APPENDIX I: Level of Service

Functional Classification of Streets

Historically, one of the most important uses of functional classification of streets has been to identify streets and roads that are eligible for federal funds. The original Federal-aid Primary, Federal-aid Secondary, Federal-aid Urban, and National Interstate systems all relied on functional classification to select eligible routes. In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) eliminated the Primary, Secondary, and Urban Federal-aid systems and created the National Highway System (NHS). ISTEA continued the requirement that a street, road, or highway had to be classified higher than a "Local" in urban areas and higher than a "Local" and "Minor Collector" in rural areas before federal funds could be spent on it. The selection of routes eligible for NHS funding was also based on functional criteria. While eligibility for federal funding continues to be an important use for functional classification, it has also become an effective management tool in other areas of transportation planning. As one indicator of a route's relative importance in the movement of goods and people, functional classification is used as a basis for system needs and fiscal studies.

Figure I.1: Hierarchy

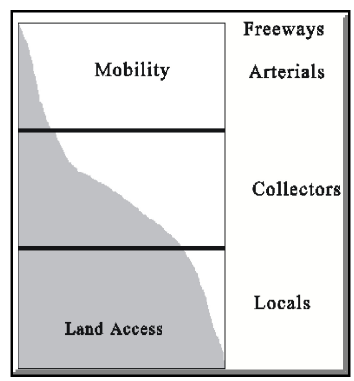


Figure I.1 helps depict the functional street system, or hierarchy, for the community as a whole. As the illustration indicates, local streets provide the most access to the adjacent properties, but function poorly in terms of mobility. Freeways exhibit high mobility because of speeds and volumes, serve poorly as access to adjacent roads and properties. With this in mind, streets that carry higher volumes of traffic should have a limited number of "curb cuts" (driveway openings), exits and/or extended block lengths (i.e., fewer intersections) so traffic movement will not be impeded.

Streets are grouped into functional classes according to the character of service they are intended to provide. This system translates into physical design features per each roadway type to allow for various street sections and pavement standards. Figures I.2 through I.9 illustrate the design features for the SA. Streets are classified according to their functional role in terms of movement and access. Oklahoma's Functional Classification system undergoes a comprehensive review after each decennial U.S. Census. ODOT and local jurisdictions cooperate in designating new boundaries for all urban and urbanized areas based on the new boundaries established by the U.S. Census Bureau. These adjustments result in the transfer of some mileage and routes from the rural and urban systems and, therefore, may require a change to the local system. The functional classification of streets is shown Map I.1 and includes the following functional classes: Interstate, Freeway, Principal Arterial, Minor Arterial, Collector and Rural Collector.

Street Classification Criteria

Criteria used in determining the functional classifications of streets are shown in Table I.1.

Classification is based on each roadway's functional role in the roadway network, and the existing and future travel patterns and areas served. The functional classification of a street normally does not change as traffic increases and improvements are made.

Table I.1: Roadway Functional Classifications and General Planning Guidelines

CLASSIFICATIONS	FUNCTION	CONTINUITY	APPROXIMATE SPACING (MILES)	DIRECT LAND ACCESS	MINIMUM ROADWAY INTERSECTION SPACING
Freeway and Expressway	Traffic Movement	Continuous	4 miles	None	1 mile
Arterial or Major Roadway	Moderate distance inter-community traffic movement. Minor function -- land access should primarily be at intersections.	Continuous	½ to 1 ½ miles	Restricted- some movements may be prohibited; number and spacing of driveways controlled. Maybe limited to major generations on regional routes.	1/8 mile 1/4 mile on a regional route
Collector	Primary -- collect/distribute traffic between local streets and arterial system. Secondary -- land access. Tertiary -- inter neighborhood traffic movement.	Not necessarily continuous; may not extend across arterials.	1/4 to ½ mile	Safety controls; limited regulation. Residential access prohibited; commercial access allowed with shared driveways.	300 feet
Local/ Residential	Land Access Sidewalks	None	As needed	Safety controls only.	300 feet

Source: FHWA

Principal Arterial

Principal Arterials are designed to provide a high degree of mobility and generally serve longer vehicle trips within urban areas. The principal arterial system carries the majority of trips entering and leaving the urban area, as well as the majority of through movements desiring to bypass the central city. The movement of people and goods is the primary function of an arterial street. Access control must be maintained.

Minor Arterial

The urban minor arterial street system interconnects with and supports the urban principal arterial system and provides service to trips of moderate length and a somewhat lower level of travel mobility than principal arterials. This system also distributes travel to geographic areas smaller than those identified with the higher system. The urban minor arterial street system includes all arterials not classified as a principal arterial and contains facilities that place more emphasis on land access than the higher system, and offer a lower level of traffic mobility. Such facilities ideally should not penetrate identifiable neighborhoods.

Collector

The collector street system provides both land access service and traffic circulation within residential neighborhoods, commercial and industrial areas. It differs from the arterial system in that facilities on the collector system may enter residential neighborhoods, distributing trips from the arterials through the residential area to the ultimate destination. The collector street also collects traffic from local streets in residential neighborhoods and channels it into the arterial system.

Local

The majority of streets in the LMA are classified as Local. The general purpose of this street is to carry traffic having destination or origin on the street itself. Local streets must be designed to discourage use by through traffic and provide access to abutting property. These streets should be designed to carry the least amount of traffic at the lowest speed.

Street Capacity

Capacity is the measure of a street's ability to accommodate the traffic volume along the street. Level of Service (LOS) is a phrase representative of several factors, including speed, travel time, traffic interruptions, and operating cost of a traffic facility (roadway), used to measure the quality of the facility. In addition, a roadway link refers to a specific length of roadway, usually between two intersections. Level-of-service is related to the physical characteristics of the roadway and the different operating characteristics of the roadway when it carries different traffic volumes. Level-of-service range from LOS A, which indicates good operating conditions with little or no delay, to LOS F, which indicates extreme congestion and long vehicle delays. The definition of each service level and methodology for estimating level-of-service is provided in the Highway Capacity Manual, Special Report 209, Transportation Research Board, 1994.

Street Standards

Streets perform certain basic functions in the community such as providing routes for vehicles and transit. The design of a street affects how successful it is in performing these functions. The quality of a street and its connections can affect whether people choose to walk or cycle, or take the car. It can affect whether people feel safe. For a community to develop into a walkable area design standards for streets must be re-evaluated. The Context Sensitive Solutions (CSS) report includes information and recommendation a community can utilize to design and develop streets that are friendlier.

Map I.1: SA Functional Classification System

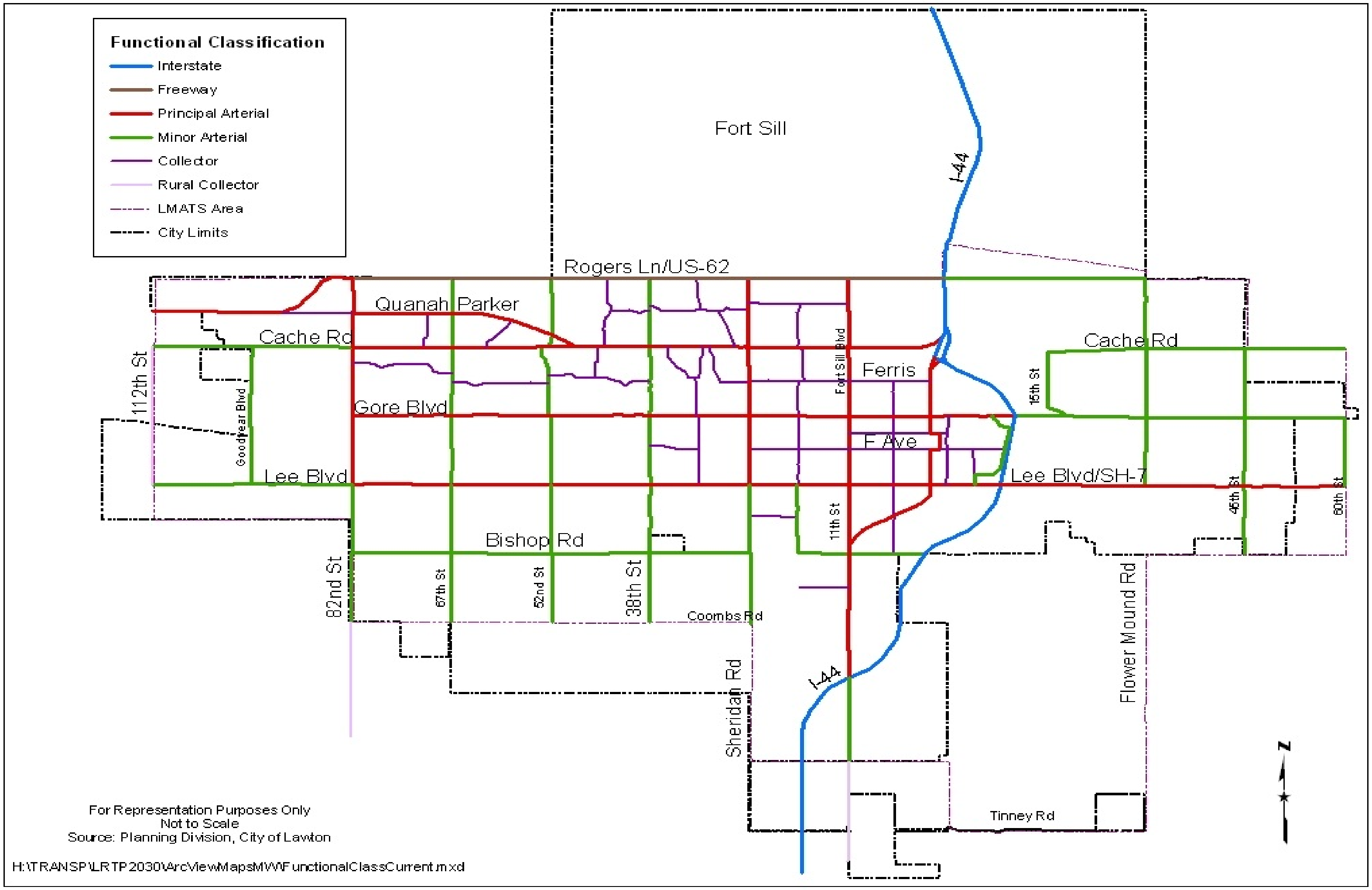
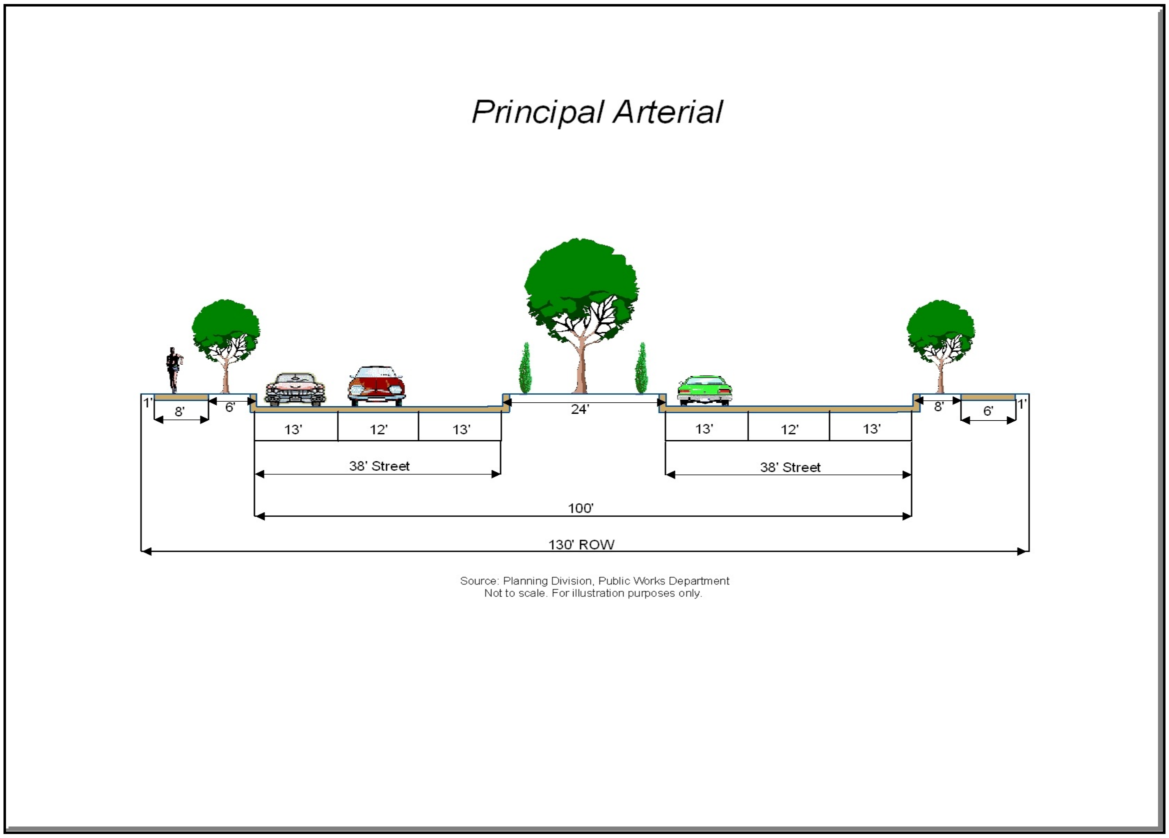


Figure I.2: Street Section Principal Arterial

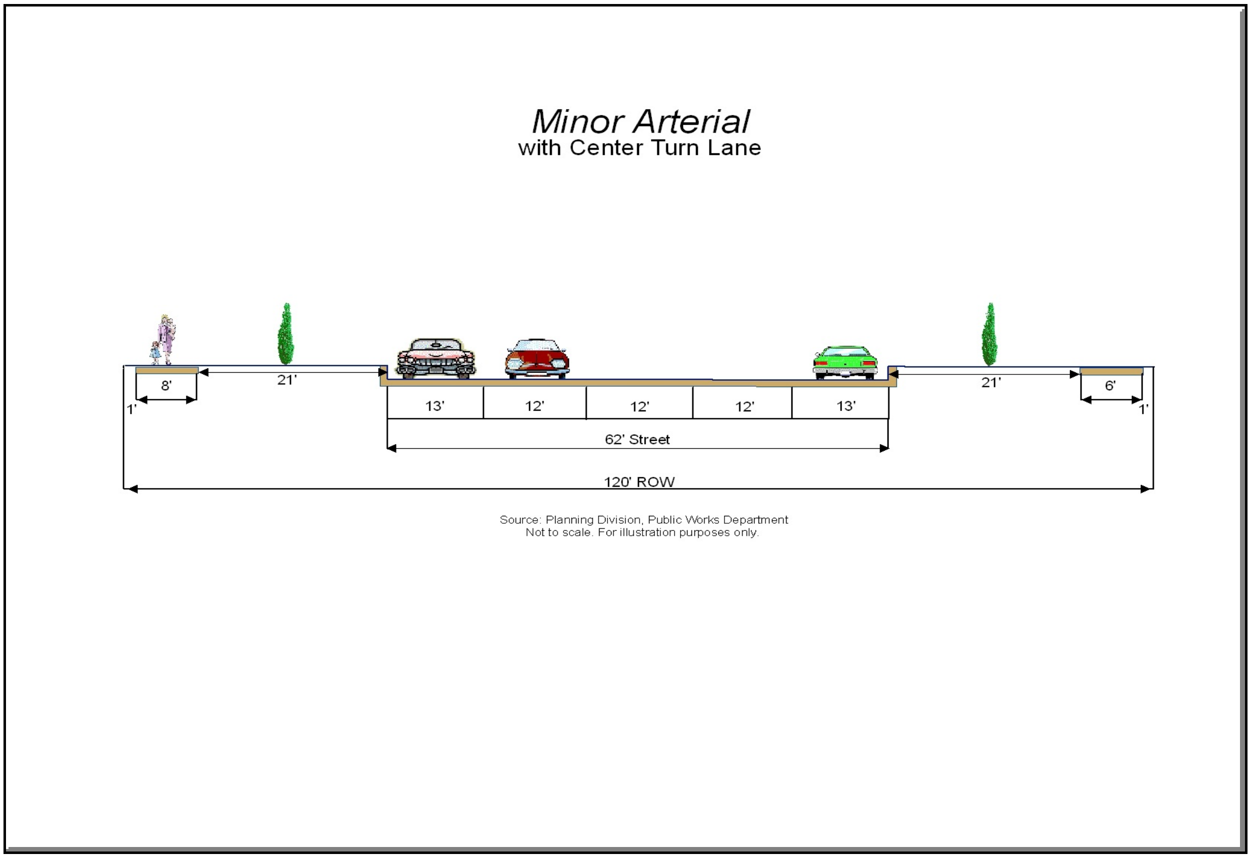


Minimum ROW Width	130’	Number of Through Lanes	4 to 6	Design Speed	45 mph
Minimum Pavement Width (face of curb to face of Curb)	100’	Minimum Sidewalk Width	8’ & 6’**	Minimum Street Jog (centerline to centerline)	250’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	100’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	13’*	Median	Required	Minimum On Street Parallel Parking Width	Not allowed

* Allows additional 1’ for lanes with gutter

** 8’wide on one side of street, 6’ wide on the other side of street

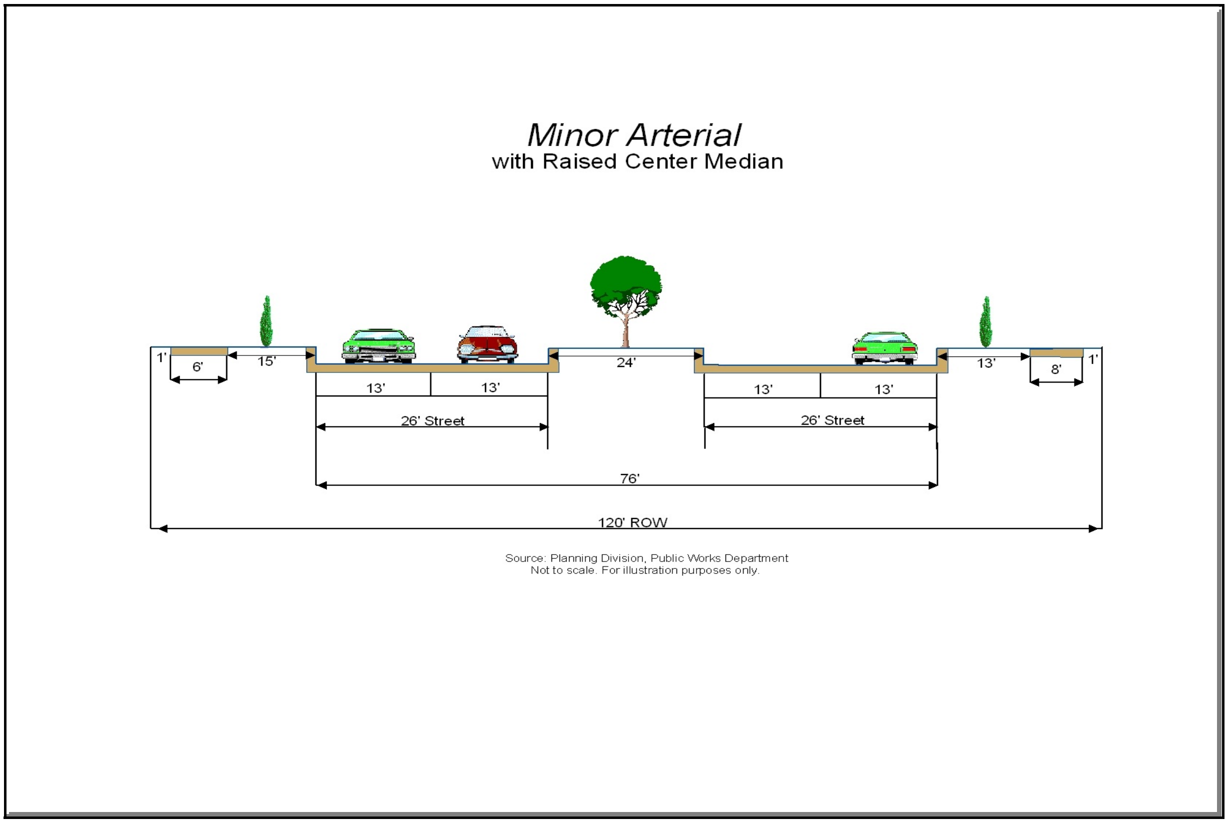
Figure I.3: Street Section Minor Arterial With Center Turn Lane



Minimum ROW Width	130’	Number of Through Lanes	4	Design Speed	40 mph
Minimum Pavement Width (face of curb to face of Curb)	62’	Minimum Sidewalk Width	8’ & 6’**	Minimum Street Jog (centerline to centerline)	250’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	100’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	13’*	Median	Required	Minimum On Street Parallel Parking Width	Not allowed

* Allows additional 1’ for lanes with gutter
** 8’wide on one side of street, 6’ wide on the other side of street

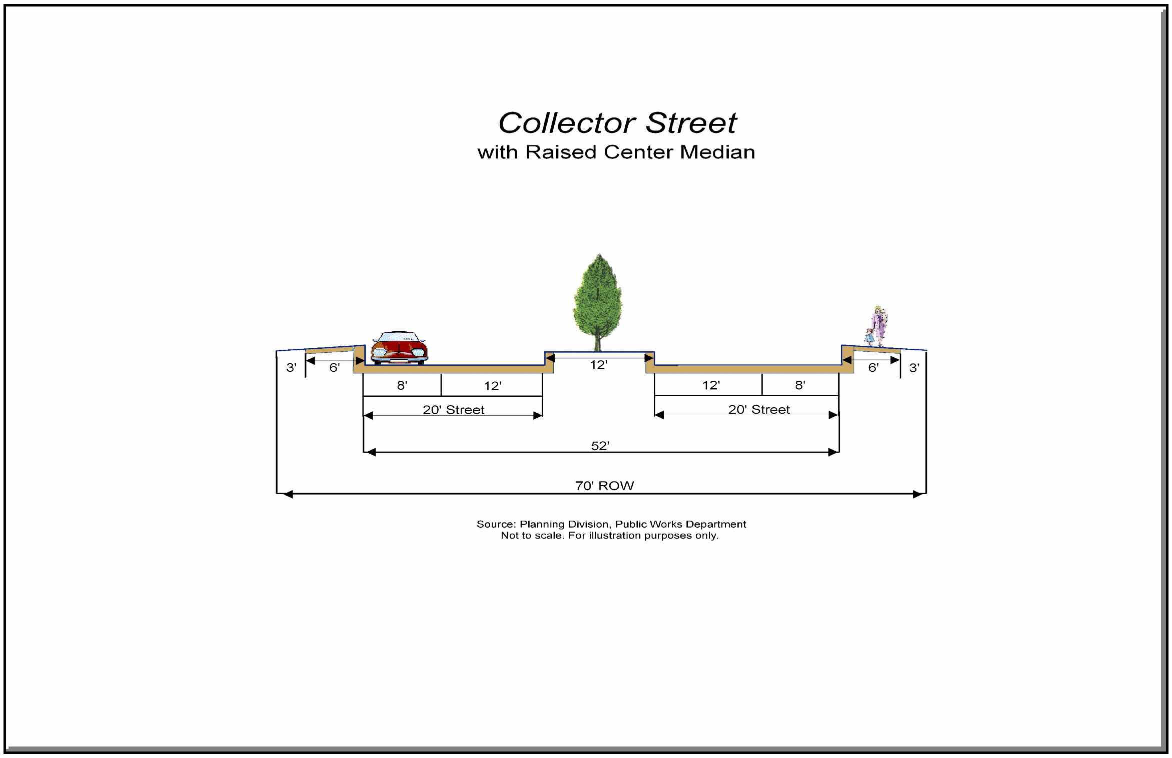
Figure I.4: Street Section Minor Arterial With Raised Center Median



Minimum ROW Width	120’	Number of Through Lanes	4	Design Speed	40 mph
Minimum Pavement Width (face of curb to face of Curb)	76’	Minimum Sidewalk Width	8’ & 6’**	Minimum Street Jog (centerline to centerline)	250’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	100’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	13’*	Median	Required	Minimum On Street Parallel Parking Width	N/A

* Allows additional 1’ for lanes with gutter
** 8’wide on one side of street, 6’ wide on the other side of street

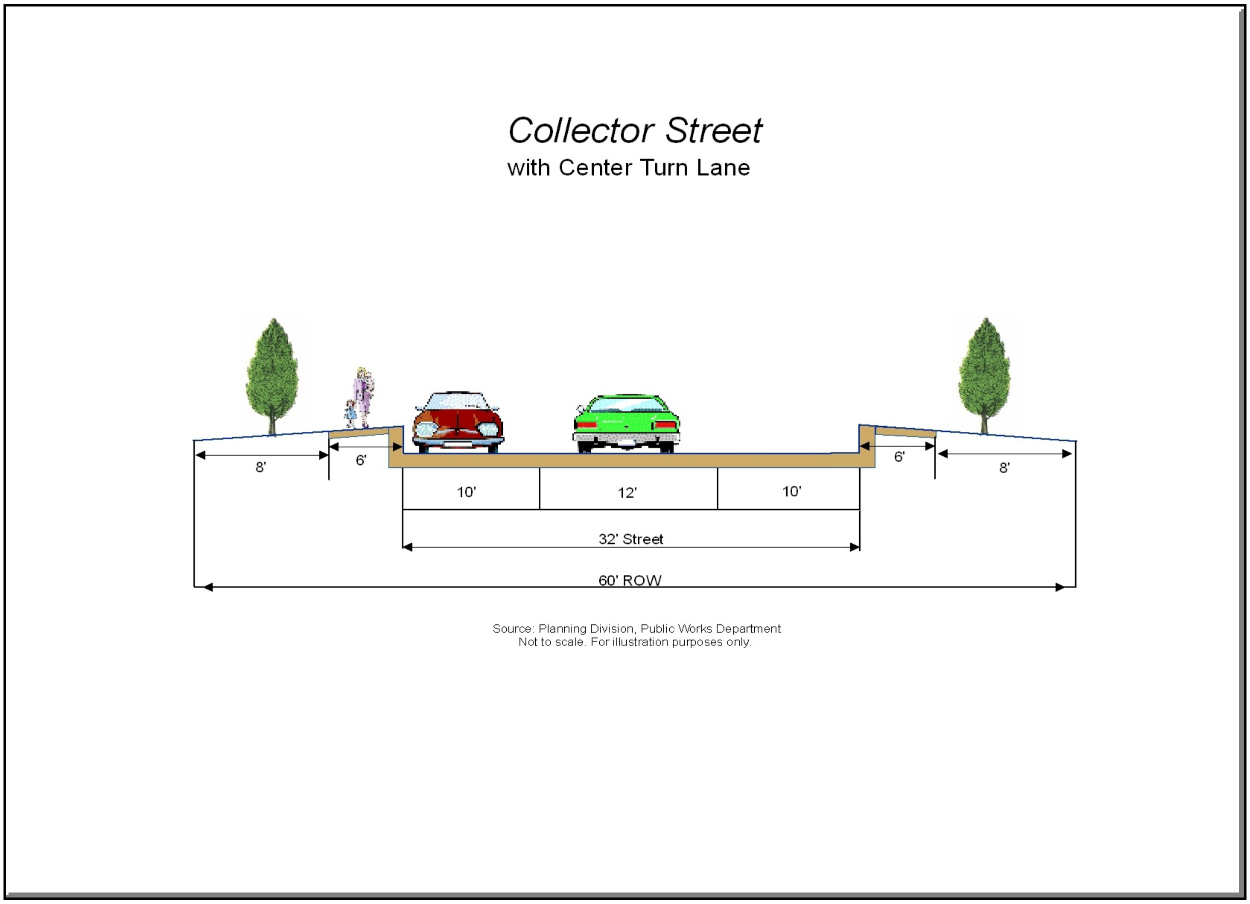
Figure I.5: Street Section Collector With Raised Center Median



Minimum ROW Width	70’	Number of Through Lanes	2	Design Speed	35 mph
Minimum Pavement Width (face of curb to face of Curb)	52’	Minimum Sidewalk Width	6’	Minimum Street Jog (centerline to centerline)	125’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	75’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	13’*	Median	Required	Minimum On Street Parallel Parking Width	8’

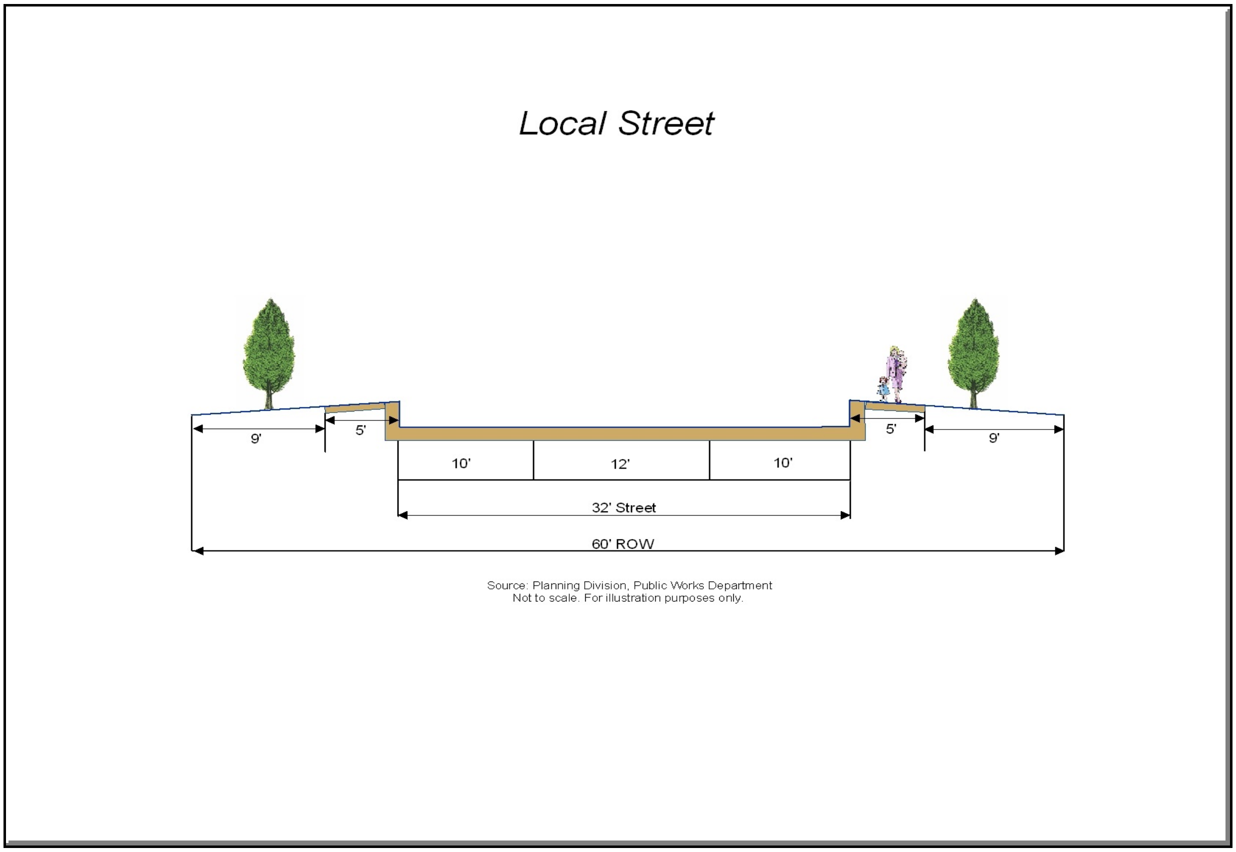
* Allows additional 1’ for lanes with gutter

Figure I.6: Street Section Collector With Center Turn Lane



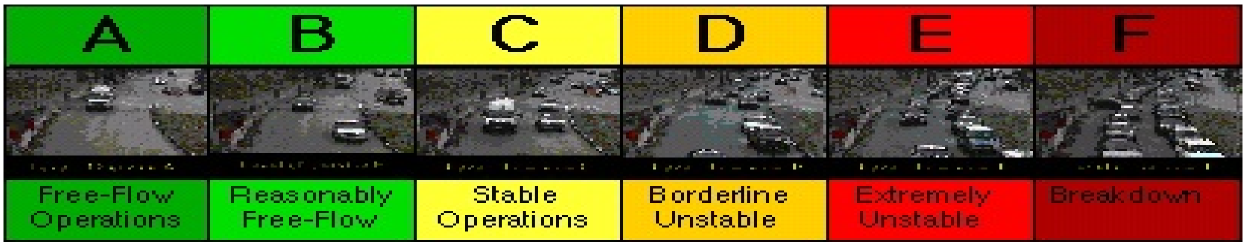
Minimum ROW Width	60’	Number of Through Lanes	2	Design Speed	35 mph
Minimum Pavement Width (face of curb to face of Curb)	32’	Minimum Sidewalk Width	6’	Minimum Street Jog (centerline to centerline)	125’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	75’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	12’	Median	N/A	Minimum On Street Parallel Parking Width	10’

Figure I.7: Street Section Local



Minimum ROW Width	60’	Number of Through Lanes	2	Design Speed	25 mph
Minimum Pavement Width (face of curb to face of Curb)	32’	Minimum Sidewalk Width	5’	Minimum Street Jog (centerline to centerline)	125’
Minimum Lane Width	12’	Minimum Distance Between Curb Cuts	50’	Bicycle Facilities	See Bicycle & Pedestrian Plan
Maximum Lane Width	12’	Median	N/A	Minimum On Street Parallel Parking Width	10’

The following is a list of the various LOS with abbreviated definitions from the Highway Capacity Manual.



- LOS A, describes a condition with low traffic volumes with little or no delays. There is little or no restriction in maneuverability due to the presence of other vehicles. Drivers can maintain their desired speeds and can proceed through signals without having to wait unnecessarily. Operating capacity can be measured as less than 30% of capacity.
- LOS B, describes a condition with stable traffic flow with a high degree of choice to select speed and operating conditions, but with some influence from other drivers. Operating capacity can be measured as less than 50% of capacity.
- LOS C, describes the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. LOS C is normally utilized as a measure of "average conditions" for design of facilities in suburban and urban locations. Operating capacity can be measured as less than 69% of capacity.
- LOS D, describes high density flow in which speed and freedom to maneuver is severely restricted even though flow remains stable. LOS D is considered acceptable during short periods of time and is often used in large urban areas. Operating capacity can be measured as less than 70% to 90% of capacity.
- LOS E, describes operating conditions at or near capacity. Operations at this level are usually unstable, because small increases in flow or minor disturbances within the traffic stream will cause breakdowns. Operating capacity can be measured as between 90% to 99% of capacity.
- LOS F, is used to define forced or breakdown flow. This condition exists whenever the amount of traffic approaching a point exceeds the amount that can be served. LOS F is characterized by demand volumes greater than the roadway capacity. Under these conditions, motorists seek other routes in order to bypass congestion, thus impacting adjacent streets. Operating capacity can be measured above 100% of capacity.

Projected LOS

Future increases in traffic volume can be traced to population growth and land use development patterns. Capacity and LOS can also be diminished by increasing the number of access points and median cuts on the road network. Current LOS deficiencies on roadways should not necessarily stop future development adjacent to these roadways. However, when the proposed new development reduces the LOS below the roadway's current level, the development should not be approved until the development's adverse impacts are mitigated by the developer.

APPENDIX J: Operation and Management Strategies

The long term viability of the street system in the LMA depends on a well-planned and constructed basic infrastructure. Preservation of the infrastructure must be a high priority in the LMA. Because of the limited resources available, it is necessary that the governmental entities in the LMA focus their resources on maintaining the physical integrity and operation of the existing transportation system. Preserving, maintaining and managing what we have is far more cost effective than investing in new roadway systems.

The purpose of a street maintenance program is to improve the integrity and service life of the streets. Over the years, the combination of heavy traffic, water (through cracks), and the aging of the asphalt has contributed to the deterioration of some streets. Preventing good streets from slipping into deterioration will prolong the life of the street. A pavement management program creates a better understanding of pavement conditions and evaluates the causes of existing pavement conditions. The program can improve the decision making process by taking advantage of preventative maintenance and selection of the most effective repair or rehabilitation. This type of management program also assists in long-term planning by coordinating pavement needs and scheduling with other budget and policy decisions. Typical activities include road and street inventory, pavement condition assessment, maintenance and rehabilitation strategies, prioritizing needs and requirements, and budgeting necessary funds.

A portion of the City's street resurfacing budget is allocated to slurry seal, asphalt overlay and crack seal programs which are low cost efforts to avoid further deterioration of the good streets. Street maintenance projects during the year varies due to weather conditions. The temperature has to be a certain degree for some of the work to be performed. If the temperature is too cold, concrete, asphalt and paint will not set up. The crack seal maintenance cannot be done if the temperature is too warm. The winter maintenance includes crack sealing, roadbeds, and blading gravel roads. The summer maintenance includes paint and permoline, overlays, reconstruction and concrete work.

The City of Lawton's Public Works Department maintains approximately five hundred miles of streets and bridges. ODOT maintains the Interstate, US and SH highways and Comanche County Commissioners maintain the roadways outside the city limits. Presently the City's street maintenance program is conducted by a visual inspection for deterioration and safety hazards. The Public Works Department staff evaluates roadway maintenance needs based on condition, field observation, and complaints. Some streets may appear to be in relatively good condition but may be at point where "timely" lower cost maintenance is needed. If left unattended these streets will enter the deterioration phase; increasing the maintenance cost and overall reconstruction cost. The maintenance for the street segments consist of rehab, overlay, mill-overlay, and reconstruction. After the inspection and evaluation is completed a list is created prioritizing the projects. This list contains the street segments that are so deteriorated that they present a safety issue. There are additional streets that receive routine maintenance that are not included on this list. Presently there are forty-three street segments on the 2005 CIP maintenance list (Map J.1). Table J.1 provides the estimated cost for the street segments that are funded by the 2005 CIP.

Map J.1: City of Lawton 2005 CIP Road Projects

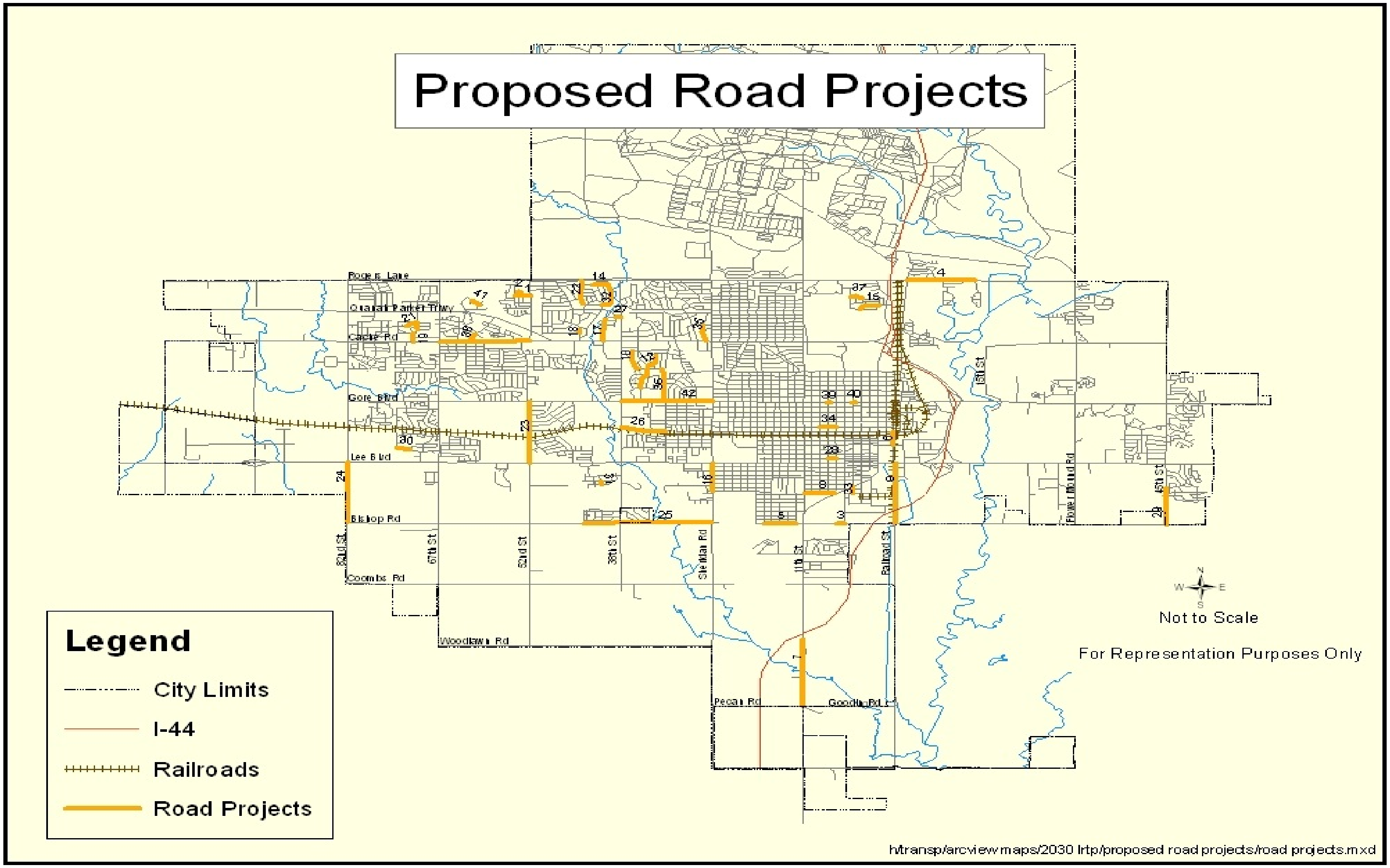


Table J.1: City of Lawton 2005 CIP Road Projects

MAP ID	STREET	FROM	TO	PROJECT	EST. COST
1	Ashy Ave.	52nd St.	Robinhood Dr.	Reconstruct	$195,000
2	Cedric Cir.	Ashby Ave.	Ashby Ave.	Rehab	$30,000
3	Bishop Rd.	6th St.	LATS Station	Rehab	$25,000
4	Rogers Ln.	Village Dr.	East of Pioneer Blvd.	Rehab	$175,000
5	Bishop Rd.	12th St.	16th St.	Rehab	$50,000
6	Railroad St. (Project 1)	F Ave.	I Ave.	Rehab	$25,000
7	11th St.	11th St. (6201)	Pecan Rd.	Overlay	$100,000
8	Douglas Ave.	7th St.	11th St.	Overlay	$45,000
9	Railroad St. (Project 2)	Lee Blvd.	Bishop Rd.	Overlay	$100,000
10	36th St.	Ferris Ave.	Kinyon Ave.	Reconstruct	$290,000
11	Ferris Ave.	35th St.	36th St.	Reconstruct	$126,000
12	33rd St. (800 Blk)	33rd St. (826)	35th St.	Overlay	$30,000
13	35th St.	Arlington Ave.	Ferris Ave.	Overlay	$10,000
14	Lindy Ave.	4017 Lindy Ave.	4216 Lindy Ave.	Overlay	$12,000
15	Mission Blvd.	Greenmeadow Dr.	4th St.	Overlay	$30,000
16	Sheridan Rd.	Lee Blvd.	Douglas Ave.	Rehab	$475,000
17	40th St.	Cache Rd.	1803 40th St.	Overlay	$45,000
18	44th St.	44th St. (1500 Blk)	200' North	Reconstruct	$75,000
19	72nd St.	Taylor Ave.	Baldwin Ave.	Overlay	$20,000
20	Hunter Rd.	Cache Rd.	Lawton Ave.	Reconstruct	$145,000
21	Taylor Ave.	72nd St.	Hunter Rd.	Reconstruct	$145,000
22	46th St.	46th St. (2201)	Rogers Ln.	Overlay	$40,000
23	52nd St.	Lee Blvd.	Gore Blvd.	Overlay	$80,000
24	82nd St.	Lee Blvd.	Bishop Rd.	Overlay	$75,000
25	Bishop Rd.	Bishop Rd. (4602)	Sheridan Rd.	Rehab/Sealcoat	$50,000
26	F Ave.	27th St.	38th St.	Rehab	$125,000
27	Santa Fe Ave.	38th St.	39th St.	Reconstruct	$60,000
28	Summit Ave.	7th St.	8th St.	Overlay	$10,000
29	45th St.	Bishop Rd.	Fullbright Ln.	Rehab	$70,000
30	Drakestone Blvd.	Chaucer Dr.	Bainbridge Ave.	Reconstruct	$155,000
31	43rd St.	Wendy Dr.	Wolf St.	Reconstruct	$82,000
32	40th St.	40th St. (2200 Blk)	40th St. (2267)	Rehab	$20,000
33	5th St.	Douglas Ave.	US 281B	Overlay	$12,000
34	E Ave.	7th St.	9th St.	Rehab	$30,000
35	22nd St.	Cache Rd.	Baltimore Ave.	Reconstruct	$300,000
36	31st St.	Gore Blvd.	Ferris Ave.	Mill-Overlay	$80,000
37	Woodridge Dr.	5th Pl.	7th St.	Mill-Overlay	$20,000

MAP ID	STREET	FROM	TO	PROJECT	EST. COST
38	Horton Blvd.	Cache Rd.	Cheyenne Ave.	Mill-Overlay	$18,000
39	8th St. (Median)	Gore Blvd.	Gore Blvd.	Mill-Overlay	$6,000
40	5th St. (Median)	Gore Blvd.	Gore Blvd.	Mill-Overlay	$6,000
41	Williams Ave.	Williams Ave. (6000 Blk)	Williams Ave.	Mill-Overlay	$15,000
42	Gore Blvd.	38th St.	Sheridan Rd.	Mill-Overlay	$170,000
43	Cache Rd.	52nd St.	67th St.	Mill-Overlay	$185,000

Source: City of Lawton, Public Works Department

Congestion Mitigation

Demand for highway travel by Americans continues to grow as population increases, particularly in metropolitan areas. Construction of new highway capacity to accommodate this growth in travel has not kept pace. Between 1980 and 1999, route miles of highways increased 1.5 percent while vehicle miles of travel increased 76 percent. The Texas Transportation Institute estimates that, in 2000, the 75 largest metropolitan areas experienced 3.6 billion vehicle-hours of delay, resulting in 5.7 billion gallons in wasted fuel and $67.5 billion in lost productivity. And traffic volumes are projected to continue to grow. The volume of freight movement alone is forecast to nearly double by 2020. Congestion is largely thought of as a big city problem, but delays are becoming increasingly common in small cities and some rural areas as well.

Causes of Traffic Congestion

Simply, highway congestion results when traffic demand approaches or exceeds the available capacity of the highway system. While this is a simple concept, it is not constant. Traffic demands vary significantly depending on the season of the year, the day of the week, and even the time of day. Also, the capacity, often mistaken as constant, can change because of weather, work zones, traffic incidents, or other non-recurring events.

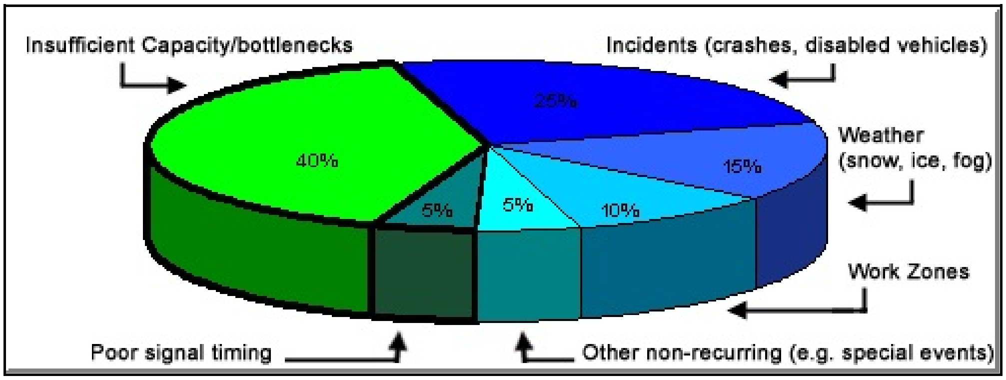
From a combination of recent studies and analytical work, it is estimated that roughly half of the congestion experienced by Americans is what is known as recurring congestion—caused by recurring demands that exist virtually every day, where road use exceeds existing capacity.

The other half is due to non-recurring congestion caused by temporary disruptions. The four main causes of non-recurring congestion are: traffic incidents (ranging from disabled vehicles to major crashes), work zones, weather, and special events. Non-recurring events dramatically reduce available capacity and reliability of the entire transportation system. Travelers and shippers are especially sensitive to the unanticipated disruptions to tightly scheduled personal activities and manufacturing distribution procedures.

Total Delay

In the congestion partnership area, we are helping our State and local transportation partners develop regional frameworks for the integrated deployment of intelligent transportation systems technology, such as traffic conditions monitoring, computerized traffic control systems, traveler information systems, and public transit information management systems. We are helping to facilitate the nationwide deployment of the 511 traveler telephone number, and we are developing and delivering guidance and training to help State and local agencies focus more on regional operations collaboration and coordination activities. These activities include the definition of local congestion and system performance problems, solutions, and measures, and adoption and implementation of strategies that cross-jurisdictional boundaries such as coordinated signal timing.

Figure J.1: How is the congestion pie sliced?



Source: Art Pendergraft, Transportation Modeling Consultant

Solutions

Solutions to congestion include both major construction projects and non construction projects such as Intelligent transportation systems (ITE),Transit, and Transportation Demand Management procedures.

Traffic Signals, Poles and Electronics

Traffic control signals are valuable devices for the control of vehicle and pedestrian traffic. Because they assign the right-of-way to the various traffic movements, traffic control signals exert a profound influence on traffic flow. Traffic Control signals, properly located and operated usually have one or more of the following advantages:

- They can provide for the orderly movement of traffic.
- When proper physical layouts and control measures are used, they can increase the traffic handling capacity of the intersections.
- They can reduce the frequency of certain types of accidents, especially the right angle type.
- Under favorable conditions, they can be coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given route.
- They can be used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.

Clean, legible, properly mounted devices in good working condition command the respect of road users. Also, consideration should be given in the design of signs to accommodate the vision of an aging population. There is not an inventory of other traffic control signs. It is strongly recommended that future signing be evaluated and comply with the requirements of the MUTCD.

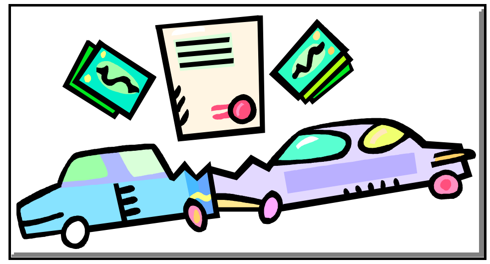
In order to evaluate the operation of signalized and unsignalized intersections, "preliminary" intersection warrants must be conducted in accordance with the guidelines developed in the Institute of Traffic Engineers (ITE) Traffic Engineering Manual and the American Association of State Highway and Transportation Officials (AASHTO) guidelines. The locations of traffic control devices on City maintained streets are reviewed by the Traffic Commission and approved by the City Council. The MUTCD should be followed when reviewing and approving the location of traffic control devices.

Public Information

Programs should be developed to keep electronic records of all the street and traffic lights in the City of Lawton. The information needed to determine maintenance and repair would be readily available thus helping with the scheduling and funding of maintenance. Streamlining the City's operations will help guarantee rapid response to citizen needs. Openly sharing information with other departments and entities will improve program delivery because more accurate data is available in a timely fashion. Providing information on the City of Lawton's web page on street closures due to street maintenance and repair would help the citizens make good route choices for their daily trips. A link to a form on the City's web page would allow citizens to report problems with streets or traffic lights. This service would help officials determine their workers daily schedules more efficiently while getting the repairs accomplished in a timely manner.

APPENDIX K: Safety & Security

The efficient movement of local and through vehicular traffic, pedestrians and bicyclists, public transportation, and movement of freight depends on a road network that incorporates safety as a major priority. SAFETEA-LU requires State departments of transportation and MPOs to incorporate safety and security as priorities in their respective transportation planning processes and activities. SAFETEA-LU also requires State DOTs to develop a Strategic Highway Safety Plan (SHSP). The SHSP identifies goals, objectives and strategies to achieve safer transportation conditions in Oklahoma. The SHSP should be used as a guiding document in the development of programs for safer transportation in the SA. A copy of the SHSP is available in the City of Lawton, Planning Division and is also available at the following website www.okladot.state.ok.us/oshsp/index.htm.



Motor vehicles accidents account for more deaths than all natural disasters combined. Nationwide multiple conditions are identified with vehicular crashes, including: design of facility, operation of a vehicle by driver, condition of a vehicle, age of a driver, type of vehicle, volume of traffic and pedestrians/bicyclists. According to data from the National Highway Traffic and Safety Administration (NHTSA) in 2000, traffic crashes cost the economy approximately $230 billion or an annual average cost of $820 for every person living in the United States. Listed below is information obtained from the Oklahoma Department of Public Safety.

- There were 73,926 reported crashes in 2003
  - 52.2% (38,582) of all reported crashes occurred on city streets
  - 72.2% (53,3989) of all reported crashes occurred in daylight
  - 44.6% (33,038) of all reported crashes occurred in clear weather
  - 70.8% (52,395) of all reported crashes involved two vehicles
- There were 595 reported fatal crashes in 2003
  - There were 671 fatalities in 2003
- There were 27,593 injury crashes in 2003
  - There were 42,678 persons injured in crashes in 2003
- Primary Causes of Urban Crashes
  - 16.9% were cause by Failure to Yield
  - 14.8% were caused by Followed to Closely
  - 13.0% were caused by Inattention

Table K.1 compares 2003 data for Comanche County and counties with approximate number of vehicle miles traveled. The impacts of traffic crashes are felt by every resident. These crashes place enormous burdens on medical facilities, police and other public and private institutions. The majority of traffic crashes are caused by driver error. Driver error can be influenced by inadequate road design or ineffective traffic controls. One of the tasks of this chapter is to identify locations where crashes occur in excessive numbers and investigate the causes of these collisions. Further study can give us a clearer understanding of the reasons for frequent crashes. With sufficient data it is possible to determine if the transportation network due to its design, condition, traffic control, etc. is a contributing factor. Remedial steps can then be taken to correct the problem.

Intersection Accidents

Staff reviewed the accident data between 1999-2004 from ODOT and identified the twelve intersections that had been assigned the highest ASI by year. This information was then combined into a table that identifies these intersections, Table K.2 provides this information.

Table K.1: 2003 Crash Data (Compare Comanche County)

	COMANCHE COUNTY (1,140,026,400 VMT)	**CANADIAN COUNTY** (1,184,421,350 VMT)	**CREEK COUNTY** (936,936,750 VMT)	**MUSKOGEE COUNTY** (930,260,900 VMT)	**PAYNE COUNTY** (700,500,700 VMT)	**ROGERS COUNTY** (986,171,600 VMT)
Fatal Crashes	5	14	14	13	9	20
Injury Crashes	839	517	392	514	523	537
Total Crashes	**2652**	**1474**	**990**	**1399**	**1436**	**1371**
Number of Fatalities	5	17	17	15	12	25
Number of Injuries	1282	787	609	812	819	849

Source: National Center for Statistics & Analysis and Oklahoma Department of Public Safety

Table K.2: Accident Severity Index by Street and Year

YEAR	E-W STREET	N-S STREET	ASI	NUMBER OF INJURIES	NUMBER OF DEATHS
2000	Cache Rd	Ft. Sill Blvd	18	5	0
2001	Cache Rd	Ft. Sill Blvd	20	7	0
2003	Cache Rd	Ft. Sill Blvd	36	7	0
2004	Cache Rd	Ft. Sill Blvd	52	9	0
1999	Cache Rd	Sheridan Rd	64	11	0
2000	Cache Rd	Sheridan Rd	24	6	0
2001	Cache Rd	Sheridan Rd	68	9	0
2002	Cache Rd	Sheridan Rd	64	12	0
2003	Cache Rd	Sheridan Rd	64	9	0

YEAR	E-W STREET	N-S STREET	ASI	NUMBER OF INJURIES	NUMBER OF DEATHS
2004	Cache Rd	Sheridan Rd	82	14	0
1999	Cache Rd	38th St	50	12	0
2000	Cache Rd	38th St	30	5	0
2001	Cache Rd	38th St	54	6	0
2002	Cache Rd	38th St	54	9	0
2003	Cache Rd	38th St	80	16	0
2004	Cache Rd	38th St	76	9	0
1999	Cache Rd	40th St	32	7	0
2001	Cache Rd	40th St	26	9	0
2003	Cache Rd	40th St	40	5	0
2004	Cache Rd	40th St	58	11	0
2000	Cache Rd	44th St	20	1	0
2001	Cache Rd	44th St	42	6	0
2002	Cache Rd	44th St	58	11	0
2003	Cache Rd	44th St	34	4	0
2000	Cache Rd	52nd St	14	5	0
2001	Cache Rd	52nd St	38	6	0
2003	Cache Rd	52nd St	36	6	0
1999	Cache Rd	53rd St	46	10	0
2001	Cache Rd	53rd St	30	5	0
2002	Cache Rd	53rd St	46	3	0
1999	Cache Rd	67th St	26	6	0
2000	Cache Rd	67th St	16	3	0
2001	Cache Rd	67th St	34	11	0
2002	Cache Rd	67th St	32	8	0
2003	Cache Rd	67th St	42	10	0

YEAR	E-W STREET	N-S STREET	ASI	NUMBER OF INJURIES	NUMBER OF DEATHS
2004	Cache Rd	67th St	48	9	0
2000	Cache Rd	Briarwood Dr	22	5	0
2001	Cache Rd	Briarwood Dr	14	4	0
2004	Cache Rd	Briarwood Dr	40	13	0
2000	Erwin Lane	Sheridan Rd	20	10	0
2001	Erwin Lane	Sheridan Rd	32	8	0
2004	Erwin Lane	Sheridan Rd	46	9	0
1999	F Ave	Railroad St	24	6	0
2000	F Ave	Railroad St	28	3	0
2001	F Ave	Railroad St	18	3	0
1999	F Ave	11th St	56	13	0
2000	F Ave	11th St	72	20	0
2001	F Ave	11th St	54	11	0
2002	F Ave	11th St	52	15	0
2003	F Ave	11th St	44	10	0
2000	Ferris Ave	Sheridan Rd	28	4	0
2001	Ferris Ave	Sheridan Rd	52	9	0
2002	Ferris Ave	Sheridan Rd	46	16	0
2003	Ferris Ave	Sheridan Rd	54	16	0
2004	Ferris Ave	Sheridan Rd	66	16	0
2000	Gore Blvd	2nd St	18	2	0
2001	Gore Blvd	2nd St W	20	5	0
2003	Gore Blvd	2nd St	34	13	0

YEAR	E-W STREET	N-S STREET	ASI	NUMBER OF INJURIES	NUMBER OF DEATHS
1999	Gore Blvd	Ft. Sill Blvd	28	5	0
2001	Gore Blvd	Ft. Sill Blvd	14	0	0
2002	Gore Blvd	Ft. Sill Blvd	40	7	0
2004	Gore Blvd	Ft. Sill Blvd	38	10	0
1999	Gore Blvd	Sheridan Rd	34	2	0
2000	Gore Blvd	Sheridan Rd	46	11	0
2001	Gore Blvd	Sheridan Rd	52	11	0
2002	Gore Blvd	Sheridan Rd	106	22	0
2003	Gore Blvd	Sheridan Rd	80	13	0
2004	Gore Blvd	Sheridan Rd	68	18	0
1999	Gore Blvd	38th St	52	6	0
2000	Gore Blvd	38th St	20	1	0
2001	Gore Blvd	38th St	54	13	0
2002	Gore Blvd	38th St	34	4	0
2003	Gore Blvd	38th St	66	6	0
2004	Gore Blvd	38th St	48	2	0
2000	Gore Blvd	67th St	24	3	0
2001	Gore Blvd	67th St	18	2	0
2003	Gore Blvd	67th St	30	5	0
2000	Lee Blvd	11th St	20	2	0
2001	Lee Blvd	11th St	18	4	0
2002	Lee Blvd	11th St	36	9	0
1999	Lee Blvd	Sheridan Rd	24	3	0
2000	Lee Blvd	Sheridan Rd	28	7	0
2001	Lee Blvd	Sheridan Rd	36	6	0
2002	Lee Blvd	Sheridan Rd	40	7	0

YEAR	E-W STREET	N-S STREET	ASI	NUMBER OF INJURIES	NUMBER OF DEATHS
1999	Lee Blvd	38th St	28	4	0
2000	Lee Blvd	38th St	28	5	0
2001	Lee Blvd	38th St	22	3	0
2002	Lee Blvd	38th St	64	11	0
1999	Oak Ave	38th St	32	6	0
2000	Oak Ave	38th St	14	2	0
2001	Oak Ave	38th St	16	9	0
1999	Rogers Lane	I-44	32	4	0
2000	Rogers Lane	I-44	36	5	0
2001	Rogers Lane	I-44	28	3	0
2003	Rogers Lane	I-44	50	7	0
2004	Rogers Lane	I-44	48	1	0
1999	Rogers Lane	52nd St	24	8	0
2000	Rogers Lane	52nd St	26	8	0
2001	Rogers Lane	52nd St	44	14	0

Source: Planning Division, City of Lawton

For this six year period the Cache Road corridor between Fort Sill Blvd. and NW 67th Street had the highest number of crashes and consistently had the highest accident severity index. The overwhelming cause of crashes in this corridor was inattention. Other causes contributing to the crashes included: following too close, failure to stop, improper turning, improper lane change and failure to yield. These accidents occurred during daylight hours by a five to one margin over accidents occurring at dark. The roadway conditions were dry by a four to one margin over wet roads. Causes of crashes locally are the same Statewide.

Safety Improvement Programs

High compliance with signals is essential for safe and efficient traffic movement, and non-compliance contributes substantially to urban motor vehicle crashes. Enforcing traffic signal compliance is difficult not only because of limited manpower but because of factors associated with traditional enforcement methods, which in many cases require police to follow a violating vehicle through a red light to stop it. Conventional traffic enforcement can be supplemented with advanced technology.

Red light cameras increasingly are being used to help communities enforce traffic laws by automatically photographing vehicles whose drivers deliberately run red lights. A red light camera system is connected to the traffic signal system and to sensors buried in the pavement at the crosswalk or stop line. The camera system continuously monitors the traffic signal, and the camera is triggered when any vehicle passes over the sensors faster than a preset minimum speed and at a specified elapsed time after the signal has turned red. A second photograph is taken that shows the violator in the intersection. The camera records the date, time of day, time elapsed since the beginning of the red signal, and the speed of the vehicle. Upon review of photographic evidence and depending on state law requirements, tickets are issued by mail to either vehicle owners or to drivers at the time of the offenses.

The City of Lawton has a Traffic Commission that traditionally base their recommendation concerning the installation of traffic signals on the Manual of Uniform Traffic Control Devices (MUTCD) to the City Council. The City has a an inventory of the signalized intersections however there is not an inventory of the pole mounted traffic control signs. A complete inventory should be conducted identifying the location, type, and age of all traffic control devices. The information would be the basis for a signalization plan which if implemented would improve congestion. Actuated signals can increase the capacity of the roadway.

Current signal lights use incandescent halogen bulbs. Newer traffic light bulbs are made out of arrays of light emitting diodes (LEDs). These are tiny, purely electronic lights that are extremely energy efficient and have a very long life. Each LED is about the size of a pencil eraser, so hundreds of them are used together in an array. Three advantages to replacing incandescent traffic lights with LED units:

- LEDs are brighter. The LED arrays fill the entire "hole" and have equal brightness across the entire surface, making them brighter overall.
- LED bulbs last for years, while halogen bulbs last for months. Replacing bulbs costs money for the trucks and people who do the work, and it also ties up traffic. Increasing the replacement interval can save a city big dollars.
- LED bulbs save a lot of energy.

Traffic Calming is a way to reduce accidents, noise, pollution, congestion and vehicle speed. It is most appropriate in residential neighborhoods and commercial districts. There are about twenty different techniques that engineers can use to slow traffic, such as:

- Bulb-outs can narrow roads at crossing points, reducing traffic speeds and reducing the distance pedestrians must travel to cross.
- Roundabouts are used successfully in many parts of the world. Unlike traffic signals and stop signs, they cannot be run.
- Angled parking can slow traffic and make commercial areas safer for pedestrians. It can increase parking availability by 40% to 100% at almost no cost.
- Landscaped roadway medians narrow the perceived width of the road way and reduce traffic speed.

Pedestrians/Bicyclists

The pedestrian and bicyclist in the LMA are forced to walk/bike alongside traffic due to lack of facilities. This non-motorized segment of the community must also contend with crossing four-to-five lane streets with no medians or crossing points. Sidewalks are required in new developments in the City of Lawton, but are not required to be installed in the area outside of the City of Lawton. Sidewalks previously installed are generally in the location of utility impediments, mail boxes and parking. This is a hindrance for non-motorized transportation.

Trucking

The American Association of State Highway and Transportation Officials (AASHTO) recommends minimum lane widths of 12 feet where high truck volumes are combined with high speeds. Where the lane width is less than 11 feet or the truck is not positioned properly on entrance to the curve, the truck may encroach onto an adjacent lane. The curb returns for entrances into industrial area or areas with large truck delivery should be designed to meet the ITE requirements.

Aging Population

The senior population is growing at a faster rate than any other age group. Roadways can be improved to better accommodate changes in eyesight, reaction time and muscle dexterity, which naturally decline with age. Navigating intersections, merging and weaving and interpreting traffic signs and signals are most challenging for seniors.

Roadway safety improvements that can benefit the seniors as well as drivers and passengers of all ages:

- Rumble strips to guard against running off the road;
- Bigger and brighter signs and pavement markings to aid fading eyesight;

Security

One of the eight planning factors of SAFETEA-LU is security of the transportation system. This section discusses security of the local network and system. The prevention of security incidents requires the local governmental entities, transit providers and emergency service providers to work together to develop a plan. The transportation planning aspect of security includes: analyzing the transportation network for emergency route planning, development and maintenance of demographic databases, development and maintenance of electronic maps that identify: the network, sidewalks, transit routes, signal locations, railroads, and floodplains.

APPENDIX L: Intelligent Transportation Systems

In 1991, recognizing the critical need to address the nation's aging transportation network and its pressing challenges, Congress created an Intelligent Transportation Systems (ITS) program. The program is guided by four key principles:

1. To promote the implementation of a technically integrated and jurisdictionally coordinated transportation system across the country;
2. To support ongoing applied research and technology transfer;
3. To ensure that newly developed ITS technologies and services are safe and cost-effective; and
4. To create a new industry by involving and emphasizing the private sector in all aspects of the program.

This is a worldwide effort that seeks to develop coordinated technologies to improve the efficiency and safety of surface transportation through better informed travelers, improved traffic controls, information technology and electronic systems that increase the efficiency of commercial vehicles and transit operations.

The ITS program focuses on intelligent infrastructure and intelligent vehicles. The concept of an intelligent infrastructure was developed to fulfill the transportation needs of metropolitan areas, rural areas and the trucking industry. Intelligent vehicles, on the other hand, complement the ITS infrastructure by focusing upon safety and information systems for cars, trucks, buses, and trains. The goal of the ITS program is to manage and operate the transportation system while reducing congestion and enhancing emergency response through the use of advanced technologies and new intergovernmental arrangements. The ITS approach combines several key elements:

1. Traffic signal control – modernized systems that automatically adjust themselves to optimize traffic flow;
2. Freeway management – the latest in systems that provide information to motorists, detect problems to allow for increased capacity and flow, and minimize congestion resulting from crashes;
3. Transit management – updated systems that allow new ways of monitoring and maintaining our nation's sizable transit fleets through advanced locating devices and equipment monitoring systems;
4. Incident management – innovative programs that enable communities to identify and respond to crashes or breakdowns with the best and quickest emergency services, minimizing clean-up time;
5. Electronic toll collection – that provides drivers and transportation agencies with convenient and reliable automated transactions, dramatically improving traffic flow at toll plazas and increasing the operational efficiency of toll collecting;

6. Electronic fare payment – new systems that enable a person to pay for parking, bus and train fares, as well as tolls, by using a single smart card;
7. Railroad crossings – that are coordinated with traffic signals and train movements, and that notify drivers of approaching trains through in-vehicle warning systems;
8. Emergency response – coordination that ensures the closest available and most appropriate emergency unit can be dispatched to a crash;
9. Regional multi-modal traveler information – widely expanded systems that provide road and transit information to travelers, businesses and truckers, so they can adjust their travel plans when necessary.

At this time, the LMPO has seen limited deployment of equipment that could be considered part of the ITS program. Because of the need to develop a consistent and technically integrated system, the City and County should coordinate the establishment of equipment standards that would be utilized on a daily basis. It is anticipated that the following equipment will be deployed in the SA during the life of this plan.

1. Signal Equipment
    a. Devices that, when activated by emergency services vehicles, cycle traffic signals for opposing streets to red to allow for improved response times and greater safety.
    b. Synchronized signals provide coordinated movement along streets with several signals spaced at periodic intervals. This is accomplished by setting the time relationships between adjacent signals and the amount of green time at each signal in such a way that the number of stops is minimized.
        i. The disadvantage to synchronized operation is it leads to longer delays to side street vehicles and pedestrians waiting to cross or enter onto the arterial. A fixed cycle length must be used for each intersection in order to keep the signals synchronized along the arterial (a cycle is the time it takes to give a green light to all of the different movements at an intersection). The synchronization obviously works better on some roads than on others.
        ii. This is because other factors such as signal spacing and the amount of interference from unsignalized access points play a major role in the performance of a synchronized signal system.
    c. Fully Actuated timing may be used at isolated intersections. Isolated intersections are those where vehicle arrivals on each approach are random. There are typically no other signals nearby.
        i. At isolated intersections, there really isn't any opportunity to minimize stops as there is no way to predict when vehicles will arrive. The approach used at these locations is to time the signals to minimize the amount of delay experienced by drivers. This is best achieved by using fully traffic actuated operation.
        ii. Fully traffic actuated signals have vehicle detectors on all approaches and cycle only in response to the actual demand on each approach. While delays are typically short at isolated intersections, the downside to this timing philosophy is that the vast majority of motorists have to stop. That is the nature of the least delay timing solution. The amount of time spent waiting is minimal but nearly everyone ends up stopping at least for a short time. That makes this strategy inappropriate along arterial streets where signals are closely spaced.

d. Pedestrian Signals - The pedestrian signals are timed to allow a person to walk across the street before conflicting traffic gets a green light.
   i. The "WALK" portion is only intended to get pedestrians started across the street. It is typically only on long enough for a person to make sure it is clear and then start walking. Most of the crossing actually occurs during the flashing "DON'T WALK" that follows the "WALK". Flashing "DON'T WALK" means it is okay to finish crossing once you've started but you should not start across if you haven't left the curb area yet.
   ii. The steady "DON'T WALK" is next and it means to wait until the next "WALK" light is displayed before trying to cross.

e. Green Arrow Signals - Left turn arrows are installed where they can reduce the overall delay experienced by motorists or at locations that have an identified left turn accident problem that a left turn arrow can help improve.
   i. Left turn arrows typically decrease the delay experienced by left turning drivers. However, what many people don't realize is that they also usually increase the delay and number of stops for non-turning traffic. This results because some green time must be taken from other movements in order to give green time to the arrow. It is not simply a matter of putting in an arrow to improve things for left turning traffic.

      (1) At locations where there is a high volume of left turns and left turn delays are high, the increase in delay to through traffic caused by an arrow can be offset by the decrease in the delay to the left turns. However, where the through traffic volume is considerably higher than the left turning traffic volume, the benefit to left turning traffic usually does not outweigh the increase in delay and stops for through traffic.
      (2) If arrows are installed under these circumstances not only does it lead to more congestion, it also leads to an increase in fuel consumption, vehicle emissions and, potentially, an unnecessary increase in rear end accidents (because of the increase in stops for through traffic).
      (3) Left turn arrows may operate in a protected/permissive mode. That is, cars can turn left when the arrow is on and then continue to turn left after yielding to oncoming traffic when the green ball is displayed.
      (4) Left turn arrows that operate in a protected/permissive mode are an efficiency tool much more so than they are a safety tool. Where left turn volumes are high and delays to left turners are correspondingly high, arrows can be used to decrease the overall delay at an intersection.