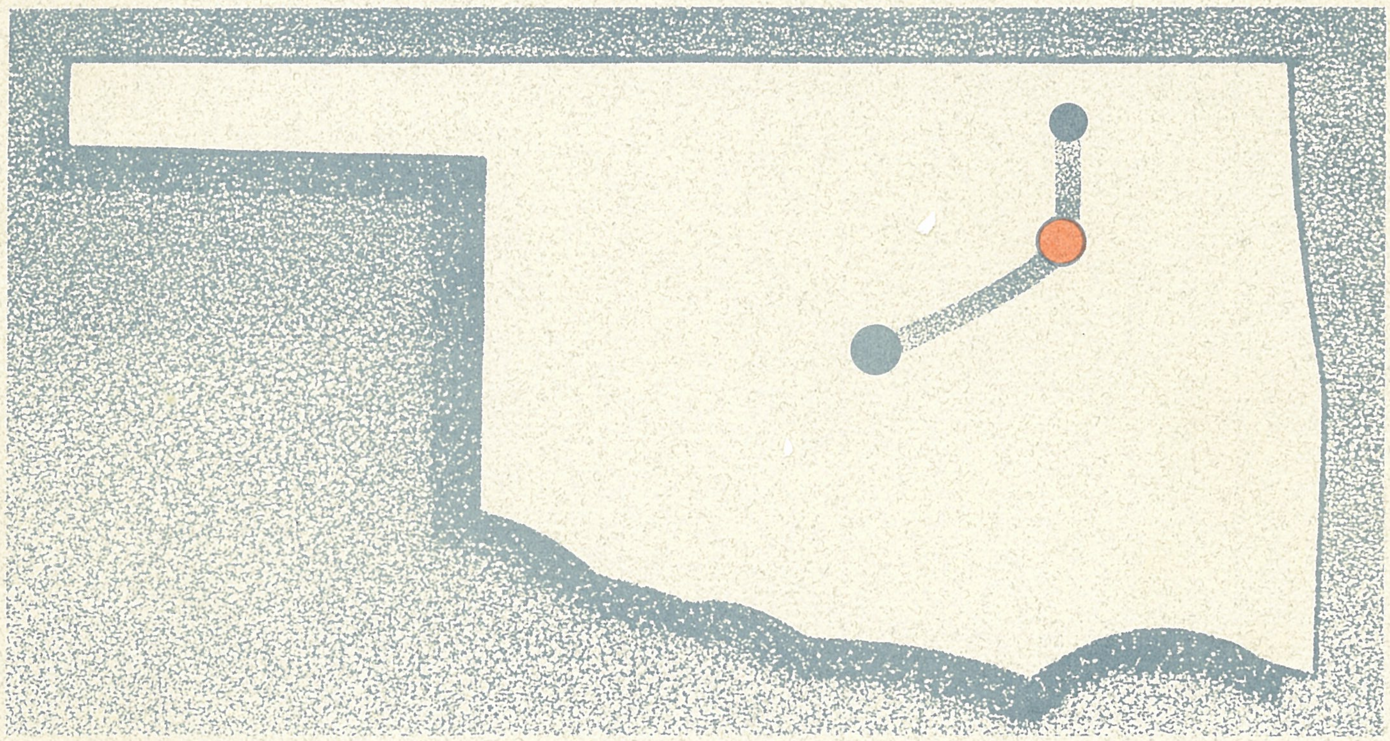
OKLAHOMA FIXED GUIDEWAY TRANSPORTATION SYSTEM STUDY

Tulsa Urban Area Phase I-Final Report



Prepared for

The State of Oklahoma Department of Transportation

Prepared by

Parsons Brinckerhoff Quade & Douglas, Inc.

OKLAHOMA FIXED GUIDEWAY TRANSPORTATION SYSTEM STUDY

PHASE I - SYSTEMS PLANNING

TULSA URBAN AREA

TASK 18

FINAL SYSTEMS PLANNING PROJECT REPORT

Submitted to:

Oklahoma Department of Transportation

Submitted by:

Parsons Brinckerhoff Quade & Douglas, Inc.

In association with:

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MGR, Inc.
RGDC, Inc.

September 1989

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1.0 INTRODUCTION

Since World War II, Oklahomans, like other Americans, have developed and maintained a strong dependence on the private automobile and have increased their levels of single family home ownership. These increases have coincided with generally healthy economic growth in spite of a recent downturn in the Oklahoma economy.

In the Tulsa Metropolitan Statistical Area (MSA), population increased by nearly 25 percent from 1970 to 1980 and by over ten percent from 1980 to 1984. Employment also increased. By 1984, approximately 359,000 people comprised the civilian labor force.

These increases are expected to continue well into the 21st Century. Population is expected to grow to over 675,000 people by 2005 and the labor force to over 420,000. Daily trips are expected to increase by over 30 percent, and as urban sprawl continues, motorists will travel an increasing number of miles to reach their destinations.

In Tulsa, the Oklahoma Department of Transportation (ODOT) will be spending an estimated $36 million for an approximately five year project to widen the Broken Arrow Expressway from four to six lanes.* The currently recommended plan for the Tulsa area, if full implementation is achieved, would meet the majority of the 2005 traffic demands; however, with increased construction costs and limited capacity, it is becoming apparent that new transportation facilities and services will be needed to accommodate projected traffic demands later in the 21st Century.

In recognition of this need, ODOT has undertaken a long range study to assess the feasibility of fixed guideway transportation in the Tulsa urban area. Fixed guideways are transit services that use vehicles which are physically guided by a guideway. Examples include rail, monorail, and automated guided transit (AGT), among other technologies. This report marks the completion of the first study phase and identifies the travel corridors in the Tulsa urban area that may be suitable for future fixed guideway transportation system development.

STUDY PHASES

The approach to the Tulsa urban area study is to work in the context of the U.S. Department of Transportation, Urban Mass Transportation Administration's (UMTA) Major Capital Investment Policy, to produce an analysis of the potential for fixed guideway systems that satisfies local requirements, and to utilize a process that is in keeping with federal policies and guidelines. UMTA can provide capital assistance to metropolitan areas considering the development of fixed guideway transit systems. Its federally-prescribed planning process should be followed explicitly in order to avoid a locally adopted project being either ineligible for federal assistance, or delayed for extended periods while additional studies are performed to satisfy the needs of the federal program. The planning process involves a technically sound planning procedure that can be conducted in a reasonable amount of time. It will produce suitable recommendations for development of transit solutions to transportation problems.

The UMTA major capital investment process has five phases which lead from the conception of a project to its completion. These phases are: 1) systems planning (and transition studies), 2) alternatives analysis and environmental impact statement, 3) preliminary engineering, 4) final design, and 5) construction. This report is the first element of the systems planning phase. For this study, systems planning has been divided into three phases. In the first phase, travel

* The plans have been recently modified to widen the Broken Arrow Expressway to eight lanes at an additional cost of $61 million. The forecast, however, was based on the six-lane plan.

corridors are identified and evaluated, and the most promising is recommended for more detailed studies in subsequent phases of systems planning.

SYSTEMS PLANNING

The systems planning phase follows UMTA guidelines for long-range transit planning. Its key objective is the identification of corridors that have potential for future fixed guideway development. The 18 interrelated work tasks in the systems planning phase achieve this objective through a systematic process of reviewing existing data, and preparing methodology reports. The work also includes projecting growth and travel demand, identifying network deficiencies, defining and evaluating potential transit corridors, and recommending three groupings of travel corridors for fixed guideway development. Figure 1 shows the approach to the first phase of systems planning. Appendix A contains a complete listing of the technical memoranda produced in the first part of the first phase of systems planning. ODOT has copies of these in their offices.

In particular, the transit ridership forecasting approach to the systems planning phase is best described as a "sketch planning" exercise using appropriate Urban Transportation Planning System (UTPS) model components to simulate potential transit corridors. Existing highway networks, modified as necessary, have been used to replicate possible fixed guideway routes. Such routes were initially defined on the basis of previous and ongoing studies, complemented by analysis of projected growth, land use and demographic forecasts, as well as highway capacity limitations and deficiencies. Each preliminary travel corridor was screened on the basis of the following factors:

- Travel demand
- Applicable guideway technology
- Feasible alignments
- Capital cost ranges
- Operating cost ranges
- Environmental considerations
- Potential transportation system management (TSM) opportunities

Based on this preliminary evaluation, three priority groupings of corridors have been identified for Tulsa and are detailed in this final report.

- Tier 1 - Those corridors, likely not to exceed two or three, which might be expected to have future potential for development of fixed guideway facilities as a function of forecast growth, land use and related travel demand, and diminished highway capacity.

- Tier 2 - Other corridors that could be deemed appropriate for future supplemental high capacity transit services, such as exclusive busways, express bus facilities, and park-and-ride lots, but likely to be ineffective for rail or other high capital intensive investment for many years into the future.

- Tier 3 - Those corridors which have been identified during systems planning but, upon preliminary evaluation, appear to have little or no real potential for transit development under current demographic forecasts.

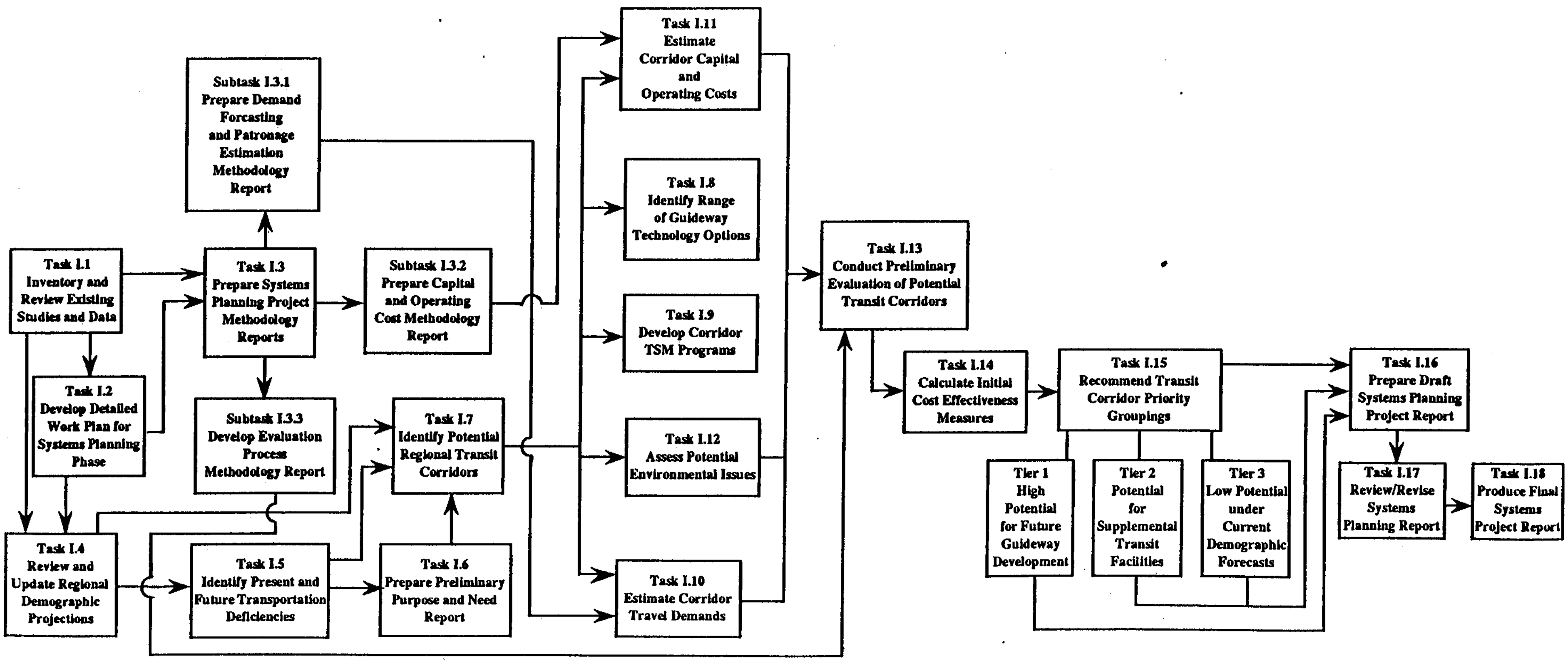
The determination of the corridor priority rankings are also partially based on early calculation of the UMTA-defined cost-effectiveness indices for each generalized corridor. This index uses values for costs and potential ridership on "generic" fixed guideway technologies derived from analysis conducted at the systems planning/sketch planning level. In this phase, no distinctions in ridership forecast exist between busways, light rail transit, and automated guideway transit because the network coding and forecasting has been made on a "sketch planning" model. Since the purpose of this early phase of systems planning is to identify suitable travel corridors, this modeling approach is appropriate. Refined transit ridership forecasts specific to the various technologies will be made in the second part of this systems planning study.

Figure 1

Project Flow Diagram

Oklahoma Fixed Guideway Transportation System Study Urban Area Studies

Phase I - Systems Planning



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2.0 DESCRIPTION OF STUDY AREA

STATE AND TULSA URBAN AREA

Economy

Until mid 1986, when the state's economy was sent reeling as a consequence of the rapid and sharp decline in world oil prices, Oklahoma's economic growth had outperformed that of the nation. Recent information and analysis suggest that as a result of the oil price decline, the state's economy bottomed out in 1987, and began recovering in 1988.

According to the Oklahoma State Econometric Model (OSEM), the state's economic output is forecast to grow faster than the gross national product (GNP) in 1988. The forecast also shows substantial growth during 1988 in both employment and per capita income, most likely a result of Oklahoma's economic diversification. Because of an expected slowdown in the national economy in 1989, however, the recovery is expected to be short term. According to the OSEM, the economy should resume solid growth in the early 1990s.

Demographics

The state's population patterns have reflected the economic patterns in the state. The decade has been one of growth, decline, and recovery. The state's population increased by 18.2 percent from 1970 to 1980, considerably faster than the 11.4 percent national average. From 1980 to 1987, the state's population grew by 8.2 percent, a rate exceeded by only 12 other states, even though Oklahoma's population declined in 1987 for the third consecutive year. The 1987 population totalled 3,272,000, a 1.5 percent increase over 1982 figures. Table 1 displays the state population figures over this decade and the 1990 projection. The state's population peaked in 1984 with a population of 3,321 million and declined in 1985 to 3,316 million. The 16 percent increase from 1980 to 1990 is impressive considering the 1.3 percent decline from 1985 to 1987.

The most significant economic implications of these population projections result from the changing age composition of the population and work force. Between 1970 and 1985 those people between the ages of 20 and 39 accounted for 62 percent of the population increase. The increasing age of the work force together with the growth of the over 65 years of age cohort will place demand on special transportation services offered, including designs to accommodate people with lessened mobility.

Table 1

**State Population
(in thousands)**

	1980	1981	1982	1983	1984	1985	1986	1987	1990
Oklahoma	3,025	3,105	3,223	3,317	3,321	3,316	3,306	3,272	3,503

Sources: U.S. Department of Commerce, Bureau of Census, State Population and Household Estimates, Series P-25, No. 1024.

U.S. Department of Commerce, State and Metropolitan Area Data Book, 1986.

TULSA METROPOLITAN AREA TRANSPORTATION STUDY

Demographic Trends

Table 2 compares the 1960, 1970 and 1980 populations of the counties in the Tulsa MSA. Tulsa County's population increased by only 36 percent between 1960 and 1980. Migration of the population to the suburbs is reflected in the lower percentage increase of Tulsa County's population compared with the percentage increase in population for the other counties (except for Osage) for the same period.

These population trends have implications for travel, specifically resulting in commuting travel beyond traditional expectations. The key elements of the boom in commuting demand are:

- Population growth has occurred in the suburbs as well as the central city;
- The baby boomers entering the work force (beginning in the 1960s) have caused the working age population to increase in greater proportion than the general population;
- The significant increase in female workers has added to the demand for commuting; and,
- Changes in the economy have resulted in job growth which exceeds population growth.

The focus of this study is on a portion of the Tulsa MSA, the Tulsa Metropolitan Area Transportation Study (TMATS) area, as shown in Figure 2. Table 3 displays demographic information for 1980 and 2005. The 1980 population was about 334,000 and total employment was about 265,000. By 2005, it is anticipated that the population in the TMATS area will reach 689,000, an increase of 29% between 1980 and 2005, and employment will reach 423,000, an increase of 60% between 1980 and 2005.

Since employment is projected to grow faster than population, existing Oklahoma commuting patterns were examined. In 1980, 83 percent of the persons who reported a place of work, worked inside their county of residence and 17 percent commuted outside their county of residence.

Figure 3 shows the commuting patterns to and from Tulsa County. Wagoner County had the highest percentage of workers commuting, with over 70 percent of its work force leaving the county to work. In addition to Wagoner, Osage, Creek, and Rogers counties also have large populations of commuters traveling to Tulsa. In Rogers and Wagoner more residents work outside the counties than inside.

In 1987, the highest traffic count location was I-244 just west of S. Yale with an average daily traffic count (ADT) of 75,000 vehicles. In 1981, this location also had the highest ADT with 72,000 vehicles per day. The location with the lowest ADT in 1987 was on US 75 north of E. 66th Street N. with only 14,000 vehicles per

Table 3

TMATS Population and Employment

	1980	2005	Growth Rate 1980-2005
Population	534,000	689,000	29%
Employment	265,000	423,000	60%

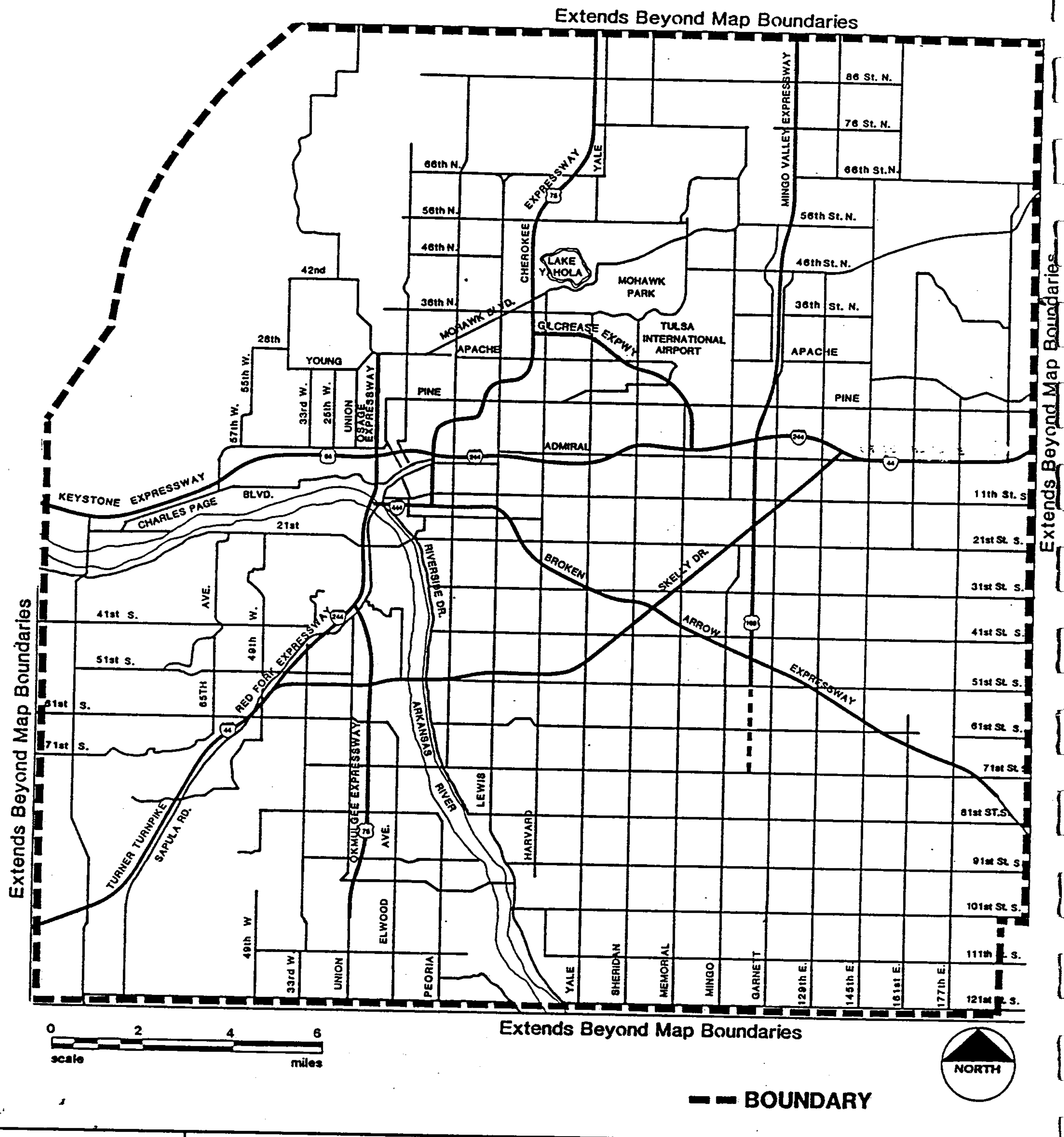
Source: Indian Nations Council of Governments (INCOG), 1987.

Table 2

Comparison of Populations
Tulsa MSA Counties

County	1960 Population	1970 Population	1980 Population	1983 Population	1984 Population	1985 Population	Increase 1960 - 1985	Percent Increase 1960 - 1985
Tulsa	346,038	401,663	470,593	511,500	509,884	512,000	165,962	48.0%
Creek	40,495	45,532	59,016	65,900	69,543	69,400	28,905	71.4%
Osage	32,441	29,750	39,227	42,600	42,027	41,300	8,859	27.3%
Rogers	20,614	28,425	46,436	53,500	54,112	55,200	34,586	167.8%
Wagoner	15,673	22,163	41,801	47,600	50,003	50,100	34,427	219.7%

Source: U.S. Department of Commerce, 1988.



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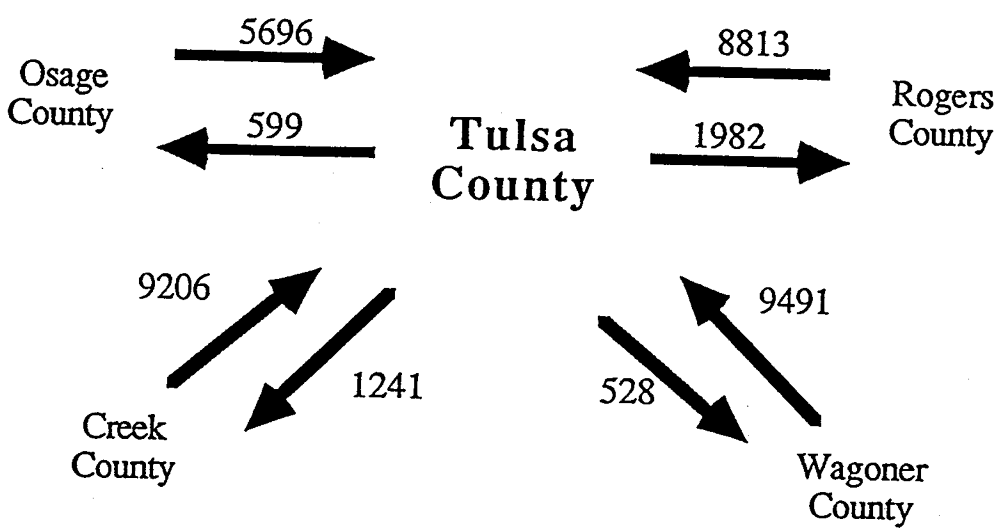
	TMATS STUDY AREA **Major Facilities**	**2**

Commuting Patterns To and From Tulsa County



Source: Oklahoma Department of Economic and Community Affairs, April 1985

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	TULSA MSA COMMUTING PATTERNS	**3**

day. This location also had the lowest ADT (12,000 vehicles) on the system in 1981. The most heavily travelled segment in the system now is I-244 from the Inner Dispersal Loop (IDL) to S. 129th E. Avenue.

According to the Summary Report on Commuting Patterns in Oklahoma Counties, 46 counties have higher commuting rates than the state average of 17 percent. Most of these are located in the eastern and central part of the state. Conversely, in 1980 Tulsa County had the lowest commute rate in the state, with only 3.3 percent. This small commuting rate indicates a major commuting center attracting large numbers of commuters from a large surrounding area.

Economic Conditions

The economic outlook for the TMATS area looks favorable for several reasons. First, the continued population and employment growth should help the economic growth. Second, the area's ability to diversify its base will help to maintain economic stability. And third, as the economy begins to prosper and take hold, it will propel itself through a multiplier effect.

Future Conditions

Population in the Tulsa metropolitan area is expected to increase 30 percent in the next 25 years. During the same period the total number of daily trips by residents will increase approximately 33 percent in the Tulsa area. On an individual basis, each person is expected to make 13 percent more trips each day than they do presently, and each trip will be 5.3 percent longer. These increases are a reflection of the projected growth in population and the addition of more Oklahomans to the work force. Disposable income is expected to continue to increase, thus encouraging more frequent jaunts for shopping and leisure time activities. As urban sprawl continues, motorists will travel more miles to reach their destination.

TRANSPORTATION SYSTEM

Operating and Physical Characteristics

The roadway system serving the TMATS area centers on five major facilities as shown in Figure 2. The Interstates, I-44 and I-244, primarily serve east-west movements. The State Highways: US 75, SH51, and US 169, primarily serve north-south movements.

In 1987, the highest traffic count location was I-244 just west of S. Yale with an average daily traffic count (ADT) of 75,000 vehicles. In 1981, this location also had the highest ADT with 72,000 vehicles per day. The location with the lowest ADT in 1987 was US 75 north of E. 66th Street N. with only 14,000 vehicles per day. This location also had the lowest ADT (12,000 vehicles) on the system in 1981. The most heavily travelled segment in the system now is I-244 from the IDL to S. 129th E. Avenue.

Levels of Service

The Tulsa metropolitan area's growth has been accompanied by an increase in traffic volumes as stated in the previous sections; however, the investment in the transportation infrastructure has not kept pace with the increased demand. Consequently, the level of service (LOS) has begun to deteriorate and will continue to worsen as growth continues.

The LOS is a ratio that compares the traffic volumes with the roadway capacity. This ratio is converted to an alphabetical rating A through F, with A/B indicating a good rate of flow and E/F indicating an undesirable rate of flow.

A computer plot of the volume/capacity ratios forecast for the 2005 TMATS system was obtained and from that plot the levels of service were developed. As shown in Figure 4, a one-half mile segment on I-44 (Skelly Drive) just west of the Arkansas River is projected to operate at LOS E/F as is a 1.5 mile segment of the Osage

Expressway. Over 22 miles of major highway segments will be at LOS D by 2005, including the most heavily traveled portions of Skelly Drive, SH 51 (Broken Arrow Expressway), and US 169 (Mingo Valley Expressway), even with planned widening of these facilities.

PUBLIC TRANSIT

Operating and Physical Characteristics, and Level of Service

In 1985, the Metropolitan Tulsa Transit Authority, or Tulsa Transit, operated or purchased operations of 108 vehicles. Eighty of these vehicles were operated during the typical PM peak period and 37 vehicles during the average base period. Over 200,000 vehicle hours and 3.2 million miles of transit service were supplied. Over 3.1 million unlinked passenger trips were taken, or 1.1 trips per actual vehicle revenue mile.

Transportation Funding

The state highway system receives funds from state and federal revenue sources. State revenues are based upon continued current percentage appropriations from the State General Revenue Fund and the dedicated state motor fuel taxes. Federal revenues are based upon an 85 percent return of Oklahoma's federal road user taxes paid into the Federal Highway Trust Fund. Current estimates indicate that $1 billion in state and federal funds will be available to ODOT for non-interstate state highway construction during the five-year period FY 88 - FY 92.

In June 1987, Oklahoma implemented an additional five cents per gallon fuel tax. With a ten cents per gallon state gas tax, approximately 95 percent of the state revenues for maintaining and improving the state highway system comes from fuel taxes. Therefore, the future revenues for highway construction and maintenance needs will be greatly influenced by the amount of fuel consumed by Oklahoma's road users.

Projections indicate that the total statewide vehicle miles of travel will continue to increase annually; however, the average statewide fuel efficiency is also predicted to increase. Therefore, ODOT estimates that the total amount of fuel consumption will actually decrease. In turn this will directly decrease highway revenues.

Over the next 20 years, increasing vehicle miles of travel offset by increasing fuel efficiency will average approximately 2.1 billion gallons of fuel consumed annually. This essentially places ODOT on a fixed annual income from state sources. At this time, no plans to offset the inflation of construction costs exist. Consequently there will be fewer dollars to build expanded and new highway facilities over the next two decades.

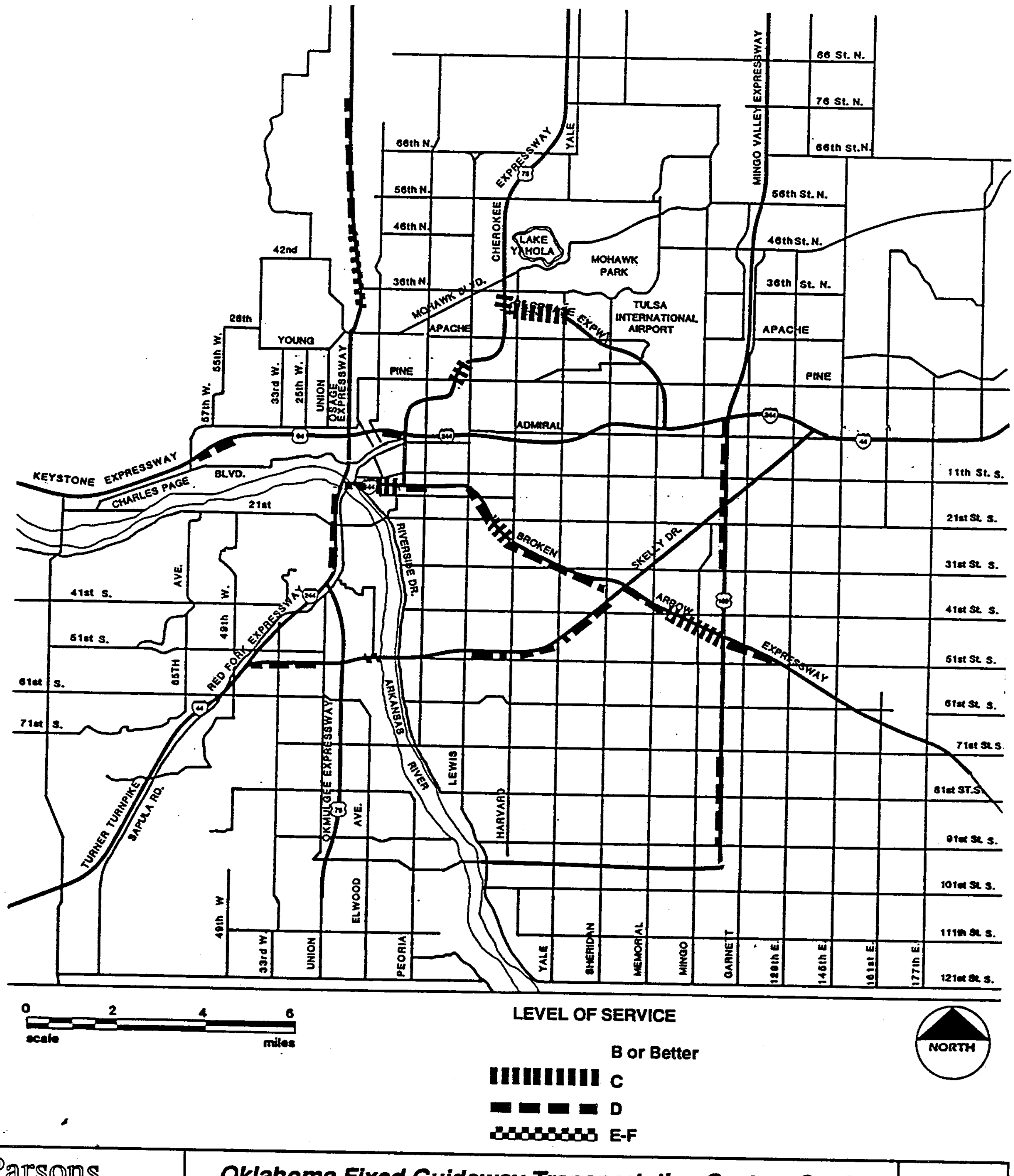
SUMMARY

Sociodemographic Context

The anticipated growth in population and employment is a positive contributor to the livelihood of the Tulsa metropolitan area. Transportation improvements to ensure necessary mobility must be planned and implemented to accommodate this growth and maintain economic stability.

Transportation Context

The current transportation infrastructure is beginning to falter under today's conditions. Without the full implementation of the regional plan it is obvious the 2005 travel demands cannot be met. Based on increased construction costs, insufficient highway funds will be available to provide the necessary additional capacity. It is apparent that additional transportation facilities and services will be needed to accommodate the projected travel demand. With this forward looking study, ODOT is taking the lead in planning for alternative transportation improvements.



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	PROJECTED LEVELS OF SERVICE	**4**

3.0 TECHNICAL APPROACH AND AGENCY/PUBLIC COORDINATION

Corridor Definition

A critical step in the fixed guideway study is the definition of potential travel corridors. Traditionally, fixed guideway transit systems have been developed in urban areas with histories of strong bus ridership. Corridors suitable for fixed-guideway service (i.e., high occupancy vehicle lanes, rail transit or automated guideway transit) were typically those which carried heavy volumes of bus riders. In recent years, cities with lower existing transit ridership have begun to examine the feasibility of including fixed-guideway transit in long range planning to meet future travel demand. Among others, these cities include San Diego, San Jose, Sacramento, and Orange County, California; Portland, Oregon; Seattle, Washington; Phoenix, Arizona; and Austin, Dallas, Houston, and San Antonio, Texas. This long range planning requires the use of transportation planning methods to identify potential transit corridors, as well as to evaluate the effectiveness of providing fixed guideway service in the area's travel corridors.

For this study, a travel corridor is considered to be a geographic area of land, usually of about two miles in width, with concentrations of residential development and employment opportunities which create defined demands for movement within the corridor. These may be relatively short (of a few miles) or extend tens of miles. They may be radially oriented to a Central Business District (CBD) or other large employment center, or operate in a crosstown mode along an axis. In either case, at least one "end" of the corridor is usually anchored by a concentration of activities (employment center, retail area, university, airport) which generate significant numbers of trips each day.

Demand Forecasting

Below is a description of the demand forecasting and patronage estimation methodology used during the system planning phase of the fixed guideway study. The methodology was used in three ways:

- An initial assessment was made of the potential for transit usage in the Tulsa urban area, identifying those trip movements which might productively be served by transit. The results of this analysis were used in identification of potential fixed guideway transit corridors and also in specification of a background bus system upon which the corridors were examined.
- Next was the identification of potential fixed guideway corridors. This identification involved both physical or supply characteristics, such as the locations of potentially available rights-of-way, as well as demand characteristics. On the demand side, two conditions were examined using the forecasting methodology: an investigation of the geographical distribution of areas with a good potential for producing and attracting transit trips; and an investigation of those areas where transit productivity would increase the most as a result of higher-speed fixed guideway transit service.
- The demand forecasting methodology was used in forecasting expected future transit travel demand in numerous potential fixed guideway corridors.

Demand forecasting and patronage estimation in the system planning phase utilize a transit sketch planning approach which facilitates a broad examination of overall potential transit demands and which is sensitive to changes in levels of transit service and transit operational characteristics. Use of the sketch planning approach allows an assessment of the potential for fixed guideway transit in the TMATS study area early in the study rather than later after a lengthy model calibration and network development process.

The sketch planning approach requires two simplifying assumptions which are appropriate at the initial system planning level. The first assumption is that a modal choice model calibrated with data from outside Oklahoma can be used to predict the expected travel behavior of residents of the TMATS area with an accuracy sufficient to identify potential fixed guideway transit corridors. The modal choice model calibrated for the Minneapolis-St. Paul Twin Cities area was used. The model is a logit formulation and has been successfully transferred to several other urban areas. It is available for application in UTPS as part of the sketch planning program RIDE.

The second simplifying assumption for the sketch planning approach is that the transit service levels utilized in the modal choice model can be represented on a non-network basis. This approach has been successfully implemented and is available for application using RIDE. The technique predicts and evaluates the impacts of different levels of transit service characteristics without having to consider the characteristics in the context of a specific transit system alternative. The approach produces information that can determine feasible transit areas and corridors and associate them with the level of transit service needed to produce a required level of patronage or to meet regional transit criteria.

The analysis process is based on three premises: a) the entire travel market should be considered in planning a transit system; b) the planning process should be as free as possible, at least in the initial phases, from prejudicial routing assumptions; and c) the specification of transit service should be based on policy service levels rather than on specific transit route spacing and headways. The second and third premises are made operational by using the concept of an ubiquitous transit system capable of directly serving each potential transit trip with a single ride from trip origin to trip destination along the shortest available route. Obviously, such transit service cannot normally be provided, but the assumption of ubiquity aids in systematic analysis by defining the system abstractly instead of specifying alternative routes. All other standard trip characteristics are considered in the modal choice analysis, including walk to and from the transit system, wait time for the transit vehicle, transit speed, parking costs, and transit fare. Transit service time includes the walk to and from the transit line and the wait time for the transit vehicle. Transit fare and speed are included in the analysis as exogenously specified variables.

Sketch planning analysis, using RIDE, can be efficiently applied at a district-level of aggregation with more detailed analysis done at the zone level in the subsequent study phase. For the first phase, a 137 district system covering the TMATS study area has been developed. Appendix A shows this district system.

Travel Orientation

In order to design a transit system efficiently, the analyst should have information available for at least these four types of transit movements. These include trips to the CBD; trips which take place within corridors focused on the CBD; trips which pass through the CBD with a possible transfer in the CBD; and circumferential trips. The need to investigate the transit potential to the CBD is obvious, and most conventional transit planning is performed using this trip movement as its prime focus. The corridor trips and the trips which transfer in CBD also play an important role in transit planning. This is because there are normally a sizable number of these trips; these trips can make use of CBD focused transit routes, and these trips tend to reinforce the CBD routes. These first three trip patterns can all be considered radial patterns. Their only differences are their destination locations. The fourth trip pattern, circumferential movements, is normally given little attention in planning a transit system since these movements are difficult and generally expensive to serve by transit. A preliminary investigation, though, will show that a high proportion of person trips fall within this category. Thus, the potential ability of transit to serve these movements should not be neglected. These four travel movements are shown schematically in Figure 5.

The terminology used for these movements is:

1. CBD movements — movements to or from the CBD.
2. Corridor movements — movements which take place within a corridor focused on the CBD.
3. Pin-corridor movements — movements which have the potential for transferring in the CBD.
4. Circumferential movements — all other movements.

Part of the system design methodology has been to define these movements and report the results of the methodology by these travel movements. The definition of CBD movements is relatively simple. The analyst need only define the CBD, and all trips to and from this area are CBD movements. The definition of corridor movement is more difficult. Rather than specify distant corridors based upon the geography of the region and the present transportation system, the concept of floating corridors is used in this methodology. The floating corridor concept is that each origin district has its own unique corridor which is defined as a rectangular area extending from the origin district to the CBD.

Mathematically, the definition of a floating corridor consists of:

1. The center line of the rectangle as defined by coordinates of the origin district centroid and the centroid of the CBD.
2. The slope of the sides of the corridor as defined by the slope of the center line.
3. The width of the corridor, which is user-defined but has typically been assumed as one mile.

The purpose of the floating corridor is to define which movements are corridor movements and which are not. By using a floating corridor, the corridor movements can be defined as any interchange movement from an origin district which ends within the corridor. For computer analysis, the beginning and end points of an interchange were described by the X and Y coordinates of the district centroids (i.e., the geographic center of the districts).

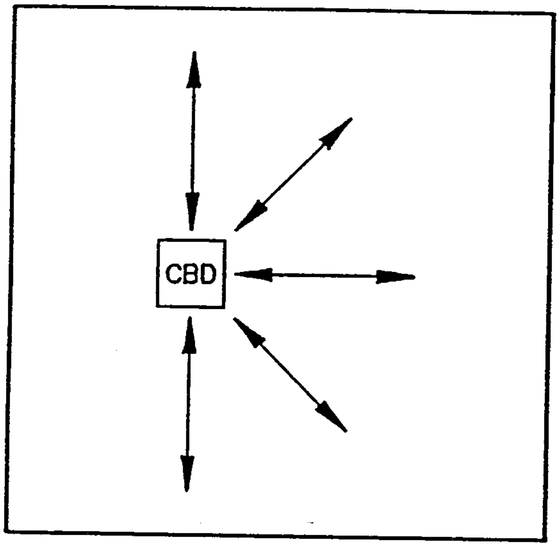
Any movement which is not a CBD or a corridor movement can be either a pin-corridor or a circumferential movement. The distinction between these two movements must be based upon the transit travel time. Thus, if a trip can be made more quickly by going to the CBD and then transferring to another radial line, it is a pin-corridor movement. Otherwise, the trip is a circumferential movement. Obviously the circumferential movement is always quicker than the pin-corridor movement if both movements have the same service level. It is therefore necessary in the methodology to define two types of service times: one for radial movements: CBD, corridor, and pin-corridor movements; and one for circumferential movements.

OPERATING ASSUMPTIONS

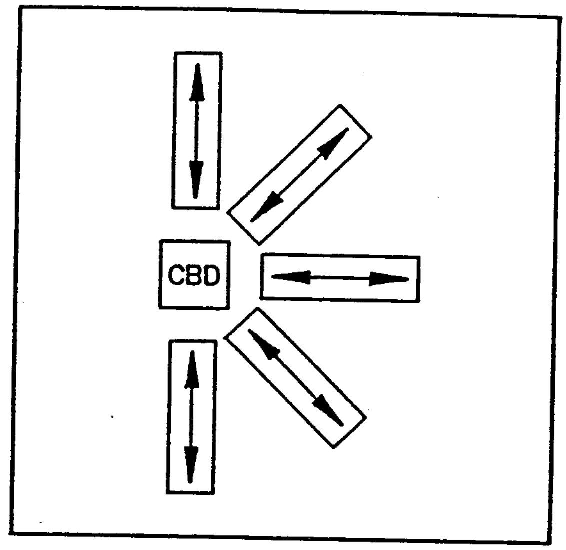
Walk and Wait Times

In the prediction of transit trips by modal choice models, the time spent waiting for and walking to a transit vehicle (access time) is a significant variable. The assumptions made in the methodology are that the walking time is related to the average spacing of the transit lines, and that the waiting time is related to the headways (frequencies) of the transit line. These assumptions are quite logical and realistic, although there may be unique situations where these relationships are not appropriate.

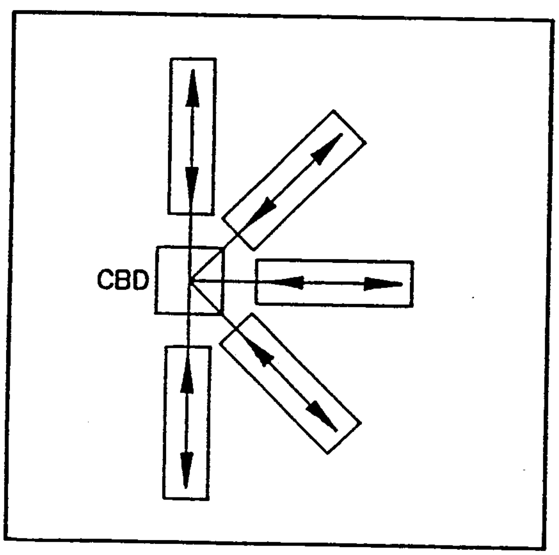
The walk to transit values have been derived from the transit line spacing. The walk distance is simply one-quarter the transit spacing. For example, in an area with one-mile spacing the



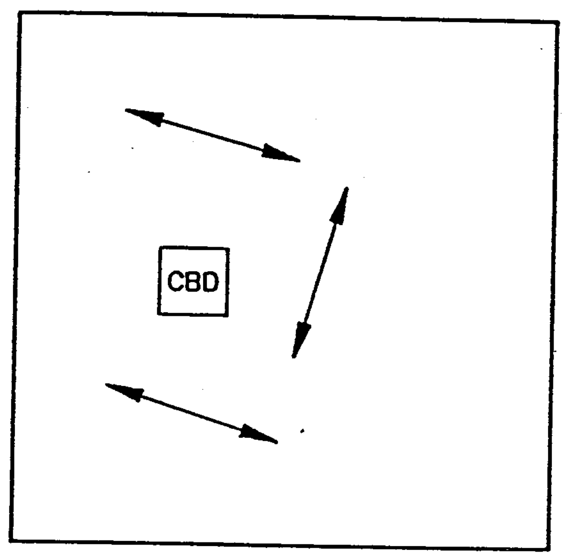
CBD Movements



Corridor Movements



Pin–Corridor Movements
through the CBD



Circumferential Movements

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average resident would have to walk one-quarter of a mile to reach a transit line. Normally, the average wait time is a simple function of headway (i.e., the average time between transit vehicles). For this analysis, it is assumed that the walk time for a given district can be calculated using the average distance and a walking speed of three miles per hour. It is also assumed that the average wait time is equal to half the headway. Other assumptions could also be used with this design approach, including ones which assign non-linear relationships between average walk time and walk distance, and between average wait time and headway.

As noted earlier, this approach uses the concept of a transit service time, which is equated to the sum of the average walk time plus the average wait time for a given zone. The transit service characteristic which is optimized, then, is service time rather that the individual walk and wait time components. This concept requires the assumption that walk and wait times are equally weighted as components in travel decisions. It also requires, in the design phase of this approach, that the service level can be broken down into its spacing and headway components. For a given service level the least cost combination of these components can be readily calculated.

Once average walk and wait times, stratified by radial movements and circumferential movements, have been calculated for all districts the total access time component for any district-to-district transit trip can be easily obtained, given the trip orientation assumptions discussed earlier. For CBD and corridor movements, the access time component for a trip from district X to district Y, equals the radial walk time for district X, plus the radial walk time for district Y, plus the larger of either the radial wait time for district X or the radial wait time for district Y. For pin-corridor movements, which assume a transfer in the CBD, the total access time equals the radial walk time, district X, plus the radial walk time, district Y, plus the radial wait time, district X, plus the radial wait time, district Y. The access time for circumferential trips equals the sum of the two circumferential walk times plus the larger of the two circumferential wait times, plus an additional wait time to reflect the possibility of transfer.

Fare and Operating Cost

Two other important characteristics of transit service are the fare and the transit running time. Since the methodology deals with transit trips on a district-to-district interchange basis, transit fares can be handled as with any other methodology. For Tulsa a set fare of 60¢ is assumed for all trips. The transit operating budget was assumed to equal the equivalent of $30 per capita per year, or a year 2005 budget of $20,670,000. Transit running time is calculated by dividing the trip distance by the speed. As mentioned in the ubiquity assumption discussion, trip distances by transit are considered equal to the minimum path highway distances for the same movements. Transit speed can be input as a system-wide value, stratified by the trip's location within the region.

Model Description

As mentioned earlier, the modal choice model used in RIDE was calibrated using Minneapolis-St. Paul, Minnesota, data. The proportion of intrazonal or interzonal trips by each mode of travel is estimated by a five-mode modal choice model with a multinomial logit formation. The five modes are:

- Transit passenger;
- One person in an auto (drive alone);
- Two persons in an auto;
- Three persons in an auto; and,
- Four or more persons in an auto.

Trip Purposes

The modal choice model imbedded in RIDE only provides a calculation of transit shares for work-purpose trips. While this may well be appropriate for service design, which is mostly controlled by peak period demand, the need in Tulsa is to identify all possible transit riders. To accomplish this, district-to-district non-work and non-home-based transit shares were estimated as a function of the district-to-district work-purpose transit share. These non-work and non-home-based transit percentages were applied to the appropriate purpose-stratified person trip tables to calculate non-work and non-home-based transit trips. The purpose factors were derived from an examination of observed transit demand data by purpose from Atlanta, Georgia; Washington D.C.; and Minneapolis-St. Paul, Minnesota:

- Home-based non-work transit share = 26% of the home-based work transit share; and,
- Non-home-based transit share = 18% of the home-based work transit share.

Operating Speeds

RIDE can be used to define fixed guideway corridors in two ways. First, the productivity analysis may directly identify corridors if higher productivity zones line up geographically with the existing traffic zone boundaries which lie in such a way as they can be aggregated to define a corridor. Second, corridor identification can be accompanied by examining the impacts on system utilization of changes in transit operating speed which would be expected to occur with a fixed guideway system. Using RIDE's service specification capabilities, two forecasts were made for a particular set of optimal service times, one with a transit speed of 12 mph and the other with a transit speed of 24 mph. By taking the difference of the two output transit matrices, a matrix of trips attracted to transit by the speed increase can be obtained. When this matrix is then displayed as desire lines, those portions of the region which would produce the largest transit trip increases, if subjected to transit priority treatments, can be located. The links with the largest numbers of trips assigned to them identify potential corridors for exclusive (fixed guideway) transit facilities.

Model Application

The program RIDE facilitated a broad examination of overall potential transit demands while being sensitive to changes in levels of transit service, transit operational characteristics, and area socio-demographic conditions. The use of RIDE's non-network-based transit service simulation also permitted the prediction and evaluation of the impacts of different levels of transit service characteristics without having to consider the characteristics in the context of a specific fixed guideway transit system alternative.

CAPITAL AND OPERATING COST METHODOLOGY

The purpose of this section is to document the cost assumptions and methodology used in estimating systems level capital and operating/maintenance costs suitable for "sketch planning" work. Specific emphasis was placed on: the identification of reasonable units for cost estimation purposes (such as miles of at-grade guideway); the development of unit costs, based on average conditions, which reflect the cost experience throughout the country; and, identification of a costing methodology which allows for the quantifying of differences between various transit investment options.

Costing information has been prepared for three transit technologies: (1) bus on shared or exclusive busway; (2) light rail transit (LRT); and (3) automated guideway transit (AGT). These technologies cover the range of transit options currently envisioned for possible application in this study. Unit cost estimates were synthesized from actual construction and planning-level experience in a number of North American cities including San Diego, San Jose, Denver, Austin, Pittsburgh, Salt Lake City, Baltimore, Milwaukee, and Calgary. Additionally, national summary reports for transit planning were reviewed.

CAPITAL COST COMPONENTS

Systems level capital costing estimates establish order-of-magnitude costs for physical elements to be procured or constructed. Included in this category of costs are rights-of-way, guideways, highways, stations, storage and maintenance facilities, power and utilities, and communications and control. Additionally, estimates were made for insurance, agency costs, construction management, and design engineering costs associated with particular alternatives.

Unit costs presented in this report were developed based on historical and estimated costs from similar projects. Estimates assume average conditions and exclude extraordinary cost items. Contingency factors, commensurate with the level of detail in this phase of the study, are included for each category of costs.

Right-of-Way

Right-of-way costs include all costs for acquiring property within the transit right-of-way (owner compensation, appraisals, agency costs), and all necessary relocations and minor demolition work. For systems level planning, right-of-way estimates were based on:

- Rural/Agricultural $5,000/acre
- Suburban $5.00/sq. ft.
- Central City $50.00/sq. ft.

As necessitated by sketch plan costing, these estimates reflect corridor-wide assumptions, and as such, are inappropriate for evaluating individual parcels.

Vehicles

Costs associated with vehicles for each technology include the cost of the vehicle itself and initial spare parts. Also included in this category of capital costs are support vehicles for routine maintenance and inspection activities.

For systems planning purposes, cost estimates were made for a standard 40 foot city bus and an articulated coach, a LRT vehicle, an AGT vehicle, and maintenance vehicles. For costing, spare transit vehicles were added at the rate of 15 percent of the peak vehicle requirements.

Facility Construction

Capital costs for the construction of transit facilities were developed for bus, LRT, and AGT technologies. Unit costs for these estimates were derived from similar projects and were adjusted to reflect cost escalation and regional variations. A 20 percent contingency has been included for this level of detail.

As appropriate, facility construction unit costs include:

- Guideway, which covers all items required to constrict the aerial or at-grade guideway structure, including site clearance, earthwork, concrete and structural work, utility relocations, lighting and drainage, and site restoration.
- Trackwork, which includes all rail, rail fasteners, and related facilities.
- Traction Power, which includes overhead catenary, cabling, transformers, and other equipment necessary to provide power to the rail vehicles.
- Train Control and Communication, which includes all necessary train signalling equipment.
- Yards and Shops, which covers all necessary items required to construct the yards and shops complex, including site clearance, earthwork, utility relocation, trackwork, buildings and equipment, and land.
- Stations, which includes the station structure and may include escalators/elevators, station lighting, station heating and ventilation, closed circuit TV system, architectural station finishes, and access improvements.

UNIT COSTS: OPERATING AND MAINTENANCE

Operating and maintenance costs reflect the labor intensive nature of transit. Unit costs are based on recent Oklahoma urban area transit data, national LRT and AGT operations and planning experience in smaller cities (such as San Diego), and national transit operating statistics.

For systems-level planning, operating and maintenance costs were computed as follows:

Buses: ($3.05 x Daily Veh. Rev. Mi. + $44.57 x Daily Veh. Rev. Hrs.) / 2

LRT: $4.90 x Daily Vehicle Revenue Miles

AGT: $3.70 x Daily Vehicle Revenue Miles

COST METHODOLOGY

A straightforward "step-wise" methodology was employed for determining the systems level costs of selected alternatives and technologies:

1. Estimate the quantity of each item listed on the unit capital cost tables (as appropriate).
2. Multiply the quantity of each item by its corresponding unit cost. For operating and maintenance costing, conversion to annual units will be made using a multiplier of 295. All units are in 1988 dollars without allowances for cost escalation to the actual date of expenditure.
3. Multiply the total item cost by its applicable contingency factor.
4. Sum the total costs for each item.
5. Add in any special design or unique systemwide costs to obtain total cost.

Quantities and the associated unit cost for each alternative were prepared in a tabular format to allow for the ready comparison of the alternatives (see Appendix B).

EVALUATION PROCESS

The following describes the framework ranking the travel corridors in the Tulsa urban area and grouping the travel corridors into the first, second, and third tier corridors. Tier 1 corridors are those corridors which might be expected to have future potential for development of fixed guideway facilities as a function of forecast growth, land use and related travel demand, and diminished highway capacity. Tier 2 corridors are corridors that could be deemed appropriate for future supplemental high-capacity transit services, such as exclusive busways, express bus facilities, and park-and-ride lots, but likely to be ineffective for rail or other high capital-intensive investment for many years into the future. Tier 3 corridors are those corridors that have been identified in the first phase of systems planning study but, upon preliminary evaluation, appear to have little or no real potential for transit development under current demographic forecasts.

It is anticipated that the highest priority grouping of transit corridors, Tier 1 corridors, will be advanced into the second phase of study. At that time, a more thorough analysis of the Tier 1 corridors will be made which will allow a more detailed evaluation among the priority transit corridors.

In this first phase, the evaluation methodology focuses on evaluating and contrasting the alternative priority corridors under consideration. This methodology has the following major objectives:

- Establish the policy and procedure for ranking the travel corridors in terms of their potential for fixed guideway implementation in this first phase of study, and then for evaluating the different alternatives in the second phase of the study. Local, state, and federal goals and policies regarding transportation capital investment are integrated into this process to assure achievement of local objectives and compliance with applicable state and federal administrative requirements.

- Define data requirements and analysis procedures to ensure that necessary information is obtained in a timely manner and at an appropriate level of detail. Early specification of data requirements alerts the responsible technical staff of evaluation data needed for the analysis. It also enables local, state, and federal study participants to develop consensus early in the study process on key measures and procedures to guide the decision making process.

- Develop a systematic process for organizing information on potential benefits and costs of the different alternatives for the second phase of the study. A comprehensive yet preliminary set of evaluation criteria and associated measures is presented for use in the second phase of study.

- Provide decision makers with a procedure for eliminating key differences among alternatives and key trade-offs involved in the identification of the three tiers of travel corridors and in selection of alternative courses of action for Tier 1, highest priority transit corridors.

IDENTIFICATION OF GOALS AND OBJECTIVES

Relevant goals and objectives relating to transit and transportation investments for the Tulsa urban area have been obtained from the following sources:

- Regional and Local Policies:
  - TMATS Long-Range Transportation Plan (LRTP), Major Update Year 2005 (1987)
  - Metropolitan Development Guidelines (1987)
  - Tulsa Metropolitan Area Comprehensive Plan, Transportation Goals (1987)

- Federal Policies:
  - UMTA Procedures and Technical Methods for Transit Project Planning (September 1986)
  - UMTA Major Capital Investment Policy (May 1984)
  - UMTA Policy on Private Enterprise Participation in the Urban Mass Transportation Program (October 1985)
  - UMTA/Federal Highway Administration (FHWA) Final Rule, Environmental Impact and Related Procedures (October 1980)
  - Council on Environmental Quality (CEQ), Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (November 1978)
  - A Detailed Description of UMTA's System for Rating Proposed Major Transit Investments (May 1984)
  - Financial Analysis for Proposed New Start Projects (September 1984)

REGIONAL AND LOCAL POLICIES

The principle guidelines, objectives, and policies directing the Tulsa Urban Area Fixed Guideway Transportation System Study are provided by the following three sources:

- Long-Range Transportation Plan, Major Update Year 2005 (LRTP) - TMATS, 1987;

- Metropolitan Development Guidelines (MDG) - Tulsa Metropolitan Area Planning Commission (TMAPC), 1987; and,
- Tulsa Metropolitan Area Comprehensive Plan, Transportation Goals (TCP) - TMAPC, 1987.

The 2005 TMATS LRTP for the Tulsa metropolitan area serves as the official regional long-range transportation plan. Officially adopted in 1982 by the TMATS Transportation Policy Committee, it outlines regional goals and objectives which are enumerated in Appendix C.

KEY ISSUES FOR RANKING THE TRAVEL CORRIDORS

A systematic classification of these local, regional, state, and federal goals, policies, and objectives results in the identification of nine key issues. These issues are for use in dividing the travel corridors into three tiers.

The nine key issues include: environmental concerns, equity, financial feasibility, federal requirements, local goals and objectives, institutional feasibility, economic land use impacts, cost, and performance. Environmental concerns provide a key issue useful in prioritizing the travel corridors. The Tulsa urban area with its myriad natural and cultural features has a high quality of life. The impact of a major transit investment to provide for future mobility must be defined and its impact on the environment must be assessed. Equity issues also help rank alternative corridors. Mass transit service must be provided on an equitable basis to current and future riders. Since the ability of an area to build, maintain, and operate a major transit capital improvement is critical in the decision whether to invest and where, financial feasibility issues are paramount in ranking travel corridors into the tiers. Related to financial feasibility issues are federal requirement issues. With an increasing number of urban areas competing for scarce federal transit dollars, the federal government, specifically UMTA, has set guidelines. (These were high-lighted in the previous section.) UMTA requires at a minimum a measure of benefits to costs, or cost-effectiveness. UMTA also supports opportunities for participation by the private sector in the projects. The Tulsa urban area includes a number of municipalities, with ordinance making powers to enforce local goals and objectives as reflected in local police powers. Issues related to meeting these local concerns must be addressed in ranking the travel corridors and dividing them into tiers. In order to provide for long-range mobility in the Tulsa urban area, appropriate institutional arrangements must exist, or where they do not, must be created/modified to implement fixed guideway development in a timely and orderly manner. Thus, issues of institutional feasibility and arrangements must be considered. In recognition of the close interrelationships between land use and transportation, particularly in fixed guideway transit development, issues of economic land use benefits will be addressed. Cost issues must also be considered in corridor ranking. Cost components include capital and annual operating maintenance costs. Finally, performance issues are useful in stratifying the corridor. Performance indicators focus on ridership and utilization. For example, differences among the percentage of work trips carried by transit, total transit ridership on annual and daily bases, et cetera, are performance indicators.

Table 4 shows how the local, regional, state and federal goals, objectives, and policies are covered by these nine ranking issues:

RECOMMENDED CLASSIFICATION OF EVALUATION INDICATORS

Based on the nine key issues described above, five major evaluation categories were also used in the evaluation process:

Cost: This category includes capital cost; operating and maintenance cost; and annual time-cost savings to transit riders, high occupancy vehicle users, and highway users. It encompasses the evaluation issue of cost.

Effectiveness: Also known as transportation system performance, the measures in this category focus on utilization, by mode; level of service; coverage; and reliability, safety, and security. This category covers the evaluation issues of performance.

Impacts: Impacts are essentially measures of effectiveness. Two primary groupings of impacts are proposed: impacts to the natural environment and to the socioeconomic environment. The former include topography, soils, habitat, wildlife, vegetation, air, noise, energy, and related areas. The latter include land use and population, housing, economic activity, joint development potential, net fiscal impact, local traffic, visual quality, and parkland/historic/cultural resources. This category embraces the evaluation issues of environmental concerns, economic land use benefits, and equity.

Financial and Institutional Feasibility: This category focuses on three key areas: sources and sufficiency of revenues; equity of benefit and burden; and compatibility with area plans, goals, and objectives. The evaluation issues of equity, local goals and objectives, and financial and institutional feasibility are included in this category.

Cost-Effectiveness: This category concentrates on the extent to which benefits achieved are commensurate with the resources committed. Of particular interest are four UMTA-required indices. Two deal with incremental and composite cost-effectiveness, and consider marginal and average differences between alternatives. The other two focus on federal and total project merit, and look at the user benefits relative to the source of project financing. This covers the federal requirements evaluation issue. Table 5 shows the evaluation categories and the goals and objectives associated with them.

AGENCY AND PUBLIC COORDINATION

The Tulsa Urban Area Fixed Guideway Transporation System Study has been a joint effort with ODOT and the Indian Nations Council of Governments (INCOG). This study and review has been coordinated through direct contact with ODOT, the Oklahoma Turnpike Authority (OTA), Tulsa Transit, INCOG, and the cities in the TMATS area. Appendix D provides additional information on the review procedures, and public and agency involvement throughout this first phase of study.

Table 4

Corridor Ranking Issues and Relationship to Goals, Objectives, and Policies

Evaluation Categories	Associated Goals and Policies
Performance	LRTP I, I.7, I.9, I.10, I.12; TCP 1.3, 1.5, 2.1, 2.2, 2.4, 3.1, 3.2, 3.3, 4.1, 5.2, 5.4, 6.1, 6.4, 7.1, 7.3, 8.1, 9.1, 9.4, 10.1, 11.1, 11.2, 11.4, 16.1, 16.2, 17.1, 17.2, 18.1, 24.2, 24.4, 25.1, 25.2, 26.1, 26.2, 26.4; MDG; UMTA
Environment	LRTP I, I.4, I.5, I.15, I.16; TCP 7.1, 7.3, 7.4, 7.6, 8.1, 8.7, 9.6, 10.1, 10.3, 10.4, 11.3; UMTA
Cost	LRTP I.17, I.18, I.20; UMTA
Federal Requirements	LRTP I.8; UMTA
Land Use	LRTP I.2, I.6, I.9, I.14; TCP 1.1, 1.2, 2.2, 3.3, 4.2, 4.4, 6.4, 7.5, 8.5, 8.6, 9.2, 9.3, 9.6, 10.2, 16.3, 17.4, 18.2, 18.4; MDG 1.1, 1.3
Equity	LRTP 1.20; TCP 7.6, 8.7, 10.5; TCP 16.5, 24.1, 35.4
Local Goals and Objectives	LRTP I.1, I.2, I.3, I.17, I.19; TCP 1.4, 2.3, 2.5, 4.3, 5.1, 5.3, 6.2, 6.3, 7.2, 8.2, 8.3, 8.8, 9.5, 10.6, 11.5, 16.4, 16.6, 16.7, 17.3, 17.5, 18.3, 18.5, 24.3, 24.5, 24.6, 25.3, 25.5, 25.6, 26.3, 26.5; MDG1.2; UMTA
Financial Feasibility	LRTP I.11, I.18
Institutional Feasibility	LRTP I.10, I.19

LRTP = TMATS - Long-Range Transportation Plan - Year 2005
TCP = City of Tulsa - Comprehensive Plan - District Goals
MDG = Metropolitan Development Guidelines - TMAPC
UMTA = Federal Requirements

Table 5

Evaluation Categories and Associated Goals, Policies, and Issues

Evaluation Categories	Associated Goals and Policies
I. Cost	
A. Capital Cost	LRTP I.20; TCP 7.1, 8.1, 10.1, 17.1, 18.1; UMTA AA
B. Annual Operating & Maintenance Cost	LRTP I.20; TCP 2.5,7.1, 8.2, 10.1, 17.1, 18.1; UMTA AA
C. Annual Time-Cost Saving to Transit Riders	LRTP I.7; TCP 2.4, 3.1, 5.4, 24.4; UMTA AA
D. Annual Time-Cost Impact on Highway Users	LRTP I.7; TCP 2.4, 3.1; UMTA AA
II. Effectiveness (Transportation System Performance)	
A. Utilization, by Mode	LRTP I.1, I.8, I.12; MDG 1; TCP 1.1, 1.3, 1.4, 2.3, 9.1, 9.4, 11.1, 16.1, 16.7, 24.5, 25.1, 25.4, 25.5; UMTA AA
B. Level of Service	LRTP I.1, I.3, I.6, I.7, I.9; MDG 1; TCP 1.1, 2.1, 3.1, 4.2, 5.2, 5.4, 6.1, 6.2, 7.1, 7.3, 8.1, 9.2, 10.1, 11.2, 11.4, 16.2, 17.1, 17.2, 24.2, 24.4, 25.2, 26.1, 26.2, 26.3, 26.4; UMTA AA
C. Coverage	TCP 1.5, 6.4, 7.6, 11.4, 16.5, 17.4, 18.2, 18.4, 25.4; UMTA AA
D. Reliability, Safety, & Security	LRTP I, I.2, I.7; MDG 1, 1.2; TCP 2.1, 2.4, 3.1, 3.2, 4.3, 5.3, 5.4, 6.1, 6.2, 6.3, 7.1, 8.1, 9.2, 10.1, 11.1, 16.2, 17.1, 18.1, 24.2, 24.3, 24.4, 25.2, 25.6 26.1
III. Impacts To Natural and Socioeconomic Environments	
A. Natural Environment: includes topography, habitat, wildlife, vegetation, agriculture, air, noise, energy, etc.	LRTP I.11, I.14, I.15, I.16; TCP 7.1, 7.6, 8.1, 8.7; UMTA AA
B. Socioeconomic Environment: includes land use & population, housing, economic activity, joint development, potential net fiscal impact, local traffic, visual quality, parkland/historical/cultural resources	LRTP 1.2, I.4, I.5, I.6, I.9, I.11, I.12, I.14, I.15, I.17; MDG 1.1, 1.3; TCP 1.1, 1.2, 2.2, 3.2, 3.3, 4.2, 4.3, 4.4, 6.3, 6.4, 7.1, 7.3, 8.4, 8.6, 9.3, 11.3, 16.4, 17.3

Table 5 - Continued

Evaluation Categories and Associated Goals, Policies, and Issues

Evaluation Categories	Associated Goals and Policies
IV. Financial and Institutional Feasibility	
A. Sources of Revenue for Capital Improvements	LRTP I.11; UMTA AA
B. Sources of Revenue for Maintenance and Operations	LRTP I.11; UMTA AA
C. Equity of Benefit and Burden	LRTP I.12, I.20; TCP 5.1, 7.6, 8.7, 10.5, 16.5; UMTA AA
D. Compatibility with Plans, Goals and Objectives	LRTP I.13, I.17, I.18; TCP 1.4, 7.5, 8.2, 8.3, 8.4, 8.5, 8.6, 9.3, 10.2, 10.3, 10.4, 10.6, 11.3, 11.5, 16.3, 16.4, 16.6, 17.2, 17.3, 18.2, 18.4, 18.5, 24.1, 24.6, 25.3, 25.6, 26.5; UMTA AA
E. Institutional Arrangements	LRTP I.10, I.19
V. Cost-Effectiveness	
A. Incremental Cost-Effectiveness Measure	UMTA AA
B. Composite Cost-Effectiveness Measure	UMTA AA
C. Federal Project Merit Index	UMTA AA
D. Total Project Merit Index	UMTA AA
E. Private Sector Revenue Participation	UMTA AA
F. Capital Cost-Effectiveness Comparison	UMTA AA
G. Operating and Maintenance Cost Effectiveness Comparison	UMTA AA
H. Total Cost-Effectiveness Comparison	UMTA AA

LRTP = TMATS - Long-Range Transportation Plan - Year 2005
TCP = City of Tulsa Comprehensive Plan
MDG = Metropolitan Development Guidelines
UMTA AA = Urban Mass Transportation Administration Alternatives Analysis Technical Guidance

4.0 POTENTIAL REGIONAL CORRIDORS

The identification of travel corridors in the Tulsa urban area involves several separate yet interrelated activities. These include: determination of major travel movements; identification of current and projected population and employment trends; determination of transportation facilities presently deficient or forecast to be unable to accommodate demand in spite of planned improvements; delineation of the area's major employers (over 500 employees) and activity centers (shopping malls, special event facilities); examination of existing public transit service ridership levels; and, identification of projected transit ridership under improved transit levels of service.

METHODOLOGY

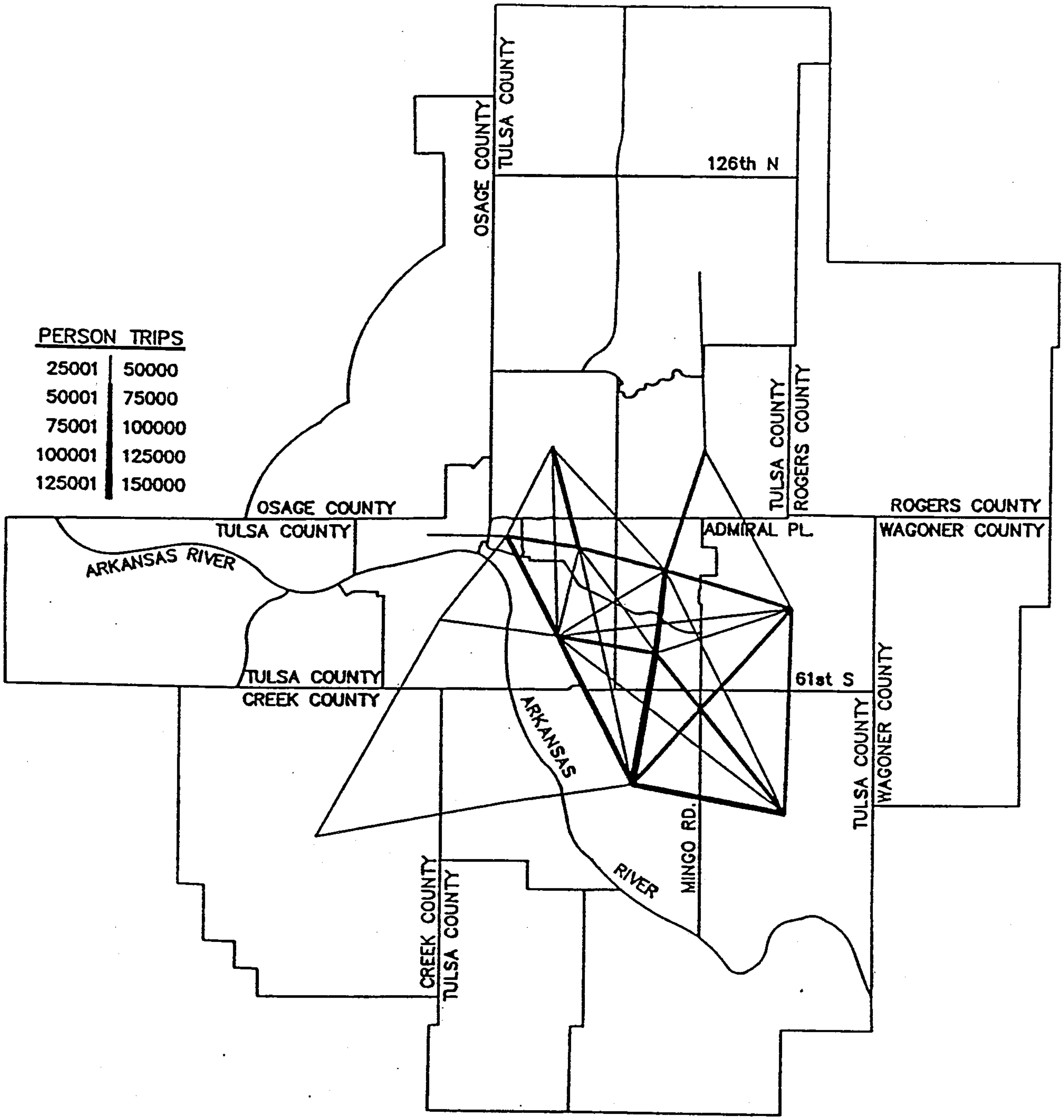
To define major travel movements forecast for 2005, the area's traffic zones were aggregated into larger districts and the person trip movements plotted. Figure 6 shows the major travel desire lines forecast for 2005 person trips. As would be expected, most heavy movements are projected to occur along existing transportation corridors, in particular paralleling the Broken Arrow Expressway, the Mingo Valley Expressway, and Riverside Drive. This reflects the historical pattern of development occurring along transportation corridors.

As part of this analysis, the locations of the region's largest employers and activity centers were mapped. Generally, the activity centers included those employers with over 500 workers and other enterprises generating substantial volumes of traffic. The latter includes, for example, American Airlines, Tulsa Junior College, Oral Roberts University, McDonnell Douglas Corporation, Woodland Hills Mall, and Eastland Mall.

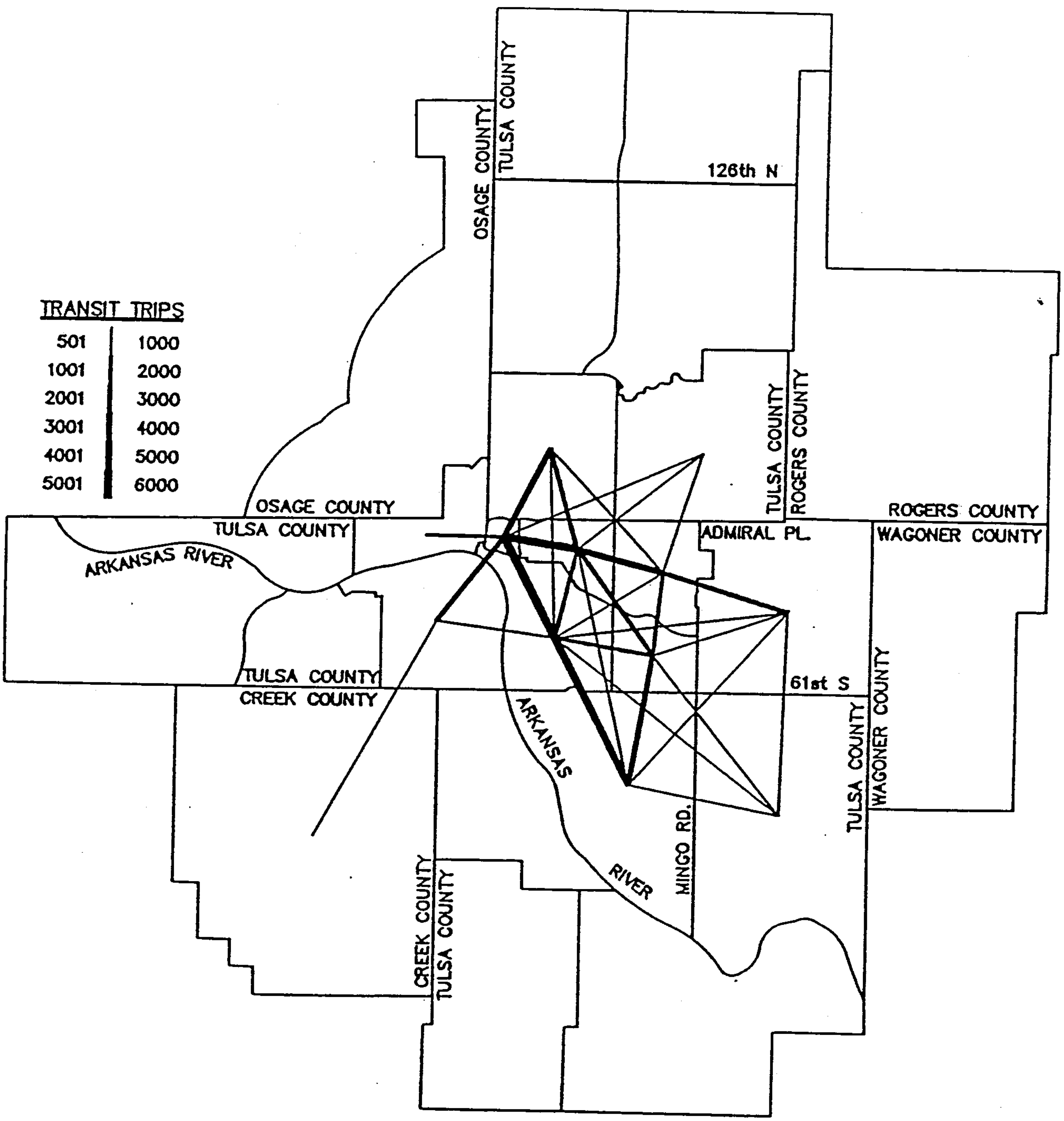
The transit sketch planning methodology described in Section 3.0: Technical Approach and Agency/Public Coordination provides useful information concerning potential transit demand which can help in the definition of fixed guideway transit corridors. The procedure, as described earlier, involved running the UTPS sketch planning program, RIDE, iteratively to define the most productive allocation of transit service within a given budget constraint. As previously outlined, the chosen transit operating cost budget constraint was $30 per capita per year, or for 2005, approximately $20,670,000 (in 1988 dollars). This budget supports a system which on the average weekday would provide approximately 20,850 transit vehicle miles, with a fleet size of 200 vehicles. This is approximately two times the 1988 transit service offered in the Tulsa area.

The projected 2005 daily transit volumes for this level of transit service (20,850 daily transit miles) are shown on Figure 7 in a desire-line format. This figure shows those movements projected to number 500 or more daily transit trips. As can be seen, the heaviest movements are radially oriented toward the CBD, particularly from the southeast quadrant between the Arkansas River and I-244. Several other radial movements are highlighted, as well as a north-south crosstown movement along Memorial Drive/Mingo Valley Expressway.

The actual identification of travel corridors was accomplished using an overlay mapping technique. Thus, over a base map, overlays of activity centers, person trip movements, projected deficient transportation facilities, low income areas, and forecast transit ridership were placed and actual corridor boundaries drawn. These initial boundaries were then modified to coincide with the boundaries of the traffic zones to aide in analyses and to be compatible with future traffic forecasting procedures.



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	***Oklahoma Fixed Guideway Transportation System Study***	Figure
	TULSA **2005 Person Trips**	**6**



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	TULSA **2005 Transit Trips**	**7**

This analysis resulted in the preliminary identification of eight travel corridors:

- Downtown/Airport Corridor
- Lynn Lane Corridor
- Broken Arrow Corridor
- Broken Arrow/Memorial Corridor
- Jenks/Riverside Corridor
- Sapulpa Corridor
- Sand Springs Corridor
- Memorial/Owasso Corridor

The first seven corridors are radially oriented to the Tulsa's CBD. The eighth corridor is a crosstown corridor falling along Memorial Drive/ Mingo Valley Expressway. Figure 8 shows the corridors.

The following sections describe in greater detail existing and forecast characteristics of the travel corridors. Beginning with a discussion of the Tulsa CBD which is in seven of the eight corridors, the descriptions of the corridors follow a clockwise rotation beginning with the Downtown/Airport corridor and ending with the Sand Springs corridor; the last section presents information on the single crosstown corridor, the Memorial/ Owasso corridor.

CENTRAL BUSINESS DISTRICT

Tulsa's CBD is bound to the north and west by I–244 and to the east and south by I-444, forming the IDL.

Table 6 compares the 1980 and 2005 socioeconomic characteristics present in the Tulsa CBD. The estimated employment in 1980 was 45,452. The employment trend for the Tulsa metropolitan area projects employment to grow faster than population and the Tulsa CBD reflects this trend. The projected growth rate in employment from 1980 to 2005 for the TMATS area is 60 percent (TMATS 2005 Plan). The Tulsa CBD shows a 27 percent increase in employment between 1980 and 2005 which is generally in line with national trends for the core area in other cities. These trends include the development of several large employment areas within a region outside of the Tulsa CBD as urban sprawl continues.

The largest number of activity centers employing 500 or more people are located in the CBD and are listed in Table 7 and shown in Figure 9. The Oklahoma Osteopathic Hospital and Tulsa Junior College are two of the largest employers with

Table 6

Central Business District
1980 and 2005 Socioeconomic Characteristics

Characteristic	1980	2005	Percent Increase	Increase
Population	2,910	3,653	743	25.5%
Dwelling Units	1,652	1,840	188	11.4%
Total Employment	45,452	57,625	12,173	26.8%
Automobiles	1,190	2,748	1,558	130.9%

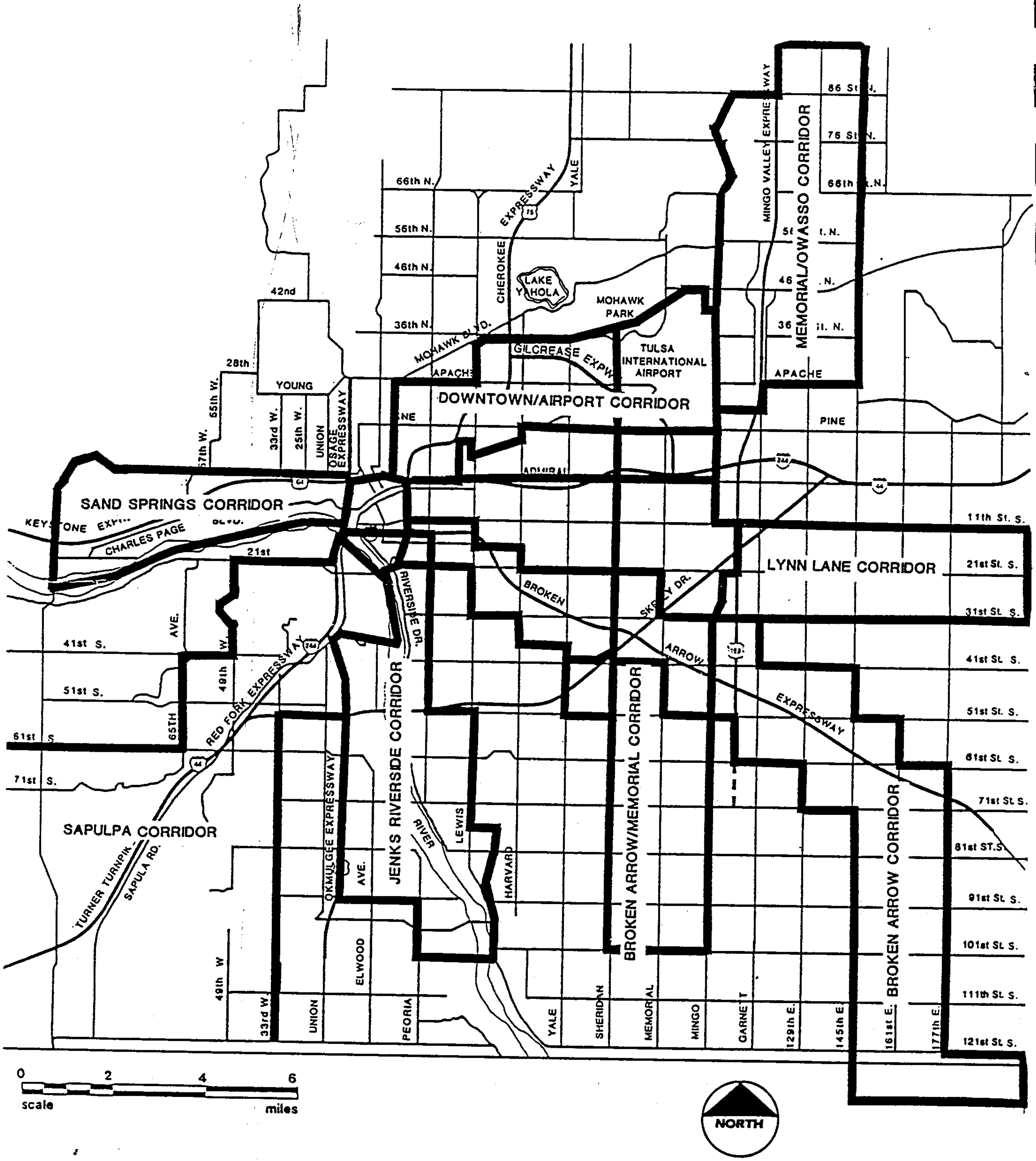
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.

an estimated 1,500 employees each; however, only 800 of the 1,500 employees of Tulsa Junior College work in the CBD. Likewise, of the 1,300 employees working at Southwestern Bell Telephone Company only 300 work in the CBD. Thus, within the CBD itself, the City of Tulsa, Sun Company, NORDAM, and Amoco Corporation are the largest employers with over 1,000 workers each.

The 1980 population was 2,910 and there were 1,652 dwelling units. Population in the Tulsa CBD is expected to increase by 25.5 percent or 743 people while the number of dwelling units is expected to increase by 11.4 percent or 188 units. Persons per household are projected to increase from 1.76 in 1980 to 1.98 in 2005. An increase of 130.9 percent in automobiles over the twenty-five year period is projected with an average annual growth rate of 5.2 percent. Automobiles per dwelling unit are forecast to increase from 1.4 in 1980 to 1.5 in 2005.

As stated in Section 2.0, LOS is a ratio comparing traffic volumes to roadway capacity (i.e., volume to capacity). The ratio is converted to an alphabetical rating, A through F, with A-B indicating a good rate of flow and E-F indicating an undesirable rate of flow. Figure 10 shows various segments of roadways in the Tulsa CBD and LOS. By 2005 most of these roadway segments are expected to meet or exceed their capacity. If employment projections hold true and an additional 10,000+ commuters travel to the Tulsa CBD, the LOS will continue to decline resulting in longer travel times and delays. This decline in travel time/LOS is expected even after highway improvements are implemented as contained in the area's long-range transportation plan.

Tulsa Transit provides public transportation for residents of the Tulsa area. All 31 bus routes begin or end in the Tulsa CBD. Also, on weekdays the Tulsa Transit Trolley provides rides around the Tulsa CBD to major downtown points. Therefore, theTulsa CBD has the most extensive coverage of bus routes present in the study area. The transit route profiles are listed in Table 8.



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	TULSA TRAVEL CORRIDORS	**8**

Table 7

Central Business District
Major Activity Centers

	Type of Business	Number of Activity Centers	Location	Employees	Year
1.	Oil/Gas	AMOCO Corporation	521 S. Boston	1,139	1988
2.	Fin.	Bank of Oklahoma	1 W. 3rd Street	630	1988
3.	Oil/Gas	OXYUSA, Inc.	110 W. 7th Street	960	1988
4.	Mfg.	NORDAM	510 S. Lansing	1,100	1988
5.	Utility	Oklahoma Natural Gas .	100 W. 5th Street	775	1988
6.	Med.	Oklahoma Osteopathic Hospital	744 W. 9th Street	1,500	1988
7.	Utility	Public Service Company	212 E. 6th Street	800-1,000	1988
8.	Commun.	Southewestern Bell Telephone	509 S. Detroit	1,300[1]	1988
9.	Petrol.	Sun Company	907 S. Detroit	1,100	1988
10.	Gov't.	City of Tulsa	200 Civic Center	1,290	1988
11.	Gov't.	County of Tulsa	500 S. Denver	595	1988
12.	Educ.	Tulsa Junior College	909 S. Boston	1,500[2]	1988
13.	Gov't.	U.S. Postal Service	333 W. 4th Street	880	1988
14.	Ins.	Blue Cross & Blue Shield of Oklahoma	1215 S. Boulder	715	1988
15.	Prnt.	Newspaper Printing Corp.	315 S. Boulder	900	1988
16.	Gov't.	U.S. Army Corps of Engineers	224 S. Boulder	600-700	1988

1 Only 300 employees work in the CBD.
2 Only 800 employees work in the CBD.

Source: Indian Nations Council of Governments, 1988.

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	CENTRAL BUSINESS DISTRICT **Major Activity Centers**	**9**

LEVEL OF SERVICE

B or Better

C

D

E-F

Corridor Boundary

N

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	CENTRAL BUSINESS DISTRICT **Level of Service**	**10**

Table 8

Central Business District Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
1	Suburban Acres	1,435
2	S. Yale/St. Francis	185
3	E.3rd Street/S. Memorial	506
4	N. Lewis/TJC	338
5	North Peoria	776
6	E. 6th Street/S. Harvard	403
7	Gilcrease	116
8	Greenwood	197
9	South Lewis	417
10	Mohawk	602
11	E. 11th Street	348
13	Independence/Pine	149
14	Charles Page Blvd.	295
15	E. 15th Street/S. Sheridan	409
16	South Peoria	623
17	Southwest Blvd./S. 33rd W. Avenue-Union	506
18	Admiral	458
20	Super Loop	1,142
21	E. 21st Street	640
31	E. 31st Street	358
101	Briarwood Express	16
102	East Tulsa Express	35
103	Woodland Hills Express	59
104	Sun Meadow Express	48
105	Regency Park Express	16
106	Mingo Valley Express	51
107	S. Sheridan Express	58
108	Harvard/Yale Express	27
109	Rolling Hills Express	32
202	Broken Arrow Express	43

* FY 88 First Quarter

Sourçe: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

DOWNTOWN/AIRPORT CORRIDOR

The Downtown/Airport Corridor generally follows an imaginary diagonal line northeast of downtown Tulsa from Admiral Boulevard and Cincinnati Avenue to N. Mingo and E. 46th Street N., north of the Tulsa International Airport, and it includes the Tulsa CBD. Specifically, the corridor is bound by I-244 at N. Cincinnati, north to E. Apache, east to N. Lewis, north to E. 36th Street N., east to the Atchison Topeka and Santa Fe Railroad tracks, northeast to E. 46th Street N., east to N. 93rd E. Avenue, south to E. 41st Street N., east to N. Mingo, south of E. Pine, west to Dawson Road/Burlingtion Northern Railroad tracks, southwest to N. Lewis, north to E. Pine, west to N. Utica , south to I-244, and west to N. Cincinnati.

The major employer in the area, American Airlines with 7,379 employees in 1988, is also the state's second largest employer. Rockwell International and McDonnell Douglas are also located within this corridor and employ 1,800 and 3,158 persons, respectively (Table 9 and Figure 11).

The 1980 and 2005 socioeconomic characteristics are presented in Table 10. In 1980, there were 30,953 people living in the corridor and 74,281 employees working there. Total employment in the corridor is projected to increase by 24.7 percent or 18,335 persons in 2005. This is an average annual growth rate of one percent. Both population and dwelling units are projected to decrease between 1980 and 2005. Nearly 25 percent, or 7,613 fewer persons are expected to reside in the corridor in 2005 than in 1980. Dwelling units will decrease from 12,684 in 1980 to 10,965 in 2005. Persons per household will decline from 2.4 in 1980 to 2.1 in 2005. Automobile ownership is expected to increase by 781 vehicles or 4.7 percent. Automobiles per dwelling unit are projected to increase from 1.3 in 1980 to 1.6 in 2005.

The increases in employment and automobile ownership will result in higher traffic volumes on the roadways and level of service will decline. By 2005, sections of US 75 North (Cherokee Expressway), SH 11 and N. Peoria will have traffic volumes approaching or equaling their design standard (Figure 12). Consequently, motorists will experience longer travel times and delays.

Several public transportation routes serve transit patrons in the Downtown/Airport Corridor, as shown in Table 11.

The transit sketch planning analysis predicts a 2005 maximum load point corridor transit volume of 4,000 trips per average weekday.

Table 9

Downtown/Airport Corridor
Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year
1.*	Trans.	American Airlines	3800 N. Mingo	7,379	1988
2.*	Mfg.	Rockwell International	2000 N. Memorial	1,800	1988
3.*	Mfg.	McDonnell Douglas	200 N. Memorial	3,158	1988

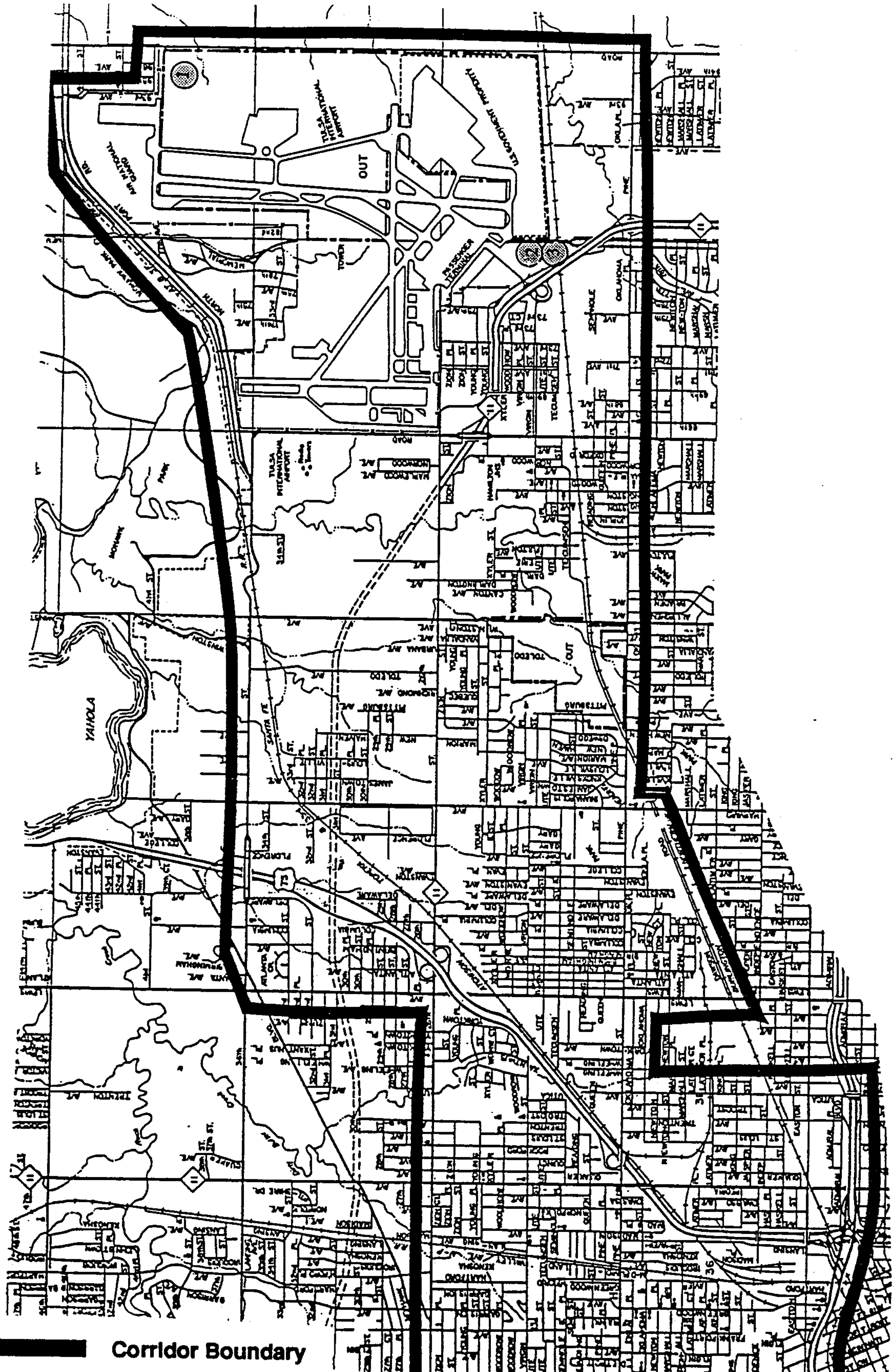
* Common to Downtown/Airport and Memorial/Owasso Corridors.
Source: Indian Nations Council of Governments, 1988.

Table 10

Downtown/Airport Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Increase/ Decrease	Percent Increase/ Decrease
Population	30,953	23,340	-7,613	-24.6%
Dwelling Units	12,684	10,965	-1,719	-13.6%
Total Employment	74,281	92,616	18,335	24.7%
Automobiles	16,777	17,558	781	4.7%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.



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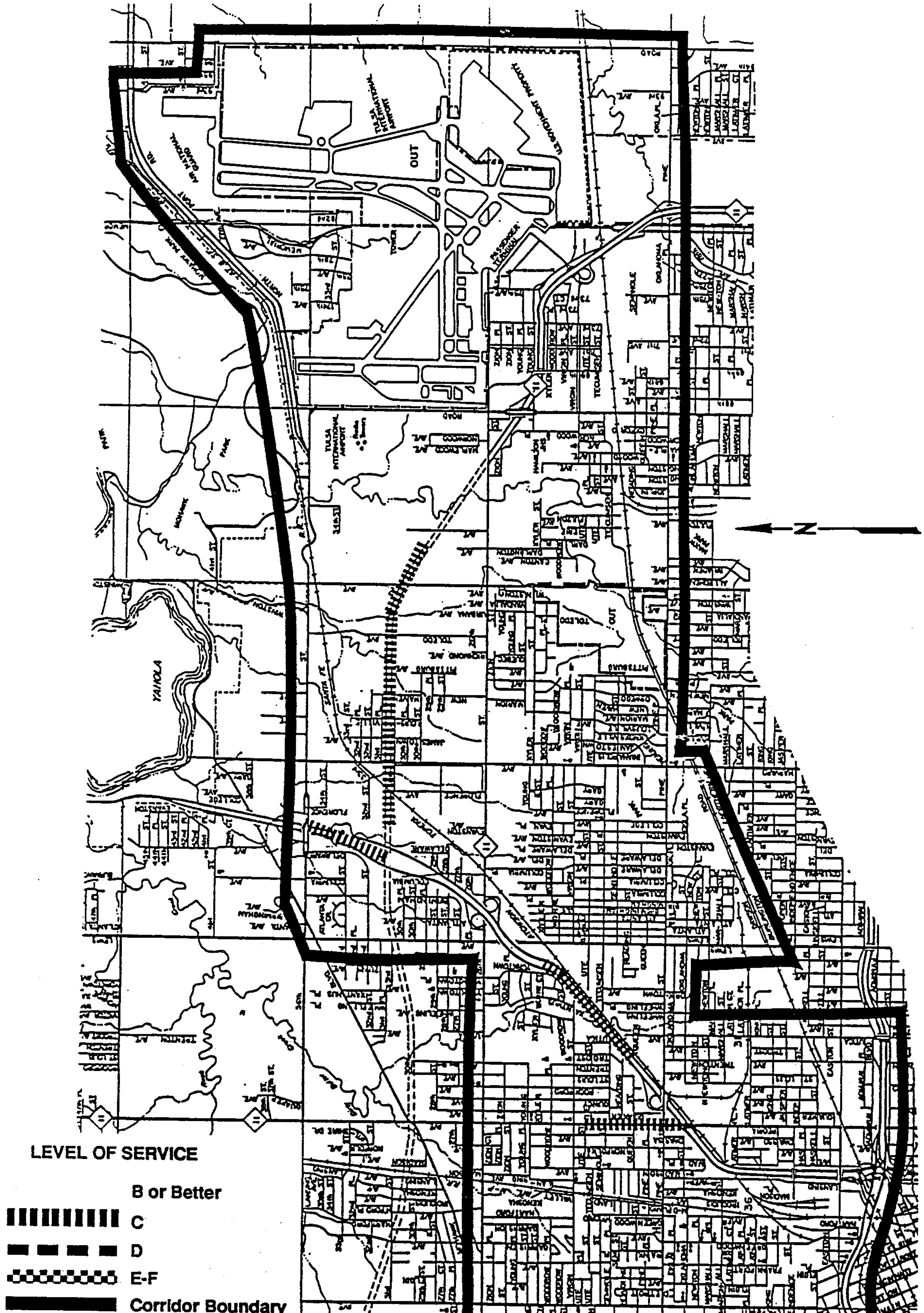
	DOWNTOWN/AIRPORT CORRIDOR **Major Activity Centers**	**11**



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DOWNTOWN/AIRPORT CORRIDOR
Level of Service

Figure 12

Table 11

Downtown/Airport Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
1	Suburban Acres	1,435
4	N. Lewis/TJC	338
5	N. Peoria	776
8	Greenwood	197
10	Mohawk Blvd.	602
13	Independence/Pine	149
20	Super Loop	1,142

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

LYNN LANE CORRIDOR

The Lynn Lane Corridor which includes the CBD, extends east of downtown and generally follows E. 11th Street between I-244 and E. 31st Street to the Tulsa/Wagoner County Line. The boundaries of the corridor are: Cherokee Expressway at Admiral Boulevard, east to N. Mingo, south to E. 11th Street, east to the Tulsa/ Wagoner County Line, south to E. 31st Street, west to S. Memorial, north to E. 21st Street, west to S. Harvard, north to E. 15th Street, west to S. Lewis, north E. 11th Street, west to Cherokee Expressway, and north to Admiral Boulevard.

The University of Tulsa and Walmart Discount Stores are a few of the major employers in the area, each employing over 500 people. Table 12 lists the major activity centers in the corridor and their locations are shown on Figure 13.

Comparison of the 1980 and 2005 socioeconomic characteristics is shown in Table 13. The 1980 population was 68,725 persons and 71,592 persons worked in the corridor. Total employment in the area is projected to increase by 41.8 percent or by 29,911 persons. This is an average annual growth rate of 1.7 percent. The population is forecast to decrease by 2.9 percent or 1,974 persons between 1980 and 2005. The number of dwelling units is expected to increase very moderately from 28,596 in 1980 to 30,553 in 2005; an increase of 1,957 units or 6.8 percent. Persons per household will decrease from 2.4 in 1980 to 2.2 in 2005.

Automobile ownership is projected to increase by 7,648 vehicles or 15.9 percent. This is an average annual growth rate of 0.6 percent. Automobiles per household are forecast to increase from 1.7 in 1980 to 1.8 in 2005.

The increase in employment and automobile ownership will result in greater traffic volumes on the roadways and LOS will decline. Motorists will experience longer travel times and delays.

Figure 14 shows the sections of roadways in the corridor with LOS C or worse. In 2005, sections of S. Harvard, S. Yale, S. Sheridan, S. Memorial and E. 11th Street will have LOS C, where traffic volumes are approaching or equaling the design standard. I-244, S. Lewis, Broken Arrow Expressway, E. 15th Street, S. Mingo, and US 169 are projected to have LOS D, where traffic volumes are approaching roadway design standards.

As shown in Table 14, the Lynn Lane Corridor is served by 16 different routes.

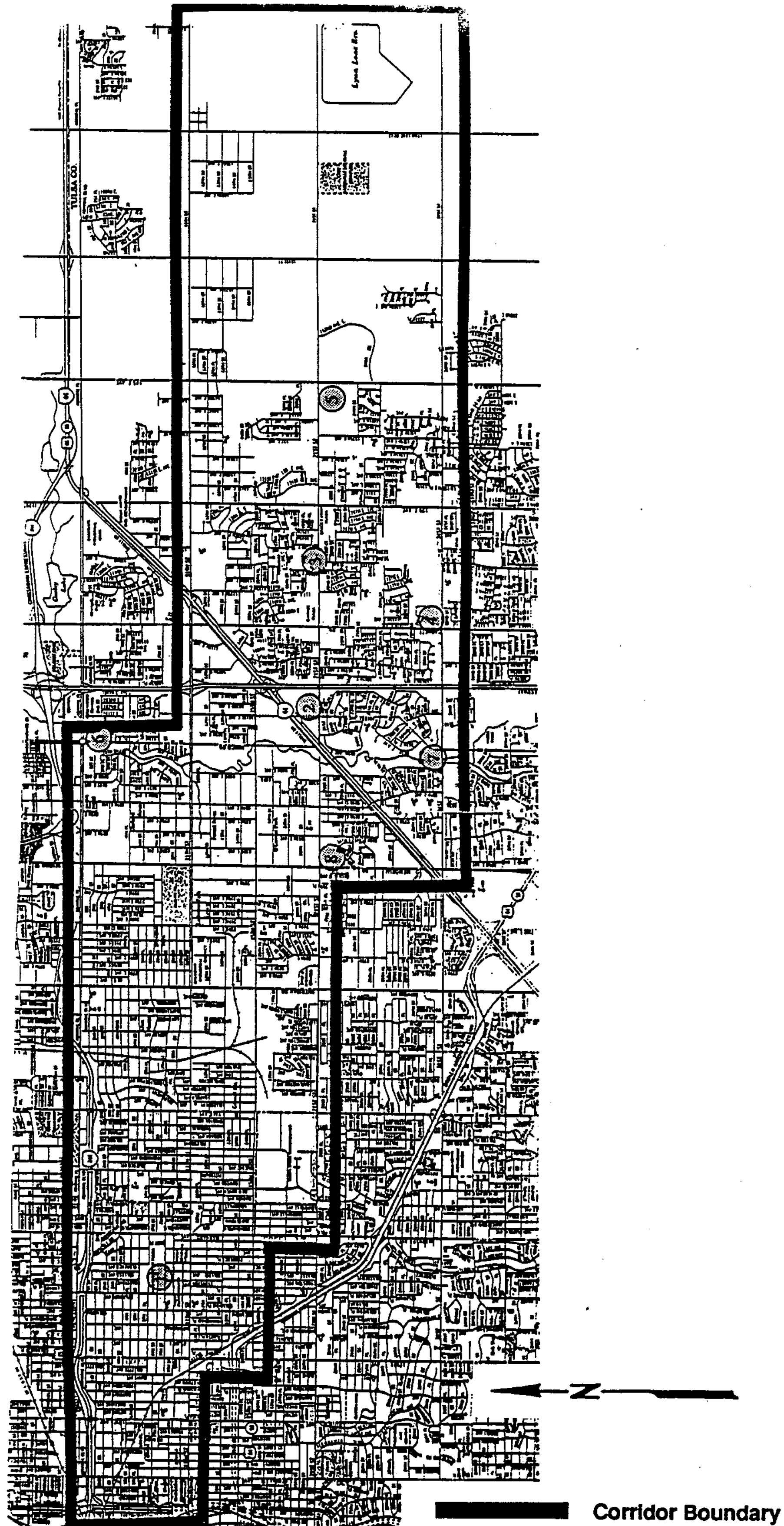
The transit sketch planning analysis predicts a 2005 maximum load point corridor transit volume of 5,100 trips per average weekday.

Table 12

Lynn Lane Corridor
Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.	Educ.	University of Tulsa	600 S. College	900	1988	150,000-300,000 sf[2]
2.	Retail	Crosstown Center	By E. 21st Street and S. Mingo	—	1988	100,000-150,000 sf
3.	Retail	Forum 21 Center	E. 21st Street between S. Garnett and S. 129th E. Avenue	—	1988	100,000-150,000 sf
4.	Retail	Garnett Plaza	S. Garnett and E. 31st Street	—	1988	100,000-150,000 sf
5.	Retail	Eastland Mall	E. 21st Street and S. 145th E. Avenue	—	1988	300,000 sf
6.+	Retail	Walmart Discount Stores	9797 E. Admiral Place	500[1]	1988	100,000-150,000 sf
7.*	Retail	Briar Village	S. Mingo and E. 31st Street	—	1988	100,000-150,000 sf
8.*	Retail	Tri-Center North	E. 21st Street and S. Memorial	—	1988	150,000-300,000 sf

+ Borders corridor boundary.
* Common to Memorial/Owasso and Lynn Lane Corridors.
1 Less than 500 employees at each location.
2 sf = square feet/footage
Source: Indian Nations Council of Governments, 1988.



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LYNN LANE CORRIDOR
Major Activity Centers

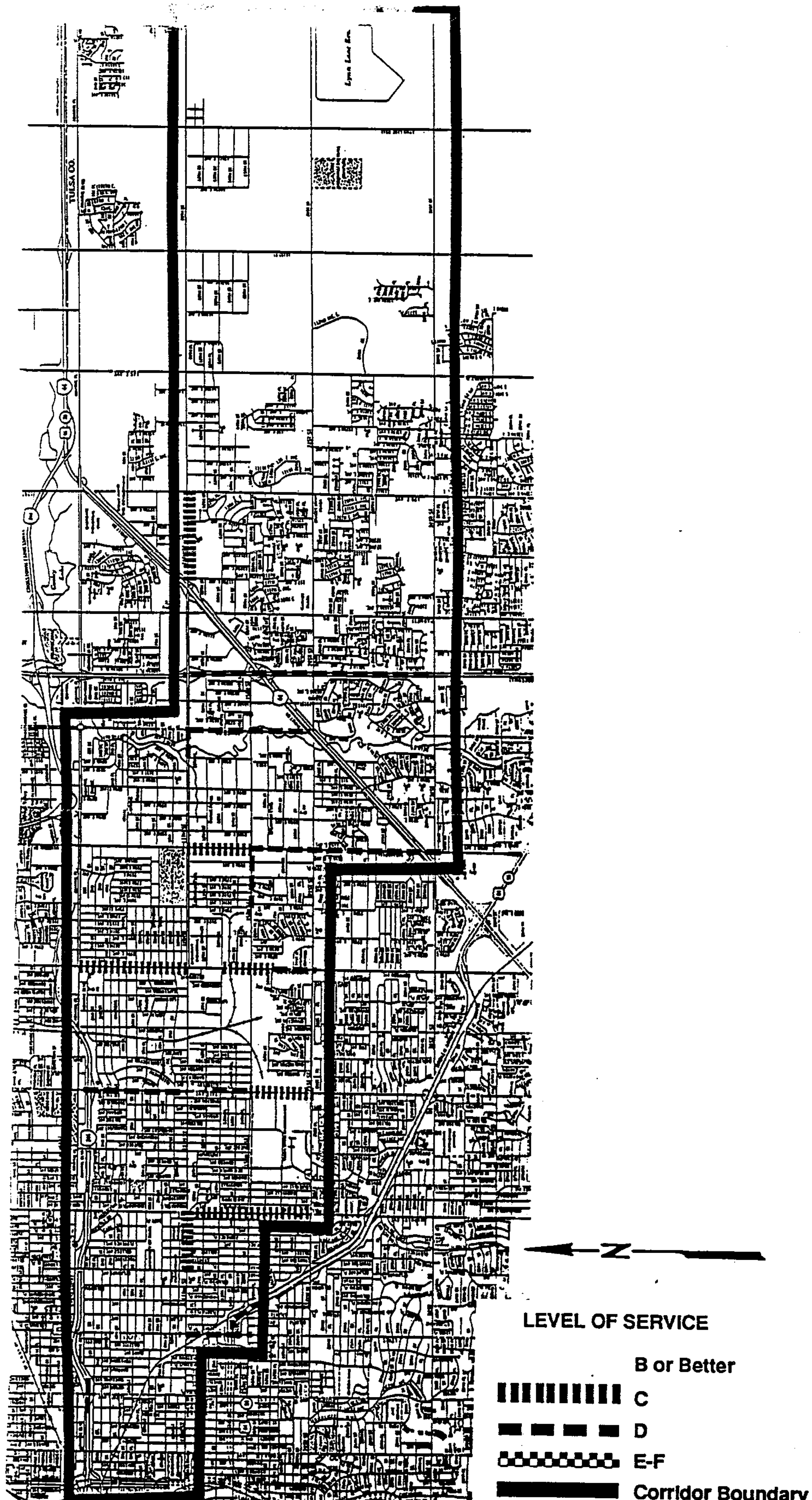
Figure 13

Table 13

Lynn Lane Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Increase/ Decrease	Percent Increase/ Decrease
Population	68,725	66,751	-1,974	-2.9%
Dwelling Units	28,596	30,553	1,957	6.8%
Total Employment	71,592	101,503	29,911	41.8%
Automobiles	48,134	55,782	7,648	15.9%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.



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LYNN LANE CORRIDOR
Level of Service

Figure 14

Table 14

Lynn Lane Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
3	E. 3rd Street/S. Memorial	506
4	N. Lewis/TJC	338
5	N. Peoria	776
6	E. 6th Street/S. Harvard	403
11	E. 11th Street	348
13	Independence/Pine	149
15	E. 15th Street/S. Sheridan	409
18	Admiral	458
20	Super Loop	1,142
21	E. 21st Street	640
31	E. 31st Street	358
101	Briarwood Express	16
102	East Tulsa Express	35
103	Woodland Hills Express	59
105	Regency Park Express	16
106	Mingo Valley Express	51

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

BROKEN ARROW CORRIDOR

The Broken Arrow Corridor generally includes a one mile area on either side of the Broken Arrow Expressway southeast from downtown Tulsa to N. 9th Street (S. 177th E. Ave.), then turns south and includes a one mile area on both sides of Elm Place (S. 161st E. Avenue) to W. Jasper Street (E. 131st Street). It also includes the Tulsa CBD. The actual boundaries are I-444 at E. 11th Street, east to S. Lewis, south to E. 15th Street, east to S. Harvard, south to E. 21st Street, east to S. Memorial, south to E. 31st Street, east to S. Garnett, south to E. 41st Street, east to S. Aspen Avenue (S. 145th E. Ave.), south to E. 51st Street, east to S. 161st E. Avenue, south to E. Albany Street (E. 61st Street), east to S. 177th E. Avenue, south to E. Tucson Street (E. 121st Street), east to the Tulsa/Wagoner County line, south to E. 131st Street, west to S. 145th E. Avenue, north to W. Kenosha Street (E. 71st Street), west to N. Olive Avenue (S. 129th E. Avenue), north to E. 61st Street, west to the Mingo Valley Expressway, north to E. 51st Street, west to S. Memorial, north to E. 41st Street, west to S. Sheridan, north to I-44, southwest to E. 41st Street, west to S. Yale, north to E. 36th Street, west to S. Harvard, north to E. 31st Street, west to S. Lewis, north to E. 21st Street, west to I-444, and north to E. 11th Street.

The major activity centers offer a variety of services: manufacturing, education, medical, retail, etc., and includes the Ford Motor Company, Hilti Inc., Tulsa Public Schools, Hillcrest and St. John Medical Centers. Table 15 lists these major activity centers and Figure 15 shows their locations.

In 1980, the population was 75,673 and there were 92,395 persons employed in the corridor (see Table 16). Broken Arrow is the corridor with the greatest increase in the total number of employees between 1980 and 2005. Total employment in the corridor is projected to increase by 58,176 employees or by 63 percent in 2005. This is an average annual increase in employment of 2.5 percent. Population and dwelling units are projected to increase moderately between 1980 and 2005. Population is forecast to increase by 18,075 persons or 23.9 percent. The average annual growth rate for both population and dwelling units is less than one percent. Persons per household are expected to decline from 2.5 in 1980 to 2.4 in 2005. Automobile ownership is projected to increase by 20,543 vehicles or 38.5 percent. Automobiles per household will increase from 1.75 in 1980 to 1.9 in 2005.

The projected increases in automobile ownership, population, and employment in the corridor will increase traffic volumes, and the roadway system LOS will decline. The 2005 LOS is depicted on Figure 16. S. Yale between E. 31st and 41st Streets, E. 21st Street between S. Utica and S. Lewis, and S. Memorial between E. 32nd and Broken Arrow Expressway are projected to have LOS E/F or an undesirable rate of flow. As LOS declines motorists will experience longer travel times and a greater number of delays. These delays are expected to exist even with scheduled highway improvements as called for in the adopted long-range transportation plan.

Several public transportation routes serve portions of the Broken Arrow Corridor, some more extensively than others (Table 17).

The transit sketch planning analysis predicts a 2005 a maximum load point corridor transit volume of 5,100 trips per average weekday.

Table 15

Broken Arrow Corridor
Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.*	Med.	Hillcrest Medical Center	1120 S. Utica	1,852	1988	
2.*	Med.	St. John Medical Center	1923 S. Utica	2,600-2,700	1988	
3.*	Educ.	Tulsa Public Schools	3027 S. New Haven	500[1]	1988	
4.*	Retail	Southroads Mall	E. 41st Street and S. Yale	—	1988	300,000 s f[2]
5.*	Serv.	Avis Rent-a-Car	6128 E. 38th Street	650	1988	
6.*	Retail	Alameda	E. 21st Street & S. Sheridan	—	1988	100,000-150,000 sf[2]
7.	Retail	C.R. Anthony	11105 E. 41st Street	50[1]	1988	
8.	Bldg Ind.	Hilti, Inc.	5400 S. 122nd E. Avenue	638	1988	
9.	Mfg.	Ford Motor Co.-Tulsa Glass Plant	555 S. 129th E. Avenue	1,100	1988	

* Common to Broken Arrow and Broken Arrow/Memorial Corridors.
1 Less than 500 employees at each location.
2 sf = square foot/footage
Source: Indian Nations Council of Governments, 1988.

Table 16

Broken Arrow Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Increase	Percent Increase
Population	75,673	93,748	18,075	23.9%
Dwelling Units	30,556	38,888	8,332	27.3%
Total Employment	92,395	150,571	58,176	63.0%
Automobiles	53,377	73,920	20,543	38.5%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.

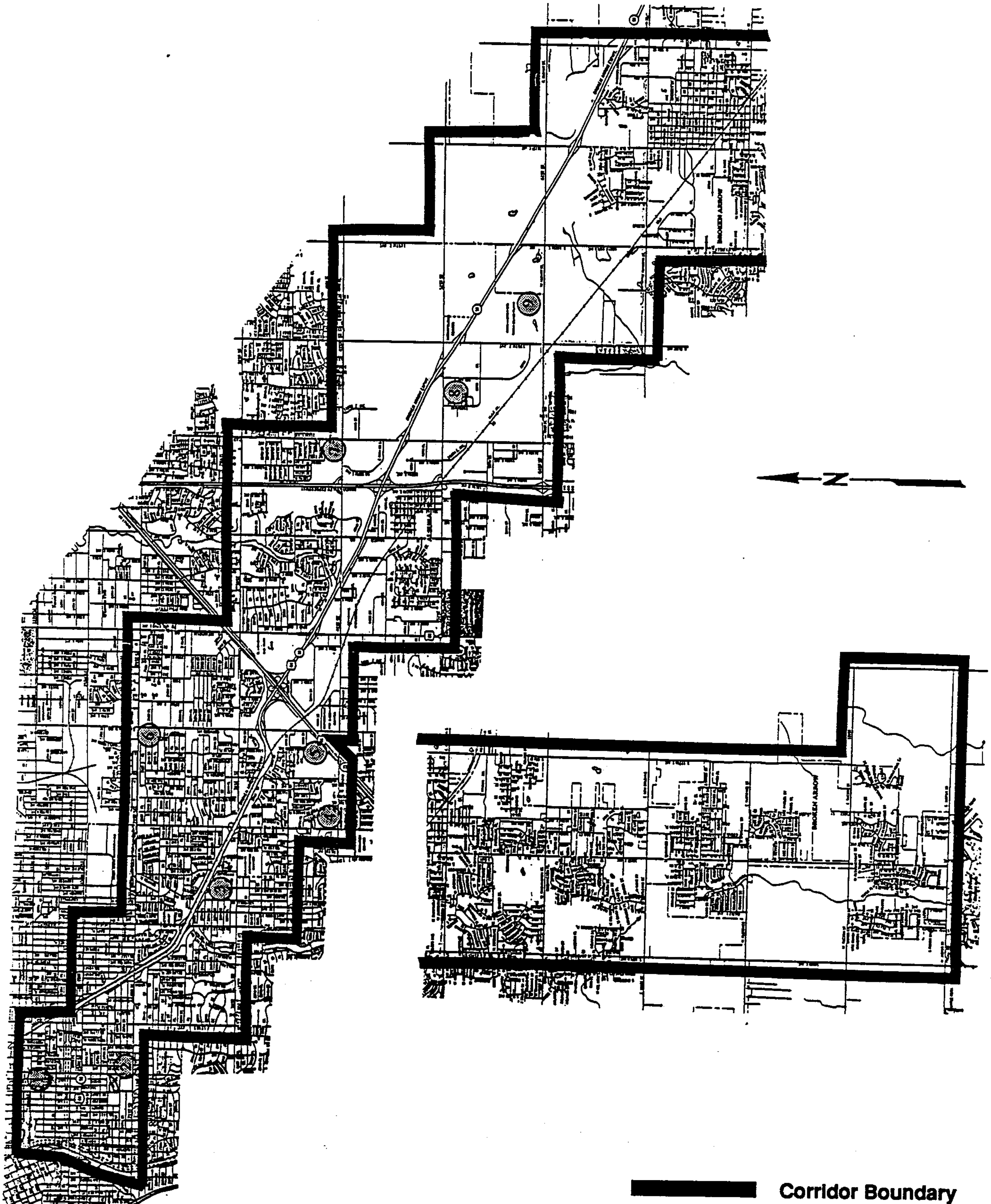

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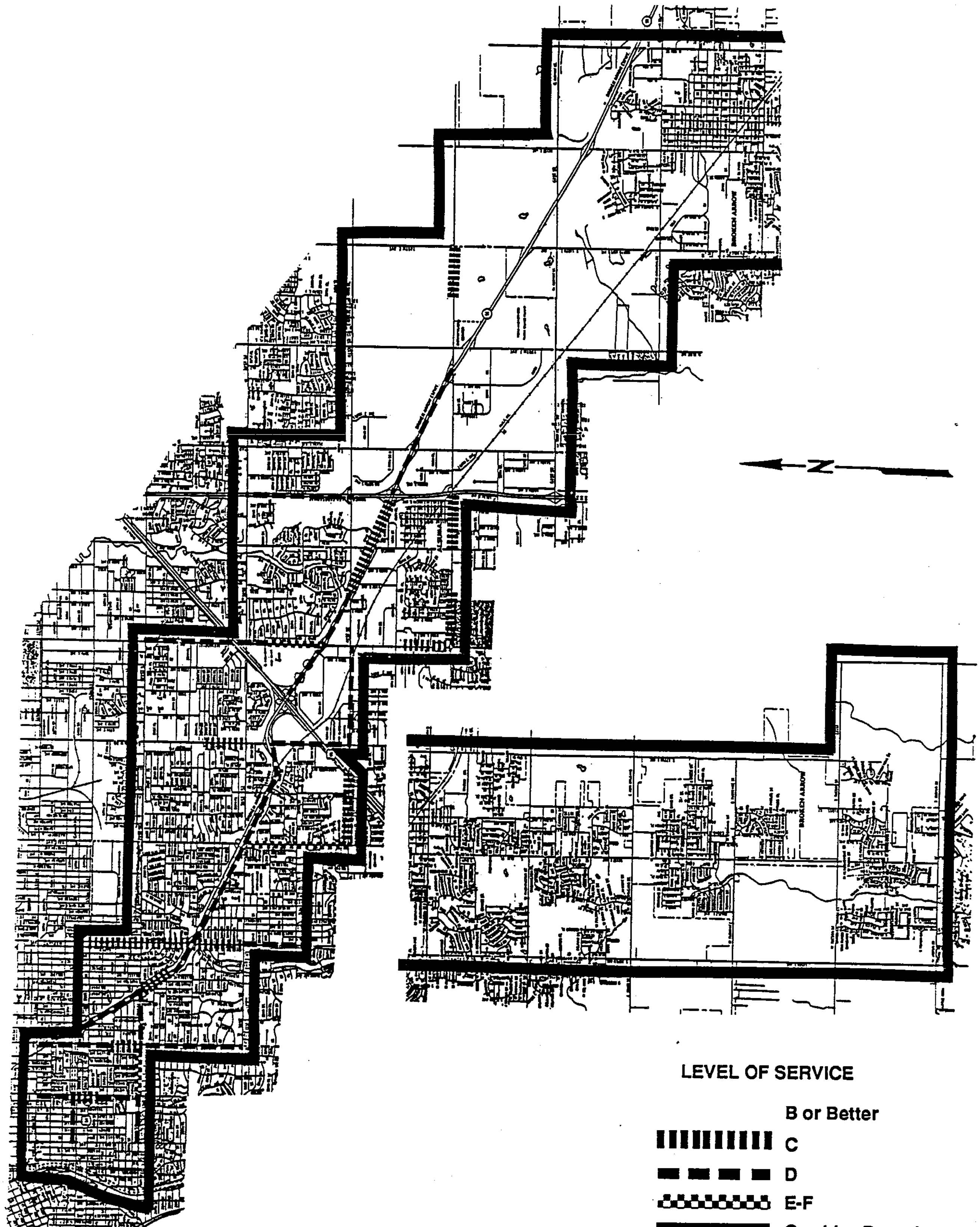
Figure 15

BROKEN ARROW CORRIDOR
Major Activity Centers



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	BROKEN ARROW CORRIDOR **Level of Service**	**16**

Table 17

Broken Arrow Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
2	S. Yale/St. Francis	185
3	E. 3rd Street/S. Memorial	506
4	N. Lewis/TJC	338
6	E. 6th Street/S. Harvard	403
9	S. Lewis	417
11	E. 11th Street	348
15	E. 15th Street/S. Sheridan	409
20	Super Loop	1,142
21	E. 21st Street	640
31	E. 31st Street	358
101	Briarwood Express	16
103	Woodland Hills Express	59
105	Regency Park Express	16
106	Mingo Valley Express	51
107	S. Sheridan Express	58
202	Broken Arrow Express	43

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

BROKEN ARROW/MEMORIAL CORRIDOR

Generally, the Broken Arrow/Memorial Corridor follows an imaginary diagonal line from I-444 and E. 11th Street to E. 51st Street and S. Memorial, then south to E. 101st Street between S. Mingo and S. Sheridan. It includes the Tulsa CBD. The corridor is actually bound by I-444 at E. 11th Street, east to S. Lewis, south to E. 15th Street, east to S. Harvard, south to E. 21st Street, east to S. Sheridan, south to E. 41st Street, east to S. Memorial, south to E. 51st Street, east to S. Mingo, south to E. 101st Street, west to S. Sheridan, north to E. 51st Street, west to S. Yale, north to E. 36th Street, west to S. Harvard, north to E. 31st Street, west to S. Lewis, north to E. 21st Street, I-444, and north to E. 11th Street.

Table 18 enumerates and Figure 17 depicts the location of the major activity centers in the corridor. The majority of the major activity centers in the area are retail businesses. The Hillcrest and St. John Medical Centers plus Tulsa Public Schools are also located within the corridor.

The 1980 and 2005 socioeconomic characteristics are listed in Table 19. In 1980, 57,189 people lived in the corridor and there were 41,324 employees. Total employment is forecast to increase by 42,962 persons or 49.6 percent between 1980 and 2005. This is an average annual growth rate of 2.0 percent. Population is forecast to increase by 43.5 percent or 24,861 persons. Population is forecast to increase by 43.5 percent or 24,861 persons. The number of dwelling unit is expected to increase by 9,549, or from 24,939 in 1980 to 34,488 in 2005.

Persons per household are expected to increase from 2.3 in 1980 to 2.4 in 2005. The Broken Arrow/Memorial Corridor has the greatest increase in the number of automobiles projected of all the corridors. The number of automobiles is expected increase by 25,815 vehicles or 62.5 percent between 1980 and 2005. This is an average annual growth rate of 2.5 percent. Automobiles per household will increase from 1.7 in 1980 to 2.0 in 2005.

The increases in automobile ownership and employment will result in higher traffic volumes on the roadways, and the LOS will decline. Figure 18 depicts the LOS for those sections of roadways with LOS C or worse in 2005. Sections of E. 21st Street and S. Yale will have LOS E/F which reflects a volume 25 percent greater than the design standard of the roadway. S. Memorial, S. Utica, S. Lewis, E. 21st Street, S. Yale, E. 41st Street, E. 51st Street, and S. Mingo will have sections with LOS C/D. This will result in longer travel times and more frequent delays.

Several bus routes transport public transportation patrons to various sections of the Broken Arrow/Memorial Corridor. Table 20 presents information on these routes.

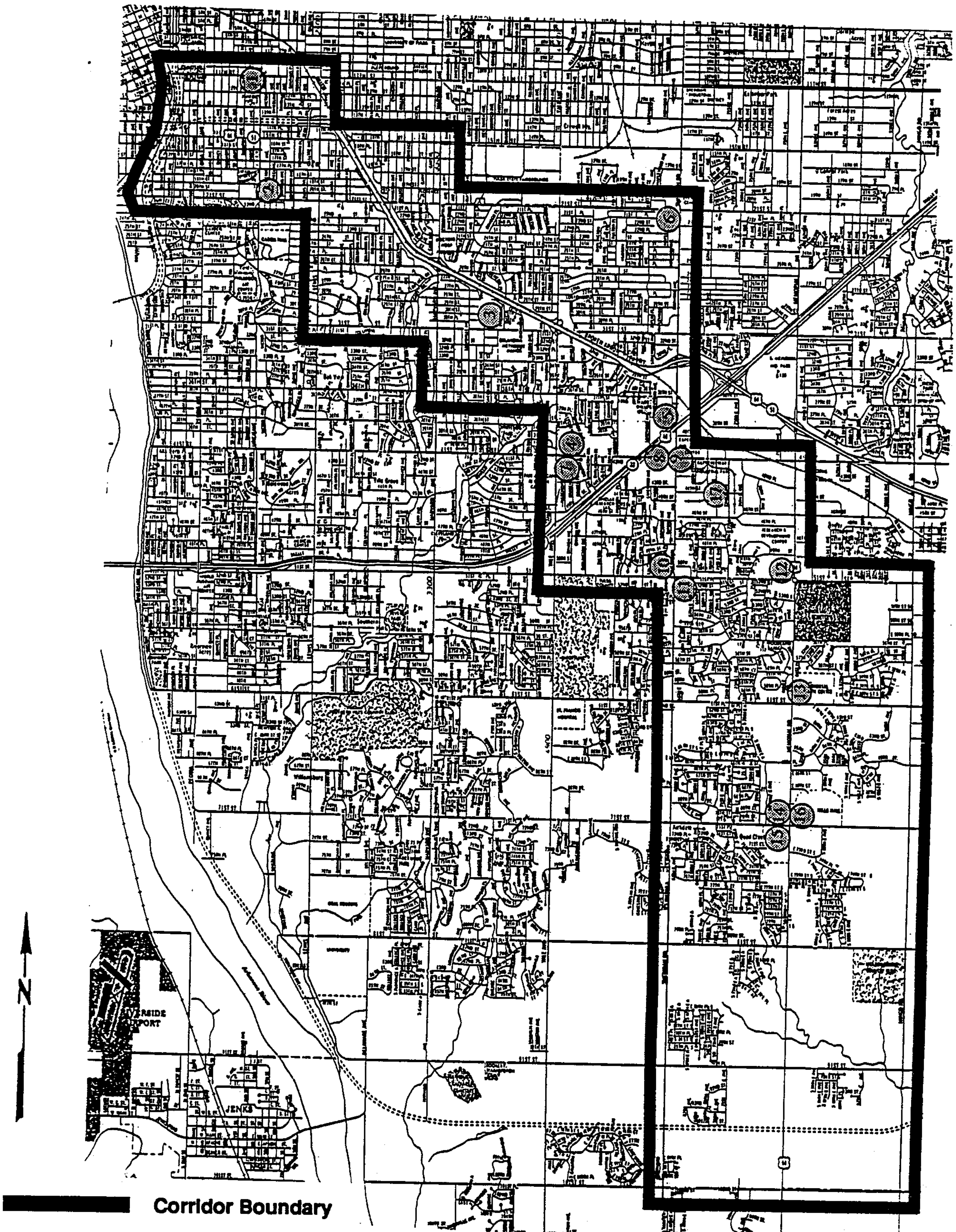
The transit sketch planning analysis predicts a 2005 maximum load point corridor transit volume of 5,400 trips per average weekday.

Table 18

Broken Arrow/Memorial Corridor Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.*	Med.	Hillcrest Medical Center	1120 S. Utica	1,852	1988	
2.*	Med.	St. John Medical Center	1923 S. Utica	2,600 - 2,700	1988	
3.*	Educ.	Tulsa Public Schools	3027 S. New Haven	500[1]	1988	
4.*	Retail	Southroads Mall	E. 41st Street and S. Yale	—	1988	300,000 sf[2]
5.*	Serv.	Avis Rent-a-Car	6128 E. 38th Street	650	1988	
6.*	Retail	Alameda	E. 21st Street & S. Sheridan	—	1988	100,000-150,000 sf
7.	Retail	Tulsa Promenade	E. 41st Street & S. Yale	—	1988	300,000 sf
8.	Mfg	Telex Computer Products	6422 E. 41st Street	1,000	1988	
9.	Retail	Highland Plaza	E. 41st Street & S. Sheridan	—	1988	100,000-150,000 sf
10.	Retail	Park Lane	E. 51st Street & S. Sheridan	—	1988	100,000-150,000 sf
11.+	Retail	The Farm	E. 51st Street & S. Sheridan	—	1988	150,000-300,000 sf
12.+	Retail	Fontana	E. 51st Street & S. Memorial	—	1988	300,000 sf
13.+	Retail	Eaton Square	E. 61st Street & S. Memorial	—	1988	150,000-300,000 sf
14.+	Retail	Center 71 Annex	E. 71st Street & S. Memorial	—	1988	150,000-300,000 sf
15.+	Retail	Crossing Oaks	E. 71st Street & S. Memorial	—	1988	150,000-300,000 sf
16.+	Retail	Woodland Hills Mall	E. 71st Street & S. Memorial	—	1988	300,000 sf
17.+	Rest.	Mazzio's Corporation	4441 S. 72nd E Avenue	500[1]	1988	

* Common to Broken Arrow and Broken Arrow/Memorial Corridors.
+ Common to Broken Arrow/Memorial and Memorial/Owasso Corridors.
1 Less than 500 employees at each location.
2 sf = square feet/footage
Source: Indian Nations Council of Governments, 1988.



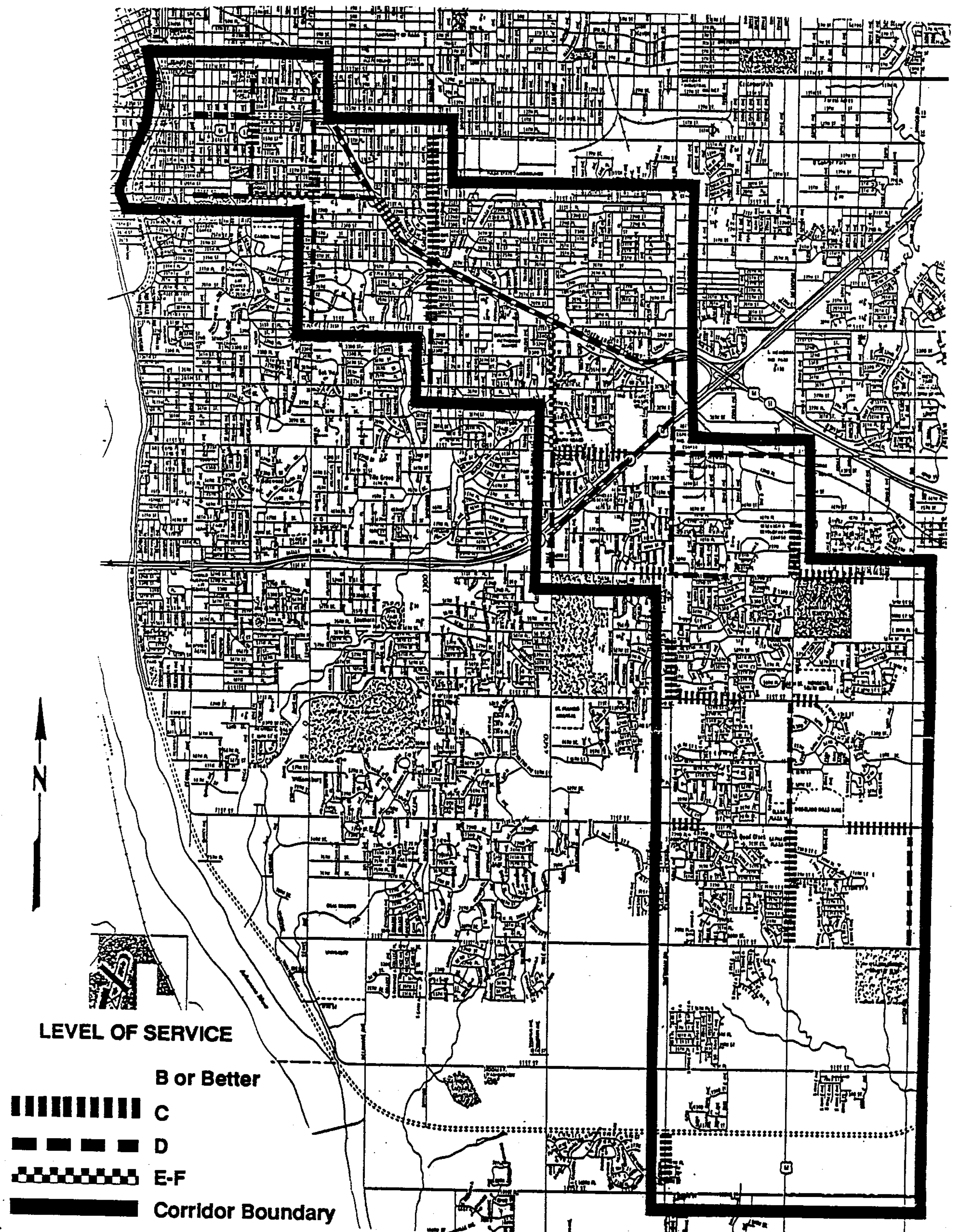
Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	BROKEN ARROW/MEMORIAL CORRIDOR **Major Activity Centers**	**17**

Table 19

Broken Arrow/Memorial Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristics	1980	2005	Increase/ Decrease	Percent Increase/ Decrease
Population	57,189	82,050	24,861	43.5%
Dwelling Units	24,939	34,488	9,549	38.3%
Total Employment	86,607	129,569	42,962	49.6%
Automobiles	41,324	67,139	25,815	62.5%

* Includes Central Business District data.
Source: INCOG, Tulsa Metropolitan Area Transportation Study: 1980 and 2005, 1988.



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	BROKEN ARROW/MEMORIAL CORRIDOR **Level of Service**	**18**

Table 20

Broken Arrow/Memorial Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
2	S. Yale/St. Francis	185
3	E. 3rd Street/S. Memorial	506
4	N. Lewis/TJC	338
6	E. 6th Street/S. Harvard	403
9	S. Lewis	417
11	E. 11th Street	348
15	E. 15th Street/S. Sheridan	409
20	Super Loop	1,142
21	E. 21st Street	640
31	E. 31st Street	358
101	Briarwood Express	16
103	Woodland Hills Express	59
104	Sun Meadow Express	48
105	Regency Park Express	16
107	S. Sheridan Express	58
202	Broken Arrow Express	43

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

JENKS/RIVERSIDE CORRIDOR

The Jenks/Riverside Corridor generally extends south of downtown Tulsa along the Arkansas River, between US 75 South (Okmulgee Expressway) and S. Lewis, and includes the Tulsa CBD. Specifically, the corridor boundary begins at I-444 at S. Peoria, south to E. 51st Street, east to S. Lewis, south to E. 76th Street, east to S. Delaware, south to E. 101st Street, west to S. Elm Street (S. Peoria), north to E. 91st Street, east to Arkansas River, north to I-444, and east to S. Peoria.

The major activity centers are listed in Table 21 and shown on Figure 19. Oral Roberts University, Texaco U.S.A., and Family/Warehouse Markets are among the major employers in the corridor.

The 1980 population was 42,595 and there were 62,350 employees working in the corridor (see Table 22). Employment is projected to increase by 30.9 percent or 19,255 employees between 1980 and 2005. This is an average annual growth rate of 1.2 percent. Population and dwelling units are forecast to increase by 13.8 percent and 20.6 percent, respectively. Persons per household are expected to decrease from 2.17 in 1980 to 2.05 in 2005.

The number of automobiles is projected to increase by 13,446 vehicles or 46 percent between 1980 and 2005. This is an average annual growth rate of 1.8 percent. Automobiles per dwelling units are forecast to increase from 1.5 in 1980 to 1.8 in 2005.

Level of service on existing roadway facilities will continue to decline as a result of the increase in population and employment. The LOS is depicted on Figure 20. It is important to note that this decline in mobility is expected to occur in spite of scheduled highway improvements, as outlined in the regional long-range transportation plan.

I-44 between the Arkansas River and the Missouri Pacific Railroad tracks will have LOS E/F. Sections of Riverside Drive, E. 36th Street, and S. Lewis will have LOS D indicating congested travel conditions approaching stop-and-go conditions. As level of service declines, motorists will experience longer travel times and delays.

The Jenks/Riverside Corridor is served by 12 public transportation routes. Characteristics of these routes are shown in Table 23.

The transit sketch planning analysis predicts a 2005 maximum load point corridor transit volume of 5,400 trips per average weekday.

Table 21

Jenks/Riverside Corridor
Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.*	Petro.	Texaco U.S.A.	1437 S. Boulder	850	1988	
2.	Groc.	Family/Warehouse Markets	6207-A S. Peoria	500[1]	1988	
3.	Retail	Kensington Galleria	S. Lewis & E. 71st Street	—	1988	150,000-300,000 sf[2]
4.	Retail	Loehmann's Plaza	S. Lewis & E. 81st Street	—	1988	100,000-150,000 sf
5.	Educ.	Oral Roberts University	7777 S. Lewis	781	1988	
6.	Med.	City of Faith Hospital & Research Center	8181 S. Lewis	1,906	1988	

Common to Sapulpa and Jenks/Riverside Corridors.
1 Less than 500 employees at each location.
2 sf = square feet/footage
Source: Indian Nations Council of Governments, 1988.

Table 22

Jenks/Riverside Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Percent Increase	Increase
Population	42,595	48,484	5,889	13.8%
Dwelling Units	19,646	23,698	4,052	20.6%
Total Employment	62,350	81,605	19,255	30.9%
Automobiles	29,229	42,675	13,446	46.0%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.

Table 23

Jenks/Riverside Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership*
2	S. Yale/St. Francis	185
9	S. Lewis	417
15	E. 15th Street/S. Sheridan	409
16	S. Peoria	623
17	Southwest Blvd./S. 33rd W. Avenue-S. Union	506
20	Super Loop	1,142
102	E. Tulsa Express	35
103	Woodland Hills Express	59
104	Sun Meadow Express	48
105	Regency Park Express	16
108	Harvard/Yale Express	27
109	Rolling Hills Express	32

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

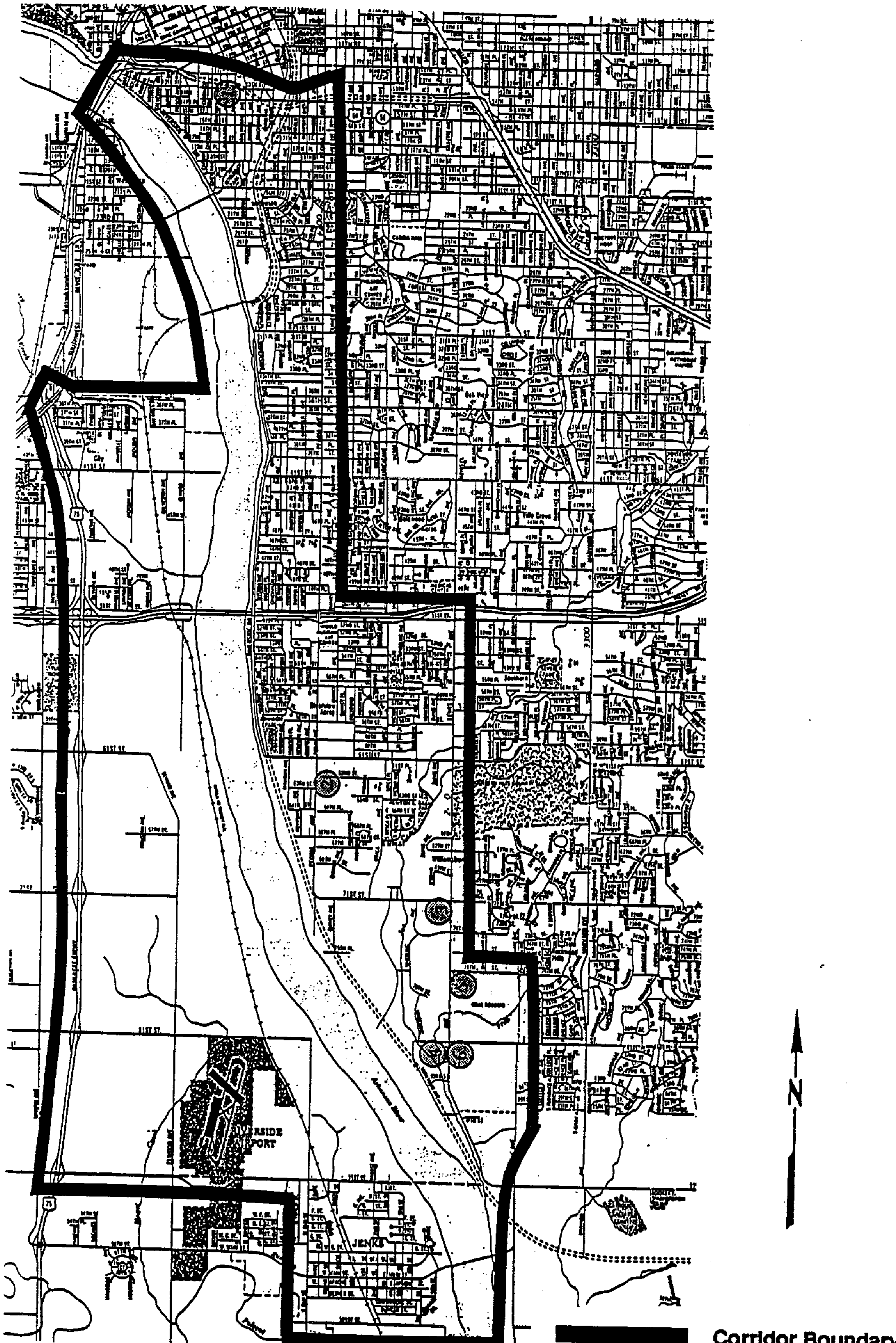


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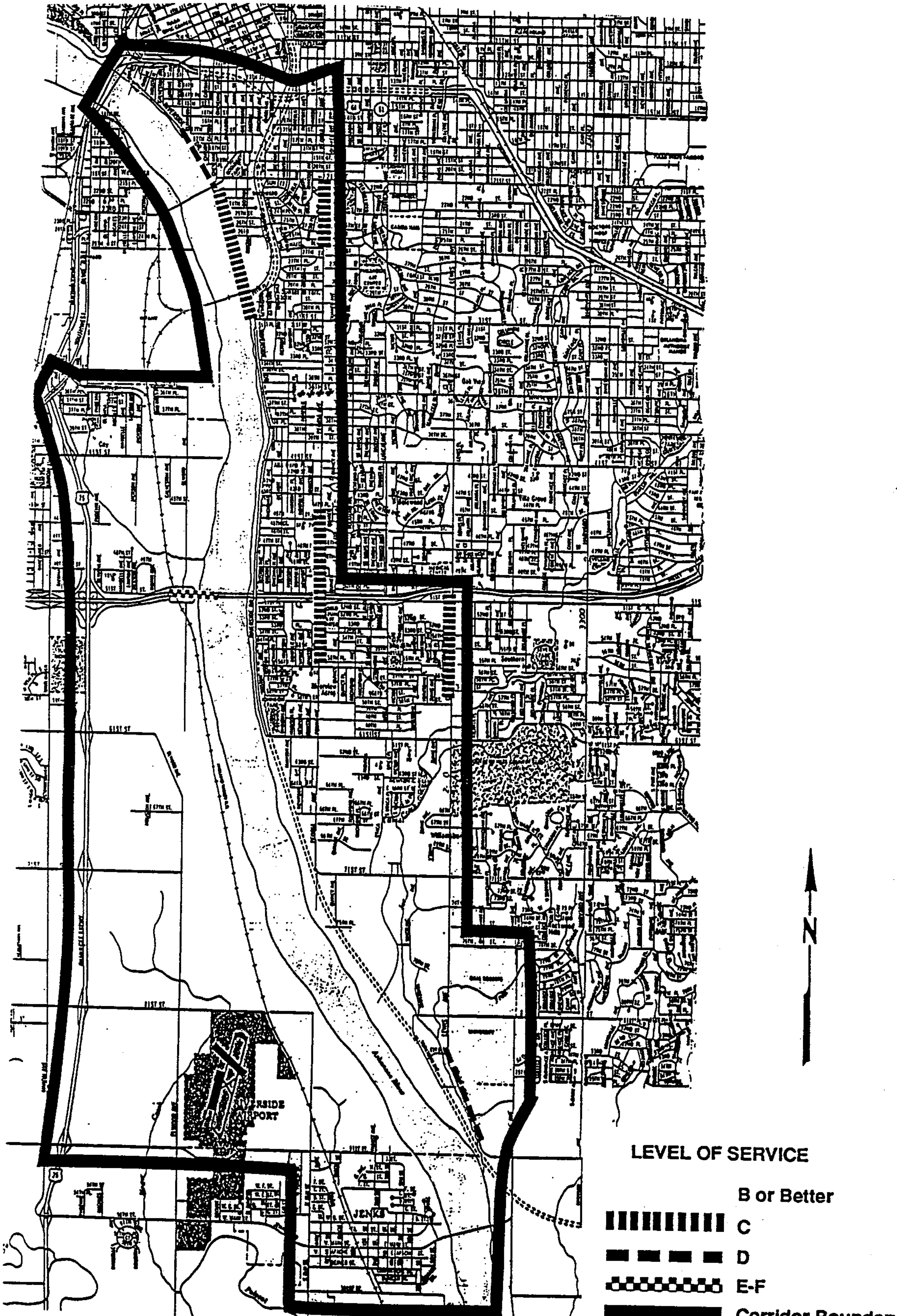
Figure 19

JENKS/RIVERSIDE CORRIDOR
Major Activity Centers



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	JENKS/RIVERSIDE CORRIDOR Level of Service	**20**

SAPULPA CORRIDOR

Generally, the Sapulpa Corridor extends southwest of downtown Tulsa along I-44 (Turner Turnpike) between Tulsa/Creek County line and Burlington Northern Railroad to W. 101st Street, and includes the Tulsa CBD. Specifically, the corridor is bound by I-444 at Riverside Drive, south to E. 18th Street, west to S. Boulder, southwest to Arkansas River, south to E. 36th Street, west to I-244 (Redfork Expressway), southwest to Okmulgee Expressway, south to I-44, west to S. 33rd W. Avenue, south to Rock Creek, northwest to W. 101st Street, west to Burlington Northern Railroad tracks, north to W. 61st Street, east to S. 65th W. Avenue, north to W. 41st Street, east to S. 49th W. Avenue, north to W. 21st Street, east to Redfork Expressway, north to I-444.

The two major activity centers are Texaco U.S.A. and the Crystal City Shopping Center (see Table 24 and Figure 21).

The population in the corridor for 1980 was 25,051 persons and there were 58,762 employees working in the corridor. Comparison of the 1980 and forecast 2005 socioeconomic characteristics are shown in Table 25. The total number of employees is projected to increase by over 16,000 persons or by 28.2 percent between 1980 and 2005.

Population is forecast to increase by 2,769 people or 11.1 percent, and dwelling units are forecast to increase by 1,647 or 15.3 percent. Persons per household are projected to decrease from 2.3 in 1980 to 2.2. in 2005. The number of automobiles in the corridor is expected to increase by 33.6 percent or by 5,398 vehicles. Automobiles per dwelling units are projected to increase from 1.5 in 1980 to 1.7 in 2005.

The projected increases in population and the number of employees working in the corridor will put a greater demand on the roadway system. By 2005, the LOS for various sections of roadway will decline as a result of traffic volumes exceeding roadway capacity. This is projected to occur despite highway improvements planned for construction as recommended in the regional long-range transportation plan. Motorists will experience congested conditions which will result in longer delays and travel time. Figure 22 depicts the LOS for those roadways which are projected to have LOS C or worse in 2005.

Several public transportation routes serve patrons in the corridor, some more extensively than others. Table 26 presents information on these routes.

The transit sketch planning analysis predicts a 2005 maximum load point corridor transit volume of 2,200 trips per average weekday.

Table 24

Sapulpa Corridor
Major Activity Centers

Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.* Petro.	Texaco U.S.A.	1437 S. Boulder	850	1988	
2. Retail	Crystal City	W. 51st Street S. & S. 49th W. Avenue	—	1988	100,000-150,000 sf [1]

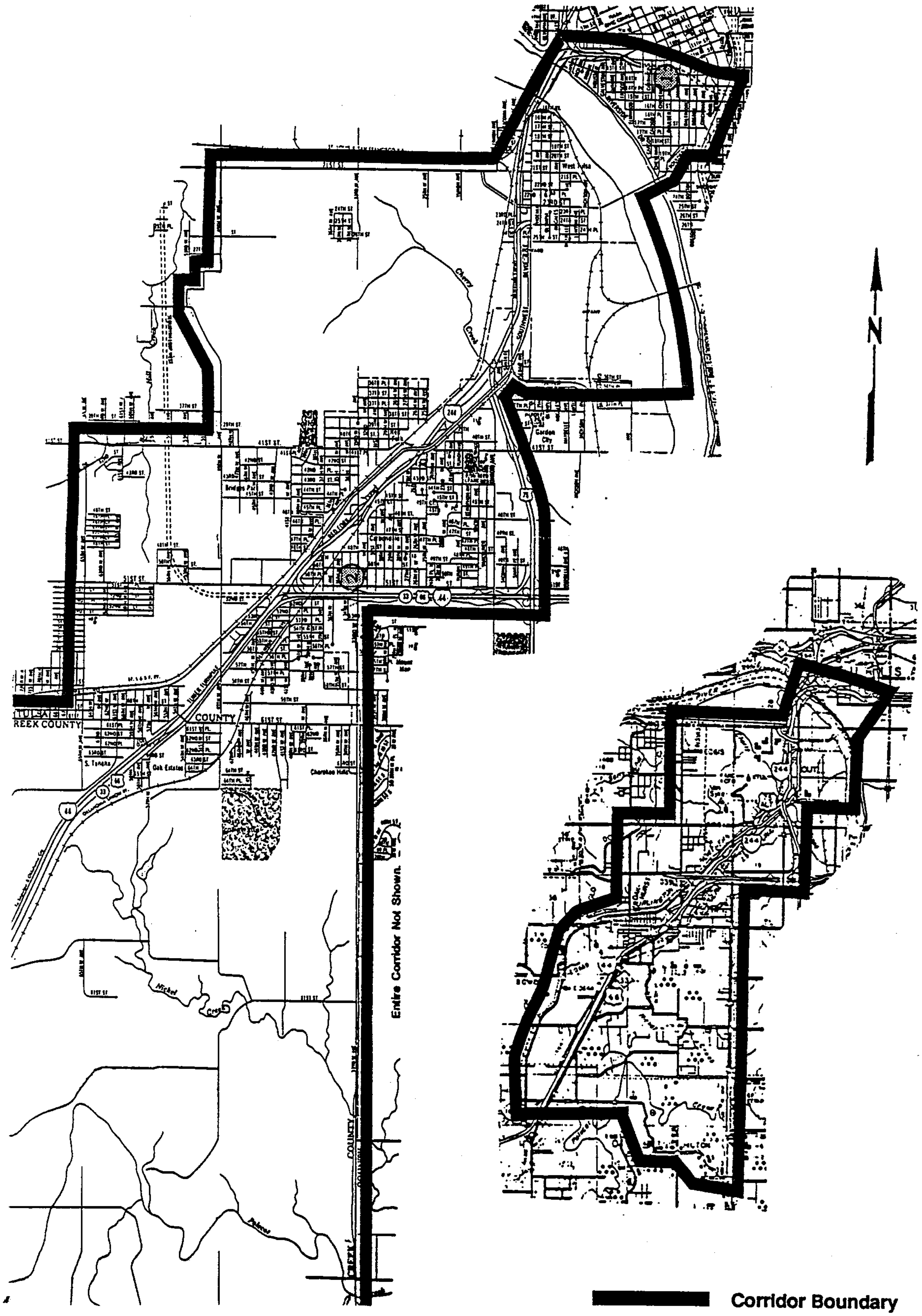
* Common to Sapulpa and Jenks/Riverside Corridors.
1 sf = square feet/footage
Source: Indian Nations Council of Governments, 1988.

Table 25

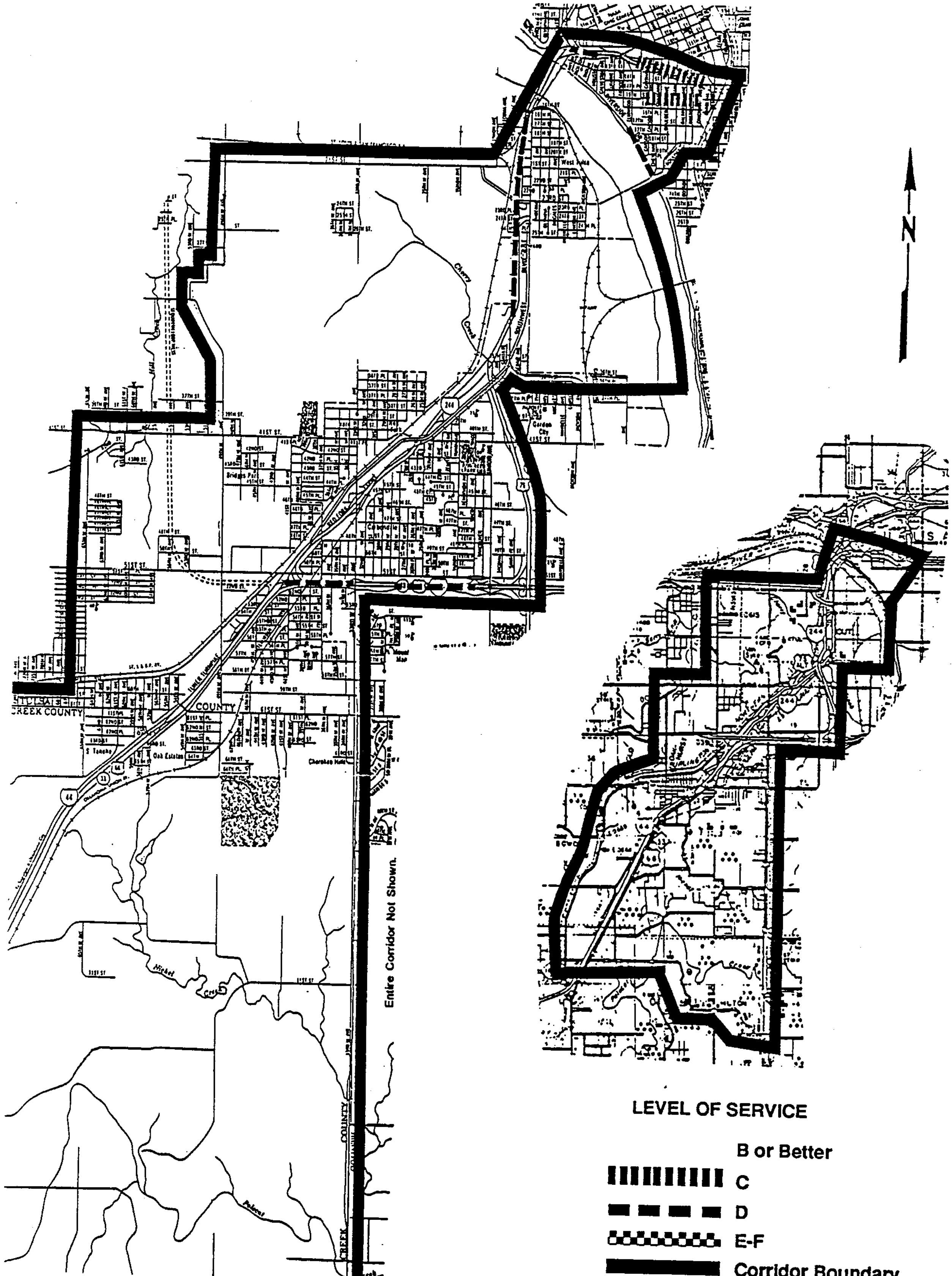
Sapulpa Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Increase/ Decrease	Percent Increase/ Decrease
Population	25,051	27,820	2,769	11.1%
Dwelling Units	10,786	12,433	1,647	15.3%
Total Employment	58,762	75,327	16,565	28.2%
Automobiles	16,066	21,464	5,398	33.6%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.



Parsons Brinckerhoff	*Oklahoma Fixed Guideway Transportation System Study*	Figure
Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	**SAPULPA CORRIDOR Major Activity Centers**	21



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	SAPULPA CORRIDOR **Level of Service**	**22**

Table 26

Sapulpa Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
9	S. Lewis	417
15	E. 15th Street/S. Sheridan	409
16	S. Peoria	623
17	Southwest Blvd./S. 33rd W. Avenue-S. Union	506
102	East Tulsa Express	35
103	Woodland Hills Express	59
104	Sun Meadow Express	48
105	Regency Park Express	16
106	Mingo Valley Express	51
108	Harvard/Yale Express	27
109	Rolling Hills Express	32

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

SAND SPRINGS CORRIDOR

The Sand Springs Corridor generally follows the Arkansas River to the west of the Tulsa CBD. Specifically, it includes the Tulsa CBD and is bound by the Osage/Tulsa County line to the north, I-244 to the east, the Arkansas River to the south, and Willow Street to the west.

The 1980 population was 24,479 and 54,458 employees worked in the corridor. There are no employers, outside of the Tulsa CBD, with over 500 employees. Growth projections of the socio-economic characteristics for the Sand Springs Corridor are shown in Table 27. By 2005, the population is expected to decrease by 12 percent of 2,972 persons. Likewise, the number of dwelling units is expected to decrease by two percent. Persons per household is projected to decline from 2.5 in 1980 to 2.2 in 2005. Automobile ownership is forecast to increase by a total of 1,706 vehicles or from 1.5 autos per dwelling unit in 1980 to 1.7 autos per household in 2005.

Total employment in the corridor is forecast to increase by 28 percent or 15,476 employees. This is an average annual rate of growth of 1.1 percent. The forecasted increase in employees will increase traffic volumes on the roadway system and LOS will decline. By 2005, the section of US 64 (Keystone Expressway) between S. 61st W. Avenue and S. 49th W. Avenue is projected to have a LOS D or traffic volumes approaching or exceeding roadway capacity.

The Sand Springs Corridor is served by two transit routes. Characteristics of these routes are shown in Table 28.

The transit sketch planning analysis estimates a potential 2005 maximum load point transit demand in the corridor of approximately 1,800 daily trips.

Table 27

Sand Springs Corridor
1980 and 2005 Socioeconomic Characteristics *

Characteristic	1980	2005	Increase or Decrease	Percent Increase or Decrease
Population	24,479	21,507	-2,972	-12.1%
Dwelling Units	9,910	9,690	-220	-2.2%
Total Employment	54,458	69,934	15,476	28.4%
Automobiles	14,977	16,683	1,706	11.4%

* Includes Central Business District data.
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.

Table 28

Sand Springs Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
7	Gilcrease	116
14	Charles Page Blvd.	295

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.

MEMORIAL/OWASSO CORRIDOR

The Memorial/Owasso Corridor is the only corridor that does not include the Tulsa CBD. In this sense, it is a crosstown corridor. Generally, the corridor extends from E. 96th Street N. between the Tulsa/Rogers County line and N. Mingo, south to E. 102nd Street between S. Mingo and S. Sheridan. The specific boundary is: N. Garnett at E. 96th Street N., east to N. 145th E. Avenue/ Tulsa-Rogers County line, south to E. Apache, west to Mingo Valley Expressway, south to Burlington Northern Railroad tracks, west to N. Mingo, south to E. 11th Street, east to Mingo Valley Expressway, south to E. 21st Street, west to S. Mingo, south to E. 101st Street, east to S. Sheridan, north to the Atchinson Topeka and Santa Fe Railroad tracks, northeast to E. 46th Street N., east to N. 93rd E. Avenue, south to E. 41st Street North, east to N. Mingo, north to E. 66th Street, east to Ranch Creek, north to E. 86th Street N., east to N. Garnett, and north to E. 96th Street N.

This corridor includes the state's second largest employer-American Airlines. The major activity centers are listed in Table 29 and their locations are shown on Figure 23. The major activity centers include several retail establishments plus Rockwell International, McDonnell Douglas, American Airlines, and Mazzio's Corporation.

There were 64,756 persons living in the corridor in 1980 and 52,794 employees. Total employment is projected to increase by 36,655 persons or 69.4 percent by the year 2005. This is an average annual growth rate of 2.8 percent. Comparison of the 1980 and 2005 socioeconomic characteristics is in Table 30. The Memorial/Owasso Corridor has the greatest increase in the number of dwelling units and population between 1980 and 2005.

Population is forecast to increase by 30,412 persons or 47 percent by 2005. Dwelling units are projected to increase by 11,408 or 46.6 percent. Both population and dwellings are expected to have an average annual growth rate of 1.9 percent. Persons per household will increase from 2.6 in 1980 to 2.7 in 2005.

By 2005, 22,618 additional automobiles are projected for the corridor. This is an increase from 48,380 vehicles in 1980 to 70,998 vehicles in 2005 or 46.8 percent. Automobiles per household are expected to remain at 2.0 between 1980 and 2005.

The increase in automobile ownership, population, and employees will result in greater volumes of traffic on the roadways and LOS will decline. The traveling public will experience longer travel times and delays. Figure 24 depicts the LOS for those roadways in the corridor projected in spite of numerous highway improvements, as recommended in the region's long-range transportation plan. S. Memorial between E. 32nd Street and the Broken Arrow Expressway, S. Mingo, E. 11th Street and the Mingo Valley Expressway are forecast to have LOS D or traffic volumes nearly equaling roadway design standards.

Seventeen public transportation routes serve transit patrons in the Memorial/Owasso Corridor, as shown in Table 31.

Table 29

Memorial/Owasso Corridor Major Activity Centers

	Type of Business	Activity Center	Location	Number of Employees	Year	Comments
1.+	Retail	The Farm	E. 51st Street & S. Sheridan	—	1988	150,000-300,000 sf[2]
2.+	Retail	Fontana	E. 51st Street & S. Memorial	—	1988	300,000 sf
3.+	Retail	Eaton Square	E. 61st Street & S. Memorial	—	1988	150,000-300,000 sf
4.+	Retail	Center 71 Annex	E. 71st Street & S. Memorial	—	1988	150,000-300,000 sf
5.+	Retail	Crossing Oaks	E. 71st Street & S. Memorial	—	1988	150,000-300,000 sf
6.+	Retail	Woodland Hills Mall	E. 71st Street & S. Memorial	—	1988	300,000 sf
7.#	Retail	Briar Village	S. Mingo & E. 31st Street	—	1988	100,000-150,000 sf
8.#	Retail	Tri-Center North	E. 21st Street & S. Memorial	—	1988	150,000-300,000 sf
9.*	Trans.	American Airlines	3800 N. Mingo	7,379	1988	
10.*	Mfg.	Rockwell International	2000 N. Memorial	—	1988	
11.*	Mfg.	McDonnell Douglas	4441 S. 72nd E. Avenue	500[1]	1988	
12.+	Rest.	Mazzio's Corporation	4441 S. 72nd E Avenue	500[1]	1988	

Common to Memorial/Owasso and Broken Arrow/Memorial Corridors

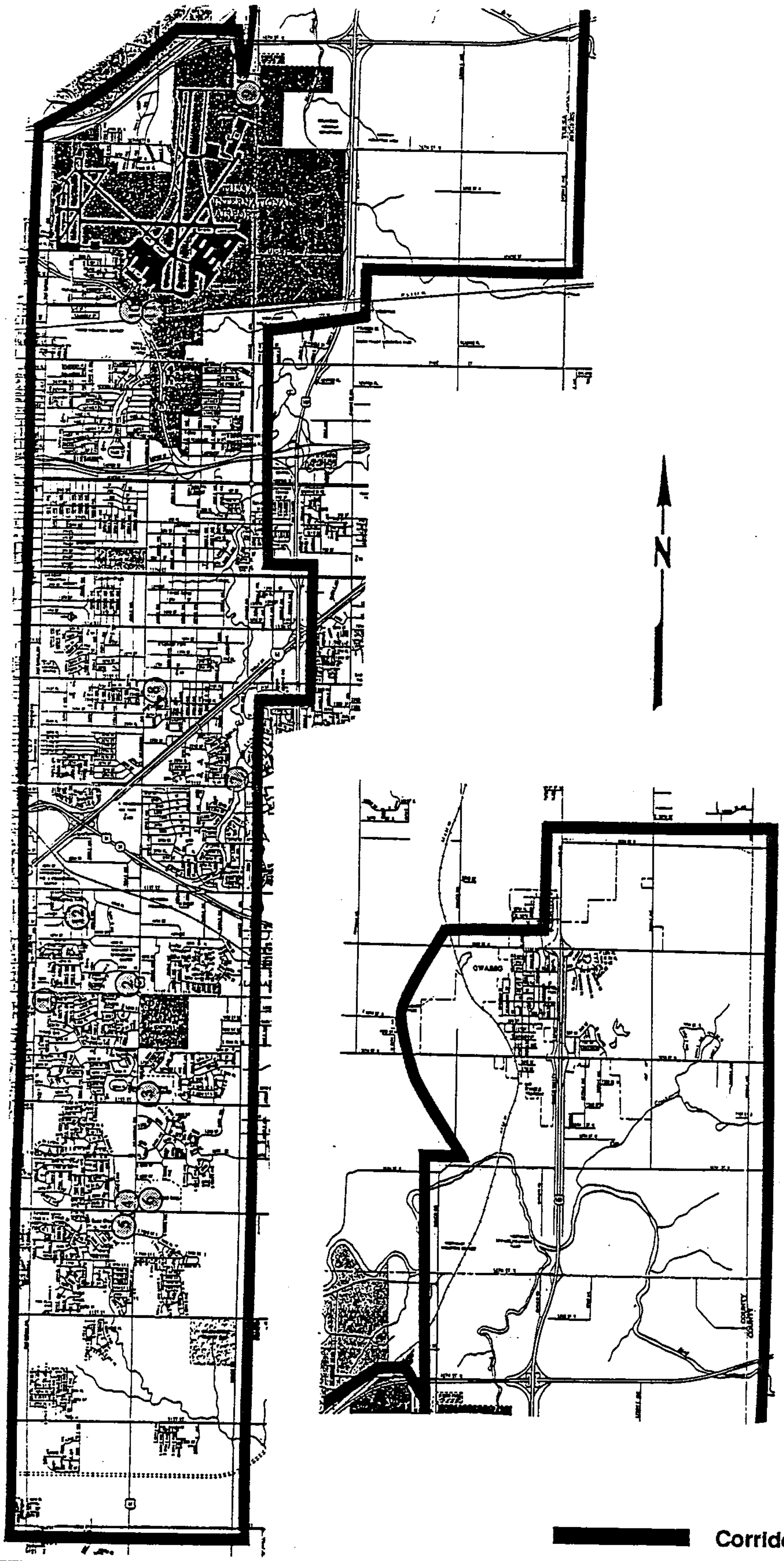
\# Common to Memorial/Owasso and Lynn Lane Corridors

* Common to Memorial/Owasso and Downtown/Airport Corridors

1 Less than 500 employees at each location.

2 sf - square feet/footage

Source: Indian National Council of Governments, 1988.



Corridor Boundary

Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	MEMORIAL/OWASSO CORRIDOR **Major Activity Centers**	**23**

Table 30

Memorial/Owasso Corridor
1980 and 2005 Socioeconomic Characteristics

Characteristic	1980	2005	Increase	Percent Increase
Population	64,756	95,168	30,412	47.0%
Dwelling Units	24,505	35,913	11,408	46.6%
Total Employment	52,794	89,449	36,655	69.4%
Automobiles	48,380	70,998	22,618	46.8%

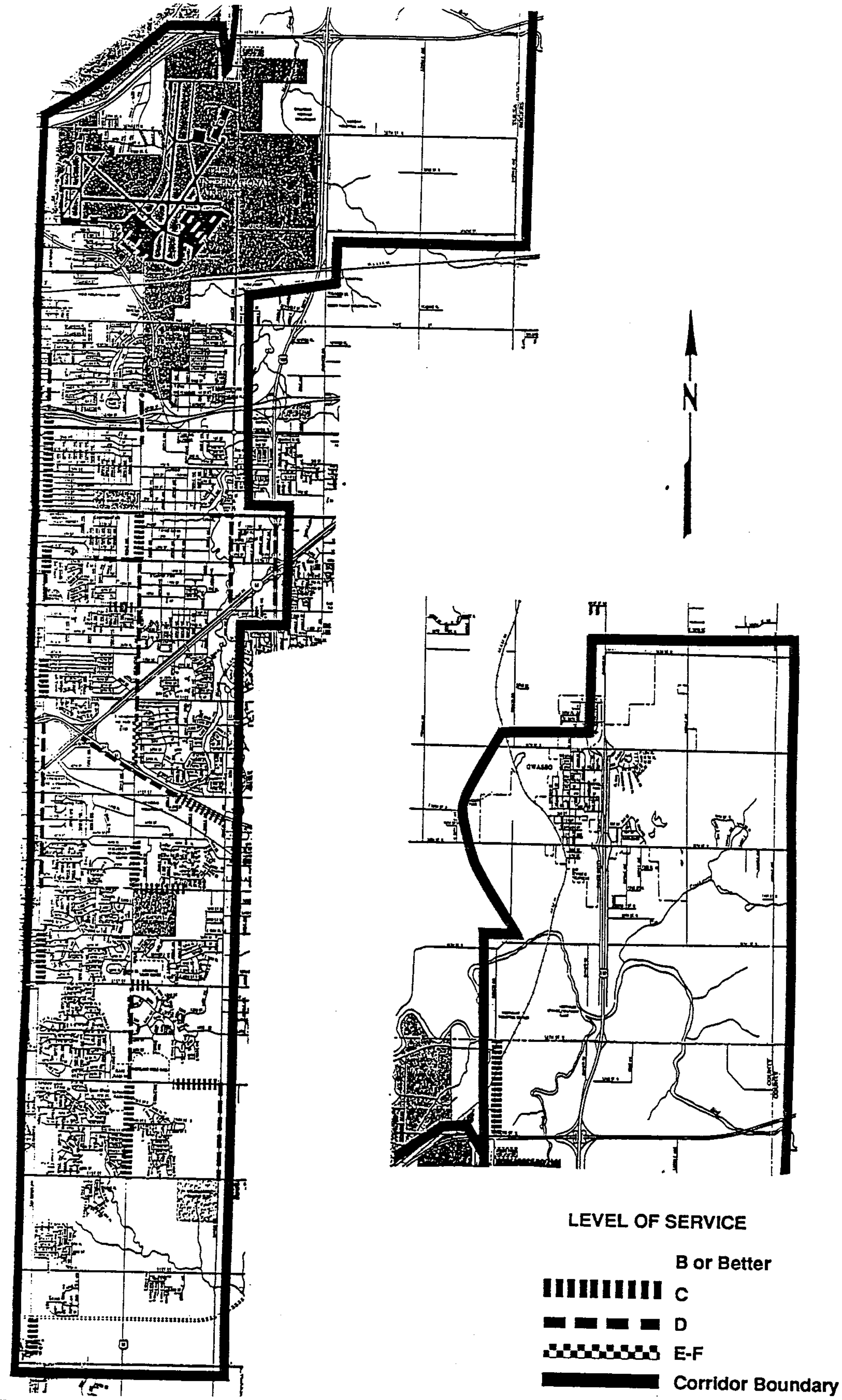
Source: INCOG: Tulsa Metropolitan Area Transportation Study - 1980 and 2005, 1988.

Table 31

Memorial/Owasso Corridor
Transit Route Profiles

Route Number	Route Name	Average Weekday Ridership *
3	E. 3rd Street/S. Memorial	506
6	E. 6th Street/S. Harvard	403
11	E. 11th Street	348
13	Independence/Pine	149
15	E. 15th Street/S. Sheridan	409
18	Admiral	458
20	Super Loop	1,142
21	E. 21st Street	640
31	E. 31st Street	358
101	Briarwood Express	16
102	East Tulsa Express	35
103	Woodland Hills Express	59
104	Sun Meadow Express	48
105	Regency Park Express	16
106	Mingo Valley Express	51
107	S. Sheridan Express	58
108	Harvard/Yale Express	27
109	Rolling Hills Express	32

* FY 88 First Quarter
Source: Tulsa Transit, Four Month Performance Report: February 1988 - Passenger Count, 1988.



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Oklahoma Fixed Guideway Transportation System Study	Figure
MEMORIAL/OWASSO CORRIDOR Level of Service	24

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5.0 GUIDEWAY TECHNOLOGY OPTIONS

This section discusses various transit technologies and their classification and application. The information is divided into four categories: rail transit; guideway transit; street transit; and other concepts that may not be fully developed in today's technologies, but may be considered in the future.

Each of the above mentioned categories is broken down into different classifications as applicable:

- Rail Transit: rapid transit; pre-metro; light rail (high and low level platforms); and commuter rail.
- Guideway Transit: automated guided transit (AGT); guided busways; monorail; and magnetic levitation (Maglev).
- Street Transit: regular buses; express buses; trolley buses; and street cars.

The objective of this organization of categories is to acquaint the reader with the various technologies available. It explains how they can be applied for fixed guideway and regular transit service in the Tulsa metropolitan area. The rail and guideway transit technologies and some of the street transit applications may be considered fixed guideways.

RAIL TRANSIT

The following paragraphs provide a discussion of each mode within the rail transit technological classification:

Rail Rapid Transit (RRT): RRT is sometimes known as "heavy-duty rail." It transports large groups of passengers on trains over exclusive rights-of-way (R/W). It has high level station platforms and may employ different degrees of automation. It is considered as semi-automated because an operator is typically present on board the train. It is characterized by high speeds of 45-80 mph, vehicle capacity of 40-80 seated and 18-119 standees, and passenger loads of 10,000 to 62,000 passengers per hour.

As compared to Light Rail Transit, a similar technology, full R/W control gives the RRT the following significant distinctions:

- Higher level of service (speed, reliability, comfort, etc.)
- Higher system performance (capacity because of long trains, productivity, efficiency)
- Greater safety (cab signaling, fail safe)
- Stronger image (separate R/W and rail technology)
- Higher land use impact and passenger attraction
- Higher investment
- Lower ability to fit into the urban environment
- Less conducive to staged construction
- Longer implementation time

Rail rapid transit (RRT) represents what many consider the "ultimate mode" for line haul transport; however, this highest performance mode usually costs more than that for some other modes. Nevertheless, in many applications, the cost differential between the RRT mode and lesser modes is slight, so, the RRT mode becomes the mode of choice even if used at lower than full capacity.

Light Rail Transit (LRT): Like RRT, LRT is a widely used class of medium capacity urban public transport. It uses electrically powered rail cars operating either as a single car (articulated or single body vehicles), or in short trains of up to four cars over fixed duo rail tracks. By its performance and cost characteristics LRT falls between streetcars (SCR) and RRT.

It can operate with high or low level platforms. Most LRT cars range in length from 25 to 80 feet; width from 6 to 10 feet; and height from 9 to 13 feet. Total capacity ranges from 30 to 65 seated, and 85 to 185 total capacity. This results in actual passenger loads of 1,200 to 18,000 passengers per hour depending upon headways. Their maximum speeds range from 40-55 mph.

LRT vehicles are typically designed with the ability to brake rapidly and traverse tighter turns than conventional (RRT) rail systems. Through the use of articulated designs, turning radius capability for long cars has been kept low - approximately 84 feet. For example, the Bombardier articulated light rail vehicle (ALRV), in operation at Tri-County Metropolitan Transportation District of Oregon, is a good example of an ALRV. The cars are 87 feet long with a total passenger capacity of 211, and a maximum service speed of 55 mph.

Stations are usually very simple stops with passengers boarding either from the street level or from low platforms. Some systems have been built with high platforms like those used in RRT. Line capacity may range from 2,000 to 20,000 passengers per hour per direction, depending upon headways. LRT may be deployed at, above, and below grade. The R/W may be exclusive or shared with other traffic; however, LRT service is typically:

- Low level (at-grade) passenger loading
- Street running (with or without automobile segregation) with reserved way running
- Overhead current collection (trolley or pantograph variations)
- One person, single car operation (in, but not confined to, off peak and/or "owl service" hours)
- Train operation in peak periods of not more than two vehicles
- Maximum speed of about 50 mph

GUIDEWAY TRANSIT

Guideway Transit (GT) includes all transit systems that do not use duo rail tracks typically used by railroads. A wide range of unique guideways and vehicle suspension systems exist. Consequently, one manufacturer's vehicles can not operate on another's guideway. All guideway modes are proprietary; the owner-operator has no option but to deal with the system supplier once the system is operational. Their unique guideway designs do not lend themselves to at-grade crossings by other traffic. Depending on the level of automation or the mode, these systems may or may not have an operator on board.

Guideway transit is classified into two types: automated guided transit modes and mixed transit. Also included in the latter classification are the monorail and the magnetic levitation (Maglev) systems.

Automated Guided Transit (AGT) consists of two groups — personal rapid transit and group rapid transit, also known as people mover systems. This application is designed for short haul medium capacity lines with 15 to 50 spaces per vehicle. They have a theoretical line capacity of 1,500 to 24,000 passengers per hour. GRT systems operate with maximum speeds of 17-60 mph.

The typical operation of AGT systems is fully automated. They have the capability of operating with a crew on board. For rapid transit modes, full automation is desirable but not crucial because of their inherently high labor productivity. The first driverless operation of a complex AGT system was the Airtrans system in the Dallas-Fort Worth Airport in Texas. The first such system applied to urban transit service is the Morgantown AGT system in Virginia.

Personal Rapid Transit (PRT) is based on the premise that the best way to attract automobile drivers to a transit system is to provide high frequency service between many points in the city without requiring the patron to transfer. To achieve this, a PRT system would consist of small "cabin" vehicles with a 2 to 6 seat capacity for use by individual persons or small groups. An extensive network of guideways with many stations would cover the city. All vehicular travel would be point to point without any intermediate stops. The control system would supervise merging and diverging areas and enable short spacings of vehicles on the guideways. The capacity of the lines could reach, supposedly, 3000 to 5000 vehicles per hour. The vehicles would be able to travel at high speeds. Expense and technology limitations have resulted in no PRT system being developed.

Group Rapid Transit (GRP) systems may have two general types of applications. First, as regular transit lines they provide medium capacity, high quality service. A GRP system operates at a cost lower than that of conventional modes. Second, GRP has uses for internal short haul transportation within various amusement parks, airports, and hospital complexes.

The Transit Expressway, popularly known as "the skybus" developed by Westinghouse Electric, is one of the earliest GRT systems developed. The "Skybus" vehicles had a modified bus suspension with two axles and eight supporting rubber tires. Eight horizontal tires running along a vertical steel I-beam in the center of the guideway provided guidance. Movement of this I-beam achieved switching. In most applications, seating was longitudinal or non-existent, and standing capacity was high.

To date, three AGT systems have been deployed in line haul applications. These include Vancouver, British Columbia; Lille, France; and Kobe, Japan.

The Urban Transportation Development Corporation's (UTDC) Advanced Light Rapid Transit Vehicle (ALRTV) was the first line haul AGT system in North America. Known as "Skytrain:, it operates in Vancouver. The system is driverless and operates high frequency train service of about three-minute headways (capable of running at 40 seconds headway during special occasions). It can handle 150,000 to 170,000 passengers per day. The system operates in four car trains capable of transporting about 10,000 people per peak hour per direction. The vehicles are 41 feet long and 8 feet wide with seating capacity of 38. Maximum speed is 56 mph.

Some of the positive and negative features of the GRT as compared with conventional rail technologies, include the following:

- Small to medium capacity vehicles with large proportion of standees
- Advantageous for short-haul
- Low to moderate speed of 17 to 41 mph adequate for short haul services

Guided Busways are special busways where the lane and buses are equipped to steer the bus automatically in the lane. This reduces the cost associated with R/W acquisition and the cost of the roadway structure. To be cost effective, savings must exceed the cost of additional equipment mounted on the roadway and the vehicle. Stations can be either on-line or off-line. Experimental examples operate in Adelaide, Australia, and Essen, West Germany.

Monorail is a transit mode riding on or suspended from a single rail, beam, or tube. Vehicles usually operate in trains. Monorails have complex guidance and switching, and most monorails are not fully automated. The oldest monorail in the world is the Schwebebahn in Wuppertal, West Germany.

Large size monorails using trains with capacities similar to light rail have been built in Japan. The Disney Mark IV and the Alweg Monorail trains lengths are three to six cars, and two to eight cars, respectively. Maximum speeds are 45 and 55 mph, respectively. The Wuppertal Monorail in West Germany and Aerobus have cruising speeds of 40-55 mph.

Transportation Group, Inc. (TGI), has developed three of the newest monorail systems: the M-Class, and XM-Class. The UM-Class is typically a people mover system with hourly capacity of 1,000 to 10,000 persons per hour (pph). Typical cruising speeds vary from 10 to 20 mph. The M-Class is an intermediate capacity urban system. With hourly capacity of 5,000 to 20,000 pph, its typical cruising speed is 40 to 55 mph. The XM-Class is high capacity urban. The interurban system has hourly capacity to 10,000 to 50,000 pph and cruising speeds of 55 to 70 mph.

The M-Class includes the Mark VI and the Mark VI-TC vehicles being built for the Walt Disney World Resort. Both the Mark VI-TC and the Mark VI characteristics are as follows: vehicles are rubber tired, cab cars are 40'-5" long and coach cars are 28'-2" long. They have seating capacities are 16 and 20 passengers; nominal standing capacities are 39 and 32. The maximum speeds are 55 and 40 mph.

Small size monorails are found primarily in amusement parks, zoos, and at world fairs. The one operating at the Oklahoma State Fairgrounds is one such example. Monorails are operated at very low speeds, less than 15 mph and have very simple suspension systems. Passenger capacity is usually 100 or less, generally all seated. Some small monorails have been provided with full automation. The Westinghouse C-10 Monotrain in Honolulu is an example.

As is the case for large monorail systems, small systems are unable to switch efficiently. Therefore, to date, their applicability has been limited to simple loop and shuttle systems.

STREET TRANSIT

Street transit are roadway transit systems characterized by vehicles operating on normal roads and streets. The following discusses two modes of roadway and street transit: bus transit and street cars. Three vehicle types of bus transit are discussed: regular buses; express buses, and; trolley buses. Any one of the three types can use articulated buses. Low capacity street transit systems are not included.

Bus Transit is the dominant mode of public transportation. This technology includes vehicles of a size to accommodate 12 to 66 seated passengers, plus standees. Articulated buses can accommodate 40 to 66 seated and 100 to 125 passenger places. In most cases the vehicles operate in a mixed flow with other traffic vehicles. They may also have use of an exclusive bus only lane or an exclusive busway.

Bus technology may be conventional diesel or electric trolley, guided buses, and dual propulsion (diesel and electric). Bus transit falls into the following classifications:

- Regular Bus Service: Regular bus service consists of buses operating along fixed routes on fixed schedules. They are street transit routes, which may represent the entire transit network, or be supplementary, feeder services to rail networks. At the lower end of their application they serve low volume suburban routes, overlapping somewhat with dial-a-ride. At the upper end of their applications range, they overlap with the LRT. They can serve lines with 3,000 to 5,000 pph. Their largest overlap, however, is with the trolley buses and street cars.
- Express Bus Service: Express bus service is provided by fast, comfortable buses on long routes with widely spaced stops. Compared to regular bus, it offers higher speed, more comfortable travel, but between fewer points. Sometimes it has higher fares. Its reliability of service depends on traffic conditions along the route.
- Trolley Bus Service: Trolley buses are the same vehicles as buses, except that they are propelled by an electric motor and obtain power from two overhead wires along their routes. Their service is basically the same as that of regular bus. Their investment cost is higher, and their operation is confined to fixed routes. Their advantages include better

ride quality (smooth vehicle motion), low noise, no exhaust, and long vehicle life span.

As mentioned earlier, bus service may be mixed with traffic or have its own R/W, bus only lane, or busway. The following are the different travelways of buses:

- High Occupancy Vehicle (HOV): HOV lane(s) restrict services to buses and high occupancy vehicles (carpools and vanpools) to express the HOV operation by segregating the buses from normal traffic lanes. Buses travel on the roadway with few or without any stops to the CBD or major activity centers. They use streets for distribution. Routes have few coordinated transfers with other routes. Transit properties offer this during peak periods only. Thus, buses on busways or HOV roadways serve the commuter market rather than regular transit market.
- Bus Only Lanes: Bus only lanes are reserved lanes for transit buses on regular streets and highways, and they can be set up for either on line or off line stops. The bus only lane may be as follows:
  - Contraflow: buses operate in the opposite direction from other traffic
  - Exclusive: lanes for bus use only, physically separated (by curbs or barriers) from other traffic, or
  - Regular: a lane on urban streets or freeways reserved for bus use only, separated from other lanes by pavement markings, signs, or rubber cones, but not by fixed physical barrier.
- Busways: Busways are essentially bus only lanes, grade separated from all other traffic. Busways do not require introduction of new technology. They can be used by many bus routes serving a large area. They speed up bus operations along heavily traveled corridors. The implementation time and cost are approximately equivalent to that of major roadway construction. Operating costs are high since busways usually serve the peak direction of travel (inbound in the mornings and outbound in the afternoons) and are not well adapted to on line stations.

Depending on the type of service, commercial bus speeds on freeways or busways range from 30 to 55 mph during the peak period while the corresponding speed on arterial streets during the same period range from 5 to 10 mph. Passenger capacity ranges from 10,000 to 32,000 pph on busways, versus 4,000 to 11,000 on arterial streets depending upon headways. The upper range of busway capacities results from lower speeds, permitting close headways (bus spacing).

In summary, busways are successful where many routes converge on a relatively short joint trunk line leading to the city center, and where buses can be distributed to several CBD streets. These streets must not be congested, or must offer regular bus lanes for service and enforcement. Houston, Texas has the largest HOV system in the country.

Two additional types of busways exist:

- Guided Busways which are special busways where the lane and buses are equipped to steer the bus automatically. Some experimental facilities have been built in Europe. The principal advantage is a reduction in required R/W width.
- Automated Guided Busways provide for automatic control of steering, propulsion, braking, and guidance. This operation offers the operator value only if the guided busway was very long.

NEW CONCEPTS

Existing technologies and operational methods offer a wide variety of service quantity and quality and can satisfy most types of urban transportation needs. This does not mean that an innovative system should be dismissed. Technologies under development include:

1. Dual Propulsion Trolley Buses: Trolley buses have been designed to operate both electrically and on diesel power in order to increase their applicability and adaptability to passenger demand. In high density areas buses can travel on their own R/W (or bus only lanes) using electric power. In low density areas and on freeways the bus will operate on diesel power. This type of system is operationally efficient, reduces environmental problems (during electrical operating mode), and permits service startup in a CBD subway where it is eventually planned to be an element of a mass transit system. Such a system is under construction in downtown Seattle, Washington.

2. Roadrailers: Many railroads today operate a combination road-rail service. This service uses trailers hauled by highway tractor to a rail terminal. They hydraulically drop a single rail axle onto the railroad to carry the load formerly carried by tires. These trailers are assembled with trains. The technology has never been applied to passenger transportation, but offers potential. The tractor trailer would operate as a regular bus on rubber tires when in low density areas and as a train along rail transit lines.

3. The "Superbus": The superbus is a bus body made from highway trailer components hauled by a tractor. This prototypical vehicle is now on trial in Los Angeles, California. The passenger portion features low level boarding and is quite spacious. If this bus were introduced in a system also using low level light rail vehicles, direct step across transfer points could be arranged.

Table 32 is a summary of the guideway technology options discussed in this section.

Table 32

Summary of Major Characteristics of the Systems/Technologies

Class	Name	Status	Systems		Max Capacity (PPH)	Max Speed (Km/hr)	Switching	Application	Built To Transit Standards	Handicapped Access
			Number	Single Lane (Km)						
Light Rail Transit	Streetcar	Mature	Numerous	E	7,200	70	Simple	Collect./Dist	Yes	Lift
	At-Grade LRT; Hard R/W	Mature	Numerous	E	9,400	85	Simple	Line Haul	Yes	Lift/Level Boarding
	Pre-Metro	Mature	Numerous	E	12,000	80	Simple	Line Haul	Yes	Level Boarding
	Grade Separated LRT Exclusive R/W	Mature	Numerous	E	12,400	85	Simple	Line Haul	Yes	Level Boarding
Rapid Rail Transit	Conventional RRT	Mature	Numerous	E	37,620	120	Simple	Line Haul	Yes	Level Boarding
	Automated RRT	Mature	Numerous	E	62,700	120	Simple	Line Haul	Yes	Level Boarding
Commuter Rail	Commuter Rail	Mature	Numerous	E	18,000	130	Simple	Line Haul	Yes	Lift/Level Boarding
Mini-Metro	Val 256 (USA) Val 206 (Europe)	Mature	2 5	25.4	23,760	82	Simple	Line Haul	Yes	Level Boarding
	ICTS	Mature	3	63	20,736	80	Simple	Line Haul	Partly	Level Boarding
	London Docklands	Mature	1	21	13,320	80	Simple	Line Haul	Yes	Level Boarding
	TAU	Under Construction	1	T	10,000	80	Simple	Line Haul	Yes	Level Boarding
	Linear Motorcar	Under Construction	1	T	15,600	80	Simple	Line Haul	Yes	Level Boarding
Larger Monorail	TGI's Disney Mark VI	Under Construction	1	23.7	5K-20K	64.4	Complex	Line Haul	No	Level Boarding
	TGI's Disney Mark VI-TC	Under Construction	1	23.7	5K-20K	88	Complex	Line Haul	No	Level Boarding
Large Monorail	Disney Mark VI	Mature	1	23.7	7,200	72	Complex	Line Haul	No	Level Boarding
	Hitachi /Alweg Monorail	Mature	5	52.5	19,200	90	Complex	Line Haul	Yes	Level Boarding
Small Monorail	Unimobil Tourister	Mature	7	13.3	1,600	19	Moderate	Theme Park Loop	No	Level Boarding
	Westghouse C-10 Monorail	Mature	1	0.4	510	13	Simple	Shopping - Ctr. Shuttle	No	Level Boarding

Table 32 (Continued)

Summary of Major Characteristics of the Systems/Technologies

Class	Name	Status	Systems: Number	Systems: Single Lane (Km)	Max Capacity (PPH)	Max Speed (Km/hr)	Switching	Application	Built To Transit Standards	Handicapped Access
Bus Transit	Dual Propulsion Articulated Bus - Renault per 180H	Mature	1	N/A	2,320	60	Not Required	Collection/ Distribution	Yes	Lift
	Artic. Guided Bus Mercedes Benz 0 405 G	Mature	2	N/A	3,450	100	Not Required	Collect./Dist Line Haul	Yes	Lift
	Dual Mode Artic. Bus -Mercedes Benz 0 305 GTD	Mature	1	N/A	3,450	72	Complex	Collect./Dist Line Haul	Yes	Lift
	Double Artic. Bus MAN SGG 240	Pre-Production	Several	N/A	4,200	60	Not Required	Collection/ Distribution	Yes	Lift
	Dual Mode Double Artic. Bus-BN GLT	Pre-Production	1	T	13,770	65	Simple	Line Haul Collect./Dist	Yes	Lift/Level Boarding
	High Capacity Busway	Mature	Numerous	E	10,000	90	Not Required	Collection/ Distribution	Yes	Lift
	Superbus	Demon-stration	1	T	6,000	80	Not Required	Line Haul	Yes	Lift
	High Speed Commuter Busway	Mature	Numerous	E	6,360	120	Not Required	Collect./Dist Line Haul	Yes	Lift
Automated Guided Transit	Westinghouse C-100	Mature	7	21	10,000	77	Complex	Shuttle Loop Line Haul	Yes	Level Boarding
	Birmingham Maglev	Demon-stration	1	1.2	3,600	47	Complex	Airport Shuttle	Yes	Level Boarding
	H-Bahn	Demon-stration	1	1.1	7,300	55	Simple	Campus Shuttle	Yes	Level Boarding
	M-Bahn	Demon-stration	Under Const.	2.4	11,200	90	Simple	Pinched Loop	Yes	Level Boarding
	Westinghouse C-45	Prototype	Under Const.	2.4	3,760	45	Complex	Shuttle Loop	Yes	Level Boarding

E = EXTENSIVE, More Than 100 Km.
T = Test Track Only

Source: "Inventory of Transit Systems/Technologies," Lea & Elliot, September 1987.

6.0 CORRIDOR TRAVEL DEMANDS

This section describes the estimated future transit demand for each of the eight potential fixed guideway corridors identified in Section 4.0: Potential Regional Corridors. Corridor transit demand is one of the key measures used in evaluating the fixed guideway potential of each corridor.

The following Figures 25 through 32 show volume demands for each of the eight potential corridors. Corridor volumes are used to calculate vehicle requirements and operating and maintenance costs. Two sets of volumes are given, volumes without fixed guideway service (local bus, base-case volumes) and volumes with fixed guideway service.

Figure 25 shows predicted 2005 transit volumes for the Downtown/Airport Corridor. As can be seen from the figure, base-case volumes are predicted to range from 300 to 500 daily transit passenger trips at the outer end of the corridor to 2700 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase significantly, with daily volumes ranging from 2200 at the outer end to 5300 approaching the Tulsa CBD.

Figure 26 shows predicted 2005 transit volumes for the Lynn Lane Corridor. The figure shows the base-case volumes to range from 100 daily transit passenger trips at the outer end of the corridor to 5000 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase up to 100%, with daily volumes ranging from 200 at the outer end to 5700 approaching the Tusla CBD.

Figure 27 shows predicted 2005 transit volumes for the Broken Arrow Corridor. The figure shows base-case volumes are predicted to range from 300 daily transit passenger trips at the Broken Arrow end of the corridor to 3800 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase significantly, with daily volumes ranging from 1200 at the outer end to 10,500 approaching the Tulsa CBD.

Figure 28 shows predicted 2005 transit volumes for the Broken Arrow/Memorial Corridor. As shown on the figure, base case volumes are predicted to range from 2200 daily transit passenger trips at the south end of the corridor to 3800 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase significantly, with daily volumes ranging from 3000 at the outer end to 10,300 approaching the Tulsa CBD.

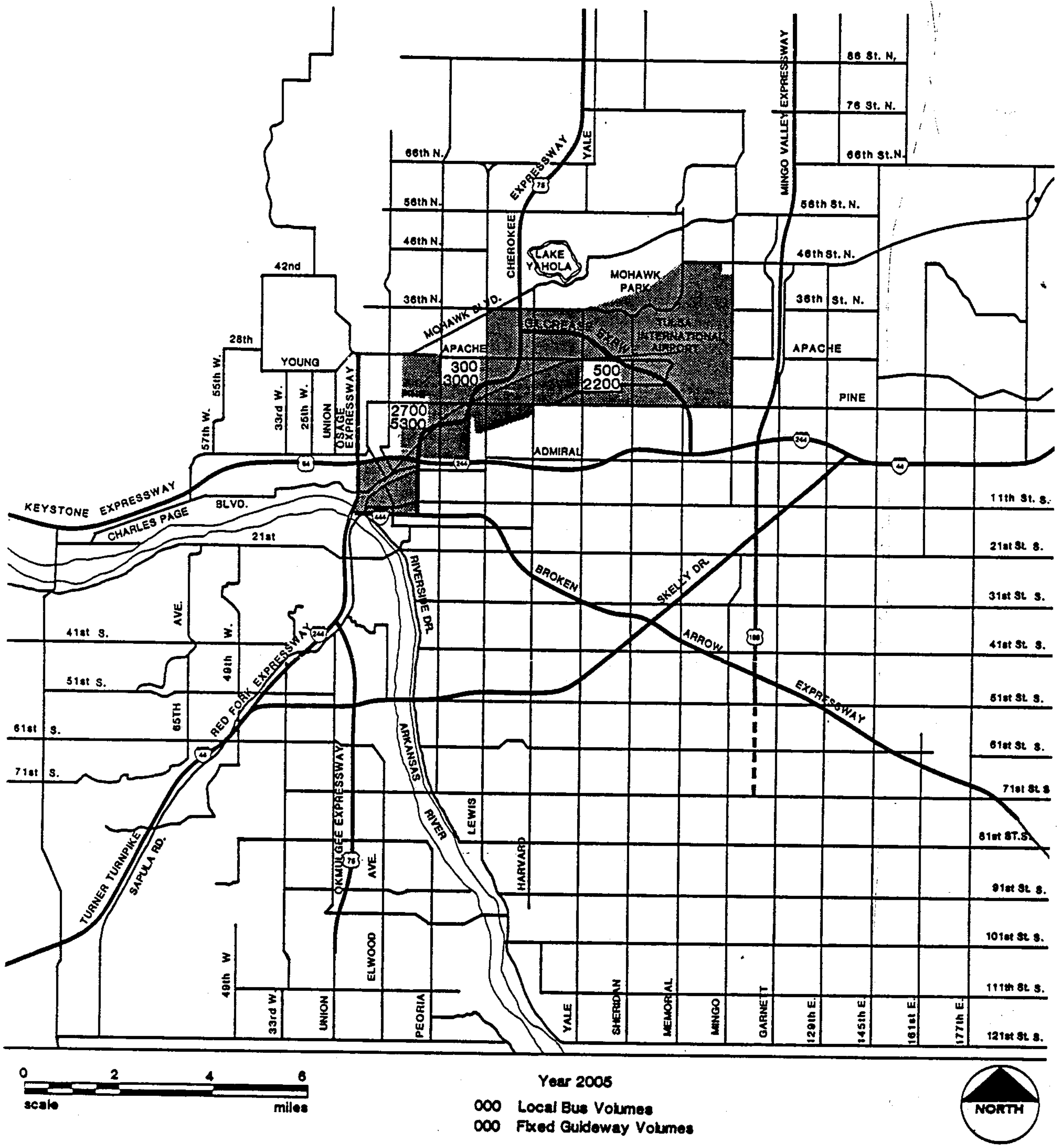
Figure 29 shows predicted 2005 transit volumes for the Jenks/Riverside Corridor. As can be seen in the figure, base-case volumes are predicted to range from 1600 daily transit passenger trips at the south end of the corridor to 5800 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase by 30% to 120%, with daily volumes ranging from 3500 at the outer end to 7800 approaching the Tulsa CBD.

Figure 30 shows predicted 2005 transit volumes for the Sapulpa Corridor. As can be seen from the figure, base-case volumes are predicted to range from 300 daily transit passenger trips at the Sapulpa end of the corridor to 5800 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase significantly, with daily volumes ranging from 1500 at the outer end to 7600 approaching the Tulsa CBD.

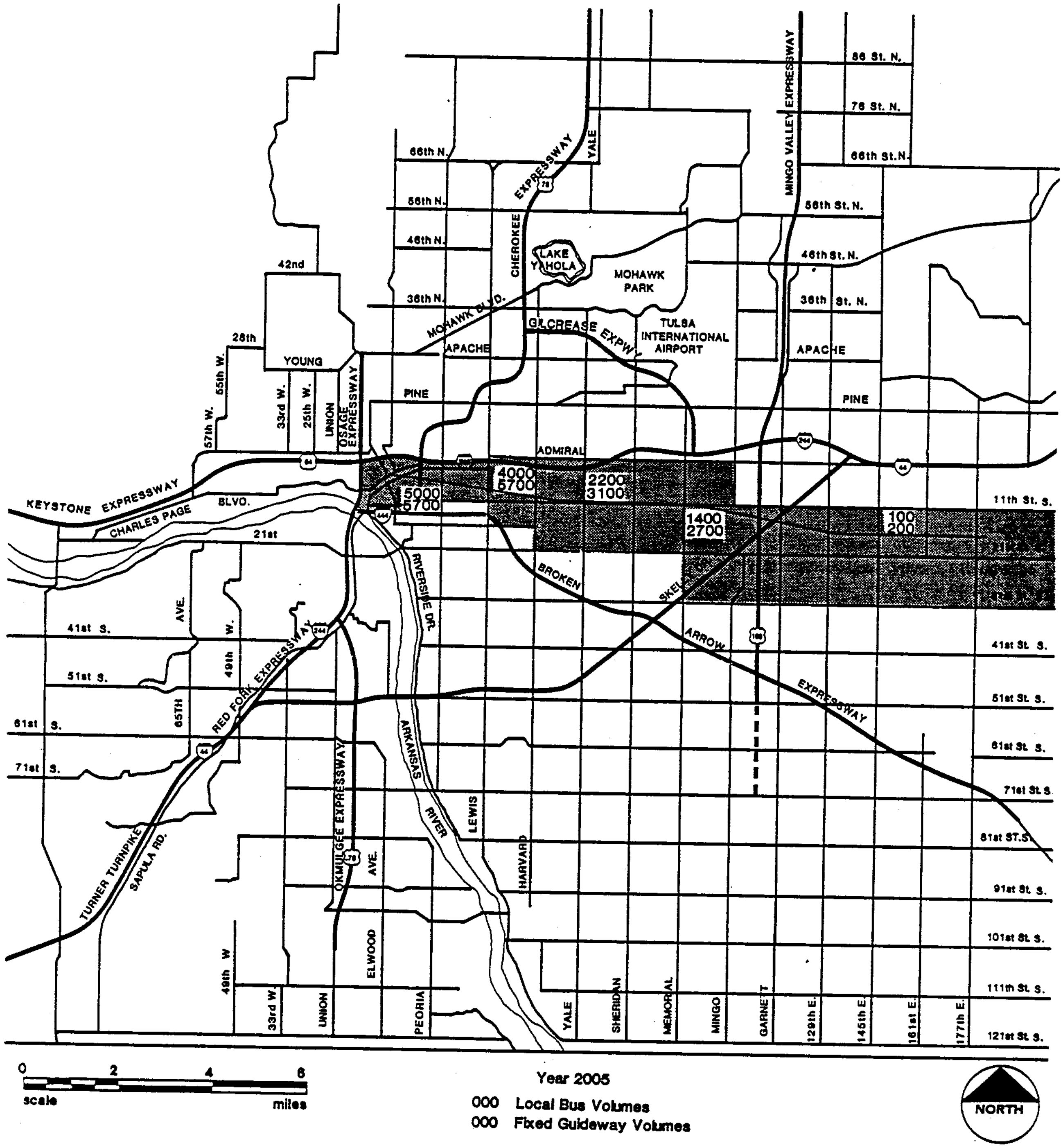
Figure 31 shows predicted 2005 transit volumes for the Sand Springs Corridor. The figure shows base-case volumes are predicted to range from

500 daily transit passenger trips at the Sand Springs end of the corridor to 1700 daily trips approaching the Tulsa CBD. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to double, with daily volumes ranging from 1200 at the outer end to 3100 approaching the Tulsa CBD.

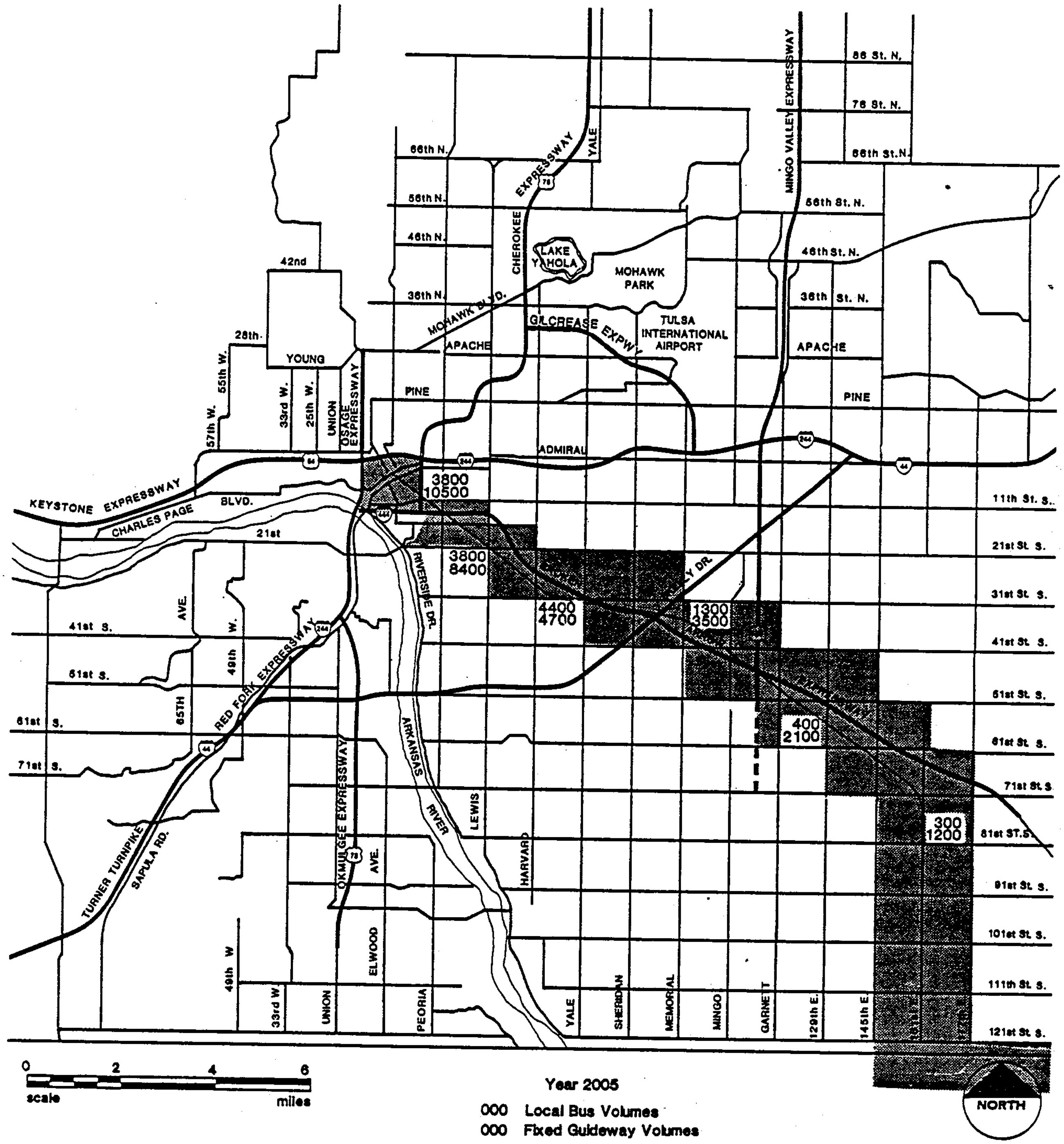
Figure 32 shows predicted 2005 transit volumes for the Memorial/Owasso Corridor. As seen from the figure, base-case volumes are predicted to range from 100 daily passenger trips at the Owasso end of the corridor to 3400 daily trips along Memorial. With fixed guideway service, corridor volumes (including trips attracted into the corridor) are predicted to increase significantly, with daily volumes ranging from 500 at the Owasso end to 4900 in the center of the corridor.



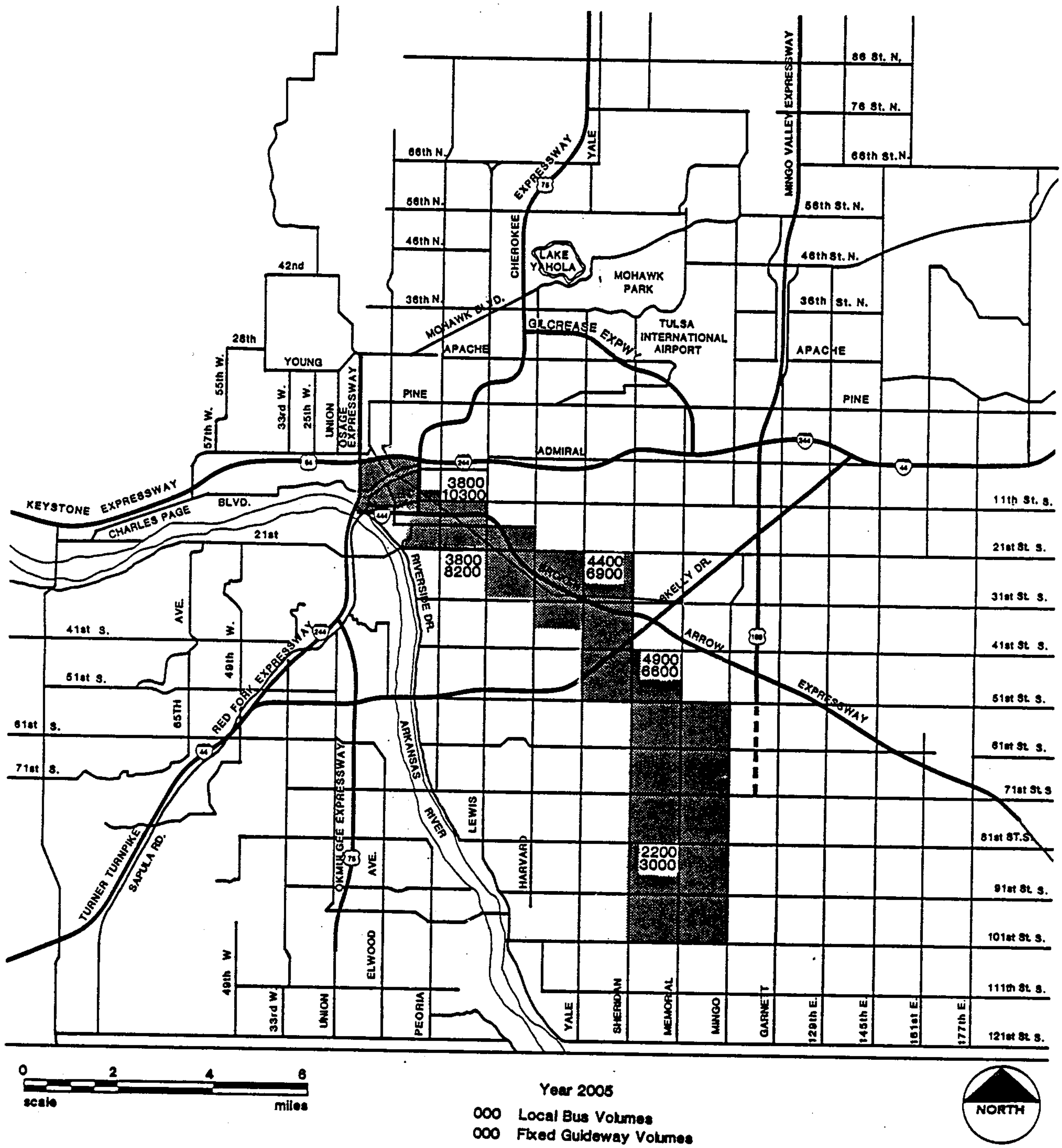
Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	DOWNTOWN/AIRPORT CORRIDOR	25



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	LYNN LANE CORRIDOR	**26**



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	BROKEN ARROW CORRIDOR	**27**



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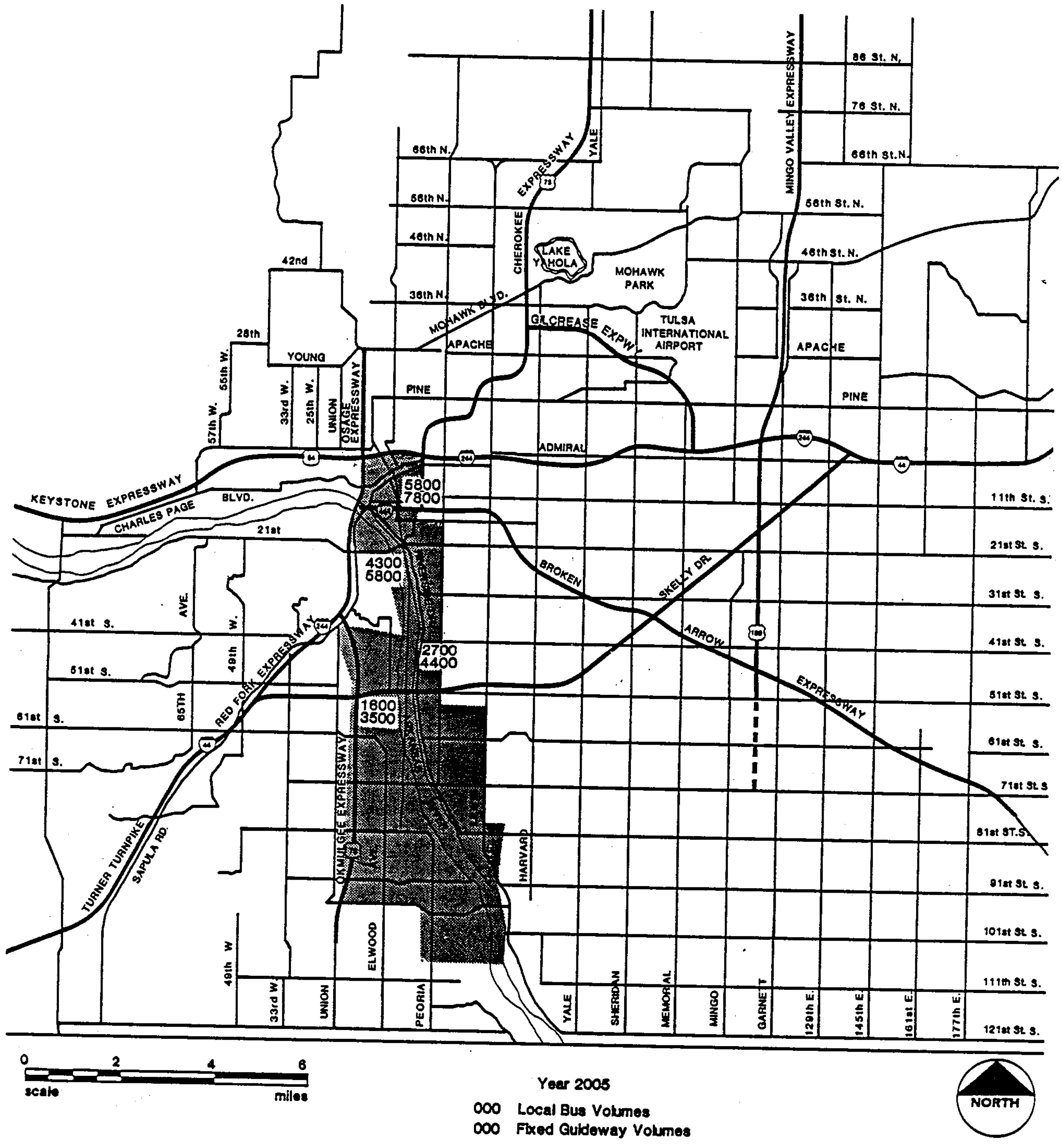
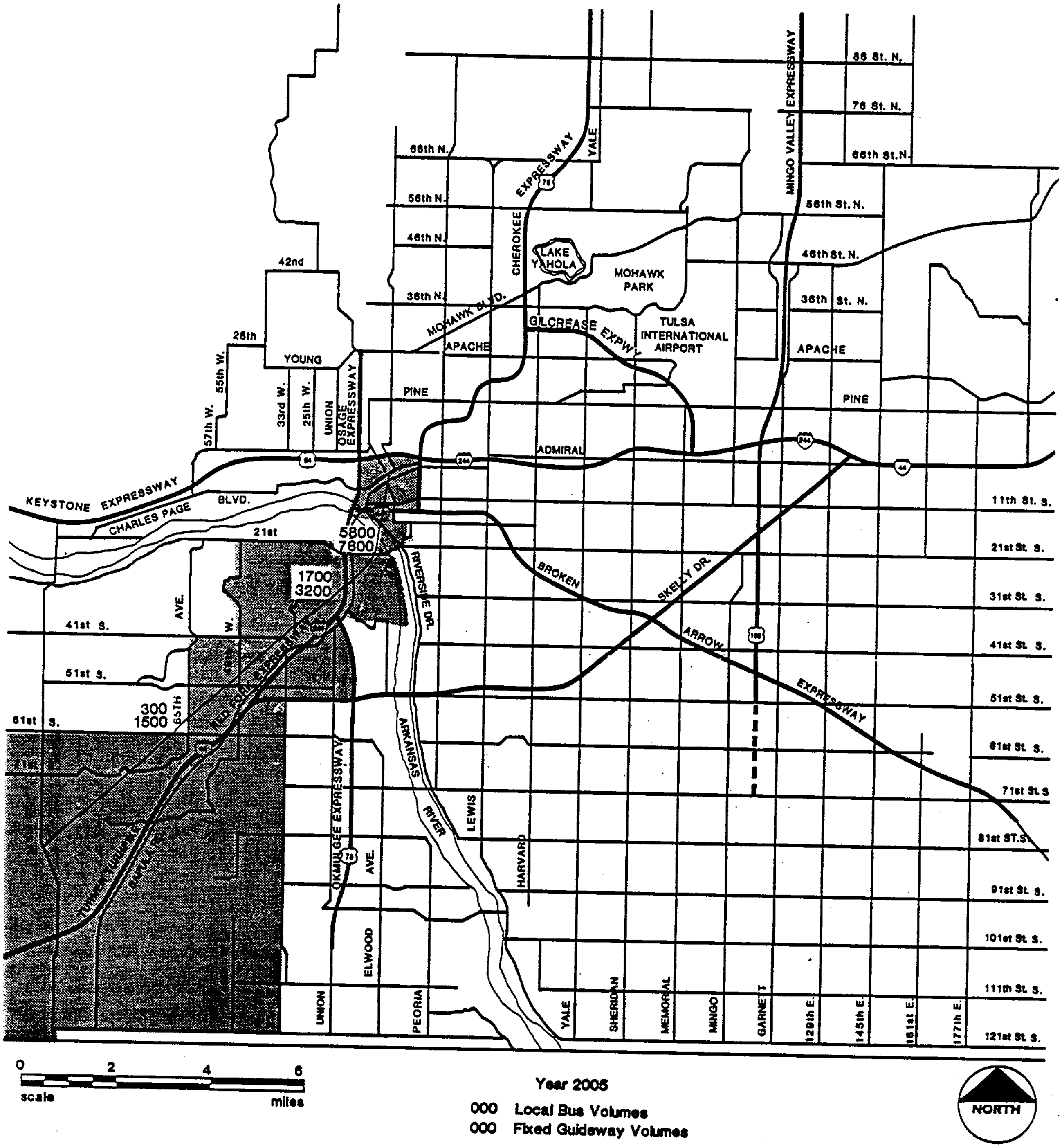
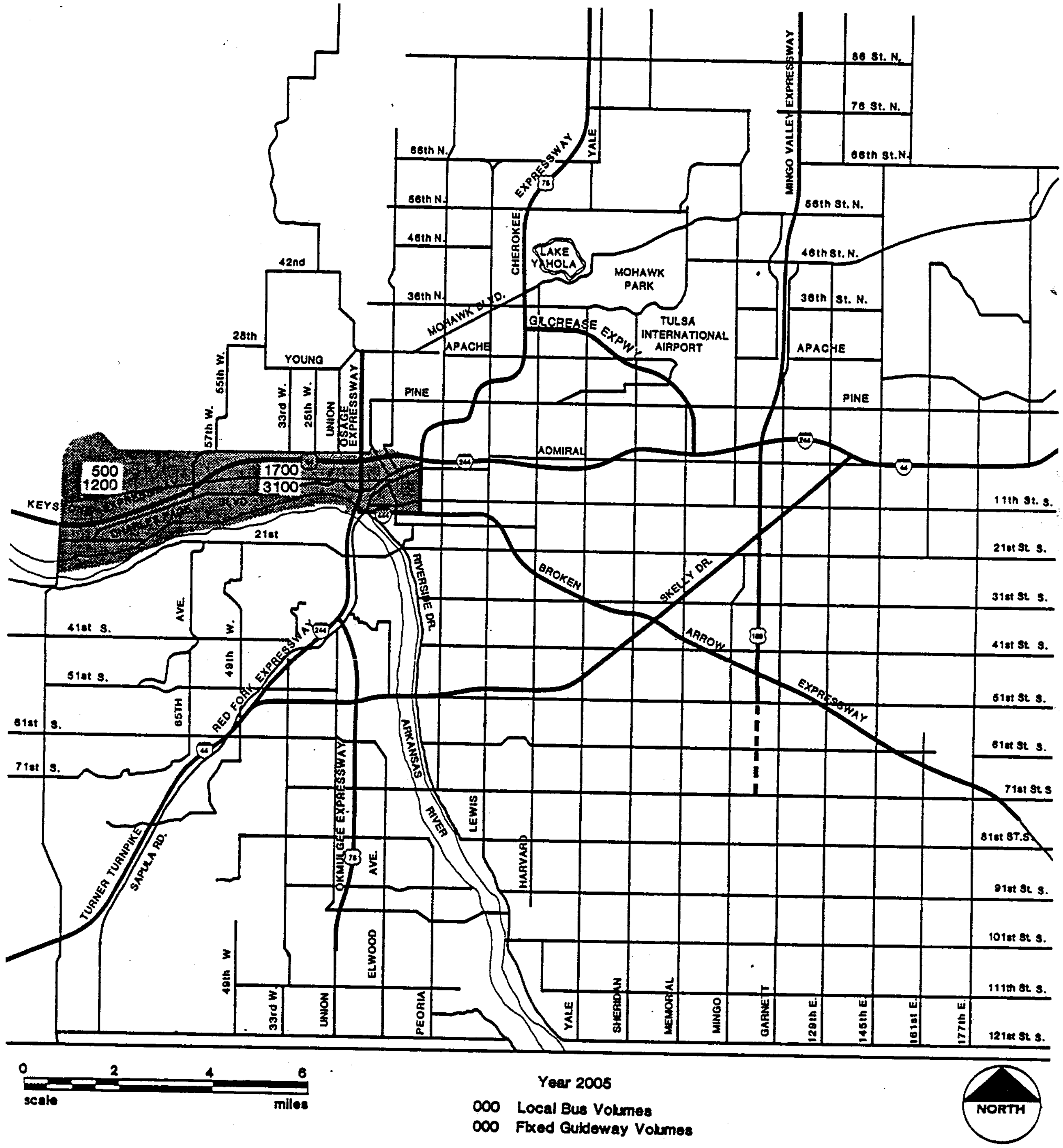
	BROKEN ARROW/MEMORIAL CORRIDOR	**28**



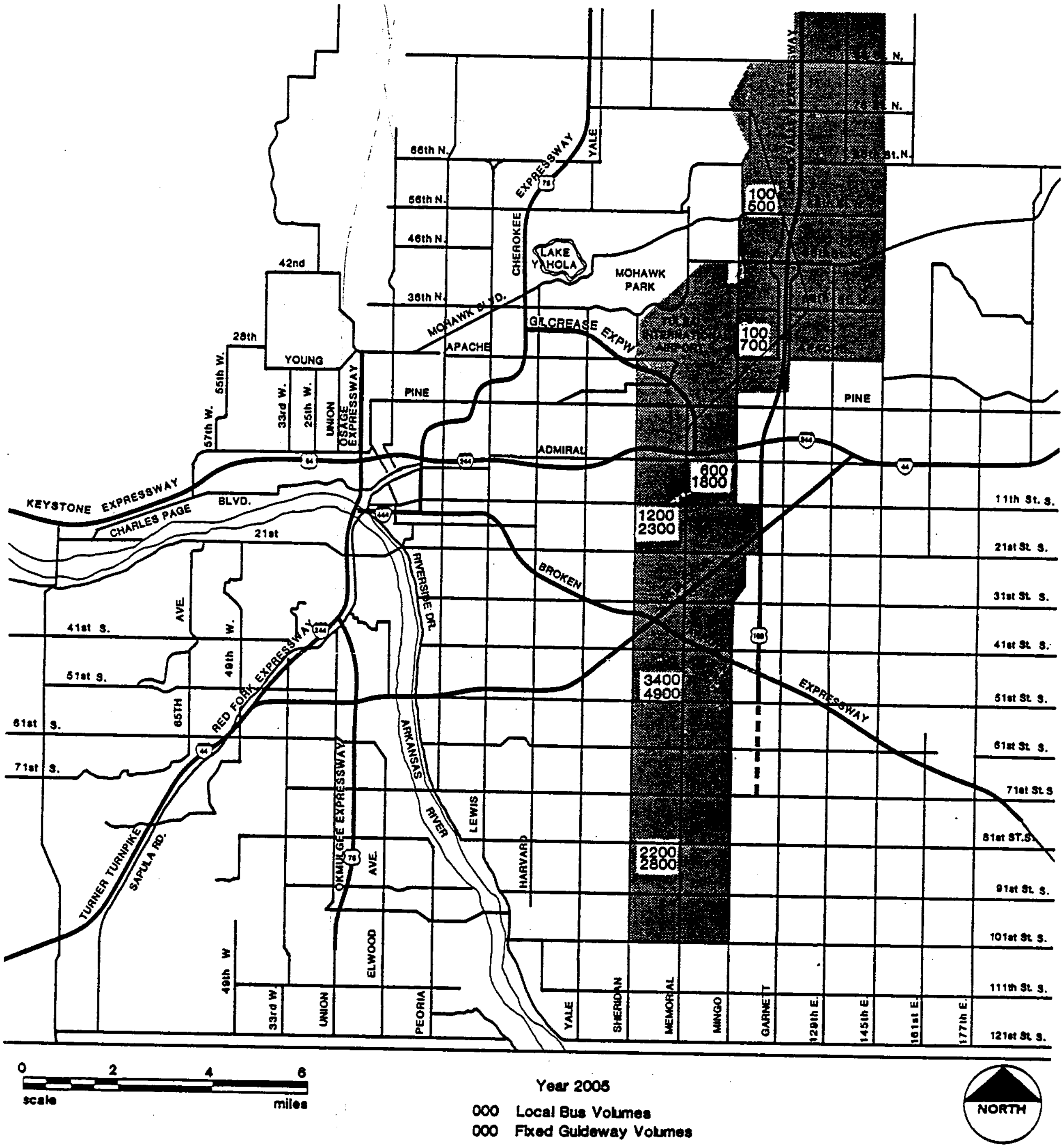
Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	JENKS/RIVERSIDE CORRIDOR	**29**



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	SAPULPA CORRIDOR	**30**



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	SAND SPRINGS CORRIDOR	**31**



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	MEMORIAL/OWASSO CORRIDOR	**32**

Transit Riders

Table 33 lists information on 2005 daily transit riders for each corridor. Total riders represents a summation of the total number of transit passengers getting on the fixed guideway system in a corridor on an average day. It is larger than the peak load point volume for each corridor since it includes the peak load plus other riders who have boarded or alighted over that segment of the guideway. New transit riders represent the new riders induced to ride fixed guideway transit, who otherwise would not ride the bus.

Table 33

Fixed Guideway Corridor Comparisons
2005 Daily Transit Riders

Corridor	Peak Load Point Volume	Total Riders	New Transit Riders
Broken Arrow /Memorial	10,300	17,500	2,000
Broken Arrow	10,500	15,300	3,800
Jenks/Riverside	7,800	9,900	700
Sapulpa	7,600	9,000	1,200
Lynn Lane	5,700	8,500	1,000
Memorial/Owasso	6,900	7,000	3,100
Downtown/Airport	5,300	6,900	3,800
Sand Springs	3,100	3,300	300

Note: Annual fixed guideway riders and total riders x 295 days annual new rider = New transit riders x 295 days

Source: Parsons Brinckerhoff, 1989.

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7.0 CORRIDOR TRANSPORTATION SYSTEM MANAGEMENT PROGRAMS

INTRODUCTION

This section identifies possible transportation system management (TSM) improvements for each of the eight potential corridors identified in Section 4.0: Potential Regional Corridors. TSM measures are operational improvements and low capital investment projects which can optimize the person-carrying capabilities of travel corridors. TSM measures can include both automotive and public transit improvements. Among others, measures to enhance traffic flow could include freeway ramp metering, carpool parking lots, high occupancy vehicle priority treatments on arterial streets and freeway ramps, traffic signal progression, and areawide carpool or vanpool matching programs. Public transit improvements could include expanded express bus service, expanded park-and-ride lot services, bus lanes on major arterials, special traffic operations to enhance bus speeds, signal preemption, bus stop pullouts, and other measures geared to give travel time advantages to the transit rider and improve the capacity of the corridors.

The TSM alternative for 2005 includes areawide automotive and transit improvements as well as improvements specific to each travel corridor. This long-range TSM alternative is an extension of the short-range TSM improvements continually being implemented in the Tulsa urban area. These include transit service improvements as defined in Tulsa Transit's Transportation Development Plan (TDP) and TSM intersection and signalization improvements undertaken by ODOT and local cities.

The remainder of this report discusses potential TSM measures. These are presented areawide, and then for the Tulsa CBD and for each travel corridor.

AREAWIDE MEASURES

Automotive Measures

The primary areawide automotive TSM measure is the operation of a carpool and vanpool matching/brokerage system. In November 1988, INCOG assumed administration of the Tulsa urban area ridesharing program previously managed by Tulsa Transit. While there are just over 100 names in the data base, INCOG currently receives an average of 20 inquiries per month for potential matches. A unique phone number has been established to readily market the ridesharing program.

Plans for the upcoming program year include efforts to target major employers for surveys of employee's interests in carpooling and vanpooling. Vanpool brokerage service, a third-party provision of vans and program administration, has been discussed. However, lack of funding for a brokerage system limits INCOG's ability to implement such a program.

Transit Measures

Tulsa Transit's TDP focuses on providing service which attracts the most riders while operating within tight financial constraints. The plan anticipates maintaining service at a generally steady level. The level of transit service provided will be small compared to many other cities the size of Tulsa. The difference is particularly noticeable when comparing Tulsa with other Southwestern cities which are considering fixed guideway transit, such as Austin, Texas, and Tucson, Arizona. For 1987, Austin provided transit service at a level of nearly $45 of annual operations per

Standard Metropolitan Area (SMA) population, Tucson at a level of more than $22 per capita, while Tulsa is at a level of $12 per capita.

For transit to be able to serve an important role in the overall transportation system in Tulsa's future, the amount of service provided will need to be increased, presumably with additional state and/or local funding. A transit operating cost budget constraint of $30 per capita per year, or for 2005, approximately $20,670,000 (in 1988 dollars) was assumed. This budget supports a system which on the average weekday would provide approximately 20,850 transit vehicle-miles, with a fleet size of 200 vehicles. This is approximately twice the 1988 transit service offered in the Tulsa area. Given this operating budget, a 2005 base level of transit service, the TSM Alternative was defined and used to compare with corridor fixed guideway services. As described in Section 3.0: Technical Approach and Agency/Public Coordination, the procedure involved running the UTPS sketch planning program, RIDE, iteratively to define the most productive allocation of transit service within the given budget constraint.

The base transit service, as mentioned, would provide approximately 20,850 transit vehicle miles of service on an average weekday. This would include approximately 13,050 vehicle miles of radial service; i.e., service oriented toward the Tulsa CBD and approximately 7,800 vehicle miles of non-radial service. Peak period service frequencies would average from three to six trips per hour for radial and non-radial service in the central portion of the region (TMATS Subareas 1, 9, 10, the south and west portions of 2, and the west half of 11). Elsewhere in the region, peak period services frequencies averaging one to two trips per hour for radial and non-radial service would be provided to most Tulsa County areas within about 12 miles of the Tulsa CBD; only limited service would be provided outside that area.

CENTRAL BUSINESS DISTRICT

Automotive Measures

The Tulsa CBD, with the region's densest concentration of employment, can be particularly affected by areawide measures such as the carpool/vanpool program. Also in the Tulsa CBD, one of the few locations with sizable amounts of pay parking, automotive travel demand can be encouraged to use higher-occupancy modes through the judicious use of parking price strategies.

Transit Measures

The Tulsa CBD is, and will remain in the foreseeable future, the major focus of transit service. As overall systemwide service increases, more frequent service will be provided to, from, and within the Tulsa CBD. Increased express service to the key destinations within the Tulsa CBD can also be expected.

DOWNTOWN/AIRPORT CORRIDOR

Automotive Measures

As is the case with the Tulsa CBD, the area around Tulsa International Airport has significant amounts of concentrated employment. This employment includes the airport, as well as the American Airlines, Rockwell International, and McDonnell Douglas operations. This concentrated employment lends itself to TSM measures such as carpool/vanpool matching/brokerage programs at the employment end. Such programs may be combined with incentives such as preferential parking for HOVs and peak management measures such as staggering work hours.

Transit Measures

Short-range transit improvements proposed for the Downtown/Airport Corridor include examining the feasibility of providing shuttle service between the airport and downtown Tulsa, perhaps with private sector financial support. Longer term improvements could include extending local radial and crosstown service in the corridor and increasing service frequencies on the local and express routes.

LYNN LANE CORRIDOR

Automotive Measures

The most congested facilities in 2005 will be perpendicular to the main axis of the corridor. However east-west travel may be affected at the intersections with the congested north-south facilities. Localized TSM measures, such as the addition of turning lanes and signalization improvements, may be beneficial in these areas.

Transit Measures

Existing local service is provided along Admiral Place, E. 11th Street, E. 21st Street, and E. 31st Street, with express service utilizing I-244. Service improvements, over time, could include increasing frequency on these routes, extending them further east, adding additional express service, and exploring opportunities for additional park-and-ride lots.

BROKEN ARROW CORRIDOR

Automotive Measures

Nearly every arterial and freeway facility in the northwestern half of the corridor is projected to be congested in 2005, with many segments operating at LOS D and worse. Facilities which are congested along a significant length generally can be relieved only with capacity additions, rather than with TSM measures. However, a more detailed examination of the causes of the congestion may identify some intersection improvements such as the addition of turning lanes or signalization improvements, such as interconnection, which could relieve some the arterial congestion.

Transit Measures

Existing transit service in the corridor consists of local routes crossing the corridor on various north-south and east-west streets and express service along the corridor on the Broken Arrow Expressway. Service improvements, over time, could include increasing frequency on local radial and crosstown routes, extending the geographic coverage, particularly in the Broken Arrow area, providing additional express service, and exploring opportunities for additional park-and-ride lots.

BROKEN ARROW/MEMORIAL CORRIDOR

Automotive Measures

Nearly every arterial and freeway facility in the northern half of the corridor is projected to be congested in 2005, with many segments operating at LOS D and worse. The southern half of the corridor is projected to have much more limited congestion, with only two facilities at LOS D, one-mile segments of S. Memorial and S. Mingo. Facilities which are congested along a significant length generally can be relieved only with capacity additions, rather than with TSM measures. However, a more detailed examination of the causes of the congestion might identify some intersection improvements such as the addition of turning lanes or signalization improvements, such as interconnection, which could relieve some of the arterial congestion, particularly in the southern half of the corridor.

Transit Measures

In the northern half of the corridor, existing local transit routes cross the corridor on several north-south and east-west streets. In the southern half of the corridor, existing local service is provided on portions of S. Sheridan and S. Memorial. Express service from the southern half of the corridor to the Tulsa CBD utilizes the Broken Arrow Expressway.

Service improvements, over time, could include increasing frequency on local radial and cross-town routes, extending geographic coverage south of E. 71st Street, providing additional express service, and exploring opportunities for additional park-and-ride lots.

JENKS/RIVERSIDE CORRIDOR

Automotive Measures

Year 2005 congested north-south facilities in the corridor are anticipated to include relatively short sections of Riverside Drive, S. Peoria, and S. Lewis. TSM measures such as intersection and signalization improvements could help to relieve congestion at these locations.

Transit Measures

Existing transit service in the corridor included local radial routes on S. Peoria and S. Lewis and express service utilizing Riverside Drive; no service is provided in the corridor west of the Arkansas River. Service improvements, over time, could include increasing frequency on local and express routes, extending local service into Jenks, adding express service on Riverside Drive and the Okmulgee Expressway, and exploring opportunities for park-and-ride lots.

SAPULPA CORRIDOR

Automotive Measures

Expected 2005 congestion in the corridor will be concentrated on two freeway segments, I-244 from US 75 to the Arkansas River, and I-44 from the Turner Turnpike to US 75, which are projected to operate at LOS D. Areawide TSM measures, such as the carpool/vanpool program, could encourage more use of HOV modes, thus reducing vehicular demand on these key facilities. Some traffic may also be diverted from I-244 to Southwest Boulevard, which is expected to be uncongested, if a synchronized signal system were installed which allowed travel along the arterial with minimal stops.

Transit Measures

Local radial service is currently provided in the Tulsa County portion of the corridor. Future improvements could include increased frequency of local service, the provision of express service from Sapulpa, with the development of park-and-ride lots.

SANDS SPRINGS CORRIDOR

Automotive Measures

Year 2005 congestion in the corridor is expected to be limited to a one mile segment of the Keystone Expressway between S. 65th W. Avenue and S. 49th W. Avenue, which is forecast to operate at LOS D. This limited extent of congestion is unlikely to be suited for improvements with TSM measures.

Transit Measures

Local radial service is currently provided in the corridor along Charles Page Boulevard. Future improvements could include increasing the frequency of this service and providing express service from Sand Springs utilizing the Keystone Expressway.

MEMORIAL/OWASSO CORRIDOR

Automotive Measures

Significant lengths of all three north-south arterials in the corridor, Sheridan Road, Memorial Drive, and Mingo Road, are projected to be congested in 2005, with many segments operating a LOS D and worse. Facilities which are congested along a significant length generally can be relieved only with capacity additions, rather than with TSM measures. However, a more detailed examination of the causes of the congestion may identify some intersection improvements such as the addition of turning lanes or signalization improvements, such as interconnection, which could relieve some of the arterial congestion. Areawide measures might also be beneficial, in particular carpool/vanpool matching/brokerage programs combined with incentives such as preferential parking for HOVs and peak management measures, such as staggering work hours, focused on the large employers in the airport vicinity.

Transit Measures

At present, north-south transit service is only provided in the southern half of the corridor, on Memorial Drive between Admiral Place and E. 71st Street, and on S. Sheridan between E. 15th Street and E. 61st Street. Future improvements could include north-south crosstown service spanning the length of the corridor, serving the airport and environs and continuing north to Owasso.

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8.0 CAPITAL AND OPERATING COSTS

This section employs the capital and cost estimation procedures outlined in Technical Memorandum 3.1: Capital and Operating Cost. A summary of the unit cost estimates used is included in Appendix B. It uses the peak load transit volumes forecast for 2005 to determine vehicle requirements and operating characteristics. These include running and cycle times, dwell time, peak and off peak headways, capacity of vehicle to use (standard or articulated coach), and revenue hours of service. Appendix E presents the assumptions in developing the daily and annual operating costs.

The capital cost estimates have been developed for a minimum of three fixed guideway alternatives for each corridor as seen in Table 34 and Table 35. These fixed guideway alternative include high occupancy or bus-only vehicle lanes, light rail transit, and automated guideway transit. The latter includes monorails, people-mover systems, and other automated, grade-separated technologies. A complete description of fixed guideway technologies is provided in Section 5: Guideway Technology Options.

This section is intended to provide cost data suitable for "sketch planning" work. The options outlined are not exhaustive; combinations of them may be made and other alignments utilized. The estimates are based on reasonable costs from actual cost experience across the country. This cost estimation process has been used to provide order of magnitude costs and to illuminate quantifiable differences among various transit investment options.

The remainder of this section is organized by potential transit corridor. It begins with a description of Tulsa's CBD and presents the subsequent corridor information in a clockwise rotation, beginning with the Downtown/Airport Corridor and ending with a discussion of the Memorial/Owasso Corridor.

CENTRAL BUSINESS DISTRICT

The Tulsa CBD is common to all of the corridors, except the Memorial/Owasso Corridor. However the corridors access the Tulsa CBD using different approaches. The Downtown/Airport, Lynn Lane, Broken Arrow, and Broken Arrow/Memorial corridors access the Tulsa CBD from the northeast; the Jenks/Riverside and Sapulpa corridors enter the Tulsa CBD from the southwest; and the Sand Springs Corridor enters the Tulsa CBD from the west. The different directions from which the corridors enter the Tulsa CBD only affect the costs for the light rail and automated guideway transit alternatives and not the express bus (HOV) alternative. The operating assumption for the express bus alternative is that the surface streets would continue to provide downtown, local bus circulation. The necessary capital improvements for the HOV alternatives would be limited to signalization.

The light rail transit (LRT) alternative in the CBD for the corridors entering Tulsa from the northeast (Downtown/Airport, Lynn Lane, Broken Arrow, and Broken Arrow/Memorial) assumes a 2.44 mile single track, embedded in city streets, and constructed on public rights-of-way (R/W). The single loop would have eight passenger stops at street level.

The automated guideway transit (AGT) alternative for these corridors entering from the northeast would also be a 2.44 mile loop, but would be completely grade-separated. The station and column footprints are assumed to use public R/W and there would be four aerial stations.

The LRT alternative in the Tulsa CBD for the Jenks/Riverside and Sapulpa corridors which enter the Tulsa CBD from the southwest assumes a 2.73 mile single track, embedded in city streets, and constructed on public R/W. This single loop would have seven passenger stops at street level.

Table 34

Operating Cost Estimates

Corridor	Daily O&M* Costs ($ Thousands)					Capital Costs ($ Millions)				
	HOV1	HOV2	HOV3	LRT	AGT	HOV1	HOV2	HOV3	LRT	AGT
Downtown/Airport	5.90	5.90	NA	11.30	8.50	53.10	112.60	NA	202.70	588.30
Lynn Lane	5.90	5.90	5.90	11.30	8.50	38.30	74.30	64.20	128.20	417.30
Broken Arrow	6.40	6.40	NA	9.70	7.30	58.70	174.30	NA	231.90	285.50
Broken Arrow/Memorial	5.20	5.20	NA	9.00	6.30	61.70	96.30	NA	163.70	353.60
Jenks/Riverside	4.20	NA	NA	7.70	5.40	37.10	NA	NA	100.40	436.00
Sapulpa	4.90	NA	NA	8.40	6.30	32.30	NA	NA	118.10	261.40
Sand Springs	3.20	NA	NA	6.30	4.40	21.80	NA	NA	146.90	201.80
Memorial/Owasso	7.00	NA	NA	13.70	9.60	80.60	NA	NA	163.90	582.50

* O&M = Operating and Maintenance

Source: Parsons Brinckerhoff, 1989

Table 35

Financial Cost Estimates

Corridor	Annualized Fixed Guideway Capital Costs ($Millions)					Change In O&M Costs ($Millions)				
	HOV1	HOV2	HOV3	LRT	AGT	HOV1	HOV2	HOV3	LRT	AGT
Downtown/Airport	$5.74	$12.78	--	$16.34	$61.98	$3.25	$3.25	--	$4.85	$4.03
Lynn Lane	$4.51	$8.65	$7.50	$14.42	$44.76	$4.65	$4.65	$4.65	$6.25	$5.43
Broken Arrow	$6.63	$19.24	--	$24.20	$30.17	$5.01	$5.01	--	$5.97	$5.27
Broken Arrow/Memorial	$7.20	$11.19	--	$16.57	$38.24	$4.81	$4.81	--	$5.93	$5.14
Jenks/Riverside	$4.40	--	--	$8.52	$46.30	$5.42	--	--	$6.46	$5.78
Sapulpa	$3.82	--	--	$19.59	$27.79	$5.61	--	--	$6.64	$6.04
Sand Springs	$2.56	--	--	$15.62	$21.24	$1.77	--	--	$2.70	$2.15
Memorial/Owasso	$9.36	--	--	$17.44	$61.97	$4.07	--	--	$6.07	$4.87

Source: Parsons Brinckerhoff, 1989

The AGT alternative for these corridors entering from the southwest would also be a 2.73 mile loop constructed at-grade in the railroad R/W and grade separated on city streets.

The Sand Springs Corridor enters the Tulsa CBD from the west. The LRT alternative for this corridor assumes a 2.64 mile embedded, single track loop constructed on public R/W with seven passenger stations.

The AGT alternative for the Sand Springs Corridor would also be a 2.64 mile loop consisting of both at-grade and grade separated sections. There would be two at-grade passenger stations and three aerial stations.

Table 36 summarizes the capital cost estimates for these alternatives, excluding vehicle costs. These costs are included in the cost estimates provided for the seven corridors which include the core area (all the corridors except the Memorial/Owasso Corridor).

Table 36

Central Business District

	Cost ($ Millions)
HOV	.12
LRT 1	7.94
LRT 2	9.72
LRT 3	9.27
AGT 1	57.65
AGT 2	62.87
AGT 3	60.84

Note:
LRT 1/AGT 1 — Downtown/Airport, Lynn Lane, Broken Arrow, and Broken Arrow/Memorial Corridors
LRT 2/AGT 2 — Jenks/Riverside and Sapulpa Corridors
LRT 3/AGT 3 — Sand Springs Corridor

DOWNTOWN/AIRPORT CORRIDOR

The alternatives for the Downtown/Airport Corridor include two high occupancy vehicle (HOV) lanes, one LRT development, and one AGT alternative. They cover approximately 19 miles of fixed guideway development.

The first HOV alternative utilizes both highways and arterials, requires a terminal park-and-ride, and four suburban lots. Fourteen standard coach buses would be required for service. The second HOV would operate on highways, arterials, and railroad R/W. It would require a total of five park-and-ride lots.

The LRT alternative would use arterial and railroad R/W. It would have a terminal, four suburban park-and-ride lots, and nine passenger stations (excluding the Tulsa CBD). It would require approximately eleven train cars.

The AGT alternative would have two aerial and two at-grade passenger stations and a total of three park-and-ride lots. Approximately 11 vehicles would be required for operations and spares.

Table 37 shows the capital and the daily operating and maintenance costs.

Table 37

Downtown/Airport Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV 1	53.1	5.9
HOV 2	112.6	5.9
LRT	202.7	11.3
AGT	588.3	8.5

Source: Parsons Brinckerhoff, 1988.

LYNN LANE CORRIDOR

The Lynn Lane Corridor includes five transit options: three HOV lane treatments, one LRT option, and one AGT development. They cover about 19 miles of fixed guideway development.

The first HOV would utilize highways and arterial streets. It would have one terminal, two suburban park-and-ride lots, and would require approximately 14 articulated buses.

The second HOV would utilize arterial streets, the Broken Arrow Expressway, and the Missouri-Kansas-Texas (MKT) railroad R/W. It would have one terminal and four suburban park-and-ride lots. Vehicle requirements are the same as HOV 1.

The third HOV would also use arterial streets, freeways, and the MKT railroad R/W, but would only have one terminal and three suburban park-and-ride lots. The vehicle requirements are the same as HOV 1.

The LRT alternative would operate on arterial streets and the MKT railroad R/W. It would have nine passenger stations, one terminal, and three suburban park-and-ride lots. It would require about 12 coaches for operations and service.

The AGT alternative would also operate on arterial streets and the MKT railroad R/W, have one terminal, two suburban park-and-ride lots, plus seven passenger stations. It, too, would require approximately 12 vehicles for operations and service.

Table 38 summarizes the capital and operating and maintenance costs.

Table 38

Lynn Lane Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV 1	38.3	5.9
HOV 2	74.3	5.9
HOV 3	64.2	5.9
LRT	128.2	11.3
AGT	417.3	8.5

Source: Parsons Brinckerhoff, 1988.

BROKEN ARROW CORRIDOR

The alternatives considered for the approximately 16 mile Broken Arrow Corridor include two HOV lane alternatives, one LRT alternative, and one AGT option.

The first HOV alternative would use existing freeway R/W along the Broken Arrow Expressway, plus the MKT railroad R/W. It would require approximately 20 articulated buses for operations and have three passenger stations.

The second HOV alternative would operate exclusively on the MKT railroad R/W. It would provide stations, park-and-ride lots, and vehicles similar to those in HOV 1.

The LRT alternative would also operate on the MKT railroad R/W. There would be four suburban park-and-ride lots, one terminal, and nine passenger stations. It would require about eight vehicles for operations and service.

The AGT alternative is similar to the LRT and would require the same number of vehicles. Also, one terminal and three suburban park-and-ride lots would be required.

Table 39 summarizes the capital and the daily operating and maintenance costs.

Table 39

Broken Arrow Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV 1	58.7	6.4
HOV 2	174.3	6.4
LRT	231.9	9.7
AGT	285.5	7.3

Source: Parsons Brinckerhoff, 1988.

BROKEN ARROW/MEMORIAL CORRIDOR

The approximately 14 mile transit alternatives considered for the Broken Arrow/Memorial Corridor are two HOV lanes, one LRT option, and one AGT alternative.

The first HOV alternative would use S. Memorial, S. Sheridan, E. 51st Street, the Broken Arrow Expressway, and the MKT railroad R/W. Approximately 16 articulated buses, one terminal, and four suburban park-and-ride lots would be required.

The second HOV alternative would use S. Memorial, E. 51st Street, S. Sheridan, and the MKT railroad R/W. It would provide similar park-and-ride lots, stations, and vehicles to those in HOV 1.

The LRT alternative would also use S. Memorial, E. 51st Street, S. Sheridan, and the MKT railroad R/W. It would have five park-and-ride lots and nine passenger stations. Eighteen LRT vehicles would be required for operations and service.

The AGT alternative would have features similar to the LRT alternative. It would require approximately 15 transit vehicles.

Table 40 summarizes the costs for these alternatives:

Table 40

Broken Arrow/Memorial Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV 1	61.7	5.2
HOV 2	96.3	5.2
LRT	163.7	9.0
AGT	353.6	6.3

Source: Parsons Brinckerhoff, 1988.

JENKS/RIVERSIDE CORRIDOR

Three fixed guideway alternatives were considered for the Jenks/Riverside Corridor. These include one HOV lane, one LRT option, and one AGT alternative. These transitways would be approximately 12 miles long.

The HOV alternative would use arterial streets: S. Lewis, E. 61st Street, and Riverside Drive. It would have one terminal and one suburban park-and-ride lot, and require approximately 11 buses.

The LRT alternative would utilize S. Lewis, E. 51st Street, S. Peoria, and E. 11th Street. It would have 13 passenger stations and about 18 transit vehicles.

The AGT alternative would use S. Lewis, I-44, S. Peoria, E. 31st Street, Riverside Drive, and the Burlington Northern railroad R/W. It would have six passenger stations and require 18 vehicles.

Table 41 summarizes the cost estimates for these alternatives.

Table 41

Jenks/Riverside Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV	37.1	4.2
LRT	100.4	7.7
AGT	436.0	5.4

Source: Parsons Brinckerhoff, 1988.

Table 42

Sapulpa Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV	32.2	4.9
LRT	118.1	8.4
AGT	261.4	6.3

Source: Parsons Brinckerhoff, 1988.

SAPULPA CORRIDOR

The alternatives for the approximately 14 mile Sapulpa Corridor include one HOV option, one LRT option, and one AGT option.

The HOV alternative would utilize the existing rights-of-way on SH 66 and I-44. It would have two park-and-ride lots and require about 14 buses for service.

The LRT alternative would operate on the Burlington Northern railroad R/W and Tulsa-Sapulpa-Union (TSU) railroad R/W. It would have two park-and-ride lots, four passenger stations, and require ten vehicles for service.

The AGT alternative would have the same alignment, number of park-and-ride lots, stations, and vehicles as the LRT alternative.

Table 42 summarizes the cost estimates for these alternatives.

SAND SPRINGS CORRIDOR

The approximately ten mile Sand Springs Corridor has three alternatives developed: HOV lane, LRT, and AGT. The HOV alternative would use the Keystone Expressway and provide two park-and-ride lots and one passenger station. It would require approximately eight articulated buses.

The LRT option would operate exclusively on the MKT railroad R/W. It would provide four park-and-ride lots and six passenger stations. It would need about 18 vehicles for service.

The AGT alternative would provide the same number of park-and-ride lots and passenger stations as the LRT. It would require approximately 15 vehicles for service.

Table 43 provides a summary of the cost estimates for the three options.

Table 43

Sand Springs Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV	21.8	3.2
LRT	146.9	6.3
AGT	201.8	4.4

Source: Parsons Brinckerhoff, 1988.

Table 44

Memorial/Owasso Corridor

	Capital Costs ($ Millions)	O & M Costs ($ Thousands)
HOV	80.6	7.0
LRT	163.9	13.7
AGT	582.5	9.6

Source: Parsons Brinckerhoff, 1988.

MEMORIAL/OWASSO CORRIDOR

The fixed guideway transit alternatives considered for the approximately 22 mile corridor include an HOV lane, LRT, and AGT. The Memorial/Owasso Corridor would operate as a crosstown service; it is the only corridor which excludes the Tulsa CBD.

The HOV facility would operate on the Mingo Valley Expressway, E. 46th Street N., N. Mingo, E. Pine, S. Memorial, I-244, S. Sheridan, E. 51st Street, and E. 71st Street. It would have one terminal and nine suburban park-and-ride lots. It would need approximately 17 buses.

The LRT alternative would use the Atchison, Topeka and Santa Fe railroad R/W, N. Mingo, E. Pine, S. Memorial, and E. 71st Street. It would have two terminals and five suburban park-and-ride lots. It would need approximately 18 vehicles for operations.

The AGT alternative would utilize the same alignment and have the same number of park-and-ride lots and stations as the LRT. It would require about 15 vehicles.

Table 44 shows the capital and the daily operating and maintenance costs.

SUMMARY OF CAPITAL COSTS

The corridor-specific cost estimates provide a range of investment decisions. Table 45 presents the capital costs, including civil works, right-of-way, and vehicle costs for the eight corridors. Generally, the HOV treatments would offer the lowest cost fixed guideway service. More exclusive HOV lanes on railroad operations are quite similar in cost to the LRT alternatives, while the fully grade-separated AGT would be the more expensive transit development alternative.

ANNUALIZED CAPITAL COSTS

In order to conduct the UMTA cost-effectiveness analysis procedure, the capital costs, expressed in 1988 dollars, are translated into equivalent uniform annual capital costs. These annualized capital costs reflect assumptions about the economic life of the capital components in each alternative and the cost of capital (i.e., the discount rate). Uniform annual capital costs are combined with annual operating and maintenance (O&M) expenses, and then compared to the benefits of each alternative. These are measured by additional transit patrons and the value of the travel time savings for these patrons. One uses this to arrive at a cost-effectiveness index for each alternative in each corridor.

Table 45

Corridor Capital Costs
Tulsa Urban Area Costs (1)
($ Millions)

Corridor	Approximate Length (in Miles)	TSM	Back-ground Bus	HOV1	HOV2	HOV3	LRT1	AGT
Downtown/ Airport(2)	19.23	3.7	3.5	53.1	112.6	—	202.7	588.3
Lynn Lane(2)	19.23	7.1	6.8	38.3	74.3	64.2	128.2	417.3
Broken Arrow(2)	16.48	7.5	7.2	58.7	174.3	—	231.9	285.5
Broken Arrow/ Memorial(2)	14.23	8	7.6	61.7	96.3	—	163.7	353.6
Jenks/Riverside(3)	12.23	10	9.5	37.1	—	—	100.4	436
Sapulpa(3)	14.23	32.3	7.5	7.2	—	—	184.1	261.4
Sand Springs(4)	9.98	2	1.9	21.8	—	—	146.9	201.8
Memorial/Owasso	21.73	4.1	3.9	80.6	—	—	163.9	582.5

(1) Excludes annual operations and maintenance costs.
Includes costs for civil works, vehicles, and rights-of-way.

(2) LRT and AGT include a 2.44 mile, single track loop.

(3) LRT and AGT include a 2.73 mile, single track loop.

(4) LRT and AGT include a 2.64 mile, single track loop.

Following the UMTA guidance on the economic lives of the capital components and the federal Office of Management and Budget (OMB) recommended discount rate of ten percent, Table 46 presents the annualization factors applied to the components of the capital costs used in this analysis. Table 47 shows the results of changing the costs into annual figures.

OPERATING AND MAINTENANCE COST ESTIMATES

Transit

One of the largest components of annual transit costs is the annual transit O&M costs. With transit being so labor intensive, the annual costs to operate and maintain a transit system are significant. The model runs were analyzed and current fixed guideway O&M costs studied to calculate the daily O&M costs. Table 48 shows the daily and annualized transit O&M costs used in this analysis. This table also shows the estimated annual linked transit riders for the transit alternatives under consideration.

Table 46

Factors for UMTA Annualization Analysis [1]

Item	Useful Life (Years)	Annualization Factors
Right-of Way	100	.10001
Structures (Guideway)	30	.10608
System Elements	30	.10608
Yard and Shops	30	.10608
Stations	30	.10608
Park-and-Ride	30	.10608
Maintenance Facilities	30	.10608
At-Grade Busway	20	.11746
Traffic Signals	10	.16275
Station Stops	5	.26380
Vehicles		
Buses	12	.14676
Light Rail Transit	25	.11017
Automated Guideway Transit	20	.11746
Planning, Engineering, Management Contingencies and Procurement	Allocate Item-Specific	

1 Table 47 summarizes the annualized equivalent capital costs in 1988 dollars for each alternative in the eight travel corridors in the Tulsa urban area.

Table 47

Annualized Estimated Corridor Capital Costs

Tulsa Urban Area

Corridor	TSM Corridor Buses Required	Annualized TSM Capital Cost	Annualized Background Bus Capital Cost	Annualized Fixed Guideway Capital Costs				
				HOV1	HOV2	HOV3	LRT	AGT
Downtown/Airport	18	$539,035	$512,083	$5,743,626	$12,777,688	--	$16,339,058	$61,980,204
Lynn Lane	35	$1,048,123	$995,717	$4,510,373	$8,647,400	$7,495,371	$14,417,357	$44,764,155
Broken Arrow	37	$1,108,016	$1,052,615	$6,632,913	$19,239,310	--	$24,200,462	$30,171,679
Bro. Arrow/Memorial	39	$1,167,909	$1,109,513	$7,183,975	$11,189,713	--	$16,574,772	$38,237,498
Jenks/Riverside	49	$1,467,373	$1,394,004	$4,375,333	--	--	$8,519,233	$46,299,679
Sapulpa	37	$1,108,016	$1,052,615	$3,817,777	--	--	$19,585,034	$27,791,251
Sand Springs	10	$299,464	$284,491	$2,562,697	--	--	$15,616,677	$21,236,740
Memorial/Owasso	20	$598,928	$568,981	$9,360,246	--	--	$17,443,711	$61,969,883

Source: Parsons Brinckerhoff, 1989

Table 48

Corridor Operating and Maintenance Costs and Ridership Estimates

Tulsa Urban Area

Corridor	Annual Corridor O&M TSM Cost	Annual Corridor Guideway O&M Costs — Alternative: HOV1	HOV2	HOV3	LRT	AGT	Annual Fixed Guideway Riders	Annual New Riders	Change in O&M Costs — Alternative: HOV1	HOV2	HOV3	LRT	AGT
Downtown/Airport	$1,593,000	$1,735,969	$1,735,969	--	$3,335,636	$2,518,745	2,001,000	1,121,000	$3,249,319	$3,249,319	--	$4,848,986	$4,032,095
Lynn Lane	$3,068,000	$1,735,969	$1,735,969	$1,735,969	$3,335,636	$2,518,745	2,494,000	295,000	$4,650,569	$4,650,569	$4,650,569	$6,250,236	$5,433,345
Broken Arrow	$3,274,500	$1,896,349	$1,896,349	--	$2,858,621	$2,158,550	4,524,000	1,121,000	$5,007,124	$5,007,124	--	$5,969,396	$5,269,325
Bro. Arrow/Memorial	$3,451,500	$1,529,489	$1,526,539	--	$2,653,460	$1,863,845	5,162,000	590,000	$4,808,414	$4,805,464	--	$5,932,385	$5,142,770
Jenks/Riverside	$4,395,500	$1,240,779	--	--	$2,280,521	$1,601,885	2,929,000	206,500	$5,416,504	--	--	$6,456,246	$5,777,610
Sapulpa	$4,395,500	$1,431,862	--	--	$2,468,336	$1,863,845	2,668,000	354,000	$5,607,587	--	--	$6,644,061	$6,039,570
Sand Springs	$885,000	$932,557	--	--	$1,860,966	$1,307,180	986,000	88,500	$1,773,307	--	--	$2,701,716	$2,147,930
Memorial/Owasso	$2,125,500	$2,050,763	--	--	$4,051,981	$2,846,195	2,059,000	914,500	$4,069,988	--	--	$6,071,206	$4,865,420

Source: Parsons Brinckerhoff, 1989

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9.0 COST-EFFECTIVENESS

UMTA COST-EFFECTIVENESS INDICES

Introduction

In system planning,UMTA requires that a cost-effectiveness measure be developed. This cost-effectiveness measure reflects current UMTA guidance on evaluation of major new transit investments which contains a means for comparing the total costs of each alternative to its benefits. The methods for determining the cost-effectiveness measures are based on the formula described in "A Detailed Description of UMTA's System for Rating Proposed Major Transit Investments," published by UMTA on May 18, 1984. The output is a fixed guideway alternative's cost-per-new-passenger-attracted relative to the "Best Bus" or the UMTA-defined TSM alternative. This cost-per-new-passenger index is compared by UMTA to threshold levels for advancing projects into various planning and design phases.

It is important to remember that these are preliminary cost-effectiveness measures useful for distinguishing among potential transit investments in the potential transit corridors. These measures also serve as an indication of whether any of the alternative fixed guideway options in any of the eight corridors may be considered cost-effective and meet standards established by UMTA in its capital investment policy ("A Detailed Description of UMTA's System for Rating Major Transit Investment," May 18, 1984). Refined cost-effectiveness measures will be developed in subsequent study phases.

The general methodology of this preliminary cost-effectiveness analysis translates the capital costs of the alternatives into equivalent uniform annual costs over the time frame of the analysis. These uniform annual capital costs reflect assumptions about the economic life of the transit capital components in each alternative and the cost of capital (i.e., the discount rate). The uniform annual capital costs are combined with annual O&M expenses, and then compared to the benefits of each alternative. These are used to arrive at a cost-effectiveness index for each alternative in each corridor. The benefits to the transit alternatives are measured by the additional transit patronage attracted to the fixed guideway system and the value of travel time savings for the "existing" transit patrons riding buses. The "existing" transit patrons are the forecasted users for the "Best Bus" alternative who would then have the choice to ride the more capital intensive alternatives, and thus save time and money. The equivalent annual capital costs and the annual O&M costs were presented in Section 8.0: Capital and Operating Costs.

UMTA will generally approve a local area's request to enter into the second phase, alternatives analysis/draft environmental impact statement (AA/DEIS), of the transit development process once the results of system planning demonstrate that there is a reasonable possibility one or more of the fixed guideway alternatives proposed for study can be shown to be cost-effective. UMTA uses two "threshold criteria" to guide their determination. These criteria are: that the priority corridor should currently have at least 15,000 daily transit riders; and, that fixed guideway alternatives in the corridor should have a total cost of no more than $10 per new transit system rider when compared to the best non-guideway option that can be developed. This latter criteria is termed the "cost-effectiveness index".

It should be made clear that the UMTA threshold values use a 1984 cost basis for capital and O&M costs and travel time values. The analysis being done in this study uses 1988 costs for capital, 1988 costs for O&M costs, and the UMTA recommended 1984 values for the travel time savings. These travel time savings values are established by UMTA for use across the United

States. UMTA has assigned the value of an hour of work (work trips) at $4 per hour and the value of non-work time (for non-work trips) of $2 per hour. These were established between 1982 and 1984 and have not been revised to reflect cost of living increases or inflation. Thus while it is recognized that the 1984 values of time understate the effectiveness of each alternative, it is necessary to use the 1984 dollar values in order to meet federal requirements. The cost-effectiveness indices are presented for the forecast year of 2005. This is the same forecast year as the regionally adopted long-range transportation plan.

Calculation of the UMTA Cost-Effectiveness Indices

The indices used in this analysis measure the additional cost of the proposed transit investment alternatives in each corridor compared to the cost of the "Best Bus" alternative per additional rider above the number of riders expected under the "Best Bus" alternative. In order to reflect the benefits of reduced travel time resulting from the HOV, LRT, and AGT projects, the value of travel time savings for existing "Best Bus" riders is also included in the formula.

One set of indices is calculated for each corridor which measures the total cost-effectiveness of the alternatives. Thus, for each corridor a set of indices has been calculated. The formula for the indices is shown below:

ANALYSIS OF ALTERNATIVES

The cost-effectiveness measure, as previously described, was calculated for each of the alternatives in the corridor for 2005. Table 49 presents the results of the calculation of the indices. It is important to note that the patronage forecasting has been made utilizing a "generic" fixed guideway alternative operating at an average speed of 24 mph. Thus, the travel time savings accruing to existing riders and new riders attracted are not mode-specific in this phase of the study. In the second study phase, the differences among the fixed guideway technologies will be modeled and the cost-effectiveness indices refined. The purpose of this analysis is to determine whether any of the fixed guideway alternatives could be cost-effective and to distinguish among the relative cost-effectiveness of the alternatives.

It is clear from the data presented that the alternatives that use the existing R/W alignments have the lowest indices and, therefore, rank higher on this cost-effectiveness measure. It is also clear from this analysis that the HOVs operating on railroad R/W (not publicly-owned) are comparable to the LRT alternatives. The AGT alternatives are the most expensive improvements per new rider attracted to the system because of the completely grade-separated design and operation.

$$\text{Total Cost-Effectiveness Index} = \frac{\Delta \$\,CAP + O\,\&\,M - \$\,TT}{\Delta\ \text{Riders}}$$

Where:

the Δ's represent changes in costs and benefits compared to the "Best Bus" Alternative (TSM), and,

$ CAP	=	Equivalent annual capital costs
$ O&M	=	Annual operating and maintenance costs
$ TT	=	Value of travel time savings for existing riders carried on the "Best Bus" Alternative; and,
Riders	=	Annual transit ridership measured in "linked" trips.

Table 49

Preliminary UMTA Cost-Effectiveness Measures

Corridor	Total Cost Effectiveness Index (CEI) ($/New Rider) HOV1	HOV2	HOV3	LRT	AGT
Downtown/Airport	$6.34	$12.61	-	$17.22	$57.20
Lynn Lane	$18.75	$32.77	$28.87	$57.75	$157.86
Broken Arrow	$6.78	$18.02	-	$23.31	$28.01
Broken Arrow/Memorial	$12.66	$19.45	-	$30.48	$65.86
Jenks/Riverside	$23.73	-	-	$48.83	$228.50
Sapulpa	$12.81	-	-	$60.28	$81.75
Sand Springs	$36.39	-	-	$194.38	$251.62
Memorial/OWasso	$11.98	-	-	$23.00	$70.37

Source: Parsons Brinckerhoff, 1989.

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10.0 POTENTIAL ENVIRONMENTAL ISSUES

The purpose of this section is to inventory and document the environmental factors (natural and built) in the potential fixed guideway transit corridors. A description of these corridors is provided in Section 4.0: Potential Regional Corridors.

The following twelve elements were inventoried and are included in this section:

- Archaeological Sites
- Floodplains
- Hazardous Waste Sites
- Indian Lands
- National Register Historic Sites
- Noise Sensitive Land Uses
- Parks, Recreation Lands, and Wildlife Refuges
- Prime and Unique Farmlands
- Superfund Sites
- Threatened and Endangered Species
- Wetlands

Archaeological sites are areas where the material remains (i.e., fossil relics, artifacts, and monuments) of past human life and activities have been discovered. These sites are regulated at the national level by the Advisory Council on Historic Preservation and are administered at the state level by the State Historic Preservation Officer (SHPO). The Governor appoints the Oklahoma Historical Society's Executive Director as the SHPO.

Floodplains, areas that may be submerged by floodwaters, are divided into two categories: one hundred year and five hundred year floodplains. They are regulated at the national level by the Federal Emergency Management Agency. At the State level, the Oklahoma Water Resources Board regulates water quality, but does not have jurisdiction over floodplains.

Hazardous waste sites are investigated by the Environmental Protection Agency (EPA) for inclusion in the Superfund Program. These sites fall under jurisdiction of the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act. The State liaisons are the Oklahoma State Department of Health and the Oklahoma Water Resources Board.

Indian lands are lands under the jurisdiction or control of an Indian tribe. These lands are restricted from being developed and are exempt from taxation or actions of eminent domain by any city, county, state or federal governmental body. In the Tulsa metropolitan area, these lands are administered and recorded by the Muskogee Office of the Bureau of Indian Affairs.

National Register Historic Sites are those districts, sites, buildings, structures, or objects included in or eligible for inclusion in the National Register. The Advisory Council on Historic Preservation regulates these sites nationally. The SHPO administers this program in the state and the data in this report was obtained from the Oklahoma Historical Society.

The identification of noise sensitive land uses consists of establishing the location of churches, schools, libraries, and hospitals, or other land uses particularly sensitive to noise. In future phases of project development, existing noise levels would be measured and forecast levels of noise developed using computer models. Mitigation measures to offset possible noise generated may be considered in further studies.

The identification of parks, recreation lands, and wildlife refuges includes these types of areas as well as some miscellaneous public open spaces such as golf courses and some of the larger cemeteries where they were included in the maps of the area. Parks, recreation lands, and wildlife refuges are protected by the U.S. Departments of Interior, Agriculture, and Housing and Urban Development, plus the Oklahoma Department of Tourism and the State Liaison Office on Recreation Lands. Encroachment of a project on these types of lands may require more detailed analyses and further documentation.

The analysis of prime and unique farmlands includes the identification of soil types that have been determined by the U.S. Soil Conservation Service to be prime farmlands. There are no soils considered unique farmlands in the study area. Identification of prime agricultural soils have been made on two levels: those areas with all prime farmland and those areas with prime agricultural soil mixed with soil that is not considered prime. The U.S. Department of Agriculture administers this program at the national level. There are no state agencies with jurisdiction over the farmlands.

The identification of slopes over nine percent (9%) is important because certain transit technologies are not capable of operating at slopes exceeding 9%, or require alternative routing or special construction techniques.

Superfund sites are toxic waste areas designated by the EPA to be permanently detoxified using advanced treatment technology. These sites are covered by the Comprehensive Environmental Response, Compensation, and Liability Act. The State liaisons are the Oklahoma Water Resources Board and the Oklahoma State Department of Health.

The threatened or endangered species (flora and fauna) that may be seen in the Tulsa metropolitan area are dominated by a number of species of migrating birds. There is one species of resident bird whose historic range once included the parts of Creek and Tulsa counties but now only occurs in four western counties of the State. This is the Black-Capped Vireo (Vireo atricapillus). This bird lives in early successional brushy areas and has not adapted well to changes in the land from urbanization and farming. The migratory birds are dominated by the Interior Least Tern (Sterna antillarum), the Piping Plover (Charadrius melodus), and Bald Eagle (Haliaeetus leucocephaus) which winter in Creek, Tulsa, and many of the surrounding counties in eastern Oklahoma. There also may be rare sitings of the American Peregrine Falcon (Falco peregrinas anatum) and the Arctic Peregrine Falcon (Falco peregrinus tundrius), both of which are known to migrate through this section of Oklahoma. The highest probability of sighting one of these migrating birds is along the rivers, lakes, and wetlands in the area. The protection of these species is the responsibility of the U.S. Fish and Wildlife Service at the national level and both the Oklahoma Department of Agriculture and the Department of Wildlife Conservation on the state level.

Wetlands, as defined in 33 Code of Federal Regulations (CFR) 328.3(b), are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The documentation of wetland ecosystems includes two general types of wetland ecosystems. These are palustrine wetlands which include marshes, bogs, swamps, and other shallow water wetland types with varied and often emergent vegetation; and lacustrine wetlands which are lakes of over 6.6 feet in depth. The U.S. Corps of Engineers is responsible for regulating the nation's wetlands .

The remainder of this section is organized by potential transit corridor and presents a brief description of only those environmental factors found within each corridor. The locations of these known environmental factors are displayed on maps in Technical Memorandum 12.0: Potential Environmental Issues. The following descriptions are of a general nature and reflect the reporting of secondary information sources only.

No on-site inventory has been performed for this stage of study. The information presented will provide data required for use in evaluating and ranking the potential travel corridors. If any of these corridors are brought forth into a second study phase, additional environmental inventories and descriptions will be made. A tabular comparison of the environmental factors within each potential transit corridor is at the end of this section.

CENTRAL BUSINESS DISTRICT

Hazardous Waste Sites

There are three known hazardous waste sites in the Tulsa CBD which have been studied by the EPA for inclusion in the Superfund program. All three of the sites have been determined by the EPA to require no further action. Two of the sites are along the northern edge of the corridor, north of Burlington Northern Railroad tracks and south of I-244. One is located at S. Cheyenne and the other at approximately S. Frankfort. The third site is in Tulsa's downtown at the intersection of E. 5th Street and S. Boston.

National Register Historic Sites

The Tulsa CBD contains 18 sites that are included in the National Register of Historic Places. These sites are centered around the intersection of E. 5th Street and S. Boston, and are spread as far south as the intersection of E. 13th Street and S. Boston and as far north as the intersection of S. Boulder and Brady Street.

Noise Sensitive Land Uses

Noise sensitive land uses in the Tulsa CBD are located west of S. Detroit. Most of these are located between S. Detroit on the east, S. Cheyenne on the west, E. 4th Street on the north, and E. 13th Street on the south.

Parks, Recreation Lands and Wildlife Refuges

There are two small city parks in Tulsa's CBD. They are Gunboat North and Gunboat South located off of S. Frankfort between E. 11th Street S. and E. 13th Street. There are no known wildlife refuges in the corridor.

DOWNTOWN/AIRPORT CORRIDOR

Floodplains

The floodplains in the Downtown/Airport Corridor follow the creekbeds of the small streams that drain the area. They are mostly 100 year floodplains with some 500 year floodplains along the edges of the one hundred year floodplains. There is a broad area of the one hundred year floodplain of Mingo Creek, nearly one-half mile wide, that is located north of the intersection of E. Pine and N. Mingo

Hazardous Waste Sites

The EPA has studied 12 hazardous waste sites in the Downtown/Airport Corridor for inclusion in the Superfund program. Three of the sites are currently under study. Two of these sites are on U.S. Government property at Tulsa International Airport, and the third is southeast of the intersection of N. Yale and E. 36th Street N. The EPA has determined that the remaining nine sites require no further study. These sites are either on the airport grounds or within one-half mile of the railroad lines that travel through the corridor (Burlington Northern Railroad and Atchison Topeka and Santa Fe Railroad).

Indian Lands

There are two parcels of Indian lands in the Downtown/Airport Corridor. One is southeast of the intersection of the Cherokee Expressway and E. Pine. The other is on the border of the corridor south of E. Pine between N. 89th E. Avenue and N. Mingo.

Noise Sensitive Land Uses

The noise sensitive land uses in the Downtown/Airport Corridor occur to the west of N. Sheridan with the highest concentration occurring west of N. Lewis.

Parks, Recreation Lands and Wildlife Refuges

There are 13 city parks in the Downtown/Airport Corridor. Those within the corridor are evenly distributed west of N. Yale with one, Mohawk Park, on the northern border of the corridor between N. Yale and N. Memorial. Included within Mohawk Park is the Oxley Nature Center and the Tulsa Zoo.

Prime and Unique Farmlands

The Downtown/Airport Corridor has areas of mixed prime farmland. They are located to the north of E. Apache and extend from the western boundary of the corridor to Tulsa International Airport and then onto the airport grounds between the runways. These lands appear to be out of agricultural production.

Slopes Over 9%

There is one area with slopes greater than 9 percent in gradient in the Downtown/Airport Corridor. It is along N. Cincinnati between E. Haskell and E. Jasper and extends approximately one-quarter mile to the east and the to west beyond the corridor boundary.

Wetlands

There are three groups of palustrine wetland sites in the Downtown/Airport Corridor. Each site is less than ten acres, but combined, they appear larger. The first of these groups is located southwest of intersection of E. 36th Street N. and N. Yale. The second is to the south in the unincorporated property along Dawson Road west of N. Yale, and the third is east of the Cherokee Expressway between E. Apache and E. 36th Street N.

LYNN LANE CORRIDOR

Archaeological Sites

Three archaeological sites in the Lynn Lane Corridor are recorded in the Oklahoma Archaeological Survey. One site is an early 20th century cemetery located along Mingo Creek north of the I-44 intersection. Of the other two sites, one is located northwest of the intersection of E. 21st Street and S. 145th E. Avenue, and the other is one-quarter mile north of E. 21st Street along S.134th E. Avenue.

Floodplains

The majority of the floodplains in the Lynn Lane Corridor are centered around the Mingo Creek drainage basin. Mingo Creek parallels S. Mingo on the west, crosses to the east and returns west for a short distance. Its floodplain is approximately one-half mile wide and is mostly of 100 year frequency. There are some sections of 500 year floodplain along its edges. In addition to the main floodplain, there are fingers of 100 year floodplain along the feeder creeks of Mingo Creek that extend to the east and west of the main floodplain. There is also a fingerlike floodplain entering from the eastern boundary, south of E. 11th Street, and extending westward into the corridor for over one mile.

Hazardous Waste Sites

The EPA has studied four hazardous waste sites in the Lynn Lane Corridor for inclusion in the Superfund program, and has determined that none of the sites require further action. Two of the sites are located in close proximity of I-44 where it crosses E. 21st Street. The other two are to the west, one at the intersection of E. 12th Street and S. Lakewood, and the other off of S. Wheeling north of E. 10th Street.

Indian Lands

The only parcel of restricted Indian land in the Lynn Lane Corridor is located on the north side of Admiral Place, one block west of its intersection with N. Yale.

National Register Historic Sites

Tracy Park Historic District, located south of E. 11th Street between S. Peoria and the Cherokee Expressway, is the only site in the Lynn Lane Corridor included in the National Register of Historic Places.

Noise Sensitive Land Uses

Noise sensitive land uses are spread throughout the Lynn Lane Corridor. Their density becomes progressively lower from west to east, with only one site located east of S. 145th E. Avenue.

Parks, Recreation Lands and Wildlife Refuges

There are 11 city parks and recreation lands in the Lynn Lane Corridor. They are evenly interspersed through the western two-thirds of the site with only one site located east of S. 129th E. Avenue. This one park site is south of E. 21st Street between S. 161st E. Avenue and S. 177th E. Avenue.

Prime and Unique Farmlands

There is mixed prime and non-prime farmland in the Lynn Lane Corridor between S. 89th E. Avenue and S. 161st E. Avenue. This area appears to be developed. There is also a smaller area extending from the northern border of the corridor east of S. 177th E. Avenue to the southern border of the corridor east of Lynn Lane Lake.

Slopes Over 9%

Slopes exceed 9 percent in three areas of the Lynn Lane Corridor. Two of these are just east of S. 161st E. Avenue. The other is located east of the intersection of E. 11th Street and S. Sheridan.

Wetlands

There are nine palustrine wetlands located in the eastern one half of the Lynn Lane Corridor. Two of the areas are along Mingo Creek and comprise the largest wetlands in the corridor. The others are east of S. 129th E. Avenue and are evenly spread throughout this area. Lynn Lane Lake is the only lacustrine wetland in the area. It is located south of E. 21st Street and east of S. 177th E. Avenue. This is the only known lacustrine wetland in any of the Tulsa study corridors.

BROKEN ARROW CORRIDOR

Archaeological Sites

There is one archaeological site in the Broken Arrow Corridor. It is located on the southern border of the corridor on the south side of E. 131st Street at Meadowood Drive in Broken Arrow.

Floodplains

There are many finger-shaped floodplains extending into the Broken Arrow Corridor, southeast of I-44. They are mostly 100 year floodplains. The largest pattern of them is part of the Mingo Creek drainage basin.

Hazardous Waste Sites

The EPA has studied three hazardous waste sites in the Broken Arrow Corridor and three on the border of the corridor for inclusion in the Superfund program. The EPA has determined that none of these sites require further action. One of the border sites is on the northern border near

S. Utica. There are three sites near the intersection of I-44 and the Broken Arrow Expressway, one is on the southern border of the corridor. One site is along the Broken Arrow Expressway west of S. 145th E. Avenue. The sixth site, which is on the border of the corridor, includes two square miles east of S. 177th E. Avenue between E. 101st Street and E. 121st Street in Broken Arrow.

Indian Lands

In the Broken Arrow Corridor there are nine parcels of restricted Indian lands. One of the sites is located northwest of the intersection of E. 51st Street and S. Mingo. Another site is southeast of the intersection of E. 91st Street and S. 177th East Avenue. The remaining sites are grouped in the southern most seven square miles of the corridor, south of E. 101st Street in Broken Arrow.

National Register Historic Sites

There are three districts and two buildings within the Broken Arrow Corridor included on the National Register of Historic Places. The three historic districts, the Gillette Historic District, the Maple Ridge Historic District, and the Tracy Park Historic District, are all located northwest of the intersection of E. 21st Street and S. Lewis. One building is located northwest of the intersection of E. 41st Street and the Mingo Valley Expressway and the other is located east of S. 177th E. Avenue south of College Street in Broken Arrow. In addition to the sites currently on the register, the neighborhood around Swan Lake Park, at the intersection of E. 17th Place and S. Utica, is in the process of obtaining Historic District designation.

Noise Sensitive Land Uses

Noise sensitive land uses are lightly dispersed through the Broken Arrow Corridor. There are no sensitive land uses between S. Garnett and S. 145th E. Avenue and south of E. 111th Street in Broken Arrow.

Parks, Recreation Lands and Wildlife Refuges

There are 16 city parks and recreation lands concentrated within two areas of the Broken Arrow Corridor. The first area northwest of I-44 includes nine of the parks. One of the parks, Swan Lake Park, northwest of E. 17th Place and S. Utica, is a city waterfowl refuge. The other area of concentration is in Broken Arrow, between E. 71st Street and E. 101st Street and contains five of the parks. Two of the parks are along the border of the corridor. One is south of E. 51st Street, east of S. Memorial, and the other is northwest of the intersection of S. 129th E. Avenue and E. 71st Street.

Prime and Unique Farmlands

There are three areas of mixed prime and non-prime farmland in the Broken Arrow Corridor, most of which appear to be developed. These lands are all southeast of I-44 with the largest area beginning approximately three miles to the southeast of I-44 and extending to the southeast through Broken Arrow to the southern boundary of the corridor.

Slopes Over 9%

There are generally three areas where slopes exceed 9 percent in the Broken Arrow Corridor. One is along E. 51st Street, east of S. Memorial. The second is east of S. 161st E. Avenue and west of S. 177th E. Avenue and extends from the northern boundary of the corridor to the south across E. 71st Street. The third area follows three creek gullies south from E. 121st Street to the southern border of the corridor.

Wetlands

There are 26 palustrine wetlands in the Broken Arrow Corridor. Two of these are located west of S. Harvard and the remaining are spread throughout the corridor to the east of S. Mingo.

BROKEN ARROW/MEMORIAL CORRIDOR

Floodplains

The floodplains in the Broken Arrow/Memorial Corridor are fingerlike floodplains of the small creeks that drain the area. They are mostly of 100 year frequency with some 500 year areas, and are located mainly southeast of I–44.

Hazardous Waste Sites

The EPA has studied three hazardous waste sites in the Broken Arrow/Memorial Corridor and one site on the border of the corridor for inclusion in the Superfund program. The EPA determined that all of the sites require no further action. The border site is on the northern boundary of the site near downtown at S. Utica and E. 10th Street. The other three are to the west of the intersection of I-44 and the Broken Arrow Expressway.

Indian Lands

There are four parcels of Indian lands in the Broken Arrow/Memorial Corridor. Two are along E. 51st Street — one is southwest of the intersection with S. Sheridan, and the other is northwest of the intersection with S. Mingo. Another site is northeast of the intersection of S. Sheridan and E. 91st Street, and the fourth site is on the west side of S. Memorial south of E. 91st Street.

National Register Historic Sites

There are three districts included on the National Register of Historic Places within the Broken Arrow/Memorial Corridor. The three historic districts, the Gillette Historic District, the Maple Ridge Historic District, and the Tracy Park Historic District, are all located northwest of the intersection of E. 21st Street and S. Lewis. In addition to the sites currently on the register, the neighborhood around Swan Lake Park, at the intersection of E. 17th Place and S. Utica, is in the process of obtaining Historic District designation.

Noise Sensitive Land Uses

Noise sensitive land uses are spread lightly through the Broken Arrow/Memorial Corridor. All but two sites are located north of E. 71st Street.

Parks, Recreation Lands and Wildlife Refuges

There are 12 city parks and recreation lands in the Broken Arrow/Memorial Corridor. These are generally spread throughout the area with five clustered northwest of the intersection of E. 21st Street and S. Lewis. One of these is Swan Lake Park, a city waterfowl refuge, located southwest of E. 17th Place and S. Utica.

Prime and Unique Farmlands

In the Broken Arrow/Memorial Corridor, there is one area of mixed prime and non-prime farmland. It is located south of E. 51st Street.

Slopes Over 9%

There are five areas having slopes over 9 percent in the Broken Arrow/Memorial Corridor. These are all located southeast of I-44. Four of the areas are between I-44 and E. 71st Street. The fifth area is to the northeast of the intersection of E. 101st Street and S. Sheridan.

Wetlands

There are ten palustrine wetlands over ten acres in the Broken Arrow/Memorial Corridor and one series of smaller wetlands. Most of the wetlands are located south of E. 71st Street, with four located in the remaining 65 percent of the corridor.

JENKS/RIVERSIDE CORRIDOR

Archaeological Sites

The Jenks/Riverside Corridor has one archaeological site within its boundaries and one along its border. The site within the corridor is located one-half mile north of E. 71st Street along the Midland Valley Railroad tracks. The other site is on the eastern boundary of the corridor. It is an old dig site whose exact location has not been verified but is approximately south of E. 31st Street near S. Rockford.

Floodplains

There are extensive floodplains along the Arkansas River in the Jenks/Riverside Corridor. The 100 year floodplains are predominantly along the Arkansas River channel and the creeks that drain the area. On the east side of the river, there are 500 year floodplains extending south of I-44 and east approximately to S. Lewis. South of E. 74th Street, the floodplain extends east of S. Lewis to S. Delaware as it parallels the river. To the north of I-44, the 500 year floodplain extends east to the corridor boundary, at approximately E. 36th Street, where high land forces the floodplain back to the main river channel at E. 21st Street. On the west side of the river, both the 100 year and 500 year floodplains follow Hager Creek across S. Elwood and then parallel S. Elwood on the east side to meet the Arkansas River. The floodplains begin to broaden again north of I-44 and extend to US 75 to the north outside of the corridor boundary.

Hazardous Waste Sites

In the Jenks/Riverside Corridor there are two hazardous waste sites which have been studied by the EPA for inclusion in the Superfund program. Both of the sites have been determined to require no further action. Both sites are located west of the Arkansas River—one is northwest of the intersection of W. 71st Street and S. Elwood, and the other is on the east side of S. Elwood at W. 36th Street.

Indian Lands

There are two parcels of Indian land in the Jenks/Riverside Corridor. One site straddles US 75 north of E. 91st Street. The other site is located near the 5400 block of S. Peoria on the east side.

National Register Historic Sites

There are two districts and five buildings in the Jenks/Riverside Corridor that are included in the National Register of Historic Places, all of which are located north of E. 31st Street and east of the Arkansas River.

Noise Sensitive Land Uses

There is an even distribution of noise sensitive land uses on the east side of the Arkansas River in the Jenks/Riverside Corridor. On the west side of the river, these land uses are limited to south of E. 91st Street and north of I-44.

Parks, Recreation Lands and Wildlife Refuges

There are 11 city parks and recreation areas in the Jenks/Riverside Corridor. The dominant park in the corridor is the Riverparks system along the Arkansas River. This system extends on the east side of the river from E. 81st Street north to the bridge at E. 11th Street, and on the west side of the river from the E. 11th Street bridge south to the pedestrian bridge north of E. 31st Street.

Prime and Unique Farmlands

Prime farmlands exist in the Jenks/Riverside Corridor between W. 71st Street and W. 81st Street east of S. Elwood. Between W. 61st Street and W. 91st Street there are areas of mixed prime and non-prime farmland. East of the Arkansas River, and south of E.61st Street, there is another area of mixed prime and non-prime farmland which is primarily developed.

Slopes Over 9%

There are five areas in the Jenks/Riverside Corridor where the slopes exceed 9 percent. Two areas are east of the Arkansas River, one parallels the river north of E. 21st Street, and the other parallels S. Delaware at E. 81st Street. West of the river there are three areas which form a belt that stretches from W. 91st Street north to W. 41st Street.

Threatened and Endangered Species

There are known nesting areas for the Least Tern in the Arkansas River as it passes through the Jenks/Riverside Corridor. There are six sites that have been identified by the staff of the U.S. Fish and Wildlife Service. One site is on the southernmost island in Zink Lake (the lake resulting from the low-water dam on the river at approximately E. 29th Place). Other sites are along the river at E. 46th Street, I-44, E. 77th Street, and E. 101st Street on the east side and south of E. 91st Street on the west side of the river. In addition, the entire Arkansas River basin is known to have wintering and nesting sites for the Southern Bald Eagle. These wintering and nesting sites for endangered species are extremely sensitive and will require mitigation for any project that encroaches on them.

Wetlands

The palustrine wetlands of the Jenks/Riverside Corridor are associated with the floodplain of the Arkansas River. One site is east of S. Peoria between E. 62nd Street and E. 64th Place away from the river. The other sites are in close proximity to the river, with the majority located along the east side of the river.

SAPULPA CORRIDOR

Archaeological Sites

The Sapulpa Corridor has one archaeological site with considerable potential. It is located near the Arkansas River northwest of the intersection of W. 21st Street and S. 33rd W. Avenue, and may be the the most significant site of those found within the corridors of the Tulsa area.

Floodplains

There are two floodplain areas in the Sapulpa Corridor. The first area are the 100 year and 500 year floodplains of the Arkansas River that extend primarily to the west of the river channel for more than one mile from the channel. The second area is the 100 year floodplains of Polecat Creek and of Nickel Creek to the south in Creek County.

Hazardous Waste Sites

There are 12 hazardous waste sites in the Sapulpa corridor which have been studied by the EPA for inclusion in the Superfund program. Two of the sites are currently under study for inclusion in the Superfund program. One of these sites is located southeast of the intersection of W. 25th Street and Southwest Boulevard, the other is along W. 21st Street and west of S. 33rd W. Avenue. The remaining ten sites have been determined by the EPA to require no further action. The majority of these sites are north of W. 44th Street. One site is on the east side of I-44 at W. 65th Street. Another site is a 640 acre section south of W. 101st Street and west of S. 33rd W. Avenue.

Indian Lands

There are three parcels of Indian lands in the Sapulpa Corridor. One parcel is south of W. 51st Street between S. Union and S. 33rd W. Avenue. The largest site in the corridor (approximately 160 acres) is west of S. 49th W. Avenue and south of W. 31st Street. The third site is located at approximately W. 71st Street one-half mile west of I-44.

National Register Historic Sites

There are five buildings in the Sapulpa Corridor that are included in the National Register of Historic Places, all of which are located east of the Arkansas River.

Noise Sensitive Land Uses

Most of the noise sensitive land uses in the Sapulpa Corridor are clustered in the developed areas north of W. 61st Street with four sites along Sapulpa Road.

Parks, Recreation Lands and Wildlife Refuges

There are seven city parks and recreation areas in the Sapulpa Corridor. They are located primarily north of W. 43rd Street with one park at S. 49th W. Avenue and W. 65th Street.

Prime and Unique Farmlands

There is a large area of mixed prime and non-prime farmland covering the entire Sapulpa Corridor to the south of W. 61st Street. There are two smaller areas of mixed farmland. One area is east of S. 65th W. Avenue and north of Sapulpa Road, and the other area extends north of W. 36th Street and west of the Arkansas River across I-44 to the northwest for approximately three quarters of a mile.

Slopes Over 9%

The Sapulpa Corridor has extensive areas of slopes with over a 9 percent gradient and they are dispersed throughout the corridor.

Threatened and Endangered Species

There is one site in the Sapulpa Corridor that has been identified by the staff of the U.S. Fish and Wildlife Service as a known nesting area for the Least Tern. This site is in the Arkansas River as it passes through the Sapulpa Corridor on the southernmost island in Zink Lake (the lake resulting from the low-water dam on the river at approximately E. 29th Place). In addition, the entire Arkansas River basin is known to have wintering and nesting sites for the Southern Bald Eagle. These wintering and nesting sites for endangered species are extremely sensitive and will require mitigation for any project that encroaches on them.

Wetlands

There are eight palustrine wetlands distributed evenly throughout the Sapulpa Corridor. In addition, the entire area of the corridor south of W. 65th Street is stippled with numerous small wetlands, too small and too numerous to document individually.

SAND SPRINGS CORRIDOR

Floodplains

The 100 year floodplain of the Arkansas River extends into the Sand Springs Corridor slightly to the north of the river from the western boundary of the corridor to approximately S. 65th W. Avenue. The floodplain then becomes of the 500 year frequency and extends, in places, for over one mile from the river and then returns to the river channel as it approaches E. 11th Street. In addition, there are fingers of 100 year floodplains extending up the small drainage creeks to the north of the river.

Hazardous Waste Sites

There are six hazardous waste sites in the Sand Springs Corridor which have been studied by the EPA for inclusion in the Superfund program. Five of these sites have been determined by the EPA to require no further action. The site under study and four of the sites requiring no further action, are located along W. 21st Street where it runs through the corridor south of Sand Springs. The sixth site is located south of Charles Page Boulevard at S. 24th W. Avenue.

Indian Lands

There are five parcels of Indian lands in the Sand Springs Corridor. These sites are in close proximity with one another (within one mile of the intersection of S. 65th W. Avenue and W. 7th Street).

Noise Sensitive Land Uses

Noise sensitive land uses occur in the Sand Springs Corridor in the developed areas of Tulsa and Sand Springs. They are of low frequency or are non-existent both along the river and in the undeveloped land between the two cities.

Parks, Recreation Lands and Wildlife Refuges

There are eight city parks and recreation areas in the Sand Springs Corridor. The parklands are distributed within the developed portions of Tulsa and Sand Springs.

Prime and Unique Farmlands

There are two small areas of prime farmland in the Sand Springs Corridor. One area is all prime land and is located along the Arkansas River between S. 81st W. Avenue and Black Boy Creek, extending north to the Keystone Expressway. The area of mixed prime and non-prime farmland is north of the Keystone Expressway and east of Adams Road.

Slopes Over 9%

North of Sand Springs is an area of slopes which extend east to Black Boy Creek. Further east are ridges that parallel the Arkansas River and extend east from S. 61st W. Avenue.

Superfund Sites

There is one Superfund site associated with the Sand Springs Corridor whose locational description is in conflict. The site is partially in the riverbed but mostly to the south of the river which is outside the corridor. The description states, however, that the site is located on the "north side of the Arkansas River" which would place it within the corridor at approximately S. 81st W. Avenue.

Threatened and Endangered Species

The entire Arkansas River basin, including the section passing through the Sand Springs Corridor is known to have wintering and nesting sites for the Southern Bald Eagle. These sites are extremely sensitive and will require mitigation for any project that encroaches on them.

Wetlands

There are five palustrine wetlands in the Sand Springs Corridor. Four of these wetlands are located along the Arkansas River. One is the Sand Springs Lake and is located east of Lake Drive and north of Sand Springs Park Drive in Sand Springs.

MEMORIAL/OWASSO CORRIDOR

Archaeological Sites

The Memorial/Owasso Corridor has the highest number of archaeological sites of the corridors in the Tulsa metropolitan area. There are fifteen sites in the corridor. The sites are generally grouped along Mingo Creek, Bird Creek and their tributaries as they flow through the corridor, and they are concentrated north of E. Apache. There are four sites along Mingo Creek — one is located at approximately E. 21st Street and is the only site south of E. Apache, and the other three are directly east of Tulsa International Airport to both the north and south of E. 36th Street N. Nine of the sites are along Bird Creek — four are west of its confluence with Mingo Creek; one is where the two creeks join; and the remaining four sites are east of the confluence. In addition, there are two sites to the north of Bird Creek along one of its tributaries, Elm Creek, located east of Owasso.

Floodplains

The Mingo Creek floodplain dominates the Memorial/Owasso Corridor and is located south of Tulsa International Airport. It runs parallel to the Mingo Valley Expressway until its confluence with Bird Creek south of Owasso. Both Bird Creek and Mingo Creek have floodplains which are one mile wide or wider in places. These floodplains are predominantly 100 year floodplains with some 500 year floodplains along the edges. In the southern of the corridor, there are fingerlike floodplains following the small creeks that drain the area.

Hazardous Waste Sites

There are 12 hazardous waste sites in the Memorial/Owasso Corridor which have been studied by the EPA for inclusion in the Superfund program. Two of these sites are currently under further study for inclusion in the Superfund program and both are within the Tulsa International Airport along N. Mingo. The remaining ten sites have been determined by the EPA to require no further action. Five of these sites are along I-44 — three are on the airport grounds; one is northwest of the intersection of E. Apache and N. 145th E. Avenue; and the last site is located along Bird Creek between E. 46th Street N. and E. 56th Street N.

Indian Lands

There are nine parcels of Indian land which are restricted from development in the Memorial/Owasso Corridor. These are spread throughout the corridor with three parcels located north of the airport, two parcels are on the south side of airport, north of I-244, and the remaining four sites are south of the Broken Arrow Expressway.

Noise Sensitive Land Uses

The majority of noise sensitive land uses in the Memorial/Owasso Corridor are scattered south of the Tulsa International Airport in the Memorial/Owasso Corridor. In addition, there is an isolated cluster in the Owasso area.

Parks, Recreation Lands and Wildlife Refuges

There are nine city parks and recreation lands in the Memorial/Owasso Corridor. Seven of these are scattered south of the Tulsa International Airport, one is in Owasso north of E. 76th Street N. and east of the Mingo Valley Expressway, and one, Mohawk Park, is north of the airport along the corridor boundary.

Prime and Unique Farmlands

There is one area of prime agricultural land in the Memorial/Owasso Corridor. It extends northwest from the intersection of N.129th E. Avenue and E. 36th Street N. to E. 66th Street N. one-half mile east of the corridor boundary and west across the boundary. Most of the remaining land in the corridor north of E. Apache and outside of Tulsa International Airport are mixed prime and non-prime farmlands. There are also areas of mixed prime and non-prime lands south of the airport along Mingo Creek and south of E. 51st Street which appear to be developed.

Slopes Over 9%

There are five areas with slopes over 9 percent in the Memorial/Owasso Corridor. These are all located southeast of I-44 with four of the areas being between I-44 and E. 71st Street. The fifth area is to the northeast of the intersection of E. 101st Street and S. Sheridan.

Wetlands

There are 34 palustrine wetland sites over ten acres in the Memorial/Owasso Corridor and one grouping of smaller wetlands. These sites are spread throughout the corridor with many of the larger wetlands following Mingo Creek and Bird Creek. The grouping of smaller wetlands is located southeast of the intersection of E. 81st Street and S. Sheridan.

SUMMARY

The corridor specific environmental factors provide a base inventory. Table 50 summarizes the 12 environmental factors present in each corridor. There are no National Register historic sites in the Memorial/Owasso Corridor. The Sand Springs Corridor is the only corridor with a Superfund Site. Jenks/Riverside, Sapulpa, and Sand Springs are the only corridors with known nesting sites for threatened and endangered species. All of the corridors (the central business district is included in all the corridors except the Memorial/Owasso Corridor) contain floodplains, hazardous waste sites, Indian lands, noise sensitive land uses, parks and recreation lands, prime and unique farmlands, slopes over 9 percent, and wetlands.

Subsequent analysis will be performed using this environmental inventory. Specifically, these inventories will be used in evaluating the alternative corridors and in recommending the transit priority groupings.

Table 50

Tulsa Urban Area Environmental Factors

ENVIRONMENTAL FACTORS	Central Business District	Downtown/ Airport Corridor	Lynn Lane Corridor	Broken Arrow Corridor	Broken Arrow/ Memorial Corridor	Jenks/ Riverside Corridor	Sapulpa Corridor	Sand Springs Corridor	Memorial/ Owasso Corridor
Archaeological Sites	--	--	●	●	--	●	●	--	●
Floodplains	--	●	●	●	●	●	●	●	●
Hazardous Waste Sites	●	●	●	●	●	●	●	●	●
Indian Lands	--	●	●	●	●	●	●	●	●
National Register Historic Sites	●	--	●	●	●	●	●	--	--
Noise Sensitive Land Uses	●	●	●	●	●	●	●	●	●
Parks, Recreation Lands, and Wildlife Refuges	●	●	●	●	●	●	●	●	●
Prime and Unique Farmlands	--	●	●	●	●	●	●	●	●
Slopes Over 9%	--	●	●	●	●	●	●	●	●
Superfund Sites	--	--	--	--	--	--	--	●	--
Threatened and Endangered Species	--	--	--	--	--	●	●	●	--
Wetlands	--	●	●	●	●	●	●	●	●

Source: Parsons Brinckerhoff, 1989

11.0 PRELIMINARY EVALUATION OF CORRIDORS

This section uses the evaluation information developed and presented in Technical Memorandum 13.0, Preliminary Evaluation of Travel Corridors, to suggest the categories in which the potential travel corridors belong for future development and/or treatment.

Applying the methodology outlined in Section 3.0: Technical Approach and Agency/Public Coordination, the reports and work products developed along the course of the first phase were gleaned in order to provide relevant data upon which the potential regional travel corridors were compared and contrasted, and their potential for fixed guideway development assessed.

The general approach was one of increasing aggregation of nine evaluation measures into five evaluation categories. The nine measures, as described in Section 3.0, include performance, environmental concerns, cost, federal requirements (related to cost per new rider attracted to the investment), land use, equity, local goals and objectives, institutional feasibility, and financial feasibility. Quantitative information on each corridor for each of the nine measures was presented. The corridor's relative potential for meeting the evaluation goal was compared, and a rating of high attainment, medium attainment, and low attainment was assigned.

These nine measures were then collapsed into five categories: cost, effectiveness (ridership), impacts, financial/institutional, and cost effectiveness. Again, the rating of high, medium, and low was assigned. The detailed quantitative data used in Technical Memorandum 13.0 are included in Appendix F. The subsequent two sections present the summary data from Technical Memorandum 13.0.

Tables 51 and 52 summarize the corridor rankings for the nine evaluation measures.

Table 51 shows how well, comparatively, a fixed guideway investment would likely perform in the nine regional corridors being studied.

Table 52 shows the number of high, medium, and low rankings each corridor received compared to the other corridors.

SUMMARY FOR FIVE EVALUATION CATEGORIES

These nine evaluation measures were distilled into five categories:

- Costs — capital, and operations and maintenance
- Effectiveness — ridership performance
- Impacts — environmental, equity, and land use
- Financial/Institutional — local goals and objectives, financial, and institutional
- Cost Effectiveness — cost effectiveness measured in costs per new transit rider attracted

Table 53 shows how the eight corridors rank in terms of these five evaluation categories, and Table 54 presents the corridor rankings measured in terms of total ridership, new ridership, and cost effectiveness.

Table 51

Fixed Guideway Investment Summary

Corridor	Performance	Cost	Federal Requirements (Cost-Effectiveness)	Land Use	Equity	Goals and Objectives	Institutional	Financial	Environmental
Downtown/Airport	◐	◐	●	◐	◐	●	●	◐	●
Lynn Lane	○	◐	○	◐	◐	◐	◐	◐	●
Broken Arrow	●	◐	●	●	●	◐	●	◐	○
Broken Arrow/Memorial	●	◐	◐	●	◐	●	◐	◐	◐
Jenks/Riverside	◐	◐	○	◐	◐	●	●	◐	◐
Sapulpa	○	◐	○	◐	○	○	●	○	○
Sand Springs	○	●	○	○	◐	○	●	●	○
Memorial/Owasso	◐	○	◐	●	◐	●	◐	◐	◐

● High potential in meeting specific performance measure
◐ Medium potential in meeting specific performance measure
○ Low potential in meeting specific performance measure

Source: Parsons Brinckerhoff, 1989

Table 52

Potential Rankings by Corridor

Corridor	Rankings		
	High	Medium	Low
Downtown/Airport	4	5	0
Lynn Lane	1	6	2
Broken Arrow	5	3	1
Broken Arrow/Memorial	3	6	0
Jenks/Riverside	2	6	1
Sapulpa	1	2	6
Sand Springs	3	1	5
Memorial/Owasso	2	6	1

Source: Parsons Brinckerhoff, 1989

Table 53

Evaluation Summary by Five Major Categories

Corridor	Cost	Effectiveness (Ridership)	Impacts	Financial/ Institutional	Cost Effectiveness
Downtown/Airport	◐	◐	◐	●	● *
Lynn Lane	◐	○	◐	◐	○
Broken Arrow	◐	●	●	●	● *
Broken Arrow/Memorial	◐	●	◐	●	◐
Jenks/Riverside	◐	◐	◐	●	○
Sapulpa	◐	○	○	○	○
Sand Springs	●	○	○	◐	○
Memorial/Owasso	○	◐	◐	●	◐

● High potential to meet stated evaluation categories
◐ Medium potential to meet stated evaluation categories
○ Low potential to meet stated evaluation categories

* Has one alternative meeting UMTA threshold of $10/new rider

Source: Parsons Brinckerhoff, 1989.

Table 54

Corridor Rankings for Various Performance Categories

Rankings in Total Riders	Rankings in New Rider Attracted	Ranking in Cost Effectiveness	
		HOV 1	LRT
Broken Arrow/Memorial Corridor	Downtown/Airport Corridor	Downtown/Airport Corridor	Downtown/Airport Corridor
Broken Arrow Corridor	Broken Arrow Corridor	Broken Arrow Corridor	Memorial/Owasso Corridor
Jenks/Riverside Corridor	Memorial/Owasso Corridor	Memorial/Owasso Corridor	Broken Arrow Corridor
Sapulpa Corridor	Broken Arrow/Memorial	Broken Arrow/Memorial Corridor	Broken Arrow/Memorial Corridor
Lynn Lane Corridor	Sapulpa Corridor	Sapula Corridor	Jenks/Riverside Corridor
Memorial/Owasso Corridor	Lynn Lane Corridor	Lynn Lane Corridor	Lynn Lane Corridor
Downtown/Airport Corridor	Jenks/Riverside Corridor	Jenks/Riverside Corridor	Sapulpa Corridor
Sand Springs Corridor	Sand Springs Corridor	Sand Springs Corridor	Sand Springs Corridor

Source: Parsons Brinckerhoff, 1989

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12.0 RECOMMENDED TRANSIT CORRIDOR PRIORITY GROUPINGS

TIER 1

For the purposes of the first phase of systems planning, Tier 1 corridors may be considered travel corridors which might be expected to have future potential for development of fixed guideway facilities as a function of forecast growth, land use, and related travel demand and diminished highway capacity. The time frame for assessing the Tier 1 corridor is the long-range planning horizon used by INCOG. The most recently adopted long-range plan uses the horizon of 2005. Using this planning year does not imply that the improvement needs to be implemented by this year; however, the targeted planning year provides a common frame of reference from which to rank the eight potential corridors, to compare the relative strengths and weaknesses of each, and to indicate the general timeframe in which the improvement may be cost effective.

Based upon the relative comparison of the eight potential corridors using the nine evaluation measures and the five evaluation categories, the consultant recommends that the following corridors be designated Tier 1 corridors:

- Broken Arrow
- Broken Arrow/Memorial
- Downtown/Airport
- Jenks/Riverside
- Memorial/Owasso

Figure 33 shows the Tier 1 corridors.

TIER 2

Tier 2 corridors are travel corridors that could be deemed appropriate for future supplemental high-capacity transit services, but are unlikely to be effective for rail or other high capital-intensive investments for many years into the future. The supplemental high capacity transit services could include such improvements as exclusive busways, express bus facilities, and park-and-ride lots.

Based upon the relative comparison of the eight potential corridors using the nine evaluation measures and the five evaluation categories, the consultant recommends that there are no designated Tier 2 corridors.

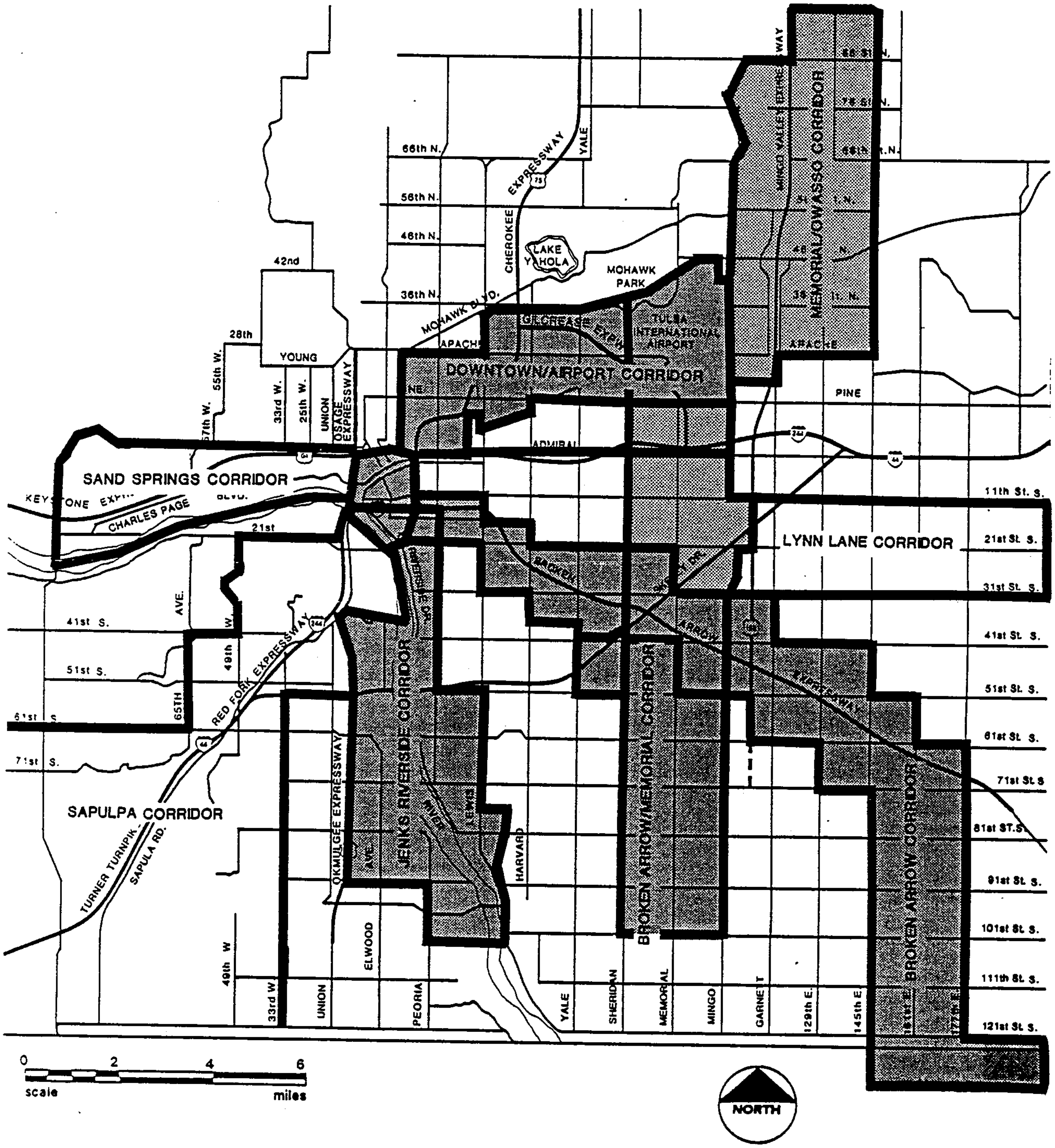
TIER 3

Tier 3 corridors are those corridors which have been identified in the first phase of systems planning study as possibly having potential for future fixed guideway development. Upon preliminary evaluation however, they appear to have little or no real potential for transit development under current demographic forecasts.

Based upon the relative comparison of the eight potential corridors using the nine evaluation measures and the five evaluation categories, the consultant recommends that the following corridors be designated Tier 3 corridors:

- Lynn Lane Corridor
- Sapulpa Corridor
- Sand Springs

Figure 34 shows the Tier 3 corridors.



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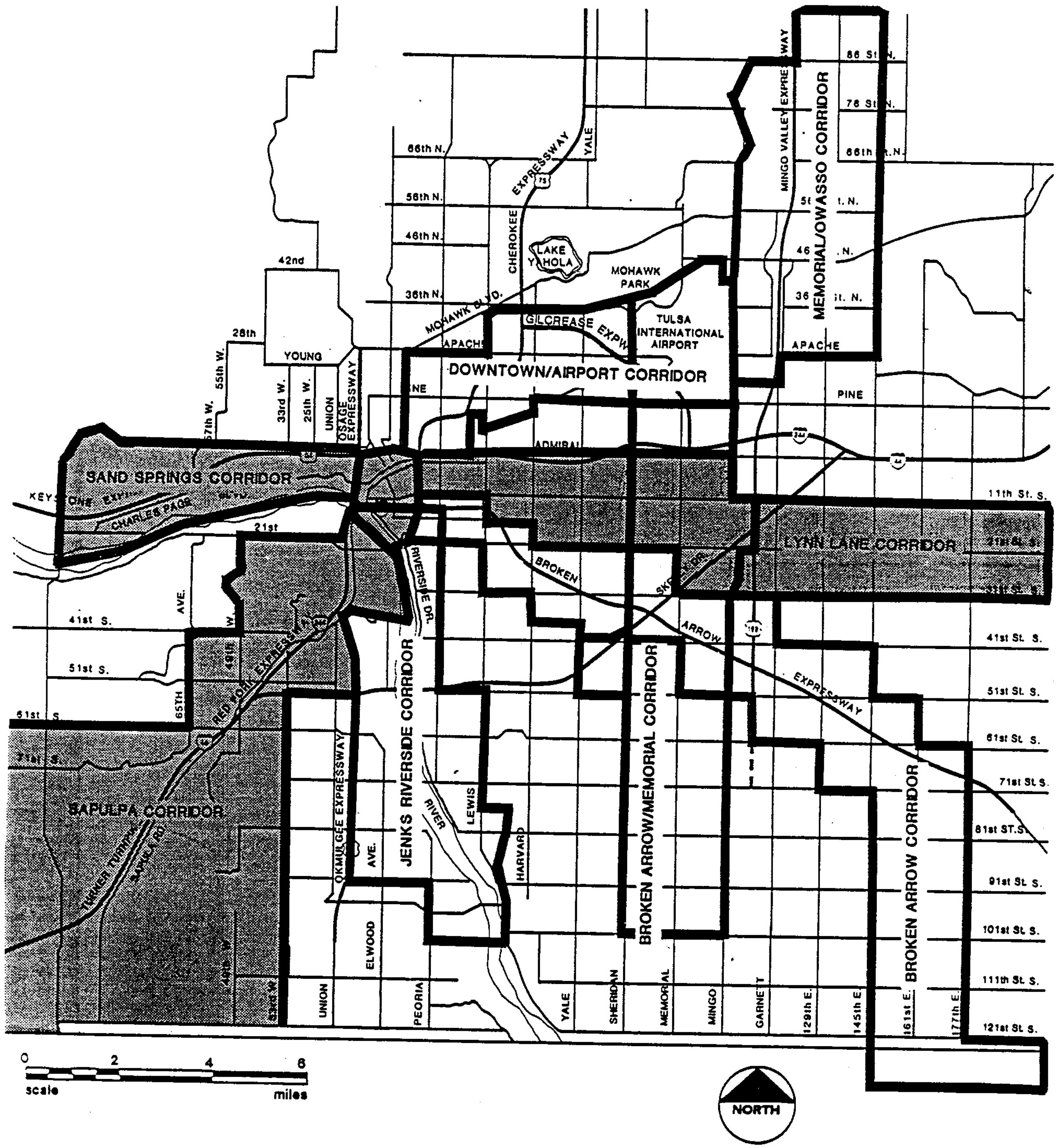
Oklahoma Fixed Guideway Transportation System Study

Figure 33

TULSA TRAVEL CORRIDORS
Recommended Tier 1 Corridors



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	TULSA TRAVEL CORRIDORS **Recommended Tier 3 Corridors**	**34**

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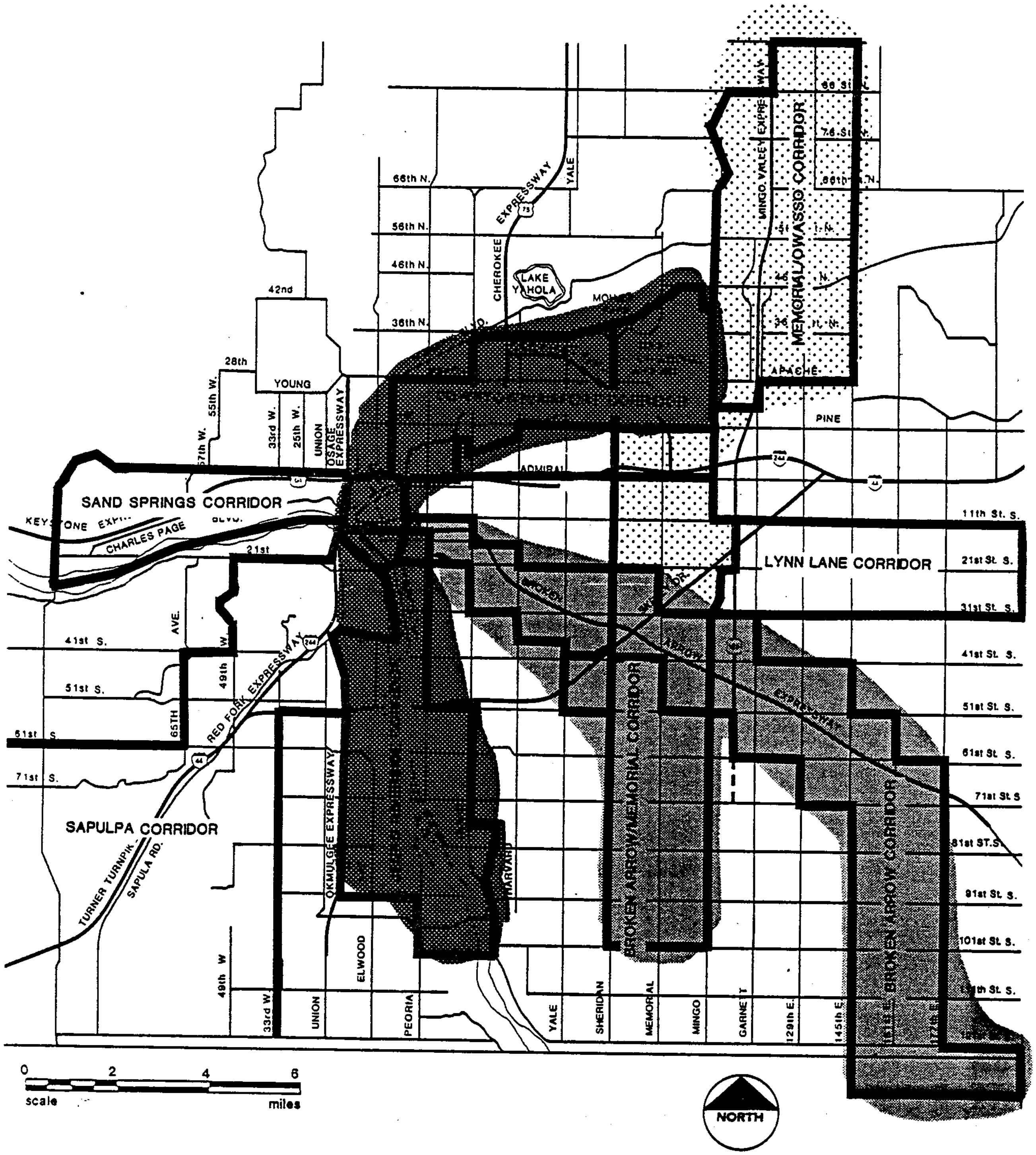
13.0 SUBSEQUENT STUDY PHASES

APPROACH

Based upon the proposed Tier 1 Corridors: Broken Arrow, Broken Arrow/Memorial, Downtown/Airport, Jenks/Riverside and Memorial/Owasso, it is recommended that these five corridors, as defined in Phase I of the systems planning study, be combined for further analysis in Phase II of the study. Specifically, it is recommended that the Broken Arrow to Downtown Tulsa diagonal be combined with a spur south along the Memorial Drive corridor. A second north-south corridor should also cover this spur north to Owasso. The third corridor would be a band between the Airport, downtown Tulsa south to the Jenks/Riverside Corridor. Figure 35 shows the location of these corridors.

A two-step screening of these five corridors would be performed early in Phase II after the modal split modeling for the system is performed. Based on resulting ridership forecasts, an analysis to identify minimal operable segments (MOS) would be conducted. A minimal operable segment as defined by UMTA officials is a stand-alone piece of a fixed guideway project that can work as an effective system or on its own, not dependent upon a later phase project implementation. In other words, it is a minimum number of miles to be constructed, in most places less than 20 miles, that the local authority can afford to finance and build, and which can be shown to be cost effective. It does not involve multiple corridors. These broad Phase I corridors would then be divided into categories of MOSs: MOS1, MOS2, MOS3, etc. The detailed analyses of costing and impacts analyses dependent on location specific information would be performed on the top three MOSs. The actions to preserve rights-of-way would be identified and forecast would still be developed for the broad corridors.

Based upon the detailed cost estimates, engineering data, environmental factors, ridership and other factors, the leading three or four MOSs will be ranked at the close of Phase II. At the same time, a staging plan for implementation will be developed. The results of the transition study (Phase II) will be identification of a single priority travel corridor. It will also specify several promising alignments and a set of alternatives. These will be brought into an Alternatives Analysis Draft Environmental Impact Study if warranted.



Parsons Brinckerhoff Parsons Brinckerhoff Quade & Douglas, Inc. Engineers • Architects • Planners	*Oklahoma Fixed Guideway Transportation System Study*	Figure
	TULSA TRAVEL CORRIDORS **Corridors Recommended for Phase II Study**	**35**

APPENDICES A THROUGH E

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APPENDIX A

Summary of Study Products

The following is a list of technical memorada prepared for Phase I:

Technical Memoranda No.	Report	Date
1.0	Existing Studies and Data	Jul 1988
2.0	Detailed Work Plan for System Planning Phase	Jun 1988
3.1	Demand Forecasting and Patronage Estimation	Jun 1988
3.2	Capital and Operating Cost Estimation	Jun 1988
3.3	Evaluation Process	Jun 1988
5.0	Transportation Deficiencies	Oct 1988
6.0	Purpose and Need	Oct 1988
7.0	Potential Regional Transit Corridors	Oct 1988
8.0	Guideway Technology Options	Oct 1988
9.0	Corridor TSM Programs	Dec 1988
10.0	Corridor Travel Demand	Jan 1989
11.0	Corridor Capital and Operating Costs	Dec 1988
12.0	Potential Environmental Issues	Feb 1989
13.0	Preliminary Evaluation of Potential Transit Corridors	Mar 1989
14.0	Initial Cost-Effectiveness Measures	Feb 1989
15.0	Transit Corridor Priority Groups	Mar 1989
16.0	Draft Systems Planning Project Report	Aug 1989

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Appendix B

Unit Capital Costs

Appendix B presents the unit cost estimate assumptions used in calculating the system-level capital costs. These are based on the methodology presented in Technical Memoradum 3.1: Capital and Operating Cost Estimation.

Table B-1

**UNIT CAPITAL COSTS:
BUS, HOV/BUSWAY AND GENERAL FACILITIES**

	Unit	Cost Per Unit
Guideway: Two-Lane Busway/HOV (At-Grade: - new facility)	Linear Foot	$ 350
Guideway: Two-Lane Busway/HOV on Railroad ROW and Two Flyovers per mile	Linear Foot	1,200
Highway: Add 12-Foot Freeway Lane	Linear Foot	100
Highway: Two 12-Foot Freeway Lanes	Linear Foot	200
Bus Maintenance Facility	Vehicle	150,000
Busway Station (At-Grade)	Each	350,000
Parking (Surface Lot/Elevated Structure)	Space	2,500/8,000
Overpass	Square Foot	75
Traffic Signalization (New Installation, Per Intersection)	Each	100,000
Insurance (6%), Agency Costs (4%), and Project Design and Construction Management (25%)		Add 35% to Total Cost
Contingency — (20%) Including Insurance, Agency Costs, and Project and Construction Management		Add 20% to Total Cost

Surface parking lots include park and ride amenities, excluding right-of-way.
All costs are Spring 1988 dollars.

Table B-2

UNIT CAPITAL COSTS: LIGHT RAIL TRANSIT (LRT)

	Unit	Cost Per Unit
Guideway, Trackwork, Power, and Control		
At-Grade (Embedded) - Single Track	Linear Foot	$ 350
At-Grade (Embedded) - Double Track	Linear Foot	700
At-Grade (Typical Ballasted Section) - Two-Track	Linear Foot	1,500
Aerial Structure	Linear Foot	4,400
Passenger Boarding Station		
At-Grade (Simple)	Each	300,000
Aerial	Each	2,500,000
LRT Maintenance Facility	Vehicle	300,0001 [1]
Insurance (6%), Agency Costs (4%), and Project Design and Construction Management (25%)		Add 35% to Total Cost
Contingency — (20%) Including Insurance, Agency Costs, and Project and Construction Management		Add 20% to Total Cost

1 For a fleet of less than 20 cars, the garage costs would be approximately $4,000,000, excluding right-of-way of about ten acres.

All costs are Spring 1988 dollars.

Table B-3

UNIT CAPITAL COSTS: AUTOMATED GUIDEWAY TRANSIT (AGT)

	Unit	Cost Per Unit
Guideway, Trackwork, Power, and Control		
At-Grade: Two-Track	Linear Foot	$ 1,700
Aerial Structure: Two-Track	Linear Foot	4,300
Aerial Structure: Single-Track	Linear Foot	2,300
Passenger Boarding Station		
At-Grade (Simple)	Each	250,000
Aerial	Each	1,500,000
AGT Maintenance Facility	Vehicle	315,000 [1]
Insurance (6%), Agency Costs (4%), and Project Design and Construction Management (25%)		Add 35% to Total Cost
Contingency — (20%) Including Insurance, Agency Costs, and Project and Construction Mangagement		Add 20% to Total Cost

1 For a fleet less than 20 cars, the facility cost would be approximately $4,000,000, excluding right-of-way of about six acres.

All costs are Spring 1988 dollars.

Table B-4

UNIT CAPITAL COSTS: VEHICLES

	Unit	Cost Per Unit [1]
Standard 40-Foot Coach	Each	$ 175,000
Standard Articulated Coach	Each	240,000
Exclusive Busway Maintenance Vehicle	Lump Sum	270,000
Light Rail Transit Vehicle	Each	1,200,000
AGT Vehicle	Each	1,050,000
LRT/AGT Maintenance Vehicles	Lump Sum	900,000
Procurement Services		Add 6% to Total Cost
Contingency (10%) including procurement services		Add 10% to Total Cost

1 Costs include equipping the vehicle with air conditioning and wheelchair lifts, fare boxes, radios, and includes spare parts, testing, inspection, and acceptance.

All costs are Spring 1988 dollars.

APPENDIX C

Corridor Evaluation/Ranking Process

EVALUATION/RANKING CONTEXT

This section provides the context for developing the types of indicators and measures appropriate for guiding the overall evaluation process. Moreover, it sets the framework for identifying the key issues necessary to stratify the numerous travel corridors into the three tiers. It presents applicable federal, regional, and local goals related to public transit and transportation improvements.

IDENTIFICATION OF GOALS AND OBJECTIVES

The primary concern in selecting appropriate evaluation indicators and measures is the extent to which they reveal how well alternative travel corridors will advance the regional transportation system toward meeting established planning goals and objectives. Relevant goals and objectives relating to transit and transportation investments for the Tulsa urban area have been obtained from the following sources:

- Regional and Local Policies
  - Long-Range Transportation Plan, Major Update Year 2005 (1987)
  - Metropolitan Development Guidelines (1987)
  - Tulsa Metropolitan Area Comprehensive Plan, Transportation Goals (1987)
  - Federal Policies
  - Urban Mass Transportation Administration (UMTA) Procedures and Technical Methods for Transit Project Plan ning (September 1986)
  - UMTA Major Capital Investment Policy (May 1984)
  - UMTA Policy on Private Enterprise Participation in the Urban Mass Transportation Program (October 1985)
  - UMTA/Federal Highway Administration (FHWA) Final Rule, Environmental Impact and Related Procedures (October 1980)
  - Council on Environmental Quality (CEQ), Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (November 1978)
  - A Detailed Description of UMTA's System for Rating Proposed Major Transit Investments (May 1984)
  - Financial Analysis for Proposed New Start Projects (September 1984)

Regional and Local Policies

The principle guidelines, objectives and policies directing the Tulsa Urban Area Fixed Guideway Transportation System Study project are provided by the following three sources:

- Long-Range Transportation Plan, Major Up date Year 2005 (LRTP) - Tulsa Metropolitan Area Transportation Study (TMATS), 1987;
- Metropolitan Development Guidelines (MDG) - Tulsa Metropolitan Area Planning Commission (TMAPC), 1987; and,
- Tulsa Metropolitan Area Comprehensive Plan, Transportation Goals (TCP) - TMAPC, 1987.

Because of the importance of these goals in shaping the evaluation process, this section assigns these sources a numerical system to summarize goals and objectives. These are used for later reference and will be directly applied to the candidate travel corridors in the first study phase and to the Tier1 travel corridors in subsequent study phases.

Long-Range Transportation Plan (LRTP), Major Update Year 2005 for the Tulsa Metropolitan Area Transportation Study (LRTP-Goals and Objectives)

The Indian Nation Council of Governments (INCOG) serves as the regional metropolitan organization for transportation planning or MPO. The study area is called the Tulsa Metropolitan Area Transportation Study (TMATS). The 2005 TMATS Plan for the Tulsa metropolitan area serves as the official regional long-range transportation plan. It outlines regional goal and objectives. Officially adopted in 1982 by the TMATS Transportation Policy Committee, the area transportation goals follow:

LRTP IV GOAL: TO PROVIDE FOR SAFE AND EFFICIENT MOVEMENT OF PEOPLE AND GOODS.

Objectives:

I.1 That a variety of trafficway types will be provided and specifically designed to serve the distinct traffic needs of the Tulsa metropolitan area;

I.2 That suitable and safe access be planned to all developed or developable property, when possible;

I.3 That vehicle storage on roadways be restricted or prohibited, where required, in order that the desired capacity and flow of the arterial street network be maintained;

I.4 That traffic related accidents, fatalities, injuries, and property damage be minimized through appropriate facility design;

I.5 That trafficways be planned to discourage non-local traffic from passing through residential neighborhoods;

I.6 That each trafficway and terminal facility be planned with sufficient capacity to accommodate anticipated traffic based on projected land use intensities;

I.7 That the transportation system minimizes travel time, travel delays, and traffic congestion;

I.8 That facilities be provided for pedestrian movements and bikeways, where feasible, and depending on cost;

I.9 That land use intensity be controlled in order that traffic generation will not exceed the planned capacity of any facility;

I.10 That the development of other transportation modes be coordinated with the transit network to encourage transit development and use, when possible;

I.11 That the development and expansion plan for transit include development of a higher speed transit system when technologically, functionally, and financially feasible;

I.12 That a balanced transportation system be provided, consisting of a variety of travel modes including highway, transit, air, water, rail, bicycle, and pedestrian, recognizing all users and their specific needs;

I.13 That the transportation planning process be an element of the adopted Comprehensive Plan;

I.14 That trafficways be located so as to preserve and enhance desirable and productive land use areas, when possible;

I.15 That trafficways be environmentally compatible;

I.16 That the transportation system be capable of minimizing energy consumption;

I.17 That future right-of-way acquisition be identified, preserved from development, when possible, and acquired well in advance of need;

I.18 That sufficient right-of-way be acquired initially to accommodate the long-range transportation needs, including transit, in a corridor, even though staged construction is necessary to finance the incremental development of the facility;

I.19 That trafficway improvements be planned, designed, scheduled, and constructed in a coordinated manner with activities associated with other public utilities and quasi-public utilities; and,

I.20 That the construction of transportation services be properly phased in order to ensure minimization of construction costs and that the most needed services have priority, including maintenance of existing facilities.

Metropolitan Development Guidelines (MDG)

The Tulsa Metropolitan Area Planning Commission, City Commission and County Commission developed and adopted "Metropolitan Development Guidelines and Zoning Matrix" for the Tulsa metropolitan area in 1987. The ones related to transportation follow:

1. Develop a balanced transportation system consisting of a variety of highways and air, rail, mass transit and water modes of travel to provide for safe, convenient, and efficient movements of people, goods, and services.

   1.1 Locate the most intense business and residential development close to high level transportation systems (freeways, railways, and transit).

   1.2 Design the transportation network for the safe movement of goods and people by minimizing conflict between vehicle and vehicle, and pedestrian and vehicle.

   1.3 Maximize the interrelation between land use and transportation and, in particular, encourage development patterns compatible with the evolution of transit systems.

Tulsa Metropolitan Area Comprehensive Plan - Transportation

The Tulsa metropolitan area has recently completed comprehensive long-range planning efforts for all components of the city's development, including transportation plans. These have been developed for all of the planning districts in the Tulsa metropolitan area. These were completed in 1987. Listed below is a summary of the adopted transportation goals for the Tulsametropolitan area. Since these come from the individual district plans, some appear duplicative; however, each district has its own set of transportation goals and objectives. A compilation of these follows. (The numbering system indicates the planning district from which the goals come. For example, Goal16.2 means this is a goal from District16.)

District 1

1.1 The appropriate use of all transportation modes for travel to and from and within the downtown should be encouraged by the development of adequate facilities and services.

1.2 The use of mass transit for trips to and from the downtown should be encouraged by the continued improvement and promotion of transit services to the downtown.

1.3 Efficient travel to and from the downtown by automobile should be maintained by providing adequate facilities and encouraging high vehicle occupancy rates.

1.4 Pedestrian movement should be encouraged as the principal form of travel within the downtown by the improvement of pedestrian facilities.

1.5 An internal transit system, adequate for accommodating nonpedestrian travel demand within the downtown, should be developed.

District 2

2.1 To improve circulation and transportation systems within District 2.

2.2 To provide an efficient and functional system of roadways within and surrounding the district to serve all levels of land activities.

2.3 To facilitate movement within the district, and to offer alternative methods of transportation.

2.4 To efficiently and safely move a large number of people throughout and outside of the district.

2.5 To ensure better maintenance of all railroad right-of-way land within District 2.

District 3

3.1 To provide a convenient, efficient, and safe system of movement for people, goods and services throughout District 3.

3.2 To provide a convenient, efficient, and functional system of roadways within and surrounding the district to service all levels of land use.

3.3 To develop a transit system which meets the transportation needs of the district residents as they relate to the land uses within District 3 and the community.

District 4

4.1 To provide an economical, convenient, and safe circulation system capable of efficiently moving people, goods and services throughout the district and that provides the district with maximum accessibility to goods and services throughout the metropolitan area and beyond.

4.2 To provide a functional, efficient, and attractive roadway system that adequately serves the needs of the district's various planned land activity areas.

4.3 To provide an aesthetically pleasing and safe pedestrian and bicycle pathway system throughout the district which connects with major metropolitan pathways.

4.4 To develop a mass transit system which serves the transportation needs of the district residents as they related to land activity areas within the district and the urban area.

District 5

5.1 To provide a range of transportation opportunities for the citizens of District 5.

5.2 To provide a complete network of roadways that are safe and efficient to the users.

5.3 To provide an aesthetically pleasing and safe pedestrian and bicycle pathway system throughout the district.

5.4 To provide a transit system which is safe, fast, and efficient.

District 6

6.1 To provide an economical, convenient, and safe circulation system capable of efficiently moving people, goods, and services throughout the district.

6.2 To provide a functional and efficient roadway system compatible with the needs of District 6.

6.3 To provide an aesthetically pleasing and safe pedestrian and bicycle pathway system throughout the district.

6.4 To develop an efficient mass transit system which serves the needs of District 6 as these needs relate to the residents and the land use within the district and the entire community.

District 7

7.1 To provide a safe, efficient, and economical movement of people and goods within and through the district, with minimum adverse impact on the environment.

7.2 To improve all major streets and highways in the district to Comprehensive Plan standards.

7.3 To provide visually attractive as well as functionally efficient streets.

7.4 To provide efficient adequate off-street parking in the district, with minimum adverse effect on other uses.

7.5 To provide walkways and bikeways in District 7 wherever it is anticipated that their use will warrant their construction, but particularly to serve persons bound to and from schools, the River Park and other recreation areas, shopping areas, and the Central Business District. These bike- and walkways should be planned in accordance with the adopted Open Space, Park, and Recreation Plans.

7.6 The provide transit facilities and services to meet the basic transportation needs of persons who cannot or choose not to use private automobile transportation. Transit should be encouraged and assisted throughout the metropolitan area, in order to facilitate transportation of the disadvantaged, reduce consumption of resources, reduce automobile traffic, and reduce air pollution.

District 8

8.1 To ensure safe, efficient, and economical movement of people and goods within and through the district, with minimum adverse impact on the environment.

8.2 To improve all major streets and highways in the district to Comprehensive Plan standards.

8.3 To improve existing private streets in Section 10 to public standards and their dedication and acceptance as public streets.

8.4 To prove adequately lit streets that are visually attractive as well as functionally efficient.

8.5 To provide efficient adequate off-street parking in the district particularly in conjunction with transit terminals with minimum adverse effect on other uses.

8.6 To provide walkways and bikeways in District 8, wherever it is anticipated that their use will warrant their construction, but particularly to serve neighborhoods, schools, recreation areas, and shopping areas.

8.7 To provide transit facilities and services to meet the basic transportation needs of persons who cannot or choose not to use private automobile transportation. Transit should be encouraged and assisted throughout the metropolitan area, in order to facilitate transportation to the disadvantaged, reduce consumption of resources, reduce automobile traffic, and reduce air pollution.

8.8 To adjust relationships between railroads, other transportation elements, and land use so that safety will be improved, rail operations facilitated, traffic-carrying capacity of major streets increased, and values of abutting properties enhanced.

District 9

9.1 To facilitate necessary movement of people and goods throughout the district with alternative methods to the maximum extent feasible.

9.2 To establish a street system the provides safety and efficiency in use and compatibility with the land activity to be served.

9.3 To provide routes through residential areas with connections to other use areas where there is a high frequency of trip desires. These routes should be accomplished with the highest possible separation from motor vehicle trafficways.

9.4 To provide the most usable possible alternative to travel by private automobile.

9.5 To continue rail services to District 9 as a part of the overall transportation service of the district and the city.

9.6 To develop future features of the rail system in harmony with other transportation, adjoining land uses, and the environment.

District 10

10.1 To ensure safe, efficient, and economical movement of people and goods within and through the district, with minimum adverse impact on the environment.

10.2 To ensure that streets are brought up to at least minimum standards to serve all developed property in the district.

10.3 To ensure that streets, particularly major streets and highways, are visually attractive.

10.4 The efficient provision of adequate off-street parking in the district, with minimum adverse effects on other uses.

10.5 To provide transit facilities and services that meet the basic transportation needs of persons who cannot or choose not to use private automobile transportation.

10.6 To adjust relationships between railways and other transportation elements and land use so that safety will be improved, rail operations facilitated, traffic-carrying capacity of major streets increased, and values of abutting properties enhanced.

District 11

11.1 To prove a balanced transportation system for the safe and efficient movement of people and goods.

11.2 To provide an efficient major trafficways network.

11.3 To provide a system of walkways and bicycleways to serve the residents in a safe, aesthetically pleasing, and functional manner.

11.4 To expand efficient mass transit service to the area.

11.5 To provide convenient and safe access to the district and metropolitan area for those persons utilizing private aviation.

District 16

16.1 To provide a total transportation system to move people and goods intercity or intra-city.

16.2 To provide a street system in District16 capable of carrying the traffic in a safe and efficient manner.

16.3 To provide a safer and more efficient trafficway system through the prevention of strip commercial and multiple curb cuts along major streets.

16.4 To provide an aesthetically pleasing and safe pedestrian and bicycle pathway system throughout the district.

16.5 To have an alternative means of transportation that will supplement the family automobile in providing the people of District16 a way to work or shop.

16.6 To have the best possible airport facility that Tulsa can afford continuing to provide employment and air transportation to northeastern Oklahoma.

16.7 Continue rail service to District16 as a part of the total transportation services to Tulsa and District16.

District 17

17.1 To provide an economical, convenient, and safe circulation system capable of efficiently moving people, goods, and services throughout the district.

17.2 To provide a functional and efficient roadway system compatible with the needs of District 17.

17.3 To provide an aesthetically pleasing and safe pedestrian and bicycle pathway throughout the District.

17.4 To develop a mass transit system which serves the needs of the residents of District 17 as these needs relate to the land use within the district and the entire community.

District 18

18.1 To provide an economical, convenient, and safe circulation system capable of effectively moving people, goods, and services throughout District 18.

18.2 To provide an efficient and functional system of roadways within and surrounding the district to serve all levels of land activities.

18.3 To provide throughout the district an aesthetically pleasant and safe pedestrian and bicycle pathway system.

18.4 To develop a mass transit system which serves the transportation needs of the district residents as they relate to the land uses within District 18 and the community.

18.5 To provide District 18 with the proper and safe rail facilities required to support existing as well as future industrial activities.

District 24

24.1 To provide a range of transportation opportunities for all citizens of District 24.

24.2 To provide a complete network of roadways that are safe and efficient to the users.

24.3 To provide a system of sidewalks for pedestrians to move in a safe manner throughout the district.

24.4 To provide a bus system which is safe, fast, and efficient.

24.5 To utilize rail to economically transport goods and provide transport services to the commercial and industrial land uses in District 24.

24.6 To provide a safe and efficient system of bikeways to meet both recreational and transportation needs of the district.

District 25

25.1 To provide a total transportation system to move people and goods both inter-city and intra-city.

25.2 To provide a street system in District 25 capable of carrying traffic in a safe and efficient manner.

25.3 To provide a minimum area for people of all ages to walk, without conflict with the automobile.

25.4 To have an alternative means of transportation that will supplement the family automobile in providing the people of District 25 a way to work or to shop.

25.5 To continue rail service to District 25 as a part of the total transportation service to Tulsa and District 25.

25.6 To provide a safe and efficient system of bikeways to meet the recreation and transportation needs of District 25.

District 26

26.1 To provide a transportation system for safe and efficient movement of people and goods.

26.2 To provide an efficient, major trafficway network.

26.3 To encourage a safe and efficient local street system.

26.4 To provide efficient mass transit service to the district.

26.5 To ensure that development does not conflict with current or potential air corridors in the fight patterns of the Riverside Airport.

Federal Policies

Various formal and informal documents issued by UMTA and CEQ contain federal goals, policies, regulations, and guidelines governing new investment in transportation and environmental protection. In general, UMTA has produced the most documentation addressing criteria for funding new transit projects. This in response to their anticipated shortfall in meeting funding requests.

Current UMTA guidance for alternatives analysis presents a structure for organizing measures. While this study is not a formal alternatives analysis, the planning process and evaluation areas provide a good, solid basis for transit decision-making in the Tulsa area. These measures are organized into four key areas: (1) effectiveness, (2) cost-effectiveness, (3)financial feasibility, and (4) equity. From these four perspectives the characteristics of a desirable project are described briefly below:

- Effectiveness - that the project yields benefits in terms of mobility, environmental protection, urban development, energy conservation, and so forth;
- Cost-Effectiveness - that the project costs, both capital and operating, be commensurate with its benefits. UMTA requires cost-effectiveness measures as part of this process.
- Financial Feasibility - that project funds for the construction and operation be readily available in the sense that they do not place undue burdens on the sources of those funds. UMTA strongly encourages private sector financial participation for new projects.
- Equity - that the costs and benefits be distributed fairly across different population groups.

Other statements of federal policy which generally apply to transit investments include:

- Serve populated areas;
- Be integrated with overall regional transportation strategy;
- Help ensure environmental protection;
- Promote energy conservation;
- Aid urban economic development and central city economic activity;
- Support orderly patterns of urban growth; and
- Provide a maximum level of services (capacity) at minimum cost.

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Appendix D

Agency and Public Coordination

In additon to progress meetings and reports with ODOT, advisory groups have met to cover issues related to the Fixed Guideway Feasibility Study for the Tulsa metropolitan area. Below is a list of those meetings held and the topic(s) of discussion.

TMATS TECHNICAL ADVISORY COMMITTEE (TAC)

05-12-88 (2:00 pm)	A special joint meeting of the TMATS TAC and the TMATS Transportation Policy Committee (TPC) at which Parsons Brinckerhoff staff gave a slide presentation on the Fixed Guideway Feasibility Study their firm would be performing for the Tulsa metropolitan area.
06-09-88 (10:30 am)	The TMATS TAC was briefed under Staff Report of the progress on the Study, noting that INCOG staff had met with Parsons Brinckerhoff staff on data needs for the Study.
08-18-88 (10:30 am)	Parsons Brinckerhoff staff presented to the TMATS TAC four reports completed to this stage in the Study: Task 1.0 - Existing Studies and Data; 3.1 - Demand Forecasting and Patronage Estimation; Task 3.2 - Capital and Operating Cost Estimation; and Task 3.3 - Evaluation Process. The TMATS TAC received and accepted the four reports.
10-20-88 (10:30 am)	The TMATS TAC was briefed by INCOG staff that it probably will be necessary to have a special meeting of the Committee on November 10, 1988, to receive and review work from Parsons Brinckerhoff on the Fixed Guideway Feasibility Study for the Tulsa metropolitan area.
11-10-88 (10:30 am)	At a special meeting of the TMATS TAC, Parsons Brinckerhoff staff informed the Committee that approximately 60 to 65 percent of Phase I of the Study had been completed, and issued a copy of the Project Flow Diagram for the project. Parsons Brinckerhoff staff then reviewed for the Committee the following Phase I reports: Task 5.0 - Transportation Deficiencies; Task 6.0 - Purpose and Need; and Task 7.0 - Potential Regional Transit Corridors. A slide presentation was given on Task 8.0 - Guideway Technology Options. The TMATS TAC received and accepted the four reports as presented.
01-19-89 (10:30 am)	An updated Project Flow Diagram and Project Schedule were presented to the TMATS TAC by Parsons Brinckerhoff staff. The following Fixed Guideway Feasibility Study reports associated with the Tulsa metropolitan area were presented to the Committee: Task 9.0 - Corridor TSM Programs; Task 10.0 - Corridor Travel Demand; and Task 11.0 - Corridor Capital and Operating Costs (Summary). The three reports were received and accepted by the TMATS TAC as presented.

02-16-89 (10:30 am) At a special TMATS TAC meeting, the Committee received an updated Project Flow Diagram from the Parsons Brinckerhoff staff. The Committee was briefed on the following Study reports: Task 12.0 - Potential Environmental Issues and Task 14.0 - Initial Cost-Effectiveness Measures. The TMATS TAC received and accepted the two reports as presented.

04-20-89 (10:30 am) Parsons Brinckerhoff staff briefed the TMATS TAC on the following Study reports: Task 13.0 - Preliminary Evaluation of Potential Transit Corridors and Task 15.0 - Transit Corridor Priority Groups. An updated Project Flow Diagram was issued to the Committee. The specific corridors assigned to Tiers 1, 2, and 3 were presented to the TMATS TAC. The Committee voted to receive and accept the two tasks and the Tier 1 and Tier 3 corridors as presented.

TMATS TRANSPORTATION POLICY COMMITTEE (TPC)

05-12-88 (2:00 pm) A special joint meeting of the TMATS TAC and the TMATS Transportation Policy Committee (TPC) at which Parsons Brinckerhoff staff gave a slide presentation on the Fixed Guideway Feasibility Study their firm would be performing for the Tulsa metropolitan area.

09-08-88 (1:30 pm) Parsons Brinckerhoff staff presented to the TMATS TPC four reports completed to this stage in the Study: Task 1.0 - Existing Studies and Data; 3.1 - Demand Forecasting and Patronage Estimation; Task 3.2 - Capital and Operating Cost Estimation; and Task 3.3- Evaluation Process. The TMATS TPC received and accepted the four reports.

11-10-88 (1:30 pm) Parsons Brinckerhoff staff informed the TMATS TPC that approximately 60 to 65 percent of Phase I of the Study had been completed, and issued a copy of the Project Flow Diagram for the project. Parsons Brinckerhoff staff then reviewed for the Committee the following Phase I reports: Task 5.0 - Transportation Deficiencies; Task 6.0 - Purpose and Need; and Task 7.0 - Potential Regional Transit Corridors. A slide presentation was given on Task 8.0 - Guideway Technology Options. The TMATS TPC received and accepted the four reports as presented.

02-09-89 (1:30 pm) An updated Project Flow Diagram and Project Schedule were presented to the TMATS TPC by Parsons Brinckerhoff staff. The following Fixed Guideway Feasibility Study reports associated with the Tulsa metropolitan area were presented to the Committee: Task 9.0 - Corridor TSM Programs; Task 10.0 - Corridor Travel Demands; and Task 11.0 - Corridor Capital and Operating Costs (Summary). In response to a question from the Committee, the Committee was informed that Phase I of the Study would be completed by May 1989. The three reports were received and accepted by the TMATS TPC as presented.

03-16-89 (1:30 pm) At a special TMATS TPC meeting, the Committee received an updated Project Flow Diagram from the Parsons Brinckerhoff staff. The Committee was briefed on the following Study reports: Task 12.0 - Potential Environmental Issues and Task 14.0 - Initial Cost-Effectiveness Measures. The TMATS TPC received and accepted the two reports as presented.

05-11-89 (1:30 pm) Parsons Brinckerhoff staff briefed the TMATS TPC on the following Study reports: Task 13.0 - Preliminary Evaluation of Potential Transit Corridors and Task 15.0 - Transit Corridor Priority Groups. An updated Project Flow Diagram was issued to the Committee. The specific corridors assigned to Tiers 1, 2, and 3 were presented to the TMATS TPC. The Committee voted to receive and accept the two tasks and the Tier 1 and Tier 3 corridors as presented.

INCOG BOARD OF DIRECTORS

05-12-88 (3:00 pm) Parsons Brinckerhoff staff gave a slide presentation on the Fixed Guideway Feasibility Study their firm would be performing for the Tulsa metropolitan area. Parsons Brinckerhoff staff presented a background history on their firm, names of key people who will be working on the Fixed Guideway project, and an explanation of how they would carry out the Study in Tulsa.

01-12-89 (3:00 pm) The INCOG Board of Directors voted to approve support for Resolution No. 108, encouraging ODOT to complete the Fixed Guideway Feasibility Study for the Tulsa metropolitan area by entering into the Phase II portion of the Study.

05-11-89 (3:00 pm) Parsons Brinckerhoff briefed the INCOG Board of Directors of the corridors that were studied in Phase I and the consultant's recommendations on the Tier 1 and Tier 3 corridors. A Project Flow Diagram was issued to the Board members illustrating the process Parsons Brinckerhoff had gone through in the course of the Phase I Study. The Board was informed that the Phase I Final Report will be forthcoming, after which ODOT will have to make a decision whether or not to enter into Phase II of the Study. The INCOG Board of Directors voted to accept and file the report, Task 15.0 - Transit Corridor Priority Groupings.

TULSA METROPOLITAN AREA PLANNING COMMISSION (TMAPC)

05-11-88 (1:30 pm) The Tulsa Metropolitan Area Planning Commission (TMAPC) was briefed by the Parsons Brinckerhoff staff on the Fixed Guideway Feasibility Study for Oklahoma's main urban areas, Tulsa, and Oklahoma City. It was noted that the Study was sponsored by ODOT, largely by UMTA funds. A timetable was handed out to TMAPC members and the members were told that their input and involvement would be greater under the Phase II portion of the Study for the Tulsa metropolitan area.

05-10-89 (1:30 pm) Parsons Brinckerhoff staff briefed the TMAPC of the corridors that were studied in Phase I and the consultant's recommendation on the Tier 1 and Tier 3 corridors. A Project Flow Diagram was issued to the TMAPC members illustrating the process Parsons Brinckerhoff had gone through in the course of the Phase I Study. The TMAPC was informed that the Phase I Final Report will be forthcoming, after which ODOT will have to make a decision whether or not to enter into Phase II of the Study.

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APPENDIX E

Transit Operation and Maintenance Cost Estimate Assumptions

Appendix E presents the cost estimates for transit operations and maintenance costs as discussed in Section 8.0, Capitalized Operating Costs.

To estimate the peak hour fixed guideway transit ridership, the daily ridership is subdivided into peak and off peak figures. It assumes that daily ridership is balanced: half of the day's volume is inbound and the other half is outbound. It is further assumed that forty percent of the inbound volume occurs during the peak two hours. The balance of the daily inbound ridership (60 percent) takes place in off-peak hours.

For this analysis, it is further assumed that the fixed guideway service would be provided sixteen hours a day. The capacity for a standard coach is assumed to be 75 passengers, for articulated buses 115 passengers. The capacity for a light rail vehicle is assumed to be 160 passengers. The capacity of an automated guideway transit vehicle is assumed to be 220 passengers. Peak hour headways are assumed to be ten minutes, or the number of minutes required to carry the peak hour passengers, whichever is less. Off peak headways are assumed to be twenty minutes, or the number of minutes required to carry off peak passengers, whichever is less. The cycle time is assumed to have a ten minute recovery period.

Two vehicle types were considered for high occupancy vehicle lane service: standard 35 or 40 foot coaches or articulated buses. The distinction between the two is their capacity, 75 versus 115 passengers. The articulated vehicle type was selected when it offered substantial daily operating cost savings over standard coaches.

To calculate the daily operations and maintenance costs, the equations outlined in Section 3.0: Capital and Operation Cost Methodology were used. To calculate annual operations and maintenance costs, the daily costs were multiplied by 295. This assumes five weekdays of operations (Monday through Friday), half the level of service on Saturdays, and one quarter the level of service on Sundays and six holidays.

The detailed cost calculations for operations and maintenance are shown in the tables labeled "O&M/Vehicle Estimates" in the body of the text.

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