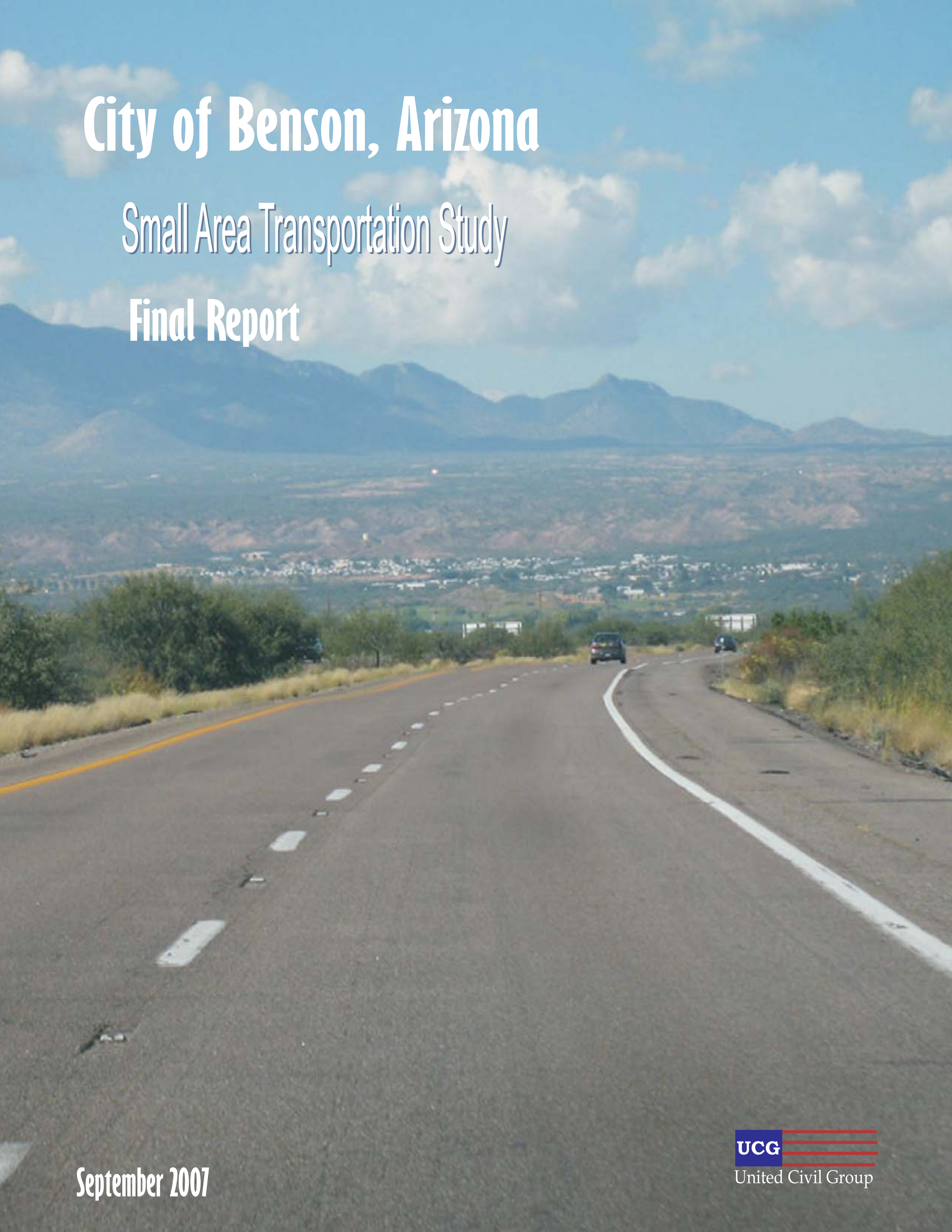
City of Benson, Arizona

Small Area Transportation Study

Final Report



September 2007

UCG
United Civil Group

CITY OF BENSON

Small Area Transportation Study
Final Report

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1.0 INTRODUCTION

1.1 Study Context

Recognizing that large investments in the transportation infrastructure will be required during the next twenty-five years to accommodate projected levels of growth and development in the Benson area, the City of Benson initiated the Benson Small Area Transportation Study (SATS) in conjunction with Arizona Department of Transportation. The City of Benson retained a consultant team led by United Civil Group Corporation of Phoenix, Arizona, to conduct the study under the direction of a Technical Advisory Committee, (TAC) that includes representatives from the City of Benson, Cochise County, Southeastern Arizona Association of Governments (SEAGO), and the Arizona Department of Transportation (ADOT).

This is the first small area transportation study for the City of Benson. This study was coordinated with other studies in the area, including the Southeastern Regional Profile and the Northwestern Cochise County Study.

The goal of the study was to develop a comprehensive transportation plan for the Benson area to guide multi-modal transportation planning and programming for the next 25 years by:

(a) providing reliable guidance on short, mid and long range planning of the study area;
(b) recommending improvements needed to permit the street system to satisfactorily accommodate current and projected traffic volumes; and
(c) assisting the City of Benson in making critical land use planning decisions regarding traffic and transportation.

A planning framework was established to address mobility and accessibility needs at three levels:

Regional – The City of Benson, Cochise County, and Arizona Department of Transportation aim to sustain growth and desirable development patterns by providing access to and through the Benson Area via State Routes 80 and 90.

Sub-regional – The study provides for meeting mobility needs between key activity centers via the state routes and major arterials.

Local – The study addresses mobility within sub-areas and neighborhoods by developing local street systems as well as local transit, bikeway, and pedestrian systems.

Key elements of the SATS work program include the following:

- Review of previous plans and studies
- Inventory of existing conditions
- Socioeconomic and land use projections
- Travel demand model development

- Analysis of future conditions
- Development of recommended improvements
- Transportation funding alternatives
- Transit element

While this study included roadway facilities owned and operated by ADOT within the study area, it is important to recognize that improvements to the state highway system can be made only after in-depth and engineering studies are conducted by ADOT, and upon approval of the State Transportation Board. The Federal Highway Administration (FHWA) must approve all traffic interchange improvements. The recommendations made by this study for improvements on state facilities can serve only as suggestions for further study.

1.2 History of Benson

Benson has a long, rich history for a small community. Benson, one of Arizona's original territorial towns, was founded in 1880. In the early 1900's, the community grew along with the demand for copper and silver. These metals were mined in the San Pedro Valley and shipped to Benson for smelting and distribution via the railroad. In the early days of the automobile, Benson was an important stop along the region's new east-west highway, Interstate 10. The City of Benson was incorporated in 1924, approximately 40 years after the completion of the Southern Pacific Railroad through southeastern Arizona.

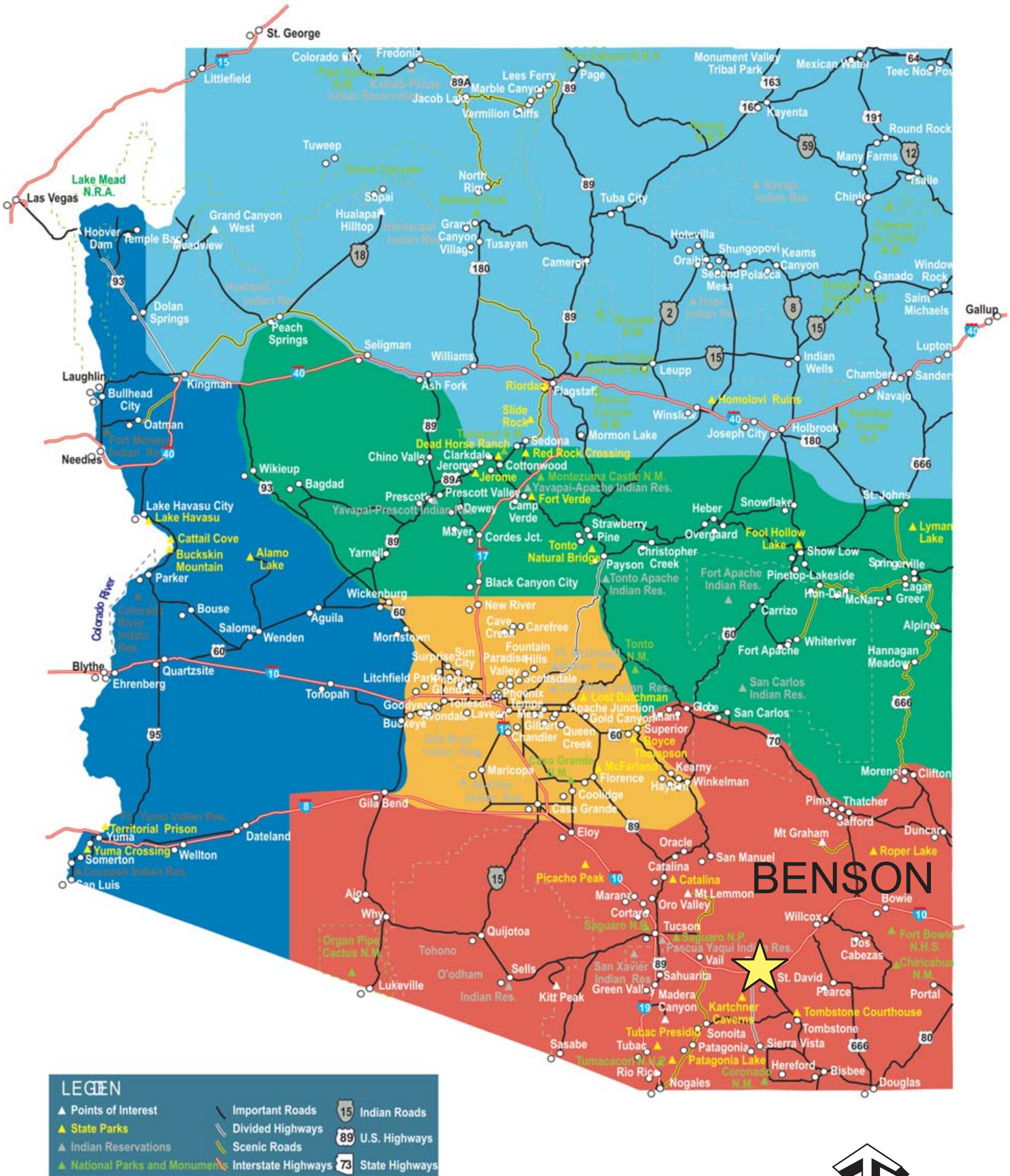
Today, Benson serves as the gateway to the southeastern Arizona region providing needed services to travelers, providing an ideal lifestyle available in a small western community, and providing the convenience of a downtown historic commercial center. Attractions surrounding the Benson area include: the Amerind Foundation, Cochise's Stronghold, Gammons Gulch Ghost Town Movie Set, Kartchner Caverns State Park, San Pedro Valley Arts and Historical Society Museum, San Pedro Riparian National Conservation Area, and the Vega Bray Observatory.

The City of Benson is located on Interstate 10 about 50 miles southeast of Tucson in Cochise County, Arizona. Benson is surrounded by hills and beautiful desert within the San Pedro River Valley, as shown on *Figure 1: Vicinity Map*.

Figure 2: Study Boundary illustrates the Benson area that was incorporated into the study. The study area includes portions of Interstate 10, State Route 90 and State Route 80. This area was defined by the Project Team to include proposed developments within the surrounding area.

1.3 Purpose

With a growing community, the future of the City of Benson will present significant challenges fiscally, organizationally, and developmentally. The City of Benson recognizes the need to research, evaluate and approve a number of important issues. None more important than a transportation plan that establishes the improvements over short, mid and long range periods incorporating roadway, non-motorized, and transit elements. Transportation improvements will be prioritized to maximize project benefits within budget limitations. This study will also define funding strategies and identify funding sources, which will allow the City to aggressively pursue local, regional, state and federal funding.



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Not to Scale

Figure 1: Vicinity Map

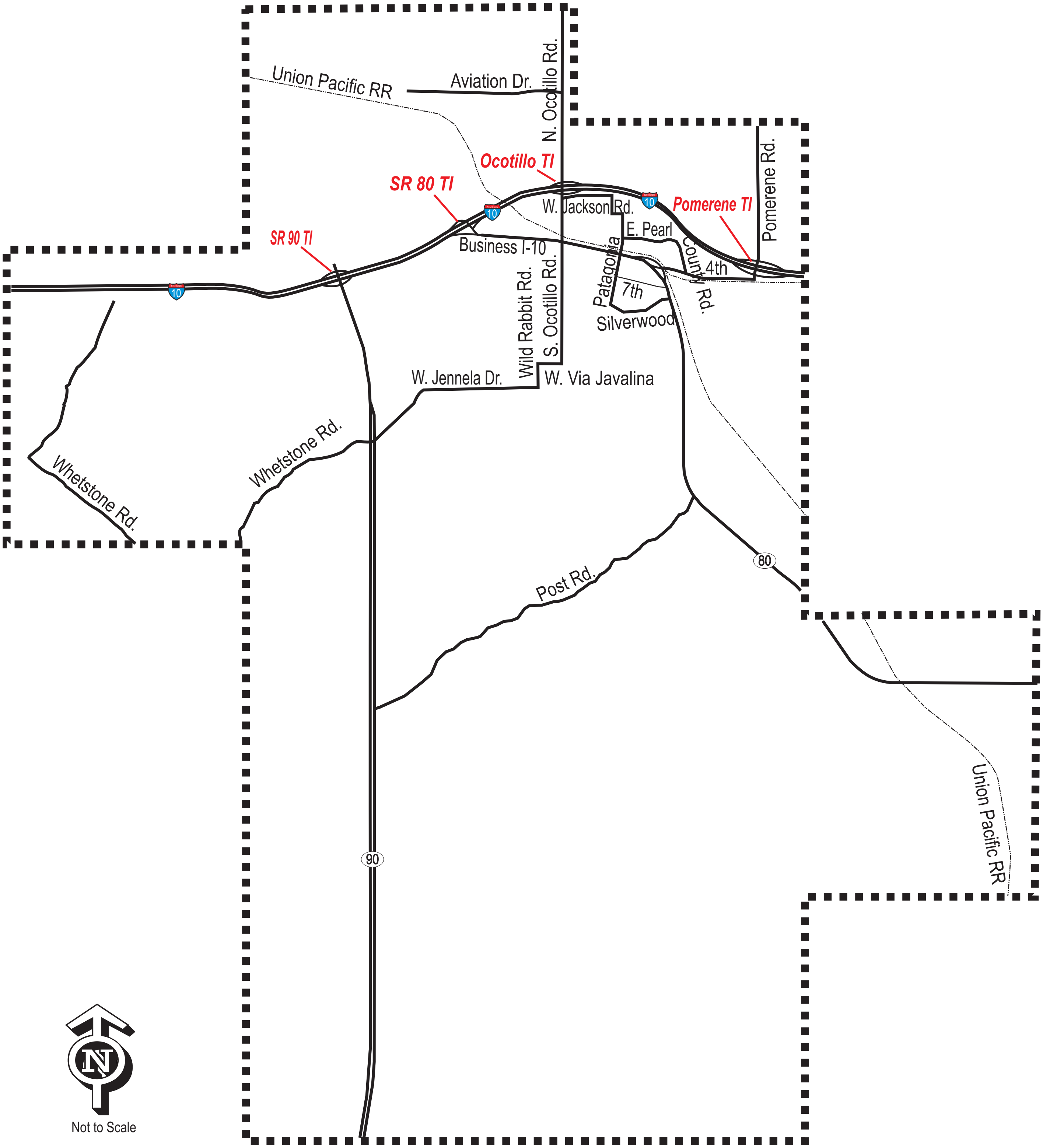


Figure 2: Study Area

1.4 Report Organization

This report is organized into twelve chapters as follows:

1.0 INTRODUCTION – Provides background information for the study.
2.0 TRANSPORTATION VISION, ISSUES, GOALS, AND POLICIES - Documents key transportation issues and proposes goals and policies to address these issues under the direction of the City Engineer.
3.0 METHODOLOGIES AND STANDARDS – Presents the methods used to evaluate the Benson area transportation system under current and future conditions.
4.0 CURRENT SOCIOECONOMIC CONDITIONS – Provides an overview of the current socioeconomic conditions within the Benson area.
5.0 ENVIRONMENTAL JUSTICE AND TITLE VI – Presents minority areas within Benson.
6.0 NETWORK INVENTORY AND EXISTING CONDITIONS – describes year 2006 transportation facilities, services, and conditions throughout the study area.
7.0 EXISTING MULTIMODAL TRANSPORTATION SYSTEM – Presents the existing trails, transit and rail services within the Benson area.
8.0 FUTURE CONDITIONS AND ROADWAY IMPROVEMENTS – outlines the population and employment forecasts for the study area and details the roadway improvement needs to accommodate the future travel demand. Proposes the recommended improvement plan.
9.0 PUBLIC TRANSIT – Presents a concept transit plan for the City of Benson.
10.0 NON-MOTORIZED CIRCULATION – Develops a plan for bicycles and pedestrians.
11.0 IMPLEMENTATION PROGRAM – Develops a strategy for implementing the recommended roadway improvement plan over the next 25 years.
12.0 POLICIES AND GUIDELINES – Provides example guidelines and policies that can be refined by the City Engineer and adopted by council in the future.

1.5 Previous Plans and Studies

Previous plans and studies have been prepared over the last five years within the Benson Region. Specific documents consulted during the preparation of this transportation study include:

- Benson General Plan
- Southeastern Regional Profile
- Northwest Cochise County Study

1.6 Community Involvement

Community involvement was a significant value to this study. It ensured the opportunity of meaningful community input and inspired a broad based citizen participation and understanding of the study process. The following sections summarize key components of the public involvement program.

1.6.1 Technical Advisory Committee Meetings

The technical advisory committee (TAC) was formed at the onset of the study. Meetings were held monthly to provide guidance to the planning process and review the results of the study sections. Throughout the study process, members of the team brought issues that required technical analysis to the attention of the team. The following agencies and their department were represented on the TAC.

ADOT Transportation Planning Division
ADOT District Office
ADOT Regional Traffic Engineering Office
SEAGO Planning Department
Cochise County Highway and Floodplain Department
Cochise County Planning and Zoning Department
City of Benson Council
City of Benson Planning and Zoning Department
City of Benson Public Works Department
City of Benson Police Department

1.6.2 Community Interviews

A series of interviews with community representatives were conducted by the Project Team in November 2006 to determine the local perspectives regarding community issues and to understand key concerns within the study area. Results from these interviews were utilized to develop key information included in the recommendations. The Project Leader, Ms. Sarah Simpson, P.E., interviewed the following community representatives:

Benson City Mayor and Council
Benson Planning and Zoning Chairman
Benson City Manager
Benson Fire Chief
Benson Police Chief
Benson Unified School District Superintendent
Benson School Board President
St. David School Board President
United Health Care Innovations
Union Pacific Railroad
Local Developers

1.6.3 Community Meetings/Public Forums

Community meetings/public forums were scheduled at two key points in the planning process and announced in the local newspaper. Flyers were also distributed to local businesses, and governmental offices to notify the public of the transportation meetings.

The first public open house was held on September 27, 2005, at the Benson Fire House. The project team gave a fifteen minute slideshow presentation of the transportation planning process. Then, the meeting was divided into an open house forum to discuss current traffic concerns and issues. The first meeting allowed the public to learn about study process, review and comment on the initial plan alternatives, and find out about the current traffic volumes on the existing roadways. The sign-in sheet shows 14 members of the general public in attendance, as well as members of the Technical Advisory Committee.

A second public meeting was held on February 28, 2007, in the City Council Chambers. Citizens were able to communicate with the local, county and state officials as well as the consultant team in an open house forum. At this meeting, potential transportation improvements along with future projected development were presented and discussed. The draft recommendations for the Benson Small Area Study were also presented. The sign-in sheet shows 10 members of the general public in attendance, as well as members of the Technical Advisory Committee.

Input received by the Project Team at the community meetings was incorporated in to the working papers and into this circulation element. At each community meeting, the Project Team distributed comment cards to solicit written comments from the public.

The Public Involvement Summary Reports for the public meetings are included in *Appendix A.*

2.0 TRANSPORTATION VISION, ISSUES, GOALS AND POLICIES

2.1 The Transportation Vision

Benson must guide rapid growth in such a way that provides careful and responsible management of natural resources, that provides leadership to strengthen neighborhoods, and ensures that services and facilities meet the expectations and needs of the residents. Benson is an established community that is dedicated to ensuring the quality of life people enjoy today, can be enjoyed by many in future generations.

2.2 Transportation Issues and Concerns

Transportation related issues and concerns were identified during discussions between the project team members, individuals interviewed, and during community involvement meetings. The list below incorporates all of the issues and concerns that were brought to the attention of the Project Team.

Population Explosion **–** The current population in Benson is approximately 5,000 residents. There are multiple master planned developments in the area of SR 90, two of which are already approved. Together, these developments are expected to increase the City of Benson population by more than 75,000 residents. This is an increase of more than 1,000% over the next 25 years. The existing transportation facilities were not designed for this population growth and will be severely deficient in coming years.

Defined Boundaries – There are issues regarding a three mile buffer zone between the City of Benson and the community of St. David. There are concerns that eliminating this buffer zone could affect Benson negatively in the future. Existing agreements made between Benson and the St. David Community regarding the buffer zones are considered “gentlemen’s agreements” and have not been recognized in court since Benson may not contractually give away a right granted to it by the courts.

Access Management – Rapid growth along SR 90 and SR 80 will require access management. This will be necessary to maintain efficiency and safety on the state routes and major arterials.

Adequacy of Emergency Access – The future projected traffic volumes and the incomplete street network will restrict emergency vehicle access to residential and commercial areas.

Congestion – The West Benson interchange experiences congestion at various periods of the day, primarily due to the bottle neck created on I-10 by the B-10 (4^{th} Street) interchange.

Portions of 4^{th} Street – 4^{th} Street is Benson’s “Main Street”. Currently, 4^{th} Street is owned and maintained by ADOT as it is part of B-10. The City and ADOT may agree to turn portions of 4th Street (B-10) to the City. Street limits and the boundary line between City limits and ADOT limits of 4th Street (B-10) should be addressed to determine which sections remain in ADOT control.

San Pedro Parkway – an alternative route could be constructed from the I-10 Pomerene Interchange south. This new route would parallel SR 80 and could be used as a by-pass route for Benson.

Truck Route Signing – Truck route signing needs to be addressed and guidelines need to be put in place on roadways that can be signed as “No Heavy Vehicles”.

Continuity of the Street Network – Future traffic volumes will cause significant congestion on state routes, arterials and collectors unless major improvements are made, including alternative east west connector routes between SR 80 and SR 90.

Lack of Alternative Transportation Mode Facilities – Currently, Benson does not have alternatives for various transportation modes due to the lack of sidewalks, and paths. These items need to be incorporated into new development plans early in the design process to create a continuous biking and walking systems.

Airport Access – Airport access needs to be improved. This could be accomplished by extending SR 90 to the north.

Routes to Tombstone and Bisbee – SR 90 and SR 80 could both be used as routes to Tombstone and Bisbee. Signing would need to be modified on I-10 redirecting some traffic to SR 90.

Roadway Functional Classification – The City of Benson lacks a roadway classification system. A structured functional roadway classification system needs to be developed and City street standards need to be defined.

Inadequate Roads and Right of Way – Arterial streets need to be expanded and gaps in the existing street system need to be improved. Adequately spaced arterial streets and reserved right of way for the future street system improve traffic circulation through the study area.

Unimproved Roadways/Dust Control– Unpaved roadways that currently experience approximately 250 vehicles per day should be considered for paving. Benefits to both the public and private users include a decrease in wear and tear on a vehicle, and a reduction in particulate emissions.

Deficiency in Roadway Construction and Maintenance Funding – There are more roadway projects that could be completed than funding available. Therefore, roadway construction projects should be prioritized and funding sources noted to allow projects to be constructed when required.

Figure 3: Identified Issues illustrates the majority of issues discussed at the public meetings graphically.

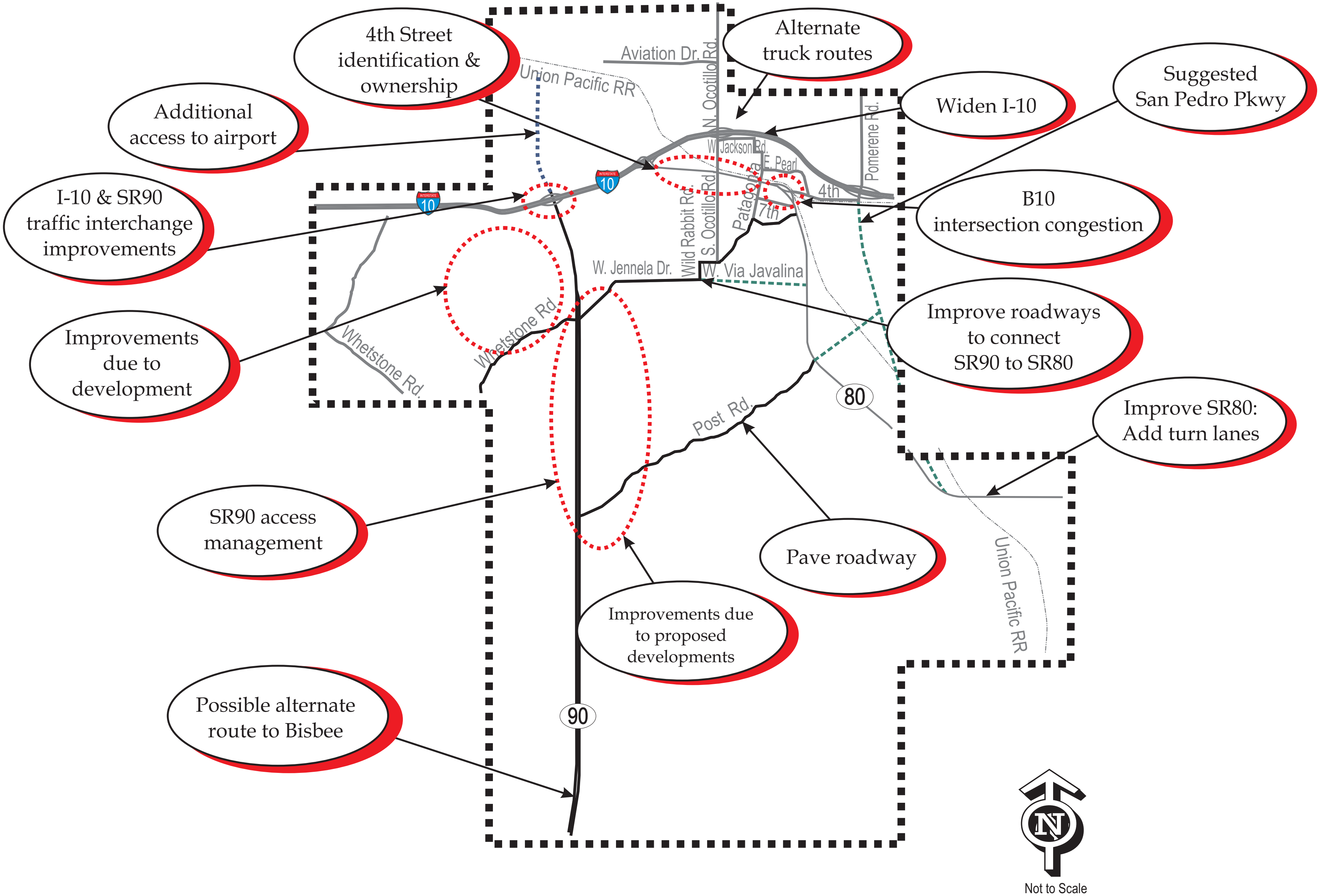


Figure 3: Identified Issues

2.3 Opportunities and Constraints

Opportunities exist within the Benson area to preserve and enhance the quality of life, to manage the transportation system, and to promote alternative transportation modes. Specific opportunities include the following:

- The City of Benson should consider the traffic impacts of residential and commercial developments, including the issues of who pays for traffic mitigation required as the result of specific development activities. These impacts need to be evaluated and, where necessary, mitigated on a project by project basis, at the direction of the City Engineer. Ideally, the City should adopt a consistent policy regarding traffic impact analysis guidelines, exactions, deductions and other forms of developer contributions to the transportation infrastructure.

- The need exists for inter-jurisdictional coordination of transportation and land use decisions. Transportation planning needs to be coordinated throughout the Benson area. The same is true of local land use planning where decisions are made in one area that can have significant impacts on areas under a different jurisdiction.

- The timing of this transportation study presents an opportunity, in advance of new development, to reserve adequate right of way widths within future roadway corridors, and to assign functional classification to various roadways within Benson.

Major constraints on the planning and implementation of transportation improvements in the Benson area include the following:

- Limited funding for the City, County and State

- Mountainous topography within the City

- Restrictions on the use of funding sources

2.4 Study Objectives

Based in public input received and related technical analyses, the following value-based goals were developed to guide the planning process:

Provide a safe roadway network system in Benson with regional accessibility.

Provide a roadway network system for year 2030 with minimal congestion.

Develop a street network for Benson that incorporates bike lanes, sidewalks and off street trail systems.

Promote multimodal services capable of accommodating current, proposed, and future land use plans. Recommend that new development include multimodal transportation facilities to fully meet future needs.

Provide for a regional public transportation system in areas where unmet transportation needs will exist at build-out.

Establish consistent landscape standards for roadways to develop a community that is cohesive, clean, and presentable.

Develop short term, mid range and long term transportation plans for the City of Benson, with projects that can be constructed within the funding budgets.

Integrate the transportation system within the land use patterns to help reduce congestion and provide convenient access.

2.5 Transportation Goals, Objectives, and Strategies

Goals, objectives, and strategies provide direction and focus to transportation plan development and the project implementation process. Goals describe a general objective to be attained while strategies describe means to achieve the goals and objectives. A set of goals, objectives and strategies was developed in response to the issues, constraints, and opportunities identified in the Benson area transportation planning process. These goals, objectives and strategies are presented herein as guidelines and therefore, should be revised by the City Engineer as needed to accomplish the desired results for each project.

It is also recognized that implementation of all the strategies listed below may not be feasible for every project because of limited funding, local priorities, and related concerns. Professional judgment and community input can assist in applying and prioritizing these policies on a project by project basis. The strategies that apply to a given project should be considered during the planning and design phase of the project.

2.5.1 Traffic Safety

Objective: *Maintain and enhance existing levels of traffic safety on the transportation system serving the Benson area.*

- Adopt appropriate measures of effectiveness (e.g. roadway segment accident rate, intersection accident rate) to facilitate evaluation of roadway traffic safety.
- Annually update a program of mitigation measures, with an emphasis on inexpensive transportation system management measures, to mitigate any safety problems identified at high accident locations
- Include pedestrian crosswalks and signal identification at all newly signalized intersections, and provide pedestrian push buttons wherever the normal green time is insufficient for a safe crossing.
- Increase the priority of roadway projects that are primarily mobility related, but that are also likely to have a beneficial impact on traffic safety.

- Wherever a new arterial is constructed or an existing two lane roadway is reconstructed, provide either a continuous center left turn lane or a physical median to separate opposing traffic streams and provide safe storage for left turning vehicles.

2.5.2 Mobility Improvement

Objective: *Maintain and enhance existing levels of mobility on roadways and other transportation modes serving the Benson area.*

- Maintain a regular traffic data collection program, including periodic traffic counts on all arterial and major collector roadways in the Benson area.
- Adopt and apply access management guidelines to enhance traffic operations and safety on the arterial streets whose primary function is mobility.
- Require traffic impact analyses and apply appropriate standard procedures to assess the traffic impacts of all new developments.
- Adopt and apply the Benson Small Area Transportation Study traffic volumes and level of service thresholds for various roadway lanes and classifications to assist in evaluating the need for capacity improvements.
- Adopt and apply consistent roadway design standards for each functional classification within the City of Benson. The design standards for new or reconstructed streets should reflect functional efficiency, operating safety, construction and maintenance costs.
- Maintain consistent roadway cross sections and access control for each functional class of roadway.
- Install new traffic signal s only at intersection that meet one or more warrants in the Manual on Uniform Traffic Control Devices, and are recommended by an engineer that has fully studied the surrounding area.
- Coordinate traffic signal timing.
- Where possible, restrict signal installations to half mile points to maintain adequate progression along the highways.
- Provide bikeway facilities on new or reconstructed arterial and collector streets.
- Revisit and update the Benson Small Area Transportation Study at least once every five years with appropriate revisions to traffic forecasting.

2.5.3 Right of Way

Objective: *Obtain adequate rights of way on all City streets.*

- Begin a right of way program to identify right of way needs and issues as they relate to current needs, future development and transportation needs.
- Seek appropriations for right of way acquisition projects.
- Assure that adequate rights of way are planned and reserved for the City on all proposed connector route between SR80 and SR90.

2.5.4 Project Funding

Objective: *Secure adequate funding levels to meet Benson's transportation priorities, including capital costs, operating and maintenance costs, and replacement costs.*

- Customize the definition of each project to reduce overall construction costs and to take advantage of multiple funding programs.
- "Piggyback" several of the funding programs to cover various aspects of a project. Based on the information presented, no single grant program is usually able to cover the entire costs of the project.
- Focus the City's efforts on a short list of programs that will offer the best potential for success.
- Annually update both short range and long range forecasts of funding available to the City for various types of projects by source.
- Annually update the five-year Capital Improvement Program that lists all infrastructural improvements to local jurisdictional transportation systems with funding sources identified for each project.
- Maximize the value of existing funding by coordinating and consolidating projects at the same location or on the same roadway segment.
- Encourage private sector financial participation in the constructions of new roadways where warranted by development activities and traffic generated thereby.

2.5.5 Land Use Integration

Objective: *Coordinate land use planning, transportation planning and decision making to ensure that transportation and land use plans and policies are mutually supportive.*

- Apply subdivision control measures to ensure that development controls are in place to plan for new transportation facilities and to protect existing investments.
- Ensure that new or improved transportation facilities are designed and constructed in a manner consistent with the established values, lifestyle and long term land use plans of the community.
- When constructing or reconstructing major roadway, secure sufficient right of way to avoid costly and disruptive takings if additional widening is likely to be required in future years.
- Where indicated by appropriate traffic engineering studies, develop and implement neighborhood traffic mitigation or calming measures to discourage through traffic from using residential streets.

2.5.6 Economic Development

Objective: *Develop a transportation system and infrastructure in a manner that directs and supports economic development of the Benson area.*

- Preserve and maintain high mobility and levels of transportation service throughout the Benson area to continue attracting jobs to the area.
- Where appropriate, establish and promote a system of truck routes to accommodate commercial traffic.
- Continue to develop transportation related amenities and enhancements such as bikeways, scenic landscaping and trails that will help attract people and jobs to the area.

- Improve street and directional signing where necessary to facilitate navigation by tourists and newcomers who may be unfamiliar with the area.

3.0 METHODOLOGIES AND STANDARDS

This chapter defines the methodologies and standards utilized in the analysis of network performance.

3.1 Functional Classification

Functional classification, the grouping of roadways by the character of service they provide, was developed for transportation planning purposes. Conflicts and congestion occur at interfaces between public roadways and private traffic generating facilities, when functional classification transitions are inadequate.

Functional classification groups streets according to the character of service they are intended to provide. These classifications are presented as follows:

Interstates are defined as a divided highway with full control of access and are constructed with two or more lanes for the exclusive use of traffic in each direction. Access to and from the interstate is limited to ramp locations, and no direct access to and from adjacent property is permitted. Interstates provide uninterrupted flow and are designed to carry the greatest amount of traffic.

State Routes connect with the Interstates and principal arterials, provide service to trips of moderate length, and distribute vehicles to the arterial routes. State routes move vehicles through an area and are designed to allow motorists to traverse through an area without major delay. However, because of the nature of a state route, towns and cities developed around the state routes and now, State Routes have turned into “Main Streets”. An example of this is 4^{th} Street/SR 80 in Benson. Therefore, on a city level, the state route functions as an arterial roadway and provides connectivity between disperse communities and also as a carrier of heavy traffic flow within the community.

Arterial Roadways are influenced by the geometric characteristics of the facility and adjacent land uses; interaction among vehicles as determined by the traffic density and the proportion of heavy vehicles and turning vehicles; and the effects of traffic signals along the roadway. Arterial routes connect the collector streets to the State Routes/Interstates and also provide some access to commercial development.

Collector Roadways provide traffic circulation within low-density areas, and can direct access from arterials to county roads. In the Benson area, these routes typically connect local streets with arterials, and are typically developed on the ¼ mile and ½ mile roadway spacing.

Local Roads, while not considered within this Small Area Transportation Study, play a major role in the transportation network. Local roads are designed to provide access to residential lots and are designed for low speeds and low volumes of traffic. Local roads are used to connect residential areas and funnel traffic to the collector routes.

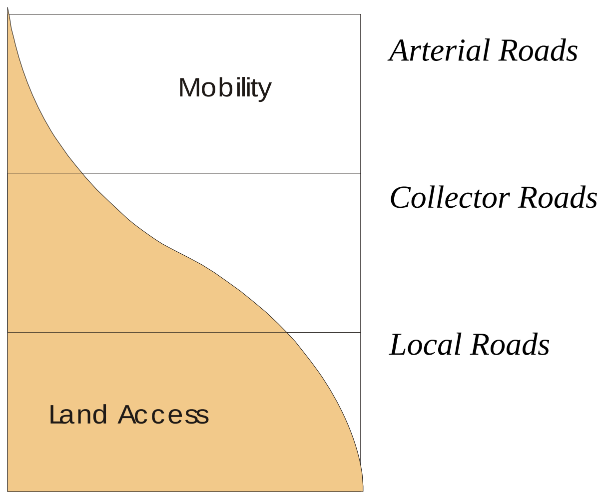


Figure 4: Proportion of Service

Source: A Policy on Geometric Design of Highways and Streets, AASHTO, 2004

Figure 4: Proportion of Service provides an illustration of the relationship between functionally classified roadways in serving traffic mobility and land access. Local roads emphasize the land access function, arterials emphasize the high level of mobility for through movements, and collectors offer approximately balanced service for both functions. As shown in figure 4, an arterial, provides mobility for linger distance trips with high speeds and minimal access to adjoining properties. Conversely, the function of a local street is to provide direct access to neighborhoods with lower speeds.

3.2 Level of Service

Levels of service provide a common and consistent means of evaluating the need for roadway improvements. The LOS concept is widely used and offers a uniform analysis methodology.

Beginning in 1965, the level of service (LOS) concept has been used in traffic engineering to describe the quality of traffic flow and the degree of congestion a driver can expect. The concept defines the near-capacity condition as Level of Service "E" while a free flow condition under which a driver would experience very little or no delay is defined as Level of Service "A". Capacity analysis is the procedure used to compare the forecast traffic volume with the theoretical carrying capacity of an intersection. The results of the capacity analysis are an estimator of the quality of flow for that intersection.

Most jurisdictions strive to obtain a level of service C or better on surface streets and D or better on highways and freeways. Roadways having a level of service in the D, E or F range are considered congested and warrant further review for possible upgrading. Where feasible, capacity improvements or other remedial actions are usually recommended if the level of service is worse than C.

Levels of service on roadway segments are defined as follows:

- **LOS A** – Free-flowing conditions. The operation of vehicles is virtually unaffected by the presence of other vehicles, and operations are constrained only the geometric features of the highway and driver preferences.
- **LOS B** – Indicative of free flow, but the presence of other vehicles begins to have a noticeable impact on speeds and freedom to maneuver.
- **LOS C** – Represents a range on which the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream and to select an operating speed is now clearly affected by the presence of other vehicles.
- **LOS D** – Borders on unstable flow. Speeds and ability to maneuver are severely restricted because of congestion.
- **LOS E** – Operations are near or at capacity and flow is quite unstable.
- **LOS F** – Represents forced or breakdown flow.

3.3 Roadway Segment Level of Service Standards and Thresholds

The analysis of roadway segment level of service is based on the number of lanes, the functional classification of the roadway, maximum desired level of service capacity, roadway geometrics, and existing or forecasted average daily traffic volume.

Table 1: Network Link Characteristics presents the proposed segment level of service LOS C and D maximum volumes for various facility classifications used in this study. The evaluation was based on Florida Department of Transportation assessment methods. These level of service capacity volumes were also used in the Northwest Cochise County Transportation Planning Study, dated July 2005.

Table 1: Network Link Characteristics

Functional Classification (Facility Type)	LOS C	LOS D
State Route divided – 6 lanes	38,000	46,100
State Route divided – 4 lanes	24,400	30,600
State Route – 2 lanes	10,500	14,500
Arterial Roadway - 5 lanes*	22,600	30,400
Arterial Roadway – 4 lanes	21,400	30,100
Arterial Roadway – 3 lanes*	11,025	14,500
Arterial Roadway -2 lanes	7,000	13,600
Collector Roadway - 2 lanes**	2,000	2,400
Unpaved Roadway***	250	350

Source: FDOT 2002 Quality/LOS Handbook, Table 4-2

Note: ** A 5 lane section and a 3 lane section include the two-way left turn lane.*
*** The LOS capacity was not defined for a collector roadway according to the FDOT method., Therefore, an average ADT was selected that reflects collector street activity for a small community.*
**** Based on dust control standards.*

The level of service for each segment in the network is determined by comparing the actual traffic volumes to the capacity calculated for each roadway type by the FDOT worksheets. The capacity is defined as the volume threshold for the type of facility. This method of assessing roadway segment levels of service is widely used for planning applications. The FDOT methods are based on the most recent version of the *Highway Capacity Manual*.

In rural areas, LOS C is the general standard for acceptable roadway performance, and LOS D is generally considered acceptable for roadways in areas transitioning from rural to urban, such as SR 80/4th Street. Capacity at LOS C and D are derived from the FDOT Generalized Annual Average Daily Volumes for Areas Transitioning into Urbanized Area, 2002 FDOT Quality/LOS Handbook.

For planning purposes, the Levels of Service are determined by:

- **LOS D or Higher** – Over Capacity
- **Between LOS C and LOS D** – Capacity
- **LOS C or Lower –** Under Capacity

It should be recognized that the actual functional capacity of roadway facilities vary by the characteristics that exist on each facility under review. Typically, the performance and level of service of a roadway segment are based on the ability of the intersections to accommodate peak hour volumes. Special designs of intersections to achieve acceptable levels of service and lower levels of approach delay could result in higher capacities compared to those shown for LOS D. For the purposes of this study, LOS C and better for roadway segments are considered acceptable for arterial and collector roadways under daily operating conditions.

3.4 Pedestrian Standards and Guidelines

The guidelines for the planning and design of pedestrian facilities in the Benson Area are based on the Pedestrian Policies and Design Guidelines 2005, dated April 2005 prepared by Maricopa Association of Governments.

3.5 Bicycle Standards and Guidelines

The guidelines for the planning and design of bikeway facilities in the Benson Area are based on the Guide for the Development of Bicycle Facilities prepared by the AASHTO Task Force on Geometric Design dated 1999 and the ADOT Statewide Bicycle and Pedestrian Plans for Phase I and II prepared by Kimley Horn dated August 2003 and December 2004, respectively. Bicycle facilities include separated shared use paths, striped bike lanes, signed bike routes, and shared roadways.

3.6 Transit Service Planning Guidelines

The Institute of Transportation Engineers, Transportation Planning Handbook 2nd Edition, dated 1999, suggests the following guidelines of bus service planning in urban areas.

- Provide ¼ mile coverage service for at least 90 percent of area residents where population density exceeds 4,000 person per square mile or three dwelling units per acre.
- Provide ½ mile coverage service 50 to 75 percent of the population where population density ranges from 2,000 to 4,000 persons per square mile.
- Service major employment centers, schools, and hospitals.
- Space routes about ½ mile in urban areas and 1 mile in low density suburban areas.

The following list different kinds of public transportation services and the varying services levels.

Local transit service – operates on streets or other right of way with frequent stops and at relatively low speeds; it serves adjacent land uses within acceptable walking distances. Shuttle services within business districts or connecting high activity centers functionally fall within this category.

Express service – does not attempt to serve all land areas through which it passes, but it offers faster speeds to a selected number of stops spaced more widely apart. It includes limited-stop and nonstop services.

Basic service – comprises routes that operate all day (although the length of the "day" may vary from about 14 to 24 hours) and at least five days a week.

Peak service – comprises routes that operate during peak demand periods only.

Special service – comprises irregular routes operated for special events or for seasonal traffic generators.

4.0 CURRENT SOCIOECONOMIC CONDITIONS

This section provides an overview of year 2005 socioeconomic conditions within the Benson study area. It includes population and employment estimates as well as economic conditions from the Census Bureau.

4.1 General Characteristics

The 2000 Census data prepared by the US Census Bureau was used as a base for the socioeconomic conditions. This information was the most current available for the Benson Study Area. Other data provided by Arizona Department of Economic Security was used only for the more current 2004 population count.

4.1.1 Total Population

In 2000, the US Census Bureau recorded a total population of 4,711 for the City of Benson. Then, in July the Arizona Department of Economic Security estimated that Benson grew to by approximately 74 people to increase its total population to 4,785.

4.1.2 Ethnicity and Race

According to the 2000 Census, Hispanics constituted 19.8 percent of the City's total population compared to 25.3 percent for the state and 12.5 percent for the nation. Native Americans accounted for 1.3 percent of the City's population, African Americans for 0.7 percent, and Asian/Pacific Islanders for 0.6 percent. Multi-racial, that is persons indicating two or more races were indicated by 2.4 percent of the population.

4.1.3 Age and Sex

The median age of Benson's 2000 population was 49.6 – notably greater than the nation median average of 35.3. This region attracts retirees, contributing to those over 65 which was 29.3 percent in Benson compared to the national average of 12.4 percent. These numbers confirm that the City supports a large retired population and is a winter refuge for visitors from colder climates.

The 2000 population in the City of Benson was 51.1 percent female and 48.9 percent male.

4.1.4 Persons per Household

The number of persons per household is one measure of population that is recorded by the Census. In 2000 the average household size was 2.2 people per dwelling unit. This is lower than the national household size which averaged 2.59 persons per household.

4.2 Social Characteristics

4.2.1 Schooling

Of the population that is 25 years or older, the 2000 Census collected data on educational achievement in Benson. Based on this data, 77.1 percent of the population was a high school graduate or higher and 14.3 percent had received their Bachelor's degree or higher.

4.2.2 Veteran Status

Approximately 23.2 percent of the Benson population, over the age of 18, are veterans compared to the national average of 12.7 percent.

4.3 Economic Characteristics

In 2000, the civilian labor force (population 16 years and older) in Benson totaled 1,938 people ~ about 47.6 percent of the population. The average unemployment rate in Benson in 2000 was 5.7 percent, slightly higher than the state average of 5 percent and the Nation average of 5.2 percent.

The 2000 Census data was also used to present employment data for the City of Benson study area. *Figure 5: Employment Classification,* shows the 2000 employed civilian population over the age of 16 (1,685 people) by type of profession.

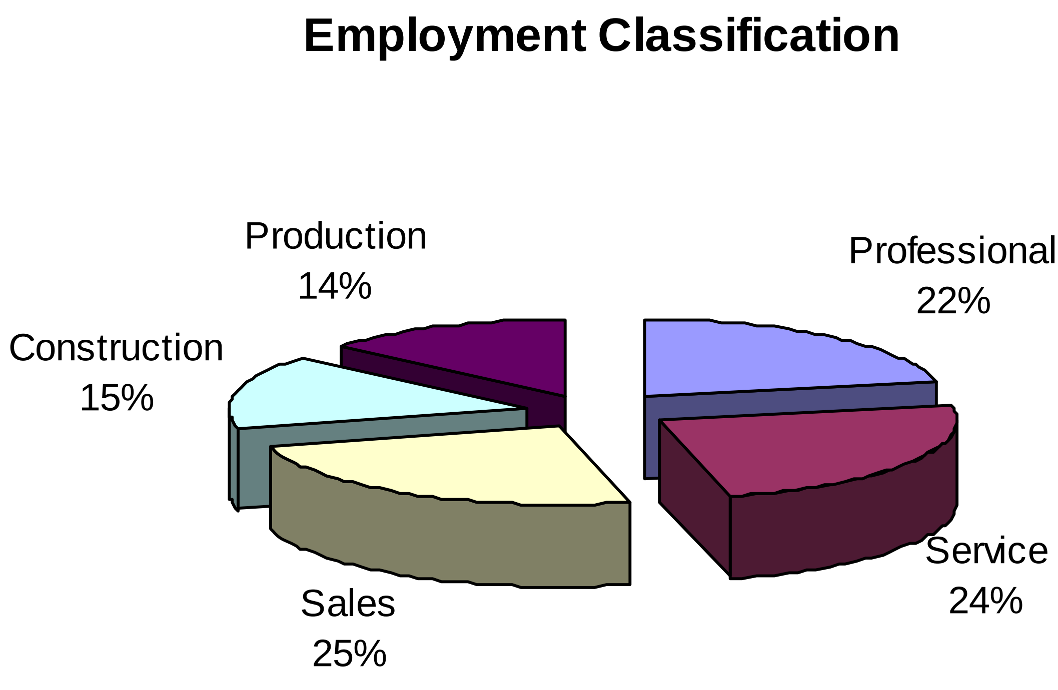


Figure 5: Employment Classification

Source: U.S. Bureau of the Census, 2000 Census

Employment by Category for the City of Benson was provided by the City of Benson General Development Plan, WLB Group, 2002. *Table 2: Employment by Category* summarizes the data. This table presents the total number of jobs available by category within the Benson area as estimated for 2002.

Table 2: Employment by Category

Category	Employment Total	
	No.	%
Government	316	5.4
Service	2268	38.8
Trade	1581	27.1
Construction	352	6.0
Transportation	841	14.4
Manufacturing	258	4.4
Finance, Real Estate	223	3.8
Total (non-agricultural)	**5,839**	**100.0**

Source: City of Benson General Development Plan, October 2002, WLB Group.

According to the Benson/San Pedro Valley Chamber of Commerce web site, Arizona Electric Power Cooperative, Inc., Apache Nitrogen Products, Benson Schools and the Benson Hospital are the area's major employers. Many residents also commute to Tucson and Sierra Vista for employment and shopping.

4.4 Work Travel

According to the 2000 Census data, 75.1 percent of those traveling to work drove alone, and the average daily commute time was 23 minutes. *Figure 6: Travel to Work,* presents the mode split and the percentages for the City of Benson.

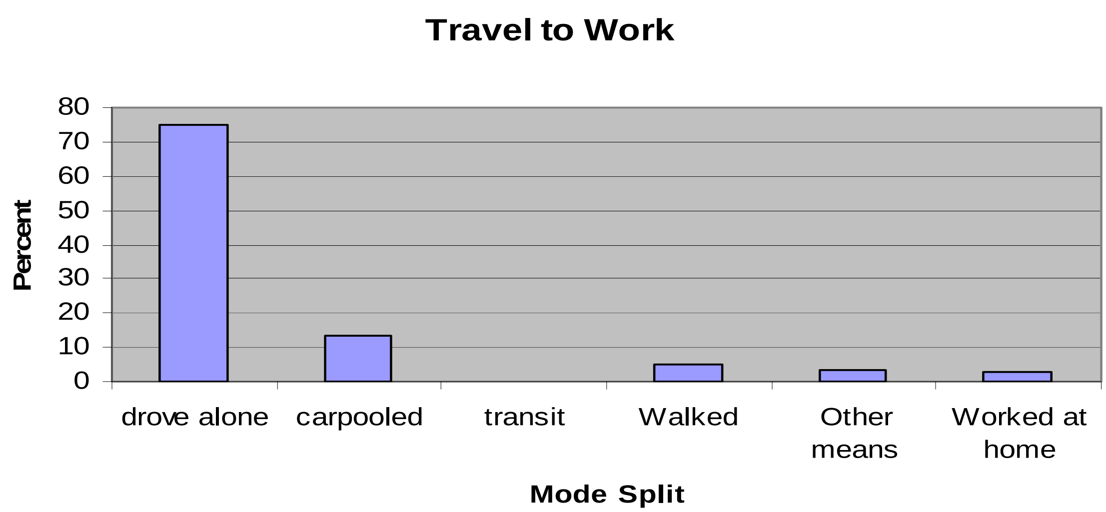


Figure 6: Travel to Work

Source: U.S. Bureau of the Census, 2000 Census

Because the roadway network carries approximately 92% of all the current trips made within the study area, it is the backbone to the community system. This network made of Interstate 10, state routes, arterials, collectors and local roads, which move people and commodities, comprise the primary surface transportation system.

5.0 TITLE VI AND ENVIRONMENTAL JUSTICE

Title VI of the Civil Rights Act of 1964 and the related statutes state that individuals cannot be excluded from participated in, denied the benefit of, or subjected to discrimination under any program or activity receiving federal financial assistance. Executive Order 12898 on Environmental Justice directs that programs, policies, and activities not have a disproportionately large and adverse human health and environmental effect on minority and low-income populations.

In recent years there has been increased attention and focus on ensuring equity, environmental justice and Title VI compliance in the delivery of government programs. Recipients of federal assistance for transportation related projects are now required to assure compliance with all civil rights standards applicable to the specified transportation related projects, as they relate to Title VI of the Civil Rights Act of 1964, as amended.

Transportation improvements implemented from this study should not adversely impact such groups disproportionately. To identify and address environmental justice issues, community outreach and public involvement programs should involve under represented populations from the planning to the implementation of any transportation improvement project. A variety of possible alternatives should be developed and considered in order to ensure all groups are fairly represented in the amount and type of transportation services provided.

To be consistent with the requirements of Title VI and environmental justice, the demographic characteristics of the study area population were examined to determine areas where various specified populations may be disproportionately affected or discriminated against. The total population per census block is shown in *Figure 7: Total Population for 2000.* This figure shows the distribution of the population for the Benson area.

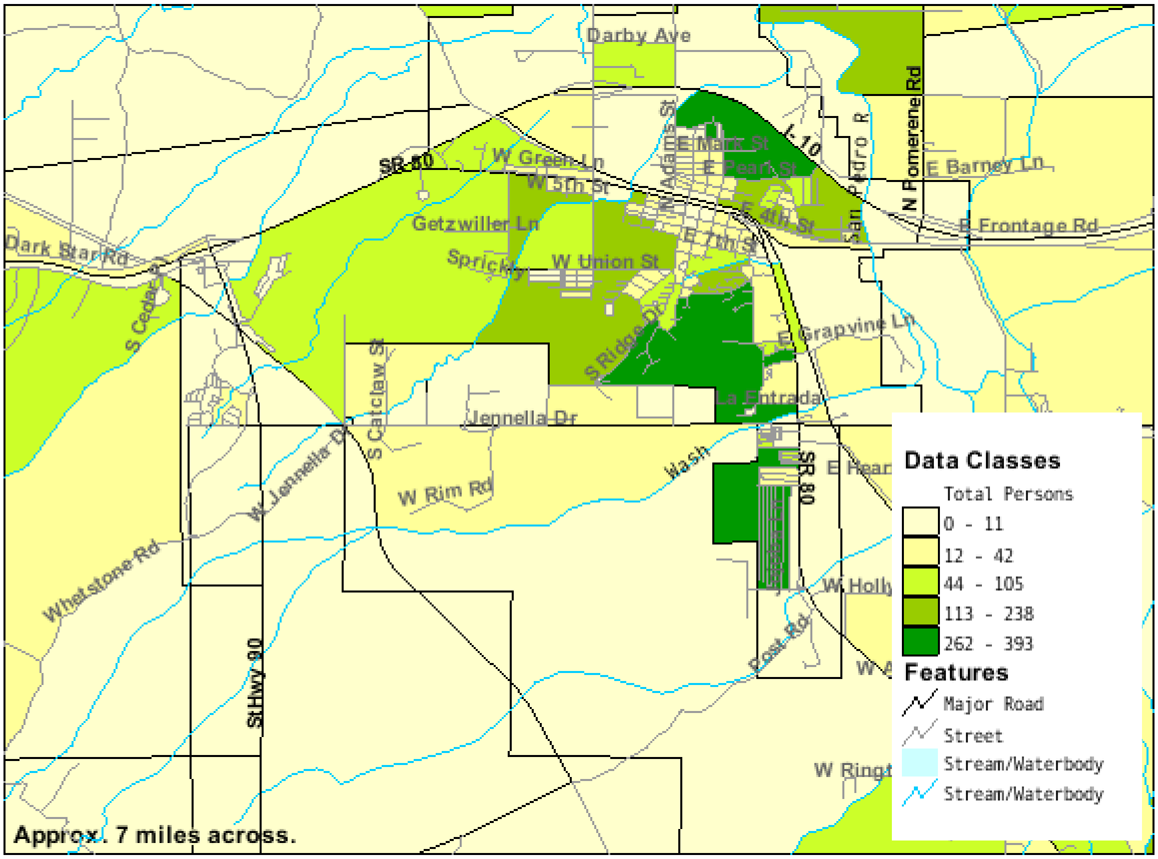


Figure 7: Total Population by Census Block

Source: US Bureau of the Census, 2000

5.1 Minority Population

The minority population was reviewed to determine if there was a high percentage of minorities living in a specific area within the study boundary. The percentage of minorities living in Benson is lower than the state of Arizona, but higher than the percentage for the national average. *Figure 8: Percentage of Minorities by Census Block* illustrates census blocks and the percentage of minorities living in each area. Based on this graphic, there are approximately 9 census blocks that have a minority population greater than 46.7 percent.

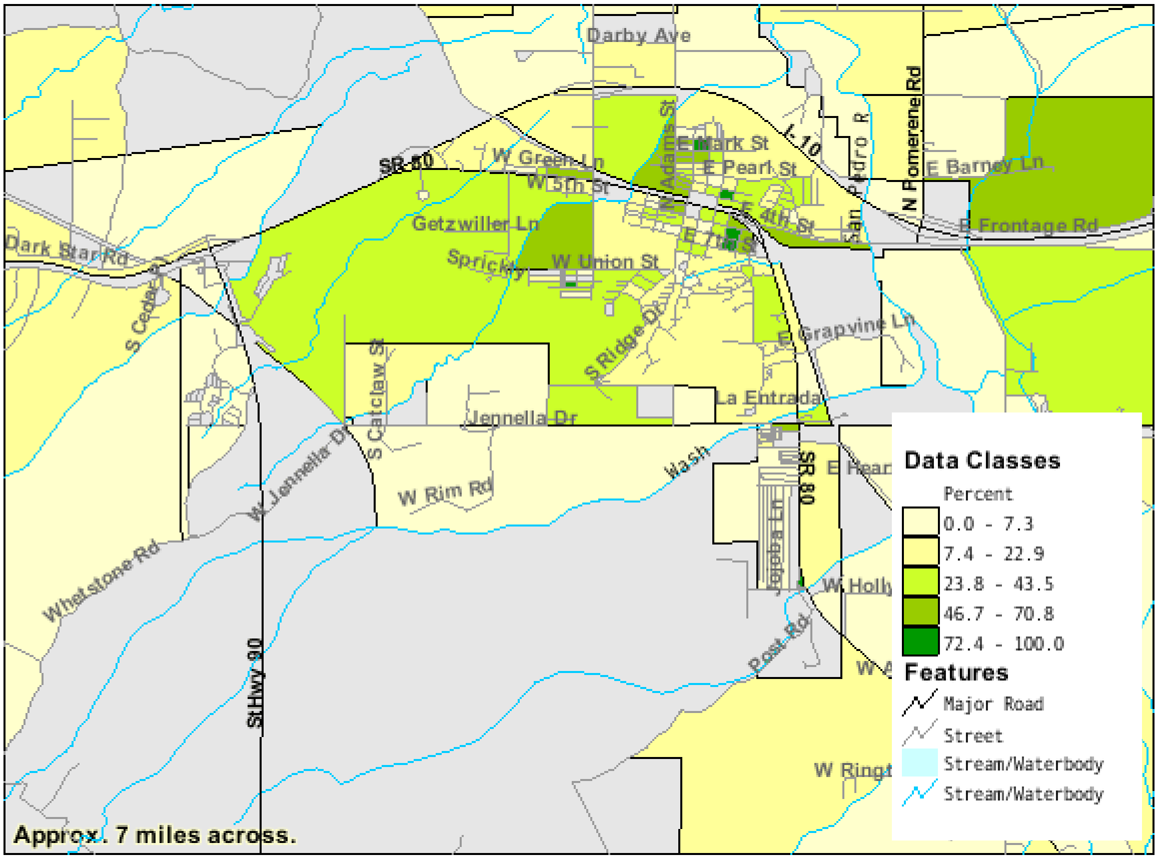


Figure 8: Percentage of Minorities by Census Block

Source: US Bureau of the Census, 2000

5.2 Aged 65 and Older

According to the census data, approximately 13 percent of Arizona's population is 65 and older. The census data shows that in Benson, approximately 29.3 percent of the population is 65 and older. This is primarily because Benson is known as a retirement community. *Figure 9: Percentage of Population 65 and Older*, presents the percentages of residents within Benson that are 65 or older by census block.

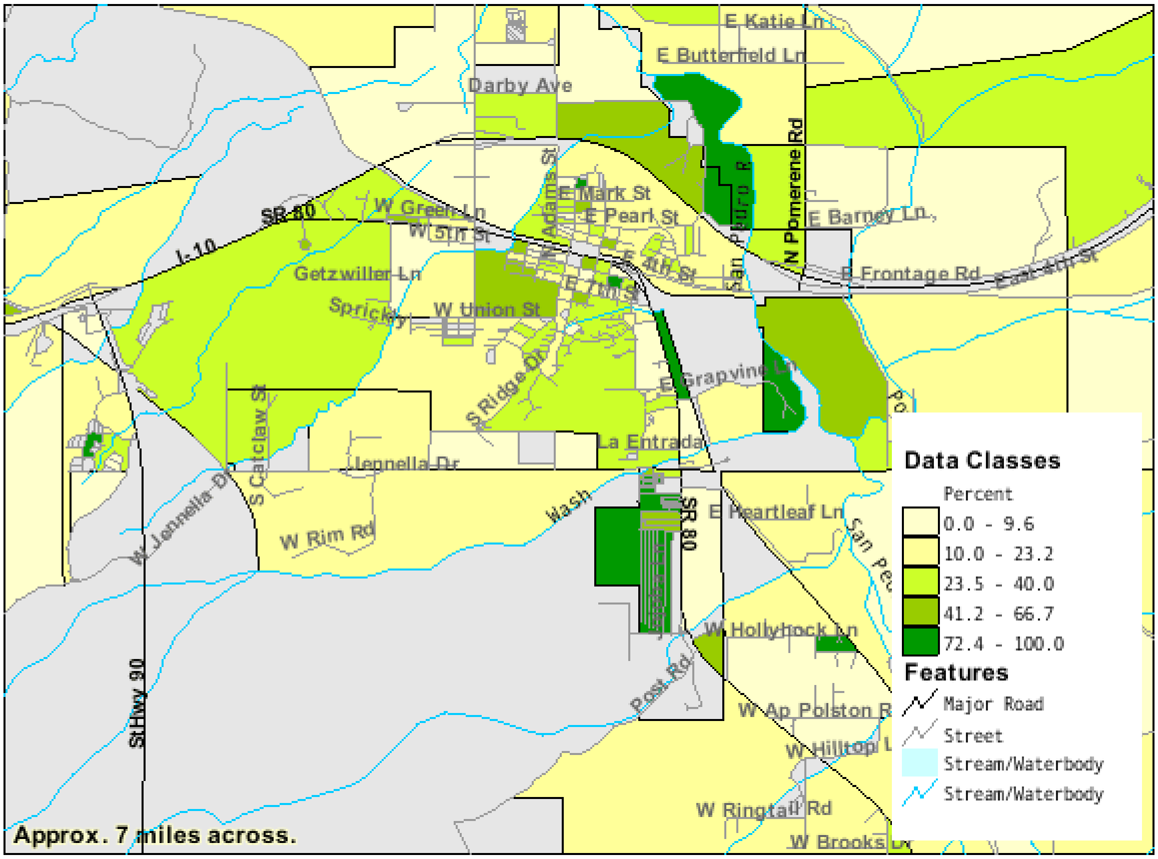


Figure 9: Percentage of Minorities by Census Block

Source: US Bureau of the Census, 2000

5.3 Mobility Limited

The Benson Area did not have adequate graphs that represent the percentage of persons disabled by census block. Therefore, *Table 3: Disability Status of the Civilian Non-Institutionalized Population* was reviewed to determine if there were a high percentage of people with a disability in Benson. Based on the state average, approximately 19.4 percent of individuals between 21 and 64 have a disability. In Benson, approximately 27.8 percent of the population, between 21 and 64, has a disability. However, 43 percent of those with a disability are employed.

Table 3: Disability Status of the Civilian Non-Institutionalized Population

Disability Status of the Civilian Non-Institutionalized Population	Number	Percent
Population 5 to 20 years	890	100.0
With a disability	57	6.4
Population 21 to 64 years	2,378	100.0
With a disability	660	27.8
Percent employed	-	43.6
No disability	1,718	72.2
Percent employed	-	66.1
Population 65 years and over	1,277	100.0
With a disability	559	43.8

5.4 Below Poverty Level

The percentages of families, families with a female householder, individuals, and individuals over age 65 were compared to the Arizona averages to determine if Benson has a high percentage of residents that are below the poverty level. Based on *Figure 10: Comparison of Below the Poverty Level for Benson versus Arizona,* the poverty levels for Benson appear to be comparable to the state averages.

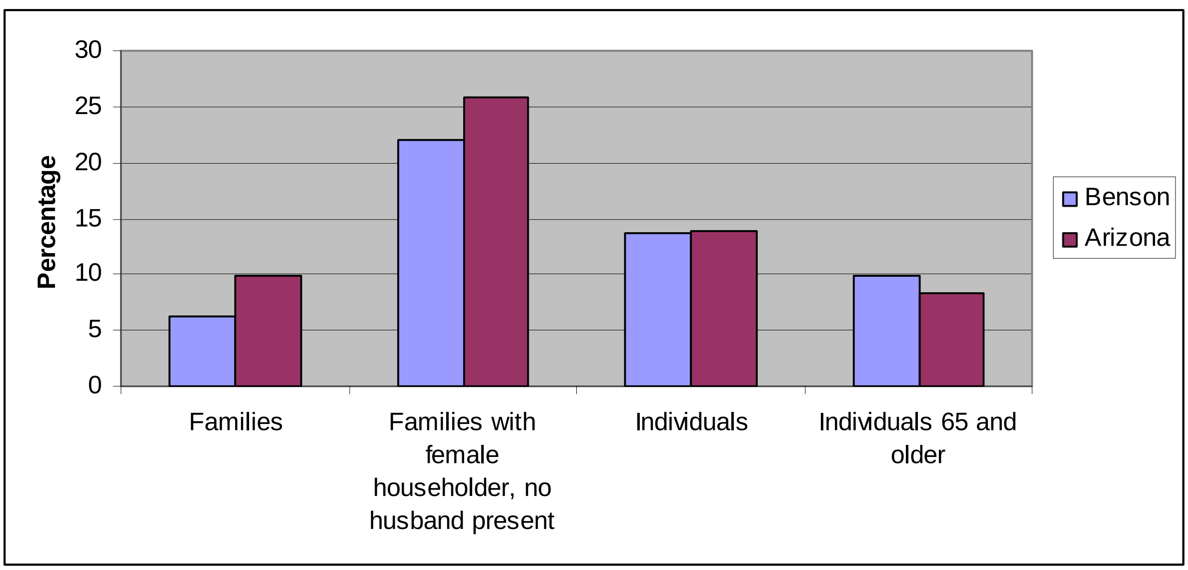


Figure 10: Comparison of Below the Poverty Level for Benson versus Arizona

Source: US Bureau of the Census, 2000

6.0 NETWORK INVENTORY AND EXISTING CONDITIONS

The City of Benson is served by Interstate 10 to the north, and by two state routes, SR 90 to the west and SR 80 to the east. Additionally, 4th Street which is SR 80 serves Benson as "Main Street". Benson is also served by a variety of arterial, collector and local roadways.

6.1 Interstate

The only interstate roadway within the Benson Study Area is Interstate 10 (I-10), which bisects the area in a generally east-west direction. I-10 is an east west interstate serving long interregional trips between California and New Mexico. The four lane interstate is a major transportation link that provides high speed automobile and truck service between the two major cities Tucson, Arizona, and Las Cruces, New Mexico. *Table 4: Traffic Interchanges*, lists all of the I-10 traffic interchanges within the study area.

Table 4: Traffic Interchanges

Interchange Name	Milepost Location
SR 90	302.4
SR 80	303.8
Ocotillo Road	304.9
Pomerene Road	306.6

Source: Arizona Department of Transportation, State Highway Log System, 1998

6.2 State Routes

State Route 90 and State Route 80 are both north south state routes that traverse through the Benson Study Area. These routes link I-10 to the north, to the southern communities of Sierra Vista, Bisbee, Douglas and on to Mexico.

6.2.1 SR 90

State Route 90 (SR 90) is an interregional route originating at I-10 and traversing southeast to connect to SR 80. SR 90 is the primary route between Benson, Sierra Vista, and Fort Huachuca. SR 90 also traverses to Karchner Caverns about 10 miles south of Benson. SR 90 is constructed as a four lane state route with limited access that also serves commercial development along the facility near the I-10 interchange.

6.2.2 SR 80

Benson's "Main Street", State Route 80 (SR 80) also named 4th Street, or Business Route 10 connects Benson to Tombstone and passes through St. David. SR 80 is constructed as a five lane section within the City and functions as an arterial roadway; however, SR 80 does transition to a two lane roadway and becomes an interregional route connecting Benson to Bisbee and Douglas.

6.3 Arterials

Both Ocotillo Road and Pomerene Road function as north south arterial routes and provide access to I-10.

Ocotillo Road is a three lane arterial that serves vehicle trips by connecting the Benson Downtown Area to the Airport Area.

Pomerene Road is a two lane arterial that connects the Benson Downtown Area to the Pomerene residential district.

6.4 Collectors

All other streets within the Benson Study Area are defined as collector streets. These include: Aviation Drive, Jennela Drive, Union Street, Silverwood Lane, Patagonia Road, Jackson Road, Haverty Lane, Pearl Street, County Rona and Wild Rabbit Road. It should be noted that only the State Routes, Arterials and Collector Routes were analyzed as a part of this study. Local Roadways were not analyzed.

Figure 11: Functional Classification illustrates the functional classification for the Benson Study Area. The functional classification established for the City of Benson is based on three primary classifications: State Route, Arterial, and Collector roads. This classification system is consistent the City of Benson General Development Plan, dated October 2002.

All of the roads analyzed within this Small Area Transportation Study are presented in Figure 11.

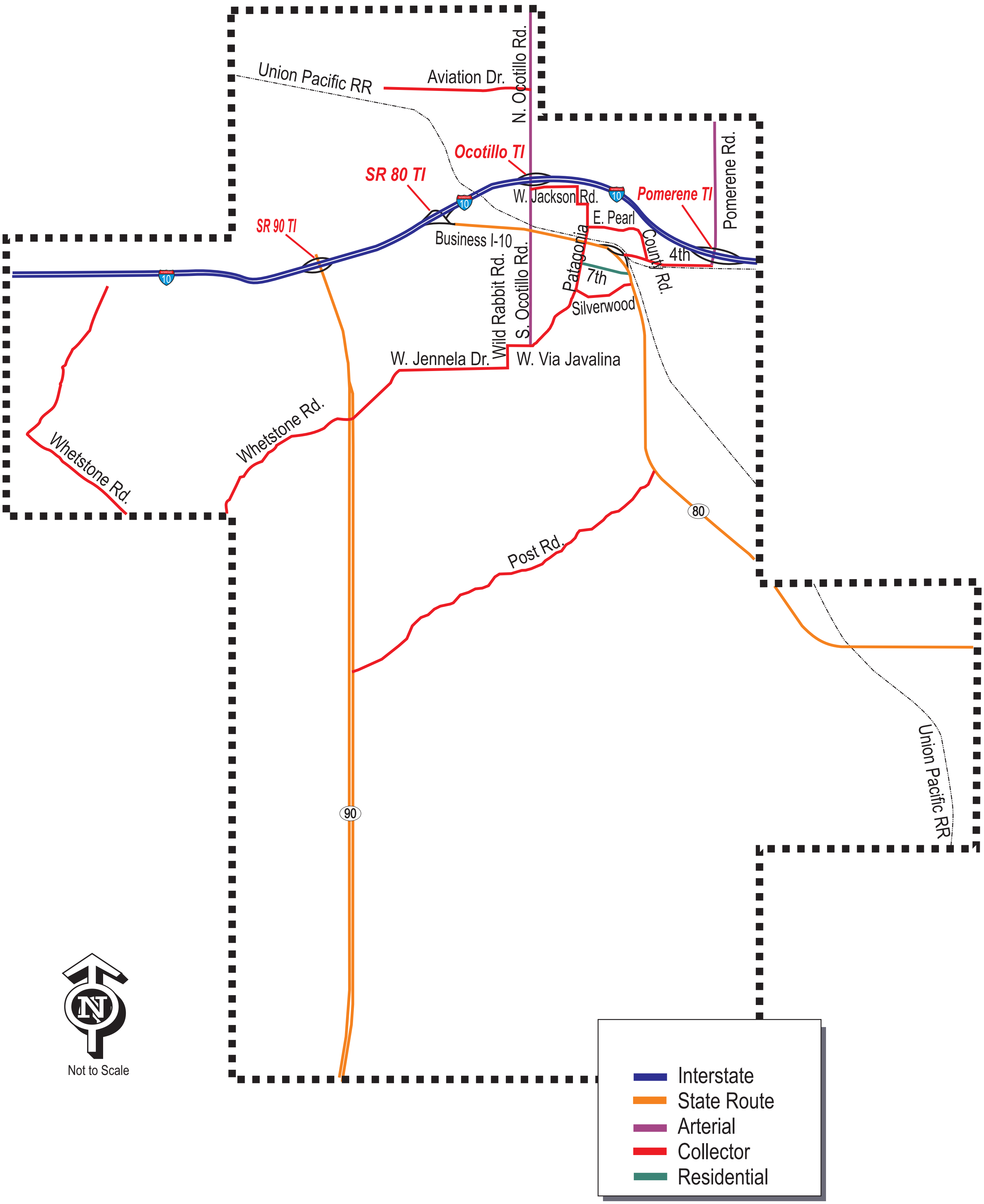


Figure 11: Existing Functional Classification

6.5 Jurisdictional Responsibility

The State of Arizona is responsible for all state routes and interstate highways within the study boundary, mainly, SR 90, SR 80 and I-10. The responsibility of the City of Benson extends to all non-state routes within the City limits. Cochise County administers all roadways in the unincorporated portions of the study area.

6.6 Number of Lanes

The number of lanes for each roadway to be analyzed within the study area was inventoried to determine the number of lanes. The data were collected by driving all of the arterial and collector streets within the study area. The cross sections of the roads were defined by the following configurations:

- 2 Lanes - unpaved
- 2 Lanes - paved with no curb or gutter
- 2 Lanes - paved with curb and gutter
- 3 Lanes - paved with no curb or gutter
- 4 Lanes - paved with no curb or gutter
- 4 Lanes - paved with curb and gutter
- 5 Lanes - paved with curb and gutter
- 6 Lanes - paved with no curb or gutter

Figure 12: Number of Lanes, illustrates the existing year 2005 number of lanes on each roadway. It should be noted that five lane roadways are comprised of four through lanes plus a continuous center two-way left turn lane. Similarly, three lane roadways have two through lanes and a continuous center two-way left turn lane.

6.7 Speed Limits

The speed limits within the study area generally range from 25 miles per hour on the local roads and collector routes to 65 miles per hour on the state routes. Streets in the vicinity of the elementary school are posted 15 miles per hour during school hours. Although many of the residential streets do not have posted speed limits, the speed limit is 25 miles per hour according to Arizona State Law. *Figure 13: Speed Limits* presents the speed limits on the various routes within the Benson Study Area.

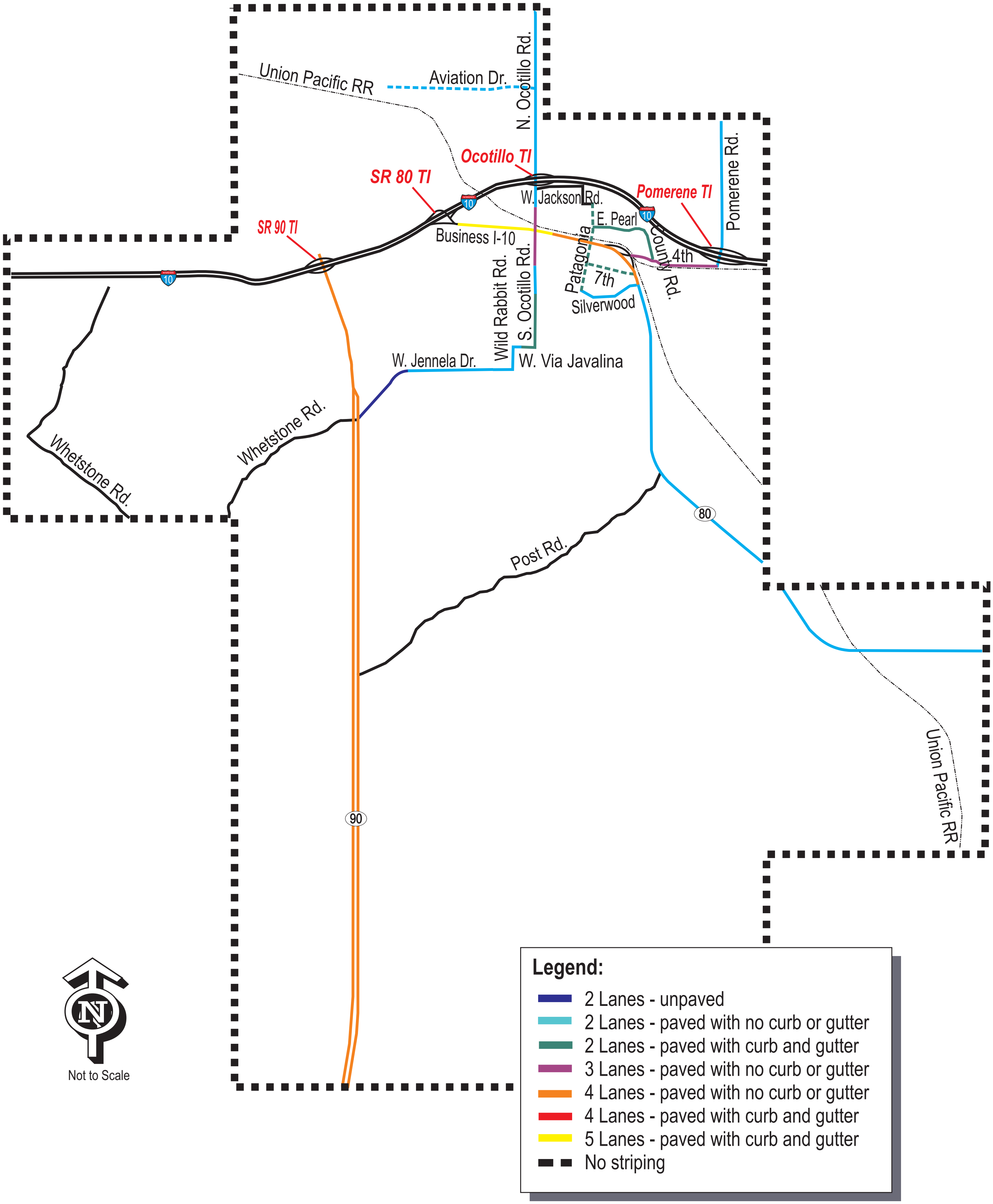


Figure 12: Existing Number of Lanes

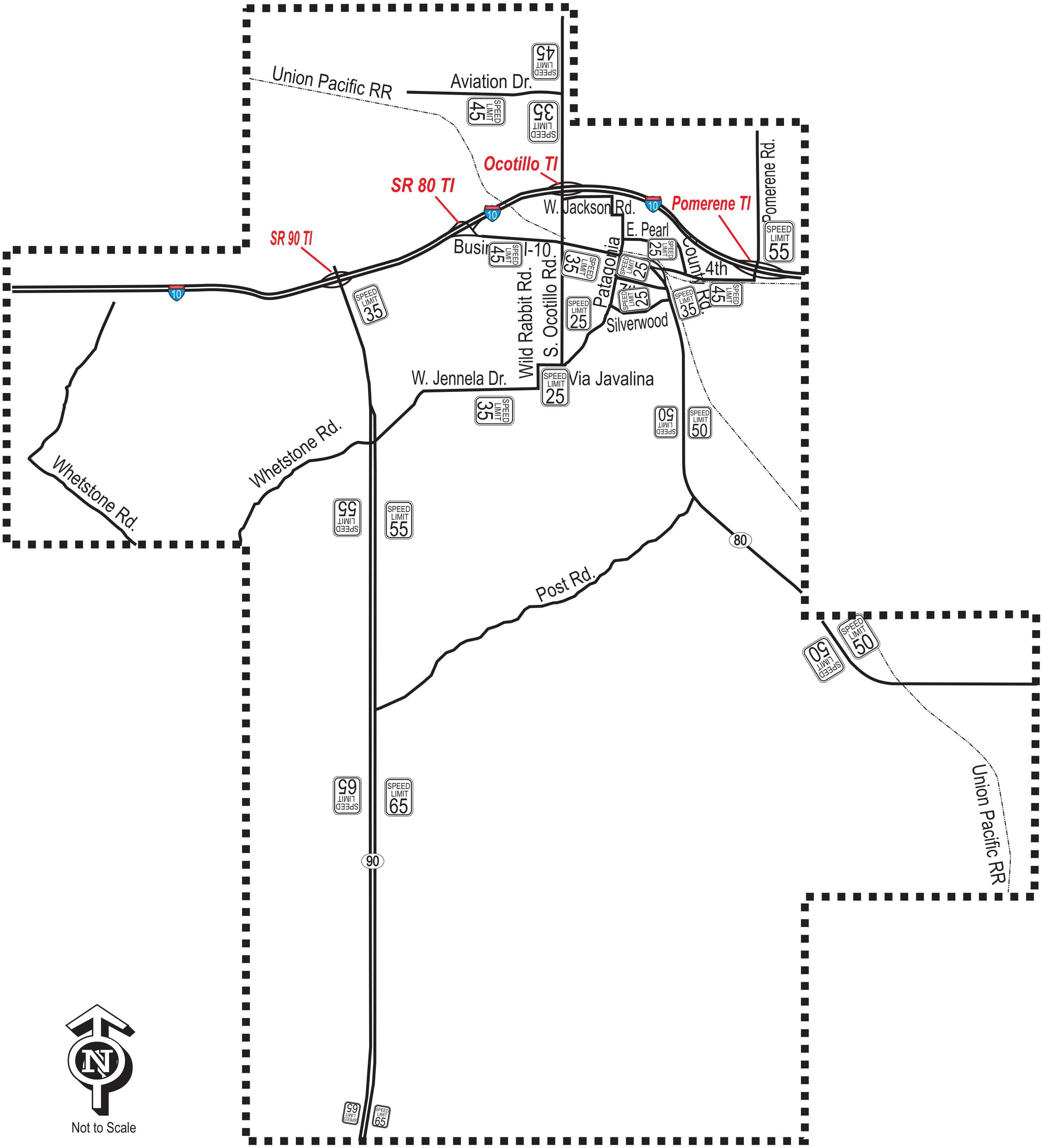


Figure 13: Existing Speed Limits

6.8 Intersection Traffic Control

The street intersections were inventoried to identify locations with traffic signals, two way stops and four way stops. *Figure 14: Existing Traffic Control Devices* shows the locations of this traffic control devices.

Traffic signals are valuable devices for the control of vehicle and pedestrian traffic. However, because they assign the right of way to the various traffic movements, traffic signals exert a profound influence on traffic flow. Currently, there are three signalized intersections within the Benson Study Area. All three signals are located on state routes in the Benson Downtown Area and are owned and maintained by Arizona Department of Transportation. Intersections that are controlled by signalization include:

- 4th Street (B-10)/Ocotillo Road
- 4th Street (B-10)/Patagonia Road
- SR 90/Whetstone Commerce Drive

All-way stop signal installation is useful as a safety measure at some locations. It is used where the volume of traffic on the intersecting roadways is approximately equal to the major roadway. Locations of all way stops were counted if they were part of the roadway network within the study area.

6.9 Pavement Conditions

The pavement conditions of the arterial and collector roadways were reviewed. *Figure 15: Pavement Conditions* illustrates the pavement quality. The categories were defined as:

- Good
- Good to Fair
- Fair
- Fair to Poor
- Poor
- Dirt

The quality of the pavement was determined by a windshield survey using engineering judgment.

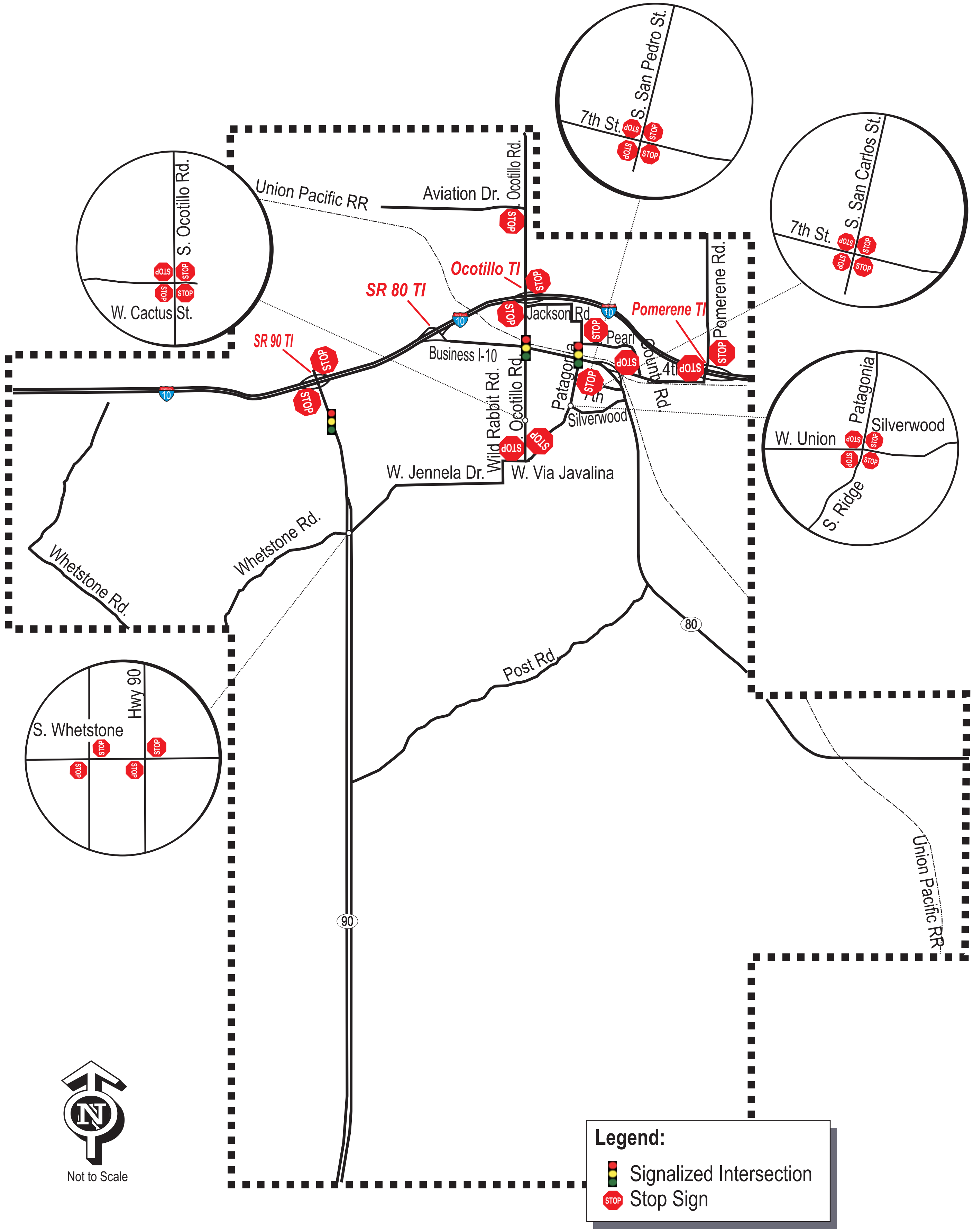


Figure 14: Existing Traffic Control Devices

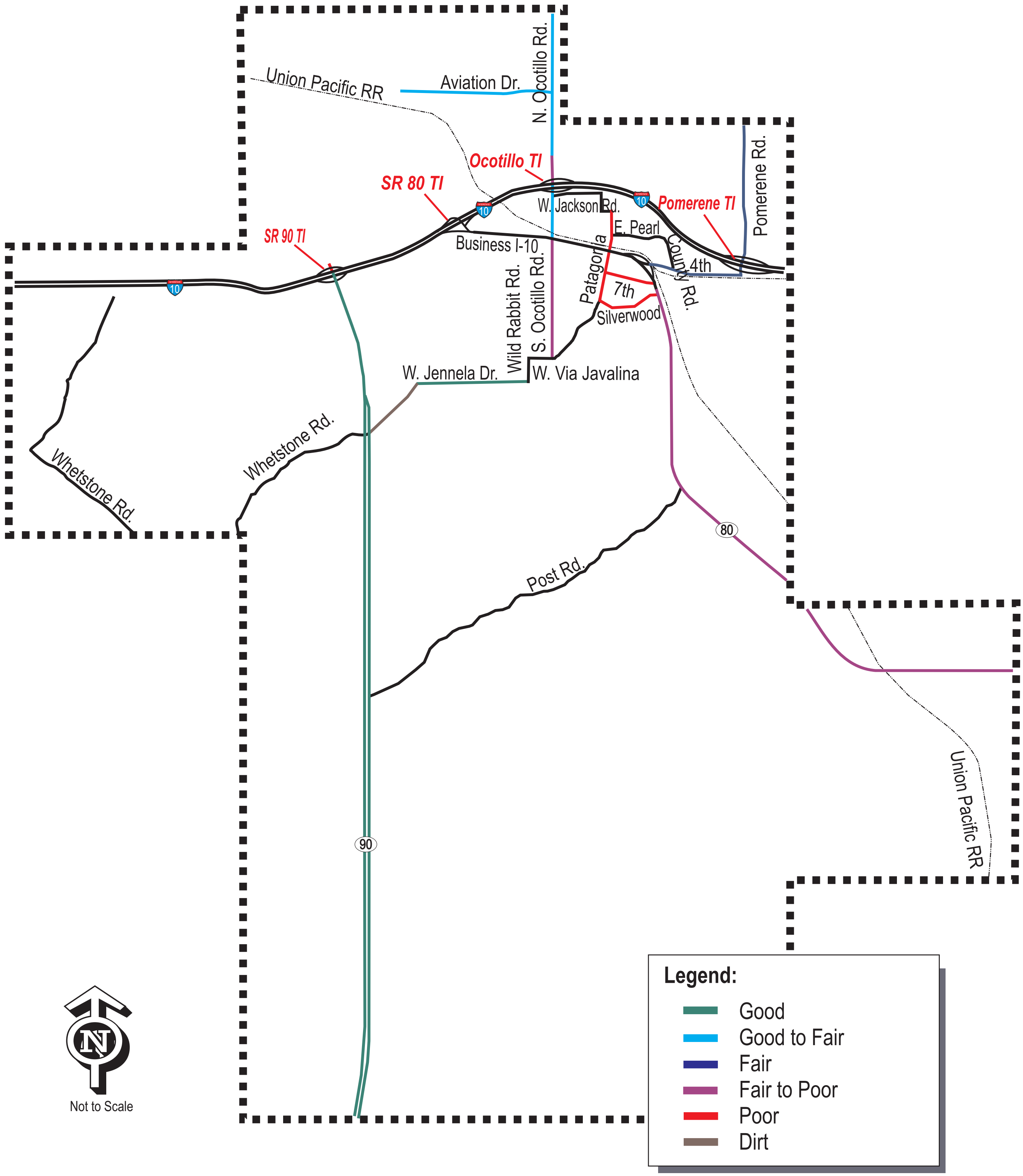


Figure 15: Existing Pavement Conditions

6.10 Traffic Data

United Civil Group collected average daily traffic volumes, speeds and vehicle classification within the City of Benson during August 2005 and January 2006, using Timemark Traffic Counters. *Table 5: Average Daily Traffic-Summer 2005* presents the background average daily traffic (ADT) volumes that were collected for a 24 hour period on an average weekday during the summer months in 2005.

Table 5: Average Daily Traffic – Summer 2005

Roadway	North- or East-bound	South- or West-bound	Average Daily Traffic
SR 90 N of Jennela Dr	4,021 (NB)	4,483 (SB)	8,504
SR 90 N of Post Rd	3,472 (NB)	4,180 (SB)	7,652
SR 90 N of Rickets Rd	3,400 (NB)	3,405 (SB)	6,805
4th St (B-10) W of Ocotillo Rd	4,880 (EB)	4,536 (WB)	9,416
4th St (B-10) W of Patagonia Rd	5,874 (EB)	5,674 (WB)	11,548
4th St (B-10) W of Pomerene Rd	1,967 (EB)	1,872 (WB)	3,839
4th St (B-10) N of Post Rd	4,023 (NB)	3,762 (SB)	7,785
4th St (B-10) S of Post Rd	2,811 (NB)	2,816 (SB)	5,627
Ocotillo Rd N of I-10	1,066 (NB)	1,062 (SB)	2,128
Ocotillo Rd N of 4th St (B-10)	1567 (NB)	1447 (SB)	3,014
Ocotillo Rd S of Union St	443 (NB)	450 (SB)	893
Pearl St E of Patagonia Av	292 (EB)	325 (WB)	617
7th St E of Gila St	376 (EB)	415 (WB)	791
Pomerene Rd N of I-10	1,264 (NB)	1,266 (SB)	2,530
Silverwood Ln E of Patrick	243 (EB)	223 (WB)	466
Post Rd W of 4th St (B-10)	31 (EB)	31 (WB)	62

Source: United Civil Group Corporation, August 2005

Table 6: Average Daily Traffic – Winter 2006 presents the traffic volumes that were collected during the peak season. These counts were used to determine the seasonal variations between the summer and winter traffic volumes within the Benson Study Area. Therefore, *Table 7: Seasonal Percent Change* shows the differences.

Table 6: Average Daily Traffic – Winter 2006

Roadway	North- or East-bound	South- or West-bound	Average Daily Traffic
SR 90 N of Jennela Dr	6,372 (NB)	5,852 (SB)	12,224
SR 90 N of Post Rd	4,369 (NB)	4,341 (SB)	8,710
SR 90 N of Rickets Rd	3,203 (NB)	4,442 (SB)	7,645
4th St (B-10) W of Ocotillo Rd	4,808 (EB)	4,659 (WB)	9,467
4th St (B-10) W of Patagonia Rd	6,490 (EB)	5,802 (WB)	12,292
4th St (B-10) W of Pomerene Rd	2,008 (EB)	1,967 (WB)	3,975
4th St (B-10) N of Post Rd	4,486 (NB)	4,421 (SB)	8,907
4th St (B-10) S of Post Rd	3,104 (NB)	2,948 (SB)	6,052
Ocotillo Rd N of I-10	1,307 (NB)	1,303 (SB)	2,610
Ocotillo Rd N of 4th St (B-10)	1,838 (NB)	1,667 (SB)	3,505
Ocotillo Rd S of Union St	571 (NB)	585 (SB)	1,156
Pearl St E of Patagonia Av	226 (EB)	292 (WB)	518
7th Street E of Gila St	409 (EB)	466 (WB)	875
Pomerene Rd N of I-10	1,089 (NB)	1,310 (SB)	2,399
Silverwood Ln E of Patrick	221 (EB)	228 (WB)	449
Post Rd W of 4th St (B-10)	14 (EB)	33 (WB)	47
Patagonia Ave S of 4th St (B-10)	409 (NB)	483 (SB)	892
Patagonia Ave N of 4th St (B-10)	311 (NB)	386 (SB)	697

Source: United Civil Group Corporation, January 2006

Table 7: Seasonal Percent Change

Roadway	Average Daily Traffic (Summer 05)	Average Daily Traffic (Winter 06)	Percent Change
SR 90 N of Jennela Dr	8,504	12,224	33%
SR 90 N of Post Rd	7,652	8,710	12%
SR 90 N of Rickets Rd	6,805	7,645	11%
4th St (B-10)W of Ocotillo Rd	9,416	9,467	1%
4th St (B-10) W of Patagonia Rd	11,548	12,292	6%
4th St (B-10) W of Pomerene Rd	3,839	3,975	3%
SR 80 N of Post Rd	7,785	8,907	13%
SR 80 S of Post Rd	5,627	6,052	7%
Ocotillo Rd N of I-10	2,128	2,610	18%
Ocotillo Rd N of 4th St (B-10)	3,014	3,505	14%
Ocotillo Rd S of Union St	893	1,156	23%
Pearl Street E of Patagonia Av	617	518	-19%
7th Street E of Gila St	791	875	10%
Pomerene Rd N of I-10	2,530	2,399	-5%
Silverwood Ln E of Patrick	466	449	-4%
Post Rd W of 4th St (B-10)	62	47	-32%
Patagonia Ave S of 4th St (B-10)	-	892	-
Patagonia Ave N of 4th St (B-10)	-	697	-

The average daily traffic volumes that were collected during the summer and winter are illustrated on *Figures 16 and 17: Traffic Counts.* Additionally, the peak hour volumes for each of these locations are shown on *Figures 18 and 19: Peak Hour Traffic Volumes*.

Traffic speeds were collected with the road tube counters. The speeds were determined by placing two road tubes 10 feet apart and perpendicular to the traffic flow. This allows for the collection of the timing pulses that are used to calculate the speeds of the axles as they traverse across the road tubes.

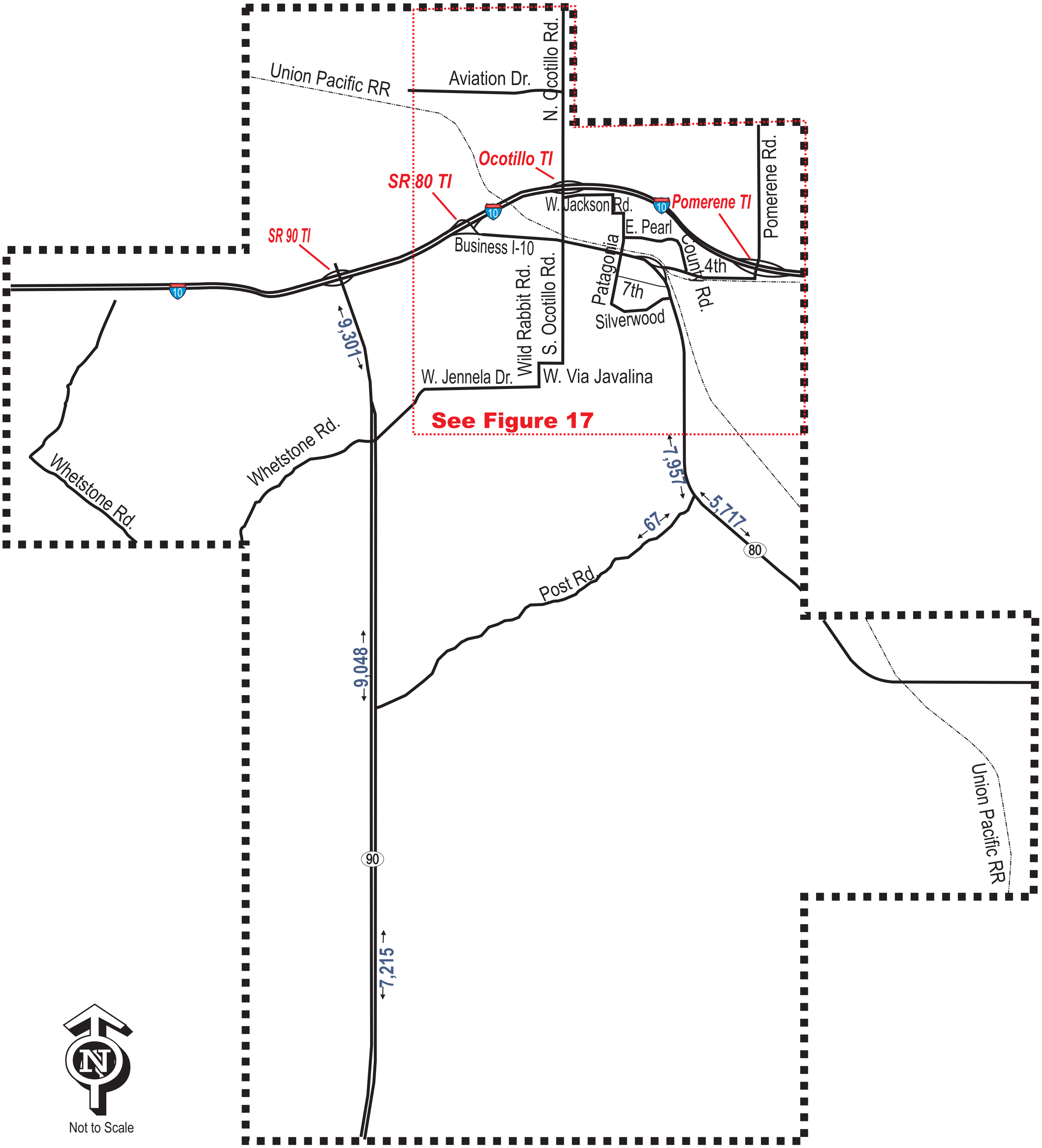


Figure 16: 2006 Traffic Counts

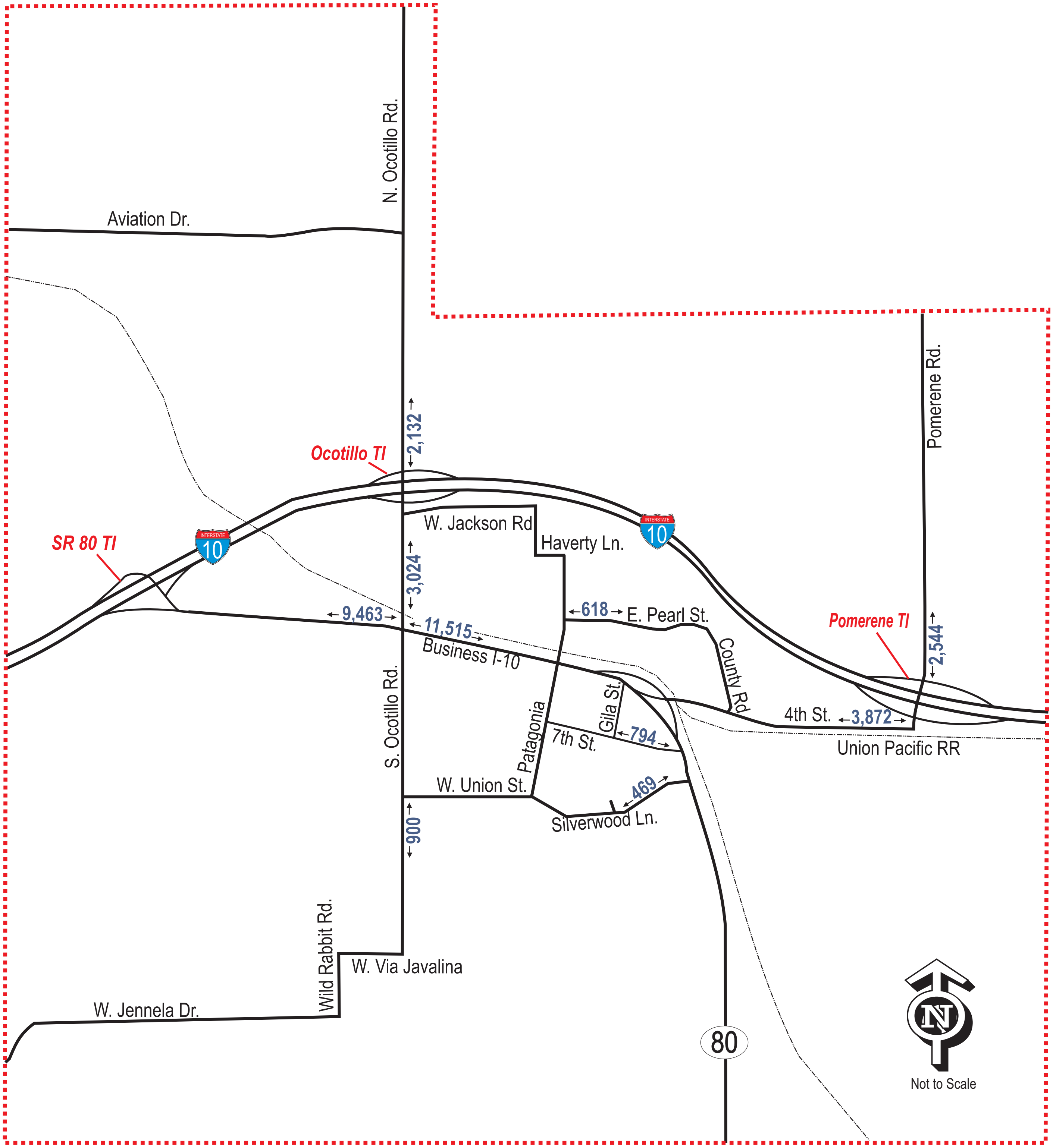


Figure 17: 2006 Traffic Counts Inset

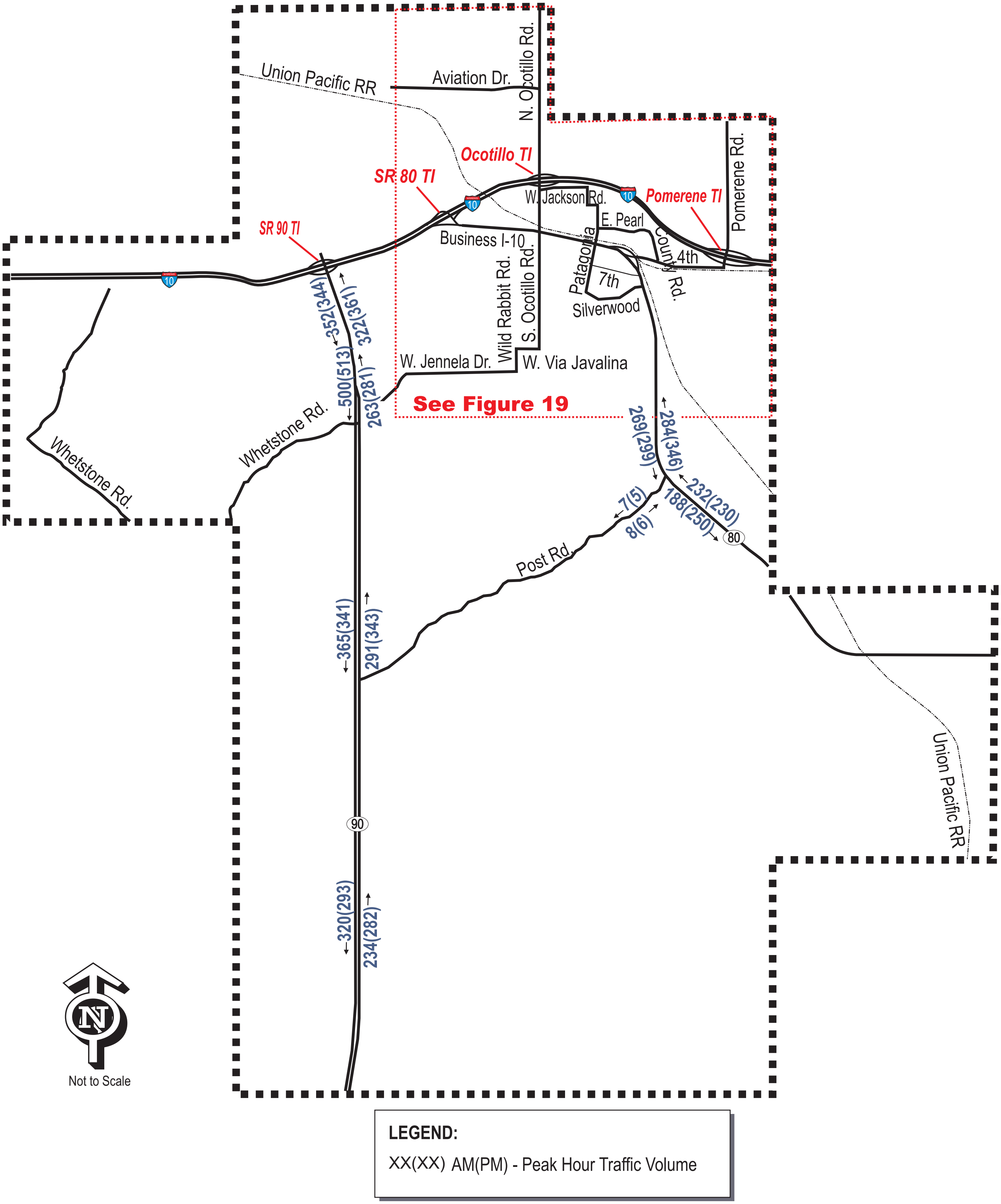
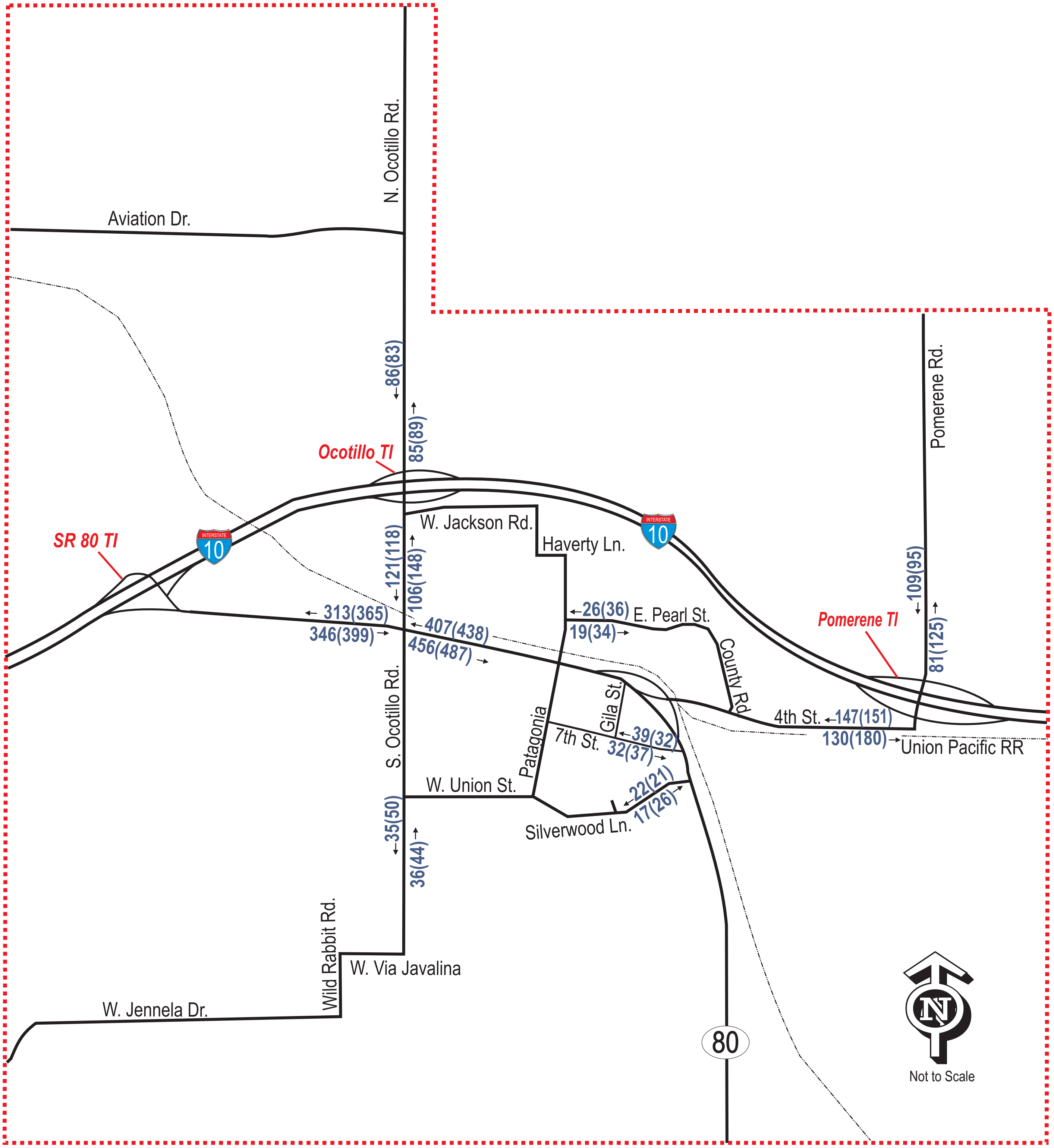


Figure 18: 2006 Peak Hour Traffic Counts



LEGEND:

XX(XX) AM(PM) - Peak Hour Traffic Volume

Figure 19: 2006 Peak Hour Traffic Counts Inset

The average and 85th percentile speeds give an indication of how well the speed limits fit the actual vehicle speeds for a given stretch of roadway. Typically, prevailing speeds are the primary determinant of speed limits, with adjustments applied as judged appropriate by remaining factors. According to the *Traffic Engineering Handbook, 5th Edition*, published by the Institute of Transportation Engineers, the primary measure computed from spot speed data collection is the 85th percentile speed of free-flowing traffic. The 85th percentile speed is that speed at which 85 percent of free flowing vehicles are traveling at or below. Use of the 85th percentile speed is based on the theory that the large majority of drivers are reasonable and prudent, do not want to have a crash, and desire to reach their destination in the shortest time possible. Once a speed study is performed, the speed limit is usually set at the nearest 5 mph increment at or below the 85th percentile.

Table 8: Average Traffic Speeds and *Table 9: 85 Percentile Speeds* present the average speeds and 85 percentile speeds for each location.

Table 8: Average Traffic Speed

Roadway	North- or East-bound	South- or West-bound	Average Traffic Speed	Posted Speed Limit
SR 90 N of Jennela Dr	62mph (NB)	58mph (SB)	60mph	55 mph
SR 90 N of Post Rd	65mph (NB)	68mph (SB)	67mph	55 mph
SR 90 N of Rickets Rd	72mph (NB)	72mph (SB)	72mph	65 mph
4th St (B-10) W of Ocotillo Rd	41mph (EB)	41mph (WB)	41mph	45 mph
4th St (B-10) W of Patagonia Rd	33mph (EB)	38mph (WB)	35mph	35 mph
4th St (B-10) W of Pomerene Rd	44mph (EB)	40mph (WB)	42mph	45 mph
SR 80 N of Post Rd	42mph (NB)	44mph (SB)	43mph	50 mph
SR 80 S of Post Rd	54mph (NB)	53mph (SB)	53mph	50 mph
Ocotillo Rd N of I-10	33mph (NB)	30mph (SB)	32mph	35 mph
Ocotillo Rd N of SR 80	36mph (NB)	35mph (SB)	36mph	25 mph
Ocotillo Rd S of Union St	22mph (NB)	22mph (SB)	22mph	25 mph
Pearl Street E of Patagonia Av	20mph (EB)	21mph (WB)	21mph	25 mph
7th Street E of Gila St	24mph (EB)	23mph (WB)	23mph	25 mph
Pomerene Rd N of I-10	40mph (NB)	42mph (SB)	41mph	55 mph
Silverwood Ln E of Patrick	25mph (EB)	22mph (WB)	24mph	25 mph
Post Rd W of SR 80	-	-	-	-
Patagonia Ave S of SR80	21mph (NB)	23mph (SB)	22mph	25 mph
Patagonia Ave N of SR80	18mph (NB)	19mph (SB)	19mph	25 mph

Source: United Civil Group Corporation, August 2005

Table 9: 85th Percentile Speed

Roadway	North- or East-bound	South- or West-bound	Average Traffic Speed	Posted Speed Limit
SR 90 N of Jennela Dr	68mph (NB)	63mph (SB)	60mph	55 mph
SR 90 N of Post Rd	70mph (NB)	73mph (SB)	67mph	55 mph
SR 90 N of Rickets Rd	77mph (NB)	78mph (SB)	72mph	65 mph
4th St (B-10) W of Ocotillo Rd	47mph (EB)	47mph (WB)	41mph	45 mph
4th St (B-10) W of Patagonia Rd	39mph (EB)	43mph (WB)	35mph	35 mph
4th St (B-10) W of Pomerene Rd	50mph (EB)	45mph (WB)	42mph	45 mph
SR 80 N of Post Rd	48mph (NB)	50mph (SB)	43mph	50 mph
SR 80 S of Post Rd	59mph (NB)	58mph (SB)	53mph	50 mph
Ocotillo Rd N of I-10	42mph (NB)	39mph (SB)	32mph	35 mph
Ocotillo Rd N of SR 80	41mph (NB)	40mph (SB)	36mph	25 mph
Ocotillo Rd S of Union St	26mph (NB)	27mph (SB)	22mph	25 mph
Pearl Street E of Patagonia Av	25mph (EB)	25mph (WB)	21mph	25 mph
7th Street E of Gila St	28mph (EB)	27mph (WB)	23mph	25 mph
Pomerene Rd N of I-10	45mph (NB)	48mph (SB)	41mph	55 mph
Silverwood Ln E of Patrick	30mph (EB)	27mph (WB)	24mph	25 mph
Post Rd W of SR 80	-	-	-	-
Patagonia Ave S of SR80	23mph (NB)	24mph (SB)	24mph	25 mph
Patagonia Ave N of SR80	21mph (NB)	21mph (SB)	21mph	25 mph

Source: United Civil Group Corporation, August 2005

Vehicle Classifications can also be collected using road tubes. In this instance, the timing of pulses is used to measure the spacing between axles and the gap to classify a vehicle. *Table 10: Vehicle Classification* presents the percentage of vehicles in each classification category.

Table 10: Vehicle Classification

Roadway	Bike	Passenger Car	Bus	Delivery Vehicle	Heavy Vehicle
SR 90 North of Jennela Drive	0.0%	88.3%	0.8%	3.9%	7.0%
SR 90 North of Post Road	0.0%	73.6%	1.3%	6.0%	6.8%
SR 90 North of Rickets Road	0.0%	59.4%	2.0%	12.8%	5.7%
SR 80 West of Ocotillo Road	0.5%	97.9%	0.7%	8.2%	5.2%
SR 80 West of Patagonia Road	0.8%	121.7%	1.0%	9.9%	5.1%
SR 80 West of Pomerene Road	0.3%	40.5%	0.2%	2.9%	1.2%
SR 80 North of Post Road	0.5%	79.2%	1.3%	7.2%	3.1%
SR 80 South of Post Road	0.1%	57.4%	0.6%	5.5%	18.9%
Ocotillo Road North of I-10	0.1%	22.4%	0.1%	2.3%	0.5%
Ocotillo Road North of SR 80	0.3%	33.1%	0.2%	1.7%	0.6%
Ocotillo Road South of Union St	0.3%	9.5%	0.0%	0.8%	0.0%
Pearl Street East of Patagonia Av	0.1%	7.0%	0.0%	0.1%	0.0%
7th Street East of Gila Street	0.1%	8.9%	0.0%	0.3%	0.0%
Pomerene Road North of I-10	0.2%	27.4%	0.1%	1.6%	0.4%
Silverwood Lane East of Patrick	0.1%	5.2%	0.0%	0.2%	0.0%
Post Road West of SR 80	-	-	-	-	-

Source: United Civil Group Corporation, August 2005

United Civil Group will collect traffic data at the locations listed above in January 2006 to give a comparison of seasons, summer traffic volumes versus winter traffic volumes. These counts will be provided in the Draft Benson Small Area Transportation Study.

Because this is the first time that traffic count data has been collected for the City of Benson, to historical growth trends for the key roadways within the study area could not be calculated.

6.11 Level of Service

The roadway levels of service for existing conditions were determined based on the existing count data collected in August 2005. Estimated capacities for both LOS C and D are presented below in *Table 11: Existing Level of Service* for the roadway segments analyzed. For planning purposes, the existing capacity was determined to be over capacity (LOS D or higher), at capacity (between LOS C and LOS D) or under capacity (LOS C or better)

Table 11: Existing LOS

Roadway	Class	Average Daily Traffic	LOS C Capacity	LOS D Capacity	Capacity
SR 90 N of Jennela Dr	6 lanes	8,504	38,000	46,100	Under
SR 90 N of Post Rd	4 lanes (D)	7,652	24,400	30,600	Under
SR 90 N of Rickets Rd	4 lanes (D)	6,805	24,400	30,600	Under
SR 80 W of Ocotillo Rd	5 lanes	9,416	22,600	30,400	Under
SR 80 W of Patagonia	5 lanes	11,548	21,400	30,100	Under
SR 80 W of Pomerene	3 lanes	3,839	11,025	14,500	Under
SR 80 N of Post Rd	2 lanes	7,785	10,500	14,500	Under
SR 80 S of Post Rd	2 lanes	5,627	10,500	14,500	Under
Ocotillo Rd North of I-10	2 lanes	2,128	7,000	13,600	Under
Ocotillo Rd N of SR 80	3 lanes	3,014	7,000	13,600	Under
Ocotillo Rd S of Union St	2 lanes	893	7,000	13,600	Under
Pearl St E of Patagonia	2 lanes (C)	617	2,000	2,400	Under
7th St E of Gila St	2 lanes (C)	791	2,000	2,400	Under
Pomerene N of I-10	2 lanes	2,530	7,000	13,600	Under
Silverwood E of Patrick	2 lanes(C)	466	2,000	2,400	Under
Post Rd W of SR 80	2 lanes (U)	62	250	350	Under

Source: United Civil Group Corporation, August 2005
Note: (D) = divided roadway, (U) = unpaved, (C) = Collector

The network performance shows that all study area facilities are operating at acceptable levels of service in the current year 2005.

6.12 Safety and Crash History

Crash records, provided by the Arizona Department of Transportation were reviewed for a three year period from May 1, 2002 through April 30 2005. *Tables 12 through 20: Crash History* summarize accidents as presented by Arizona Department of Transportation for Business Route 10/4th Street from milepost 303.50 to milepost 306.95, SR 80 from milepost 293.25 to milepost 299, and SR 90 from milepost 289.00 to milepost 297.00. This data is summarized by route, type of accident, first harmful group, and collision manner.

Table 12: Accident History Data for Business Route 10 from MP 303.50 to MP 306.95

Year	Total Acc	PDO		Injury			Fatal	Daylight Condition		
		Acc	Veh	Acc	Veh	Inj		Day	Dusk	Dark
2002*	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0
2004	4	2	4	2	4	2	0	4	0	0
2005*	2	0	0	2	5	3	0	1	0	1

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 13: Collision Type for Business Route 10 from MP 303.50 to MP 306.95

Collision Type	2002*	2003	2004	2005*	Total
Overturning	0	0	0	0	0
Collision with Other Vehicle	0	0	4	2	6
Collision with Pedestrian	0	0	0	0	0
Collision with Pedal Cyclist	0	0	0	0	0
Collision with Vehicle Other Road	0	0	0	0	0
Animal	0	0	0	0	0
Fixed Object	0	0	0	0	0
Object in Roadway	0	0	0	0	0
Other	0	0	0	0	0
Miscellaneous	0	0	0	0	0
Not Reported	0	0	0	0	0

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 14: Collision Manner for Business Route 10 from MP 303.50 to MP 306.95

Collision Manner	2002*	2003	2004	2005*	Total
Angle	0	0	2	0	2
Left Turn	0	0	0	0	0
Rear End	0	0	2	1	3
Other	0	0	0	1	1
U-Turn	0	0	0	0	0

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 15: Accident History Data for State Route 80 from MP 293.25 to MP 299.00

Year	Total Acc	PDO		Injury			Fatal	Daylight Condition		
		Acc	Veh	Acc	Veh	Inj		Day	Dusk	Dark
2002*	11	8	16	3	3	3	0	8	1	2
2003	8	5	7	3	4	5	0	6	0	2
2004	10	6	10	4	11	12	0	9	0	1
2005*	3	2	4	1	2	6	0	3	0	0

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 16: Collision Type for State Route 80 from MP 293.25 to MP 299.00

Collision Type	2002*	2003	2004	2005*	Total
Overturning	0	0	0	0	0
Collision with Other Vehicle	7	3	8	3	21
Collision with Pedestrian	0	0	0	0	0
Collision with Pedal Cyclist	0	0	0	0	0
Collision with Vehicle Other Road	0	0	0	0	0
Animal	0	1	0	0	1
Fixed Object	4	3	1	0	8
Object in Roadway	0	0	0	0	0
Other	0	0	0	0	0
Miscellaneous	0	1	1	0	2
Not Reported	0	0	0	0	0

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 17: Collision Manner for State Route 80 from MP 293.25 to MP 299.00

Collision Manner	2002*	2003	2004	2005*	Total
Not Reported	0	0	0	0	0
Single Vehicle	4	5	2	0	11
Sideswipe (same)	0	0	1	2	3
Sideswipe (opposite)	0	0	0	0	0
Angle	0	0	1	0	1
Left Turn	1	0	0	0	1
Rear End	5	3	4	0	12
Head On	0	0	2	0	2
Backing	0	0	0	0	0
Other	1	0	0	0	1
U-Turn	0	0	0	1	1

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 18: Accident History Data for State Route 90 from MP 289.00 to MP 297.00

Year	Total Acc	PDO		Injury			Fatal	Daylight Condition		
		Acc	Veh	Acc	Veh	Inj		Day	Dusk	Dark
2002*	12	10	12	2	2	3	0	2	2	8
2003	10	8	10	2	2	2	0	6	1	3
2004	11	8	8	3	3	4	0	7	0	4
2005*	6	5	5	1	1	1	0	5	0	1

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 19: Collision Type for State Route 90 from MP 289.00 to MP 297.00

Collision Type	2002*	2003	2004	2005*	Total
Overturning	2	0	0	0	2
Collision with Other Vehicle	2	3	2	1	8
Collision with Pedestrian	0	0	0	0	0
Collision with Pedal Cyclist	0	0	0	0	0
Collision with Vehicle Other Road	0	0	0	0	0
Animal	7	3	6	3	19
Fixed Object	0	3	1	1	5
Object in Roadway	0	0	0	0	0
Other	0	0	0	0	0
Miscellaneous	1	1	2	1	5
Not Reported	0	0	0	0	0

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Table 20: Collision Manner for State Route 90 from MP 289.00 to MP 297.00

Collision Manner	2002*	2003	2004	2005*	Total
Not Reported	0	0	0	0	0
Single Vehicle	10	7	9	5	31
Sideswipe (same)	0	0	1	0	1
Sideswipe (opposite)	0	0	0	0	0
Angle	0	1	0	0	1
Left Turn	0	0	0	1	1
Rear End	1	1	0	0	2
Head On	0	0	0	0	0
Backing	0	0	0	0	0
Other	1	0	1	0	2
U-Turn	0	1	0	0	1

Source: Arizona Department of Transportation, September 2005
*Note: * partial year*

Crash records were also provided by the City of Benson and were reviewed for a one and a half year period from January 1, 2004 through August 31, 2005. *Tables 21 and 22: City of Benson Crash History* summarize the accident data that was provided by the City of Benson Police Department for January through December 2004 and January through August 2005, respectively. Based on discussions with the Benson Police Chief, crash records on 4th Street, are not duplicated with records on Business Route 10 or SR 80 provided by Arizona Department of Transportation.

Table 21: City of Benson Crash History 2004

Roadway	Accident/ No Injury	Private Property Accident/ No Injury	Private Property Accident/ No Injury Hit & Run	Injury Accident	Total
500blk of 4th Street	0	17	9	0	**26**
4th Street and Patagonia	8	0	0	2	**10**
4th Street and Ocotillo	4	0	0	6	**10**
West 4th Street	9	8	1	2	**20**
4th Street and SR 80	5	0	0	1	**6**
SR 90	5	18	7	1	**31**
SR 80	9	7	2	5	**23**
East 4th Street	14	6	4	0	**24**
South Ocotillo	3	1	2	1	**7**
North Ocotillo	2	1	4	0	**7**
Patagonia Union 6th St	5	0	0	1	**6**
South Huachuca	3	1	1	0	**5**
East Pearl	4	0	0	1	**5**
East 5th Street	1	2	0	0	**3**
East Mark	2	0	0	0	**2**
East 6th Street	0	0	1	0	**1**
East 2nd Street	2	0	0	0	**2**
West Flint	1	0	0	0	**1**
West 5th Street	0	0	1	0	**1**
North Adams	0	0	0	1	**1**
East Leslie	1	0	0	0	**1**
East Mc Neil	1	0	0	0	**1**
North Easy	1	0	0	0	**1**

Source: Benson Police Department, September 2005

Table 22: Benson Crash History January-August 2005

Roadway	Accident/ No Injury	Private Property Accident/ No Injury	Private Property Accident/ No Injury Hit & Run	Injury Accident	Total
500blk of 4th Street	0	12	2	0	14
4th Street and Patagonia	2	0	0	0	2
4th Street and Ocotillo	4	0	0	0	4
West 4th Street	7	3	1	2	13
4th Street and SR 80	1	0	0	1	2
SR 90	4	5	2	1	12
SR 80	2	0	0	4	6
East 4th Street	3	4	3	0	10
South Ocotillo	2	1	0	1	4
North Ocotillo	4	4	0	0	8
Patagonia Union 6th St	5	0	2	0	7
South Huachuca	4	1	1	0	6
East Pearl	1	0	0	0	1
East 5th Street	2	1	0	0	3

Source: Benson Police Department, September 2005

7.0 EXISTING MULTIMODAL TRANSPORTATION SYSTEM

7.1 Non-Motorized Trails

Non-motorized methods of transportation are limited within the City of Benson. Currently, there are only paved shoulders ranging in two to six feet along the Interstate and State Routes within the City of Benson.

7.2 Existing Transit Service

7.2.1 Local Service

The City of Benson currently does not have a local transit system. However, there is a taxi service within the community, Benson Taxi. There is also a van service provided by the Catholic Community Services that is used to assist the community in providing the elderly with their transportation needs. This program does get assistance from the 5310 program for rural transit, section 501.C3 for the elderly. Additionally, Viacap, a volunteer non-profit organization within Benson provides transportation services to the elderly and disabled. Viacap's primary purpose is to provide transportation services for medical needs.

7.2.2 Intercity Transit

Greyhound Bus Lines has a station on 4th Street, at the Benson Flower Shop. The station is open for operation on Monday through Friday from 8 am to 5 pm and on Saturday from 9 am to 12:30 pm. As of October 2005, a one way fare between Tucson and Benson was $ 15.00 and between Phoenix and Benson was $ 36.00. Discount one way fares were available for seniors and children.

7.2.3 Existing Rail Service

Amtrak has two service lines that run through Benson, the Sunset Limited Line from Orlando to Los Angeles and the Texas Eagle from Chicago to Los Angeles. The schedules for each of these lines are shown on *Table 23: Sunset Limited Line* and *Table 24: Texas Eagle Line*.

Table 23: Sunset Limited Line

1 Read Down			Train Number		2 Read Up	
1:45P	SuTuTh	Dp	Orlando, FL	Ar	8:45P	WeSaMo
5:30P	SuTuTh	Dp	Jacksonville,FL	Dp	5:00P	WeSaMo
12:52A	MoWeFr	Dp	Pensacola, FL	Dp	6:30A	WeSaMo
11:55A	MoWeFr	Dp	New Orleans, LA	Dp	10:30P	TuFrSu
9:50P	MoWeFr	Dp	Houston, TX	Dp	6:15A	TuFrSu
5:40A	TuThSa	Dp	San Antonio, TX	Dp	1:00A	TuFrSu
5:55P	TuThSa	Dp	El Paso, TX	Dp	9:00A	MoThSa
8:26P	**WeFrSu**	**Dp**	**Benson, AZ**	**N/A**	**N/A**	**N/A**
10:10A	ThSaMo	Ar	Los Angeles, CA	Dp	2:30P	SuWeFr

Table 24: Texas Eagle Line

1 Read Down			Train Number		2 Read Up	
3:20P	SuTuTh	Dp	Chicago, IL	Ar	2:14P	WeSaMo
4:15P	SuTuTh	Dp	Joliet, IL	Dp	1:10P	WeSaMo
9:05P	SuTuTh	Dp	St. Louis, MO	Dp	8:30A	WeSaMo
4:30P	MoWeFr	Dp	Little Rock, AR	N/A	N/A	N/A
5:25A	TuThSa	Dp	Malvern, AR	N/A	N/A	N/A
5:50A	TuThSa	Dp	Arkadelphia, AR	N/A	N/A	N/A
7:15A	TuThSa	Dp	Texarkana, AR	N/A	N/A	N/A
1:40P	TuThSa	Dp	Dallas, TX	Dp	4:30P	TuFrSa
4:00P	TuThSa	DP	Forth Worth, TX	Dp	3:20P	TuFrSa
5:40A	WeFrSu	Dp	San Antonio, TX	Dp	8:00A	TuFrSu
5:55P	WeFrSu	Dp	El Paso, TX	Dp	9:00A	MoThSa
10:10A	ThSaMo	Ar	Los Angeles, CA	Dp	2:30P	SuWeFr

The schedules provided show departure and arrival times to main stations only. The Texas Eagle Line passes through Benson, AZ at 10:26 pm WeFrSu from Chicago, IL to Los Angeles, CA, and at 3:20 am MoThSa from Los Angeles, CA to Chicago, IL.

8.0 FUTURE CONDITIONS AND ROADWAY IMPROVEMENTS

As a sub-consultant to United Civil Group, the transportation modeling company, DKS Associates, developed travel forecasts for the Benson Arizona Small Area Transportation Study. These forecasts were derived by developing estimates of the increment of travel that could be expected from growth in the Benson Planning Area and adding that growth to the estimates of existing traffic volumes developed by United Civil Group. Existing (2005) traffic counts were provided for 17 locations. For each of these locations, an estimate of total daily two-way volumes was provided as well as peak hour AM and peak hour PM volumes by direction of flow. In order to forecast traffic volumes, population projections and employment projections were needed.

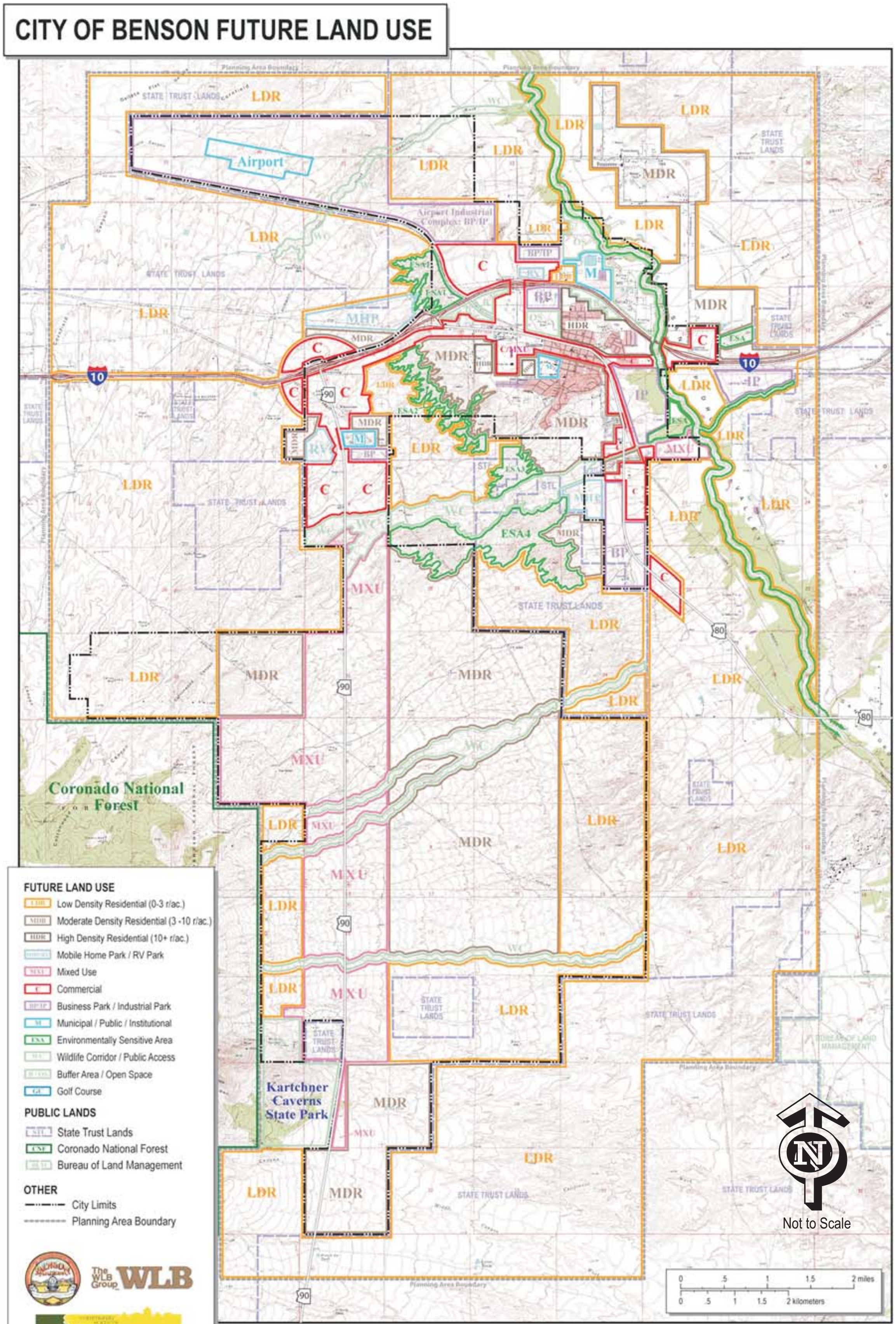
8.1 Socioeconomic Forecasting

Substantial residential development growth is expected to occur in Benson over the next 25 years, resulting in approximately 25,000 new housing units. These land use developments, not previously incorporated into published population forecasts for the City, in addition to standard estimates from other sources, were used to develop the 2030 population forecasts for Benson. These forecasts will be used to support both the Southeastern Arizona Regional Transportation Profile and the Benson Small Area Transportation Study. Methods and results are presented below.

8.1.1 Population Growth

DKS developed long-range forecasts of population (2030) using area estimates of growth developed by Cambridge Systematics for the Southeast Arizona Regional Transportation Profile Study for the Arizona Department of Transportation. For that work, Cambridge drew from population forecasts prepared by Woods & Poole, a proprietary database of population and employment forecasts used by ADOT to help forecast growth in regions across Arizona, and the Cochise County Long-Term Development and Demographic Analysis Study, which identified major new land-use development projects in the study area.

Cambridge Systematics estimated an addition of 25,400 new housing units in the study area in the next 25 years as indicated in *Table 25: Forecasted 2030 Population Growth Estimates Based on Proposed Development along SR90 Only*. *Table 26: Total Estimated 2030 Population for Benson* presents the estimated population for the entire Benson study area. *Figure 20: Future Land Use* from the City of Benson's General Plan 2002 was used to assist in determining land patterns over the next 30 years.



Source: Benson General Plan, October 2002, prepared by WLB Group

Figure 20: Future Land Use

Table 25: Forecasted 2030 Population Growth Estimates Based on Proposed Developments along SR90 Only

Region	Major Development	New Housing Units	Population Growth
Benson Study Area	Whetstone Development	14,000	33,600
	Smith Ranch Development	4,500	10,800
	Developments South of Whetstone	6,900	16,560
Total	***All Developments***	***25,400***	***60,960***

Table 26: Total Estimated 2030 Population for Benson

Region	Forecast	Population (2030)
Benson Study Area	W&P 2030 Estimate (Excludes SR90 Developments)	17,250
	Future Land Use Developments on SR 90	60,960
	Total Population	78,210

The population in major developments was then distributed based on the known locations of planned development as identified in *Table 27: Estimated Housing Units for Developments in the Benson SAT Study Area*.

Table 27: Estimated Housing Units for Developments in the Benson SAT Study Area

Subdivision Names	At Build Out	Stage
Canyons at Whetstone Phase lll*	391	Preliminary Plat
Canyons at Whetstone Phase ll*	179	Final Plat
Canyons at Whetstone*	190	Final Approval
Cottonwood Bluffs*	100	Final Approval
Cottonwood Highlands*	170	Final Approval
Kartchner Vista*	201	Final Plat
Del Webb Pulte*	13,750	Conceptual
San Pedro Golf Estates	224	Final Plat
Turquoise Hills (Hwy 80)	32	Final Plat
La Mesa San Pedro	13	Preliminary Plat
Old Homestead	24	Final Plat
San Pedro Vista	121	Preliminary Plat
House Ridge Estates	33	Final Plat
Whetstone Hills Estates*	265	Final Plat
Water Crest	53	Preliminary Plat
La Cholla Heights	45	Final Plat
Total	***15,791***	

* Those developments off State Hwy 90

Cambridge Systematics also estimated that additional housing units would be located south of the Whetstone Ranch development on SR 90. Therefore, this growth was located south on SR 90.

Home-based travel was generated for the new growth by applying vehicle trip generation rates taken from the ITE Trip Generation Manual. One-third of all new units were assumed to be for retired individuals and two-thirds for traditional populations. This is the rough splits expected in the Anthem at Whetstone Ranch development as indicated in the Preliminary Concept Plan submitted for the development.

Based on Cochise county projections, growth is also likely to occur within the currently developed areas of Benson. Therefore, approximately 5,000 units of expected growth were assumed on the basis of existing residential zoning and vacant land in the remainder of Benson – not along SR 90 or west of SR 90.

The detailed analysis of population growth is provided in Working Paper #2.

8.1.2 Employment Growth

No estimates of employment growth were developed by Cambridge Systematics for the Southeast Arizona Regional Transportation Profile Study. Therefore, estimates of employment were developed through previous studies within the region. These forecasts represent an update of forecasts prepared for the Benson General Plan, which was adopted in 2002.

It was determined that the estimated growth in employment will be approximately 3,000 jobs along SR 90 and 5,200 in the remainder of Benson. The new jobs along SR 90 were located the SR90 corridor. The locations of new jobs for the remainder of Benson were located according the amount of undeveloped land within the Benson area.

The estimates for jobs were then provided for job growth in the following categories:

- Airport Related
- Retail
- Industrial
- Other

The detailed analysis of employment growth is provided in Working Paper #2.

8.2 Transportation Modeling Process

8.2.1 Traffic Analysis Zones

Once the population estimates and employment estimates are determined, these total forecasts need to be distributed throughout the Benson region. This is done through the development of traffic analysis zones (TAZ). TAZ's are geographical zonal units used to tabulate land used and trip generation data. Boundaries of the TAZ's are defined based on similar land uses, physical barriers, census blocks and major streets in the transportation system. TAZ's were developed for the Benson region based on known growth and through the review of other studies in the area. The existing roadway network is used as the basis for the TAZ break out.

8.2.2 Traffic Assignment

Next, the population and employment estimates are assigned to the correct TAZ. Therefore, The Airport Related were located in the zone with the airport, the Retail were divided between the TAZ's with Commercial zoning, the Industrial were divided among the zones with Industrial zoning, and the Other were divided between the zones with Business Park zoning. For the retail employment, 70% was allocated to Commercial TAZ along SR 90, 20% to Commercial TAZ along SR 80 and 10% to all other commercial TAZ.

The following categories of land uses were used to obtain trip attraction rates from the ITE Trip Generation Manual:

Airport – 022 Airport
Retail – 815 Discount Retail
Industrial - 110 Light Industrial
Other Non-Retail - Average of 710 General Office Building and 770 Business Park

8.2.3 Trip Attraction

Trips generated or attracted by new development were added to the existing traffic counts by defining how trips would get into and out of each traffic analysis zone. When multiple access points were identified for a zone, percentages were identified for each access point.

For each access point, routes for exiting or entering traffic were identified and the percentage of traffic using each route was estimated. All trips entering a roadway were assumed to travel the length of the roadway from the entry point to the end of the roadway within the study area. The volume of traffic to be added to each existing traffic count are calculated by adding together all of the volumes of entering or exiting traffic that are defined to affect the individual count location. This is defined in a matrix with traffic count locations as the columns and the access points/routes of travel as the rows. A percentage in the matrix indicates that traffic from (or to) an access point /route should be added to the existing traffic count for the future forecast. The percentage indicates the portion of the traffic from the access point that should be added to the count.

The amount of traffic that should be added to a traffic count location was determined by allocating the expected growth in travel to destination areas. The 63 zones were aggregated into seven groups and four external destinations were identified to reflect destinations outside the study area. These represented the following:

- Points West on I-10
- Points East on I-10

- Points South of Benson
- Points Northeast of Benson

The seven internal groups were as follows:

- Benson Central Core
- North Benson
- South Benson
- Southeast Benson (Along SR 80)
- SR 90 Business Area
- Whetstone and other Residential on SR 90
- Smith Ranch

Within Benson, household-based trips were allocated to destinations based on the amount of employment by zone group and the residential end of trips to businesses (generated by new employment) were allocated on the basis of households. The allocations were then used to define the routes that would be used for each group-to-group pair and the routes were used to define which new trips should be added to the existing counts.

8.2.4 The Network

A network with four external and seven internal zones in the study area was then developed in Traffix to distribute trips previously generated between each zone-to-zone pair. Traffix was used to apply the new travel to selected routes and to sum the volumes for key roadway corridors in the area including I-10, Business I-10, SR-90, SR-80, Ocotillo Rd., Pomerene Rd., and Post Rd. Traffix then produced estimates of the average daily, morning peak hour, and evening peak hour traffic volumes for the future year forecasts as shown in *Figures 21 through 24: Projected 2030 Traffic Volumes* on the base network. These figures summarize the forecasted traffic growth within the Benson study area in the next 25 years on the current transportation system.

8.3 Network Deficiencies

The current transportation system was loaded with projected traffic volumes for the short, mid and long range conditions. Forecasted levels of service for the base systems present the volume to capacity ratio for each year analyzed. The roadway segment levels of service were then calculated.

8.4 Improvement Alternatives

A variety of multimodal transportation improvements with respect to land use, traffic circulation and traffic volumes were then analyzed. The types of improvements include widening of existing streets, construction of new roadways, restriping of existing roadways, improved transit operations, and provision for pedestrians and cyclists.

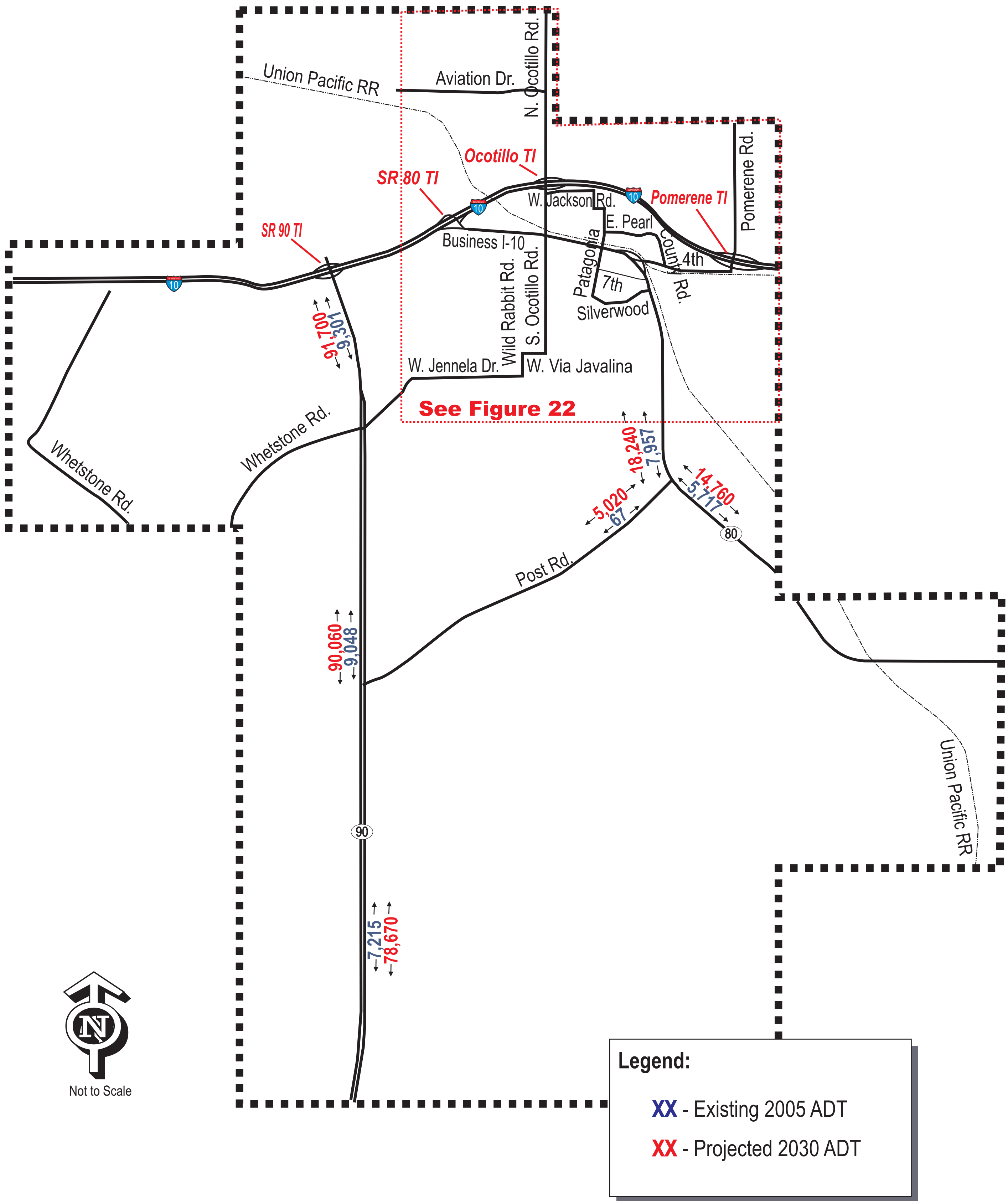


Figure 21: Projected 2030 Average Daily Traffic

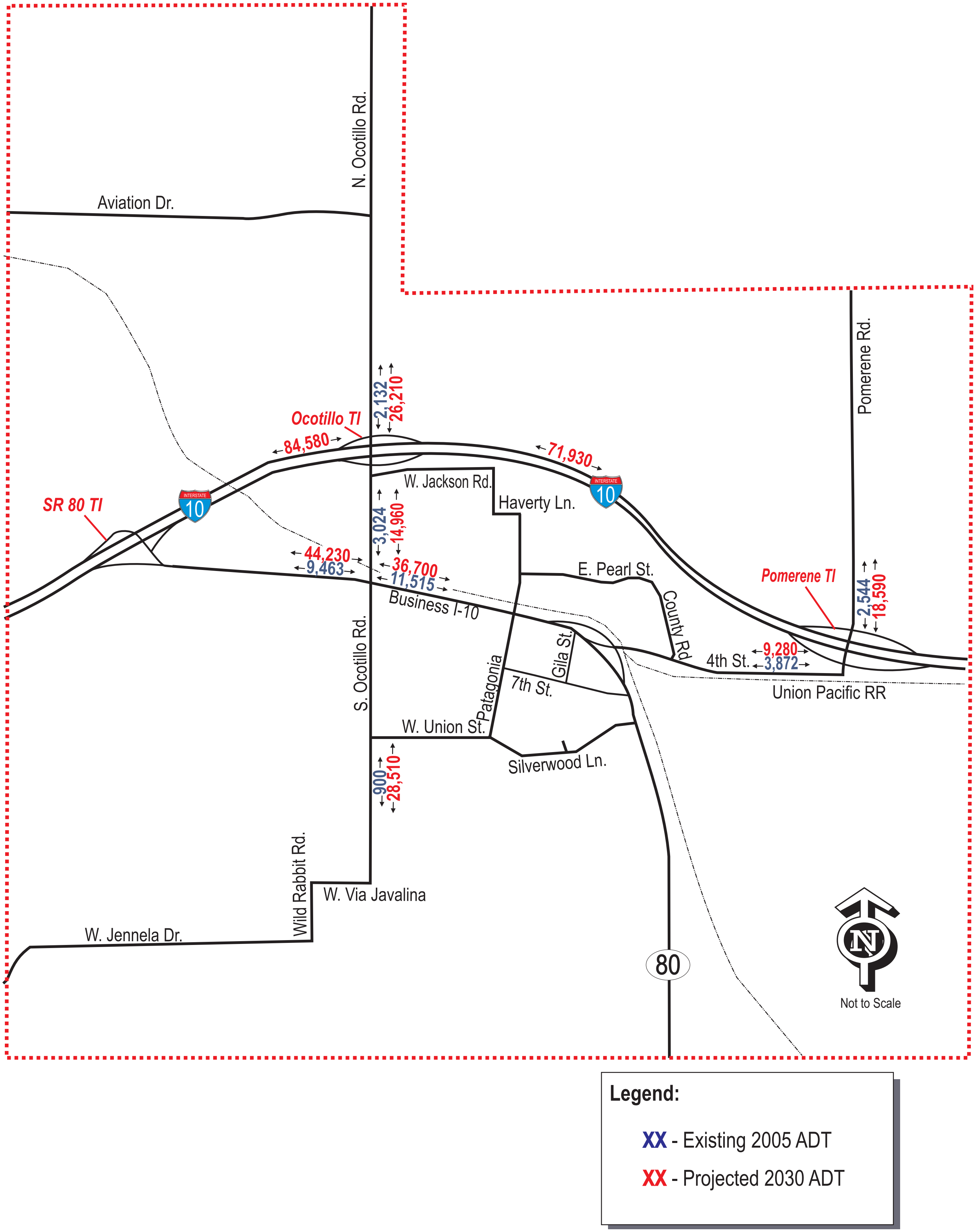


Figure 22: Projected 2030 Average Daily Traffic Inset

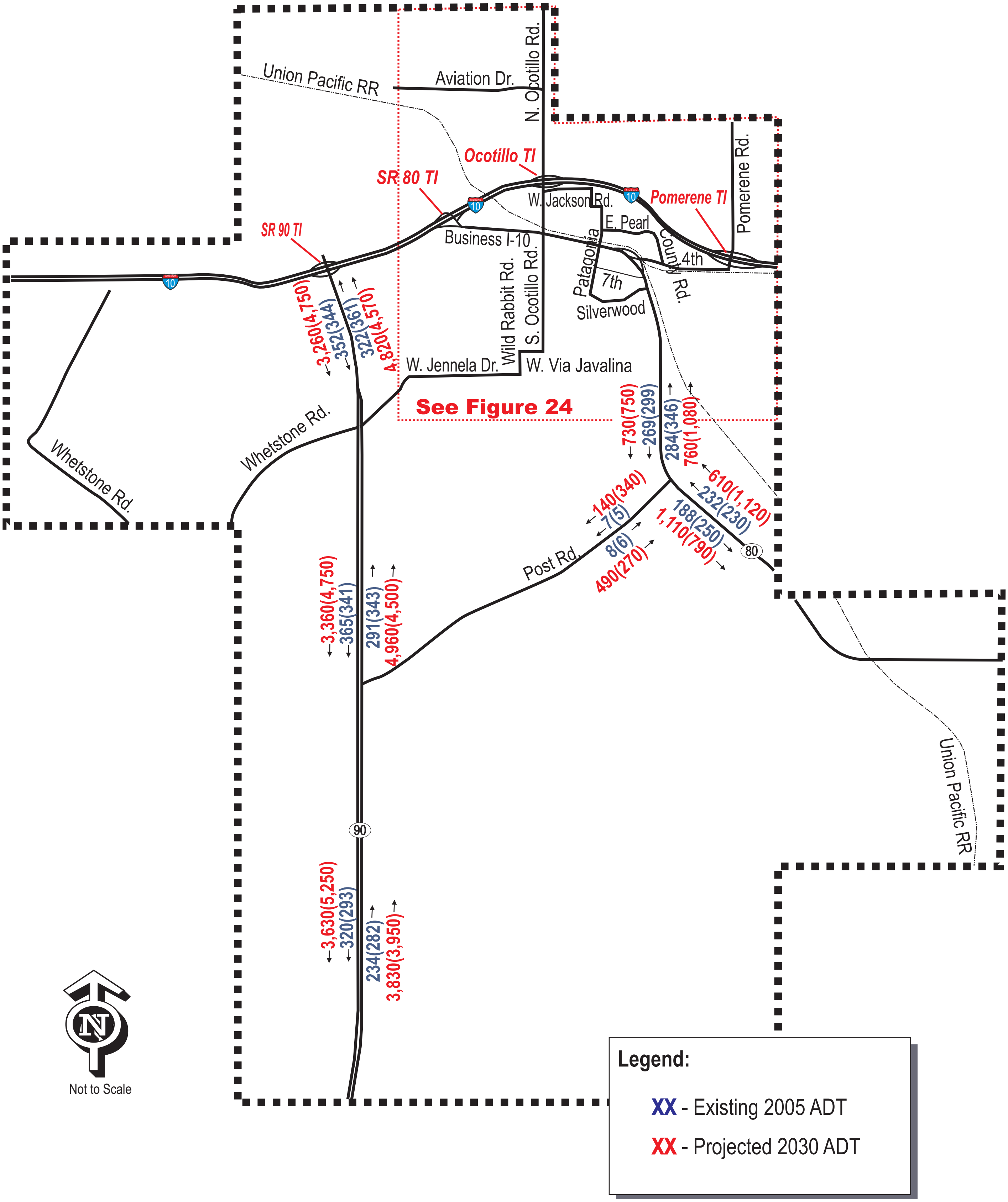


Figure 23: Projected 2030 Peak Hour Volumes

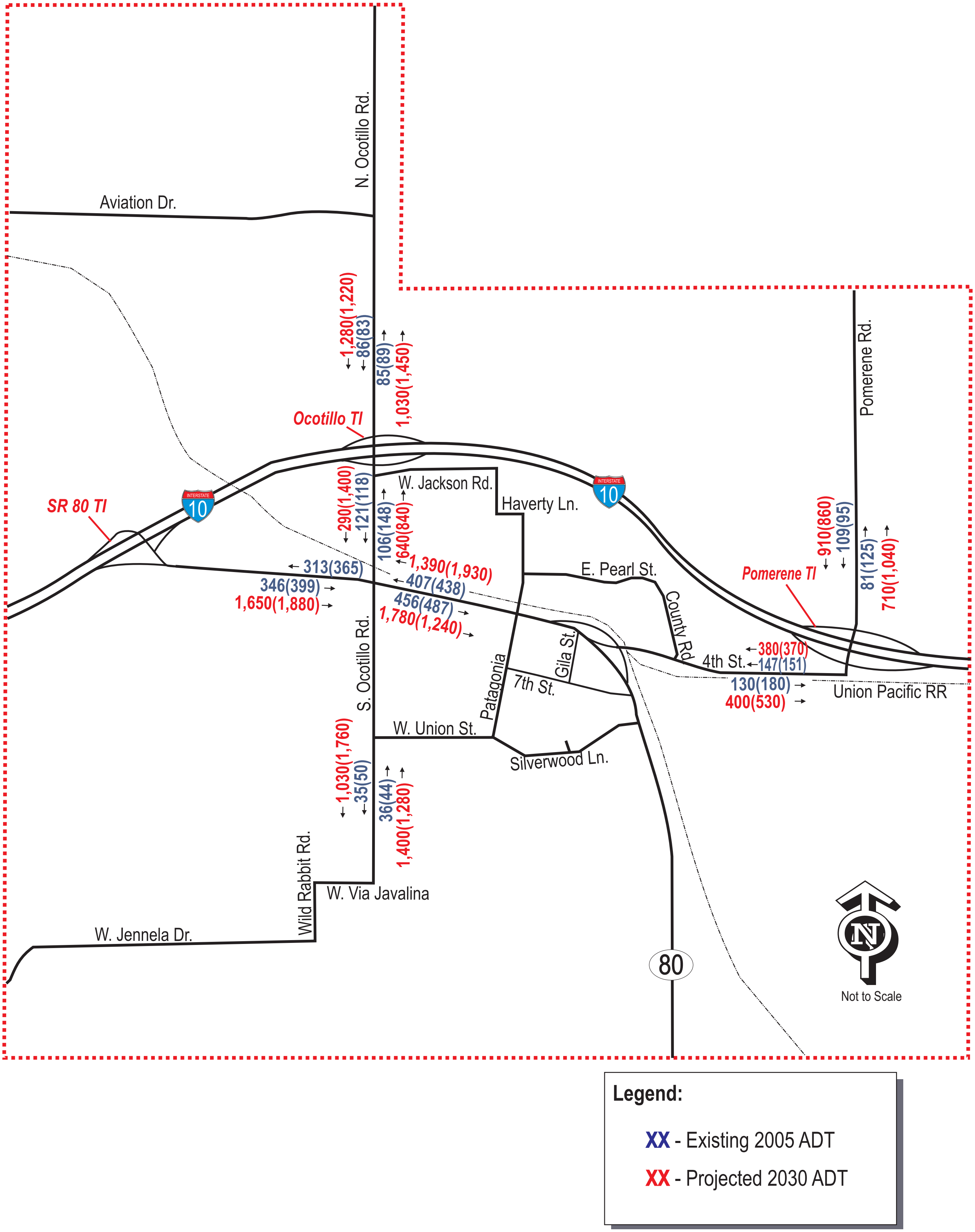


Figure 24: Projected 2030 Peak Hour Volumes Inset

The proposed projects were assigned to time frame (short, mid or long) and were also prioritized based on the following criteria. The prioritization criteria and a street plan were then developed to determine the needed improvements for the roadway network and the ranking of the improvement.

8.5 Prioritization Criteria

Limited funding typically requires prioritization of transportation improvement projects. To assist in establishing priorities, all proposed projects were evaluated under five criteria with 1 being the lowest score and 3 the highest. The highest priority projects are those with the highest total scores. The evaluation criteria and scoring categories are as follows:

Traffic Safety

1	Little or no accident reduction or mitigation is expected
2	Some accident reduction or mitigation is likely as a side benefit
3	Substantial accident reduction or mitigation will result from a safety related project

Congestion Reduction

1	No congestion is expected (the project is not a capacity related improvement)
2	The project will alleviate mild to moderate congestion (LOS D or E)
3	The project will alleviate severe congestion (LOS F)

Cost Effectiveness

Projects were assigned a 1 to 3 rating on the following basis:

- Capital cost per vehicle mile traveled (for roadway segment improvement projects)
- Capital cost per vehicle traveling through the location (for intersection or spot improvements)

Design Conformity

1	No impact on conformity with accepted design standards
2	The project mitigates a minor structural, functional or geometric deficiency (other than capacity)
3	The project mitigates a substantial design deficiency that impedes traffic operations or raises safety concerns

Economic Development Impact

Projects were assigned a 1 to 3 ranking on the following basis:

- The project was ranked with respect to City development goals (including access to or expansion of existing activity centers)

With each time frame covered by this study (short, mid and long range) projects were assigned priorities according to the following scheme:

Priority 1 = (highest priority) 12 -15 points

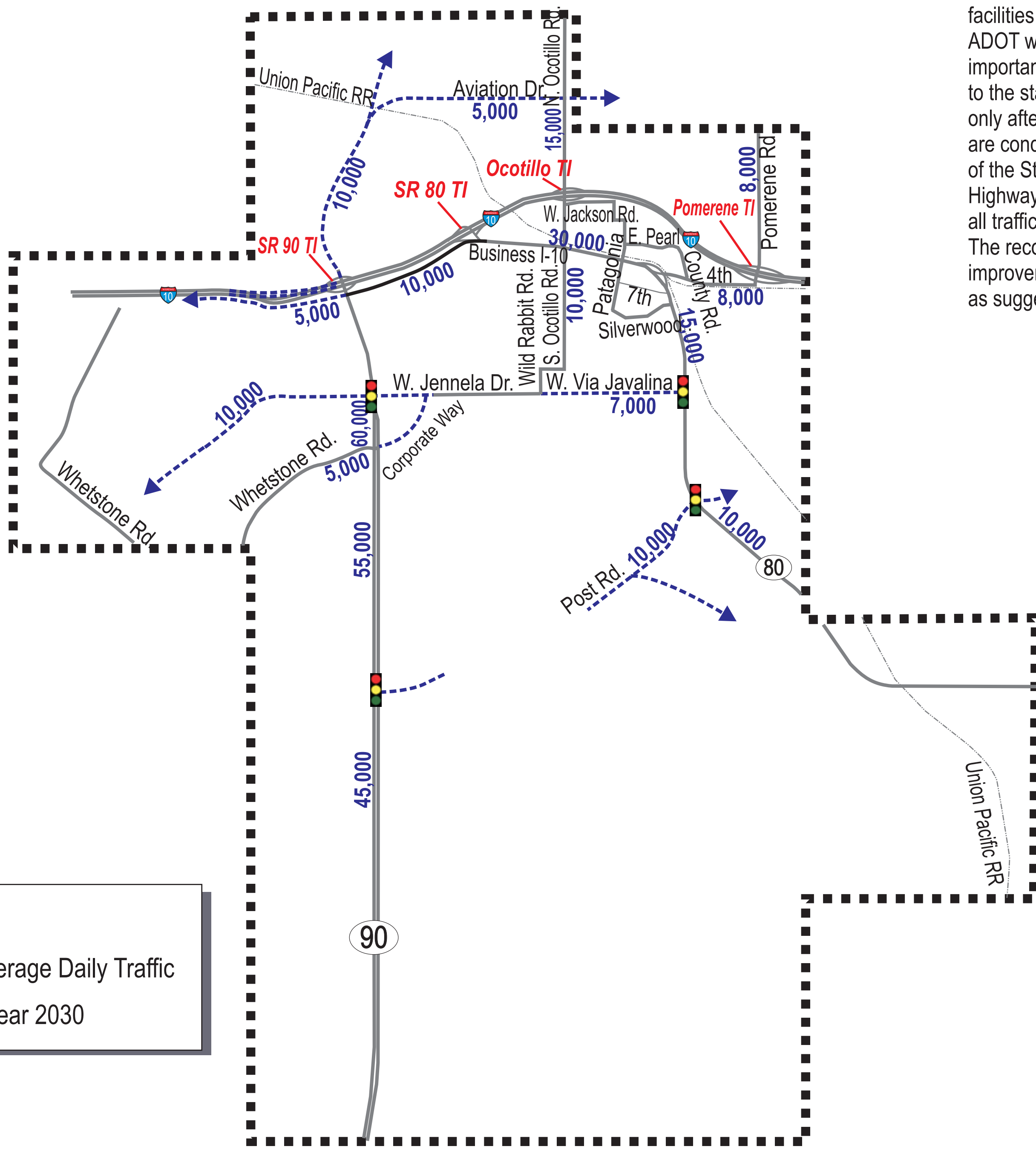
Priority 2 = (intermediate priority) 9-11 points
Priority 3 = (lowest priority) 5-8 points

8.6 ROADWAY IMPROVEMENTS

Because different areas of Benson are growing at different rates, the needs within the overall study area were broken down into three focus areas.

- Focus Area SR90, Focus Area Downtown and Focus Area SR 80. Focus Area 90 includes all of the new development on SR90 within the Study Area.
- Focus Area Downtown incorporates the issues that need to be addressed with Business Route 10 and the downtown area.
- Focus Area SR80 includes proposed developments along SR 80 and needs of the St. David community.

Tables 28 through 30: Proposed Projects for the specific focus groups list the projects that are needed for each area, the time frame and the estimated costs in today's dollars. These projects were then prioritized using the criteria as specified above for each project in the specific time frame. *Figure 25: Mid Range Plan 2020* presents the estimated traffic volumes and the proposed roadway network that may be necessary within the next 10 years. *Figure 26: Long Range Plan* presents the proposed roadway network needs over the next 25 years. These roadway networks depend upon the growth in the area and may be necessary either sooner or later than estimated based on development. A matrix presenting the calculated priority score values for each project is presented in *Appendix B.* Studies were not given a priority score as the priority criteria was designed for improvement projects. These projects were ranked as a starting point for the City of Benson; it is at the discretion of the City Engineer to make the final selection on prioritization of the projects and time frame for implementation.

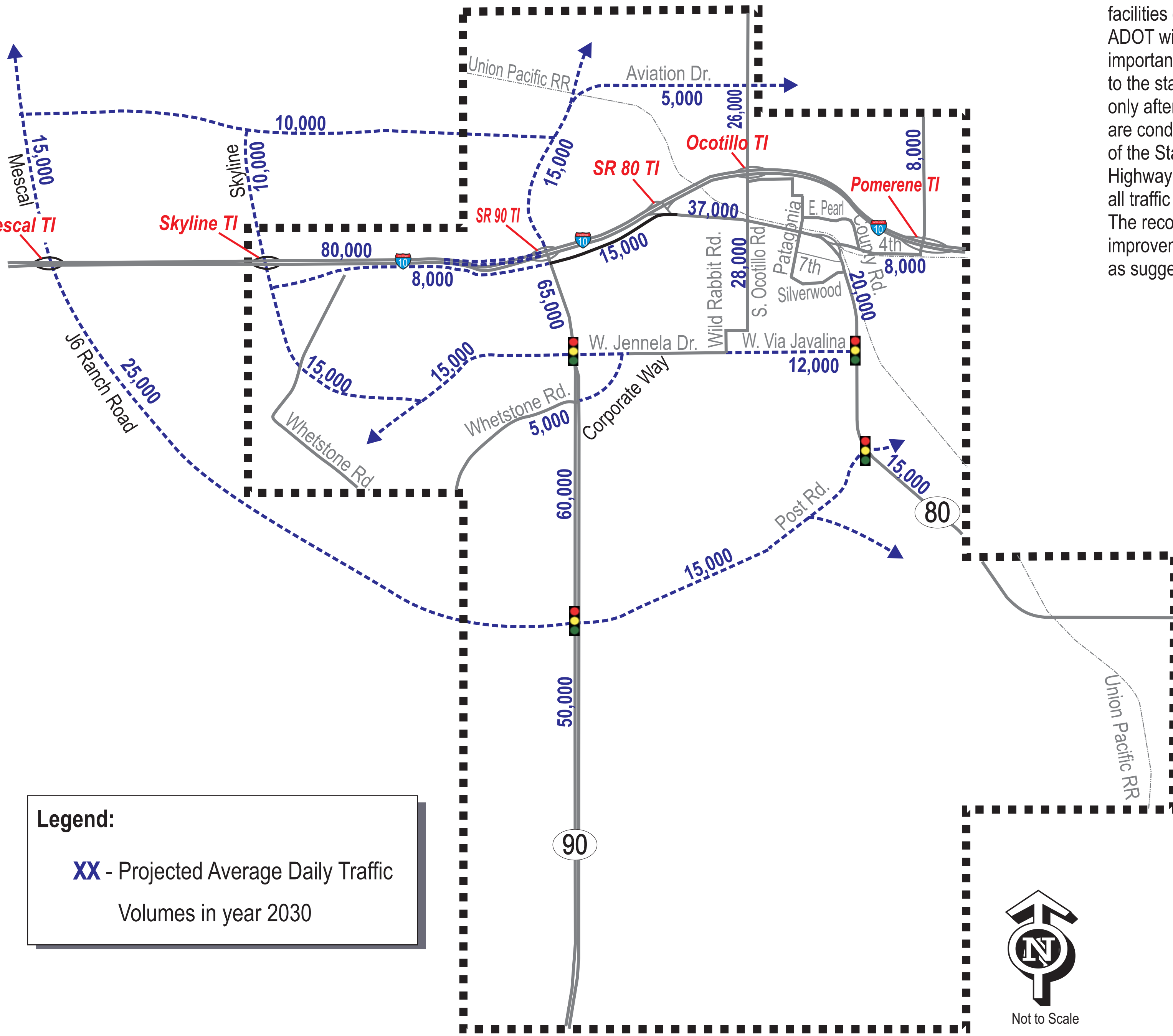


While this study included roadway facilities owned and operated by ADOT within the study area, it is important to recognize that improvements to the state highway system can be made only after in-depth and engineering studies are conducted by ADOT, and upon approval of the State Transportation Board. The Federal Highway Administration (FHWA) must approve all traffic interchange improvements.
The recommendations made by this study for improvements on state facilities can serve only as suggestions for further study.

Legend:

XX - Projected Average Daily Traffic Volumes in year 2030

Figure 25: Mid Range Plan 2020



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Legend:

XX - Projected Average Daily Traffic Volumes in year 2030

Figure 26: Long Range Plan 2030

Table 28: Potential Projects for Focus Area SR90 Ranked by Priority Score

No	Proposed Project	Time Frame	Priority Score	Estimated Cost (000)	Funding Source
1	Reserve adequate right of way on SR90 with proposed development	Short	N/A		Developer/Local /ADOT
2	Post Road Project Assessment Report	Short	N/A	100	Developer/Local
3	Conduct an access management plan for SR90 from I-10 to Karchner Caverns	Short	N/A	50	ADOT
4	Jenella Project Assessment Report	Short	N/A	100	Developer/Local
5	Improve I-10/SR 90 Interchange	Short	13	30,000	ADOT
6	Jenella Road west of SR90	Short	13	1,000	Developer
7	Prepare conceptual access design plans for SR90	Short	10	20	ADOT/Local
8	Signalization at Post Road/SR90	Short	7	300	Developer
9	Aviation Drive Project Assessment Report	Mid	N/A	100	Developer/Local
10	SR90 North to Airport Project Assessment Report	Mid	N/A	250	Local/Developer
11	Skyline Project Assessment Report	Mid	N/A	250	Developer
12	Skyline TI Project Assessment Report	Mid	N/A	250	Developer
13	Post Road from SR90 to SR80	Mid	14	4,000	Developer/Local/ ADOT
14	Jenella Road from SR90 to SR80	Mid	14	2,000	Developer/Local
15	I-10 Connector west from SR90	Mid	13	1,000	Developer
16	Design and construct SR90 north to Airport	Mid	11	3,000	Developer/Local
17	Widen Aviation Drive	Mid	9	750	Local
18	Signalize Aviation Drive/Ocotillo	Mid	7	250	Developer/Local
19	Signalize Jenella Road/SR90	Mid	7	300	Developer
20	Mescal TI Project Assessment Report	Mid	N/A	400	ADOT/Developer
21	J6 Ranch Rd Project Assessment Report	Mid	N/A	500	Developer
22	Mescal Road Project Assessment Report	Mid	N/A	500	Developer

No	Proposed Project	Time Frame	Priority Score	Estimated Cost (000)	Funding Source
23	Proposed new road Project Assessment Report	Mid	N/A	500	Developer
24	Design and construct J6 Ranch Rd	Long	14	50,000	Developer
25	Design and construct Mescal Rd	Long	14	10,000	Developer
26	Design and construct new road	Long	13	50,000	Developer
27	Modify Skyline TI	Long	13	25,000	Developer
28	Modify Mescal TI	Long	13	25,000	Developer
29	Widen SR90	Long	13	5,000	ADOT/Developer
30	Design and construct new N/S route from Skyline TI	Long	11	40,000	Developer
31	Signalization at proposed new road/Mescal	Long	11	300	Developer
32	Signalization at proposed new road/Skyline	Long	11	300	Developer

Table 29: Potential Projects for Focus Area SR80

No	Proposed Project	Time Frame	Priority Score	Estimated Cost	Funding Source
33	Prepare conceptual design plans for SR80	Short	N/A	300	ADOT
34	Conduct an access management plan for SR80	Short	N/A	300	Local/ADOT
35	Signalize Jenella/SR80	Mid	7	300	Developer
36	Signalize Post/SR80	Mid	7	300	Developer
37	Widen SR80 from B10 to Post Road	Long	13	7,000	ADOT/Developer

Table 30: Potential Projects for Focus Area Downtown

No	Proposed Project	Time Frame	Priority Score	Estimated Cost	Funding Source
38	I-10 Frontage Project Assessment Report	Short	N/A	300	Local
39	4th Street Revitalization Report	Short	N/A	300	Local/ADOT
40	Street Pavement Study and Analysis Report	Short	N/A	75	Local
41	B-10 and SR80 intersection	Short	12	6,500	ADOT
42	4th Street Revitalization (road improvements and landscape)	Short	11	1,000	Local/ADOT
43	Pavement Rehabilitation	Short	8	400	Local
44	Project Assessment Report for Ocotillo Road	Mid	N/A	300	Developer/County/ Local

No	Proposed Project	Time Frame	Priority Score	Estimated Cost	Funding Source
45	Project Assessment Report for Pomerene Road	Mid	N/A	300	Local
46	I-10/Ocotillo Road TI Project Assessment Report	Mid	N/A	300	ADOT
47	I-10/Pomerene Road TI Project Assessment Report	Mid	N/A	300	ADOT
48	I-10 Connector from Exit 303 to Exit 302	Mid	13	5,000	Local/Developer
49	I-10 Pomerene Road TI Improvements	Long	11	3,000	ADOT
50	I-10/Ocotillo Road TI Improvements	Long	11	3,000	ADOT
51	Improve Ocotillo Road	Long	10	2,000	Developer/County/ Local
52	Improve Pomerene Road	Long	10	2,000	Developer/Local

The prioritization ranking was determined based on current information. Should additional information become available, or traffic assignment be reallocated to different streets, priorities may vary. Final prioritization and project implementation is at the direction of the City Engineer.

Figure 27: Improvements presents the improvement locations based on the project numbers above.

While this study included roadway facilities owned and operated by ADOT within the study area, it is important to recognize that improvements to the state highway system can be made only after in-depth and engineering studies are conducted by ADOT, and upon approval of the State Transportation Board. The Federal Highway Administration (FHWA) must approve all traffic interchange improvements. The recommendations made by this study for improvements on state facilities can serve only as suggestions for further study.

8.7 Regional Connectivity

Currently, ADOT is preparing the Southeast Regional Transportation Profile which addresses the regional state routes that accommodate growth and future traffic needs. As major growth occurs within the Benson Area, the City will need to work closely with other agencies and jurisdictions including ADOT, Cochise County, St. David and Sierra Vista to develop these regional roadways.

State Routes 90 and 80 will remain regional routes for Benson and will require improvements as traffic volumes increase. Additional North/South regional connections should be considered to accommodate growth and to provide alternatives to SR 90 and SR 80. These routes are shown as conceptual alignments within the Benson Study Area. The conceptual alignments should connect to I-10, and could tie into points such as

Skyline Road approximately 6 miles west of SR 90 or Pomerene Road east of SR 80. Prior to any work on the conceptual alignments, design concept reports for the proposed routes should be performed to determine issues, constraints and recommendations of the alignments. Additional to the North/South regional routes, East/West regional alignments should also be reviewed to assist in eventually alleviating some congestion on I-10 within the study area.

Currently, SR 76 (Pomerene Road) is being examined as a potential alternate route around Tucson to alleviate some capacity issues on I-10 within in Pima and Pinal Counties. Because of this new regionally significant route, there has been some discussion between ADOT and the City of Benson to take SR76 (Pomerene Road) back into the state system within the Benson City limits. These discussions are in the preliminary stages; however, they do reflect the pressures of regional growth throughout the entire area.

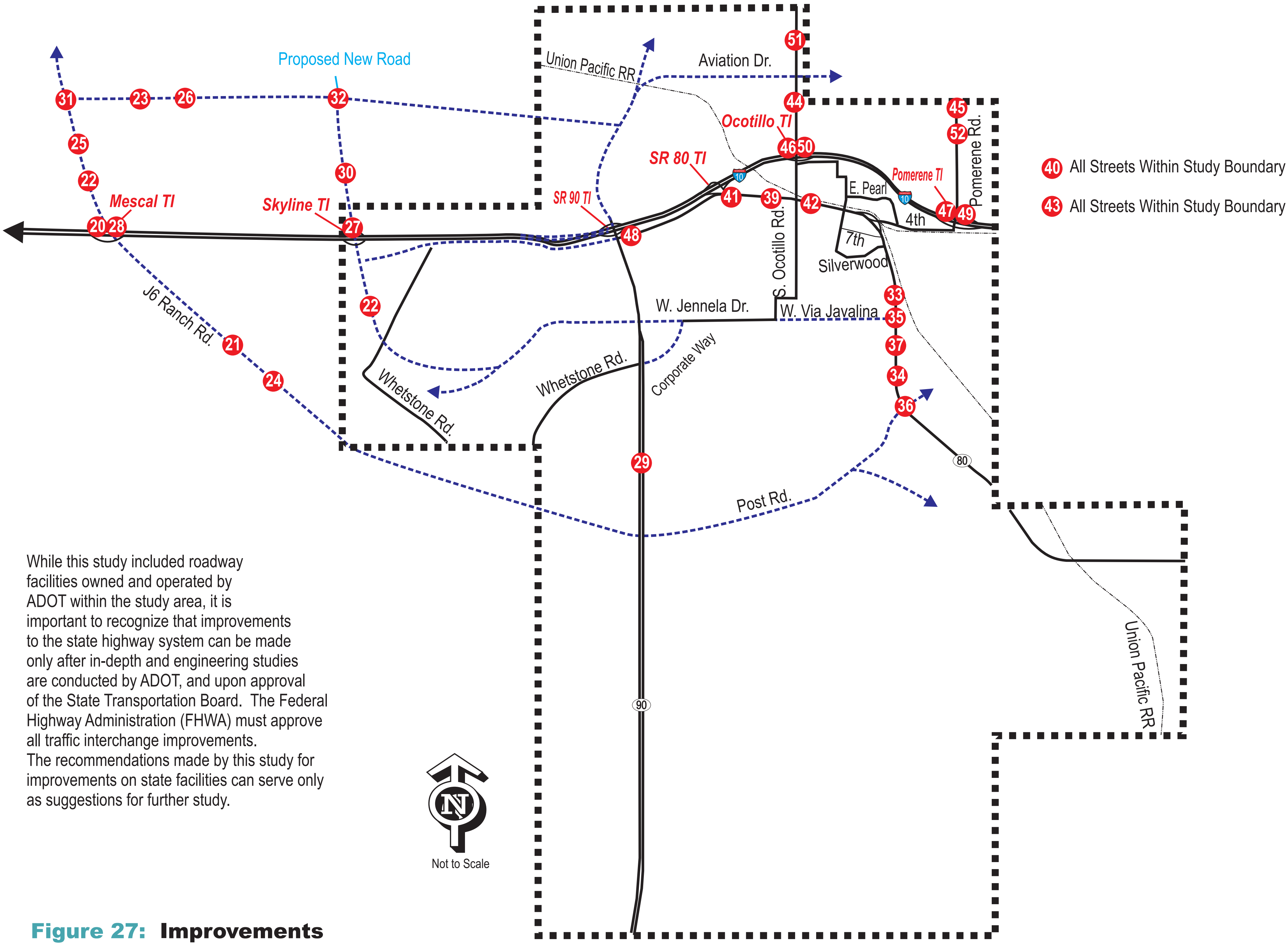

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Figure 27: Improvements

9.0 PUBLIC TRANSIT

The Benson Small Area Transportation Study Working Paper #2 defined various public transportation modes and listed their advantages and disadvantages. The analysis then evaluated the alternatives and discussed which appear more suitable for the Benson Area. Based on that analysis, the alternatives that remain open for consideration within Benson are dial-a-ride, reserve-a-ride, and point deviation. Each of these alternatives exists in comparable Arizona communities. Information on current transit systems can be obtained from the Arizona Department of Transportation Public Transportation website www.azdot.gov and the Arizona Transit Association website www.azta.org, 2006.

9.1 Recommended Transit Modal Alternatives

9.1.1 Dial-a-Ride

A demand responsive transit system in which vans, cars, or other vehicles provide door to door shared ride transportation with no fixed routes or schedules. Passengers call two hours ahead to arrange a ride. Examples: Lake Havasu and Douglas.

Advantages:

- Serves everyone within the established service area.
- Can use distance based or zone fares.
- Easy for seniors, disabled and others to use

Drawbacks:

- Unpredictable pick up and drop off times
- Requires expert real time dispatching
- Surges in demand may result in denial of service.
- High cost per passenger trip.

9.1.2 Reserve-a-Ride Service

Similar to dial a ride except must reserve a ride 24 hours or more in advance. Same day service may be provided if extra capacity is available after reserved trips are accommodated. Examples: Miami Transit and Cottonwood Area Transit System.

Advantages:

- Easier than dial-a-ride to operate cost effectively
- Works well for medical trips and other appointments.

Drawbacks:

- Shares similar limitations of dial-a-ride.
- Does not meet unexpected last minute travel needs.

9.1.3 Point Deviation Service

Transit service in which the vehicle is required to arrive at designated stops according to a fixed schedule but need not follow a specific route between stops. Unlike route deviation service, which follows a fixed route with occasional deviations, this is more of a demand responsive service with a limited number of scheduled stops. Arizona transit systems that use the check point concept include Sierra Vista Public Transit and Coolidge Cotton Express.

Advantages

- Combines a degree of fixed route predictability with dial a ride flexibility and coverage.
- Is well suited to an area with a few major activity centers and dispersed demand elsewhere
- May meet ADA requirements if all ADA requests in the service area can be accommodated.

Drawbacks:

- May entail circuitous routing between checkpoints
- Schedule adherence requires restricted service area and continuous coordination between driver and dispatcher.
- Surges in demand may result in denial of deviated service.

9.2 Proposed Starter System

As the population of the urban areas within Benson increase and new development is constructed and occupied, there will be an increasing need for intercity bus service in the Benson Area. An increase in intercity bus service could relieve anticipated congestion and increase accessibility to area residents who are mobility impaired. Establishing transit centers in Benson could provide a focal point for transit service and coordinate developing local transit service with regional transit service.

By year 2010 a starter bus system may be needed within the Benson area due to the anticipated growth. Because a long term commitment will depend on demonstrated demand, a “bare bones” starter system could be implemented for a trial period of three to six months, providing grant funding. Initially one to two vans could operate on weekdays during regular business hours as a reserve a ride or dial a ride type service. These hours would enable transit dependent persons to make medical, social service or shopping trips.

The proposed starter system would complement rather than compete with the limited services already provided by the Catholic Community Services. This service would continue to provide service to their clients particularly the elderly. The experience of similar Arizona cities shows that ample opportunity exists for both general public and specialized transit. In implementing the starter system, the City of Benson might be able to share vehicles and other resources with the Catholic Community Services. Resource sharing may be limited; however, by restrictions placed on the use of vehicles under section 5310 of the Federal Transit Act and Title III of the Older Americans Act. These federal programs are specifically targeted toward the elderly and disabled, as opposed to section 5311 which is geared toward the general public.

To develop a successful transit system, even on a small scale, aggressive and continuing marketing is essential. Prospective riders must be made aware of the service and timetables should be widely disseminated. A check point map and schedule brochure should be printed and distributed free of charge at municipal facilities and at private businesses such as banks and supermarkets. Printed schedules should also be available on the vehicles. All graphics should be easy to read with checkpoint times in large print. The route map and schedule should also be posted at each checkpoint. It is especially important to provide a concise by clear explanation of how the checkpoint system works because riders may be unfamiliar with the concept.

When service or schedule changes are necessary, riders should be informed well in advance. Notices should be posted in the vehicles and operators supplied with literature for distribution. Transit stop signs should carry a distinctive system logo, which should also appear on the printed materials and the vehicles. The signs and timetables should display a phone number for further information. Telephones should be answered during all hours when the transit service operates. Newspaper and radio advertisement is strongly recommended, especially during the first few months of operation.

Community and civic organizations, especially agencies that serve potential transit users, should be encouraged to dispense information. Educational institutions such as middle and high schools should receive informational materials for distribution to interested students. Initiation of service may be planned as a ceremonial occasion with attendance by the mayor and other dignitaries.

10.0 NON MOTORIZED CIRCULATION

Non-motorized circulation in the Benson area includes pedestrian and bicycle activity. These modes can provide viable alternatives to the automobile for a variety of trip purposes. Each of these modes of travel is addressed below.

10.1 Bicycle System Development

The bicycle, if adequately planned for and utilized, can play an important role in the transportation system. Arizona State law grants a person riding a bicycle on a roadway or on a shoulder adjoining a roadway all of the rights and all of the duties applicable to the driver of a motor vehicle. The bikeway system should enhance mobility and recreational riding through provision of one or more of the following types of facilities:

Scenic Bikeways or Multi-Use Trails (located along streams, canals or other scenic corridors)
Community and Regional Bikeways (primarily on or adjacent to streets, linking residential areas with activity and employment centers)
Neighborhood Bikeways (providing additional access to scenic and regional routes, connecting neighborhoods with local activity centers, including schools and parks)

Bike facilities are divided into the following four categories in the Benson Area, with the exception of the State Routes. All bike facilities are at the approval of the City Engineer:

Shared Use Path – A bikeway physically separated from non-motorized vehicular traffic by an open space or barrier and either within the highway right of way of within an independent right of way. Shared use paths may also be used by pedestrians, skaters wheelchair users, joggers and other non-motorized users. When parallel to the roadway, it is usually buffered from vehicular traffic through the use of a landscaped strip or physical barrier. Shared use paths may be identified with guide signing and pavement markings when constructed on their own, independent of the vehicular roadway system. When share use paths are placed parallel and adjacent to a state roadways they shall not be marked or signed for the preferential or exclusive use of bicyclists. This includes the use of centerline markings, BIKE ROUTE signs, STOP or YIELD signs, or similar devices, as presented in ADOT's Traffic Engineering Policies, Guidelines, and Procedures section #1031. Signing and Marking Shared Use Paths. The AASHTO Guide for the Development of Bicycle Facilities recommends that shared use paths, especially those designated for two way traffic, not be located immediately adjacent to roadways for operation and safety reasons. Shared use paths may be scenic recreational trails located along streams, canals, linear parks, or greenbelts rather than roadways.

Bike Lane – A bike lane is defined as a portion of a roadway which has been designated by striping, signing and pavement markings for the referential or exclusive use of bicyclists. A bike lane should be painted with standard pavement symbols to inform bicyclists and motorists of the presence of the bike lane. The standard pavement symbols are one of two bicycle symbols (or the words "BIKE LANE") and a directional arrow.

Designated Bike Route – A designated bike route is a system of bikeways designated by the jurisdiction having authority with appropriate directional and information route signs, with or without specific bicycle route numbers. Bicycle routes, which might be a combination of various types, should establish a continuous routing.

Wide Curb Lane – Although not officially designated as bikeways, curb lanes wider than the standard 12 feet on multilane roads can greatly enhance the comfort and safety of bicyclists. Wide curb lanes are appropriate where state or local authorities are reluctant to designate bike lanes or routes because of concerns about potential liability. Curb lanes designated to accommodate cyclists should be at least 14 feet wide.

The Guide for the Development of Bicycle Facilities prepared by the AASHTO Task Force on Geometric Design and the ADOT Statewide Bicycle and Pedestrian Plan provides detailed planning guidelines for bikeway facilities of all types. The Manual of Uniform Traffic Control Devices governs signs, signals, and markings for bicycle facilities.

10.1.1 Bikeway Implementation Guidelines

Bikeways should be implemented on the basis of the following design principles:

Access – the bikeway must be located where bicyclists want to go and readily accessible, safe and convenient for the user.
Continuity – the bikeway system should be internally continuous and provide access connections to bikeways in adjacent communities.

Bike lanes should be located to the right of an existing roadway lane and to the left of a right turn only lane at intersections. All bike lanes should be clearly marked and delineated so that motorists, pedestrians, and bicyclists are alerted to locations reserved for this use. To delineate a lane effectively, the pavement markings, signing and striping should be in conformance with the ADOT and AASHTO Bicycle Guidelines so that standardization may be achieved.

The following are some examples of guidelines that will aid in the provision of safe, convenient and functional bicycle mobility:

- Bicyclist skills training programs can play a substantial role by increasing bicyclists confidence and enabling bicyclists to make the street and road system work for them.

- A comprehensive bikeways and trails master plan for the City of Benson should be performed.

- A comprehensive bikeway system should serve as many destinations points as possible (schools, parks, trail heads, commercial facilities, major employers, activity centers)

- The alignment of bikeways should minimize conflicts with other modes (i.e. pedestrians, vehicles).

- Bike lanes should always be constructed in pairs, with one on each side of the street so that bicyclists move in the direction of motorized traffic.

- When located on the street, bikeways should flow with traffic and should be designated with painted indicators and the appropriate signage. Signs and pavement markings should follow the MUTCD.

- Bike lanes and routes should be located where on street parking is minimal or prohibited, if possible.

- Steep grades for bikeways should be established only where pavement can be constructed to a reasonable width. It is better to not have bikeway at all, than an unsafe or substandard facility.

- A scenic evaluation of proposed bikeway routes should be considered when planning bikeways for recreation.

- Trash containers, park benches and bicycle racks should be located throughout the off road shared use paths. Some of the more convenient locations include destination points such as schools, parks, commercial facilities, major employers and other activity centers.

- Destinations should be encouraged or required to provide convenient bicycle parking facilities.

10.1.2 Bikeway System Plan

A comprehensive Bikeway and Trails Master Plan should be completed that incorporates both urban and rural trails and bikeways into an overall system. Several trail systems that could be incorporated into a future Bikeway and Trails Plan include:

Downtown bikeway system to bring pedestrians and bicyclists into Downtown Benson.
Create a shared use path along the abandoned railroad lines connecting the proposed new development along SR 90 to the downtown Benson area.

The types of bicycle facilities may vary from location, but should generally be governed by the following guidelines, as approved by the City Engineer:

All newly constructed or reconstructed arterials should be equipped with bike lanes if otherwise possible, wide (14 foot) curb lanes are an acceptable alternative.
All newly constructed or reconstructed collector roadways, especially in residential or urbanized areas, should include bike lanes on both sides of the roadways, whenever the available right of way permits.

On minor collectors where the right of way width does not permit installation of bike lanes, designation as a bike route (signage only) should be considered where this would enhance bikeway network continuity. Bike route signage, without pavement markings or wide curb lanes, is not recommended for arterials.
Shared use paths should be considered as alternatives to bike lanes only where suitable corridors are available parallel to roadways, but outside and physically separate from the right of way.

10.2 Pedestrian System Development

Virtually all transportation system users are pedestrians during a portion of every trip in walking to and from: the school bus stop, the car on the street, or between the parking lot and the work place. Despite this, the needs and safety of pedestrians are often an afterthought in site design and street system development.

The two types of pedestrian facilities are sidewalks and shared use paths. Sidewalks are an important element along urban roadways and near local activity centers such as schools, commercial centers and public recreation areas that attract significant pedestrian travel.

Unlike sidewalks, which are generally designed for the exclusive use of pedestrians, shared use paths may be shared with cyclists and/or equestrians. Paths are often located away from major streets. They can improve circulation by providing useful shortcuts while serving a recreational function at the same time.

In developing a pedestrian system, priority should be given to segments that would provide safe school routes or to enhance continuity of the system. Since the need to cross major streets often discourages walking, signalization or other protection of pedestrian crossings at these locations should be considered where warranted.

In the development process, on-site pedestrian travel can be encouraged by allowing mixed land uses on the same site or in close proximity to one another (i.e. residential, commercial, office) with adequate buffering to protect residential character, and carefully designed parking and traffic flow to minimize pedestrian/vehicle conflicts.

It is the policy of the State of Arizona to provide accessible and convenient walking facilities and to support and encourage increased levels of walking. Sidewalks should be provided along State Highways where there are origins and destinations in close proximity. Within close proximity is defined as an origin and destination within 1.5 miles walking distance from one another and the subject facility is between the origin and destination. A transit stop should be considered a destination. Sidewalks should always be placed on both sides of the roadway or highway.

10.2.1 Sidewalk Implementation Guidelines

The following are provided as a basis for deciding when sidewalks should be constructed or included in roadway improvement projects:

- When new subdivisions of three or more units per acre are approved
- When streets are within one-half mile of school
- When a street is classified as an urban collector or arterial
- When a new sidewalk would provide system continuity between existing facilities
- When a majority of affected property owners petition for pedestrian facilities
- When health and safety are threatened due to pedestrian/vehicular traffic conflicts
- When a large number of young children and/or older citizens reside in a given area
- When parks, playgrounds or other attractions of young children are not served by sidewalks

10.2.2 Sidewalk Design Elements

The following requirements are recommended to standardize sidewalk provisions of subdivision ordinances:

Five-foot clear width sidewalks on both sides of local urban section (curb and gutter) streets in residential areas, except where the design density is less than three units per acre. Five-foot clear width sidewalks along both sides of collector and arterial streets, except where additional width is required based on anticipated usage, adjacent lane uses, system continuity or other considerations.

Local officials should have the authority to require (where appropriate) pedestrian facilities along all streets on commercial areas and along internal private streets.

In commercial district or where heavy pedestrian and vehicular volumes are anticipated, sidewalks of eight or more feet clear width are desirable.

The ADA limits sidewalk grades and cross slopes and requires curb ramp treatments at driveways and intersections. A minimum clear width of four feet is recommended for all accessible walks and ramps.

In order to maintain clear sidewalk widths, obstructions such as traffic signs, utility poles and supports should be placed outside the specified five to eight foot sidewalk widths.

Sidewalks are most desirable when separated from the roadway, in order to provide a perception to the user that some distance exists between vehicles and pedestrians, reduce grade differentials at curb cuts and provide space for signs and utilities adjacent to the roadway.

10.3 Non-Motorized Improvements

In summary, *Table 31: Proposed Non-Motorized Projects* presents projects that could be completed within Benson, as approved by the City Engineer.

Table 31: Proposed Non-Motorized Projects

No.	Proposed Project	Time Frame	Priority Score	Estimated Cost (000)	Responsible Party
53	Bike and Trails Master Plan	Short	N/A	200	Local
54	Sidewalk Inventory	Short	N/A	200	Local
55	Construct a Multi-Use Trail near Abandoned Rail Road	Long	N/A	500	Developer/Local

It is ADOT's policy to provide a transportation infrastructure that provides safe and convenient pedestrian access. However, sidewalks should not be constructed as part of the highway project. The highway cross section should provide space for sidewalks to be constructed by others. Therefore, it is the current ADOT ITD policy that bike lanes and sidewalks are allowed along the state highway if they are constructed and maintained by the City of Benson. For additional information see the ITD Roadway Design Guidelines.

11.0 EXISTING AND POTENTIAL FUNDING SOURCES

Funding is a keystone in the implementation of any transportation project. Hence, discussions of alternative actions to improve the transportation system within the Benson Area require discussions on both current and potential revenue sources. It is proposed that fifty percent of the construction sales tax is utilized to support development of the pedestrian and vehicular transportation infrastructure.

11.1 Available Funding Sources

11.1.1 Developer Funds

Aggressive funding from developers within their project area will be one of the principal sources for funding the various roadway projects listed in Tables 28, 29, 30 and 31. To determine developer contributions for each project, it is recommended that a study be prepared to implement development impact fees. Currently, exactions contribute to the completion of many projects within the project area.

11.1.2 Construction Sales Tax

Construction sales tax is one of Benson's revenue sources. This tax is regional in nature and can be used for many publics works projects including parks, trail systems and roadways.

11.1.3 Highway User Revenue Fund (HURF)

The Highway User Revenue Fund (HURF) is the principal source of funding for roadway construction and maintenance in Arizona. HURF revenues come from a variety of sources including state motor fuel taxes, motor carrier taxes, vehicle registration fees, and a portion of the vehicle license taxes. These funds are distributed by formula to every city and county in the state and to ADOT.

11.1.4 Local Transportation Assistance Funds (LTAF)

The LTAF was created in 1981 with the start of the Arizona State Lottery. The funds are allocated in proportion to the relative population of all Arizona cities and towns. Each requesting municipality is guaranteed a minimum percentage of the funds. Benson's population qualifies LTAF funds annually.

11.1.5 Private Funds

Private funding sources have been common in street construction projects for many years. This has included dedication of rights of way, participation in a proportion of construction costs, developer impact fees, and other similar items. Typically these funds are committed concurrent with site development planning for parcels adjacent to the street.

11.1.6 Special Improvement Districts

Road improvements can be provided in designated areas by means of special improvement districts. Arizona Revised Statutes Title 48 authorizes such districts and describes how they are formed. A special improvement district can be used to undertake a variety of public work improvements, including roadway widening and paving.

A district boundary is established for the purpose of making a particular improvement. Under the county controlling statutes, the owner if at least 51 percent of the property to be included on the district must apply to the local governing body to establish an improvement district. In addition, the owners of at least 51 percent of the property must submit a petition to incur the necessary improvement expenses. Under the city controlling statutes, the City Council initiates an improvement district. This is usually based on an interest by the property owners who would be beneficiaries of the improvements. After preliminary engineering plans and cost estimates are in place, the Council can initiate the formal process. Under this process it takes at least 51 percent of the property owners to protest or stop the improvement district from proceeding. In both cases the plans, specifications and cost estimate for the improvement are prepared by the improvement district engineer, and property owners are normally assessed for the improvement by linear front footage, though other assessments are also used.

11.1.7 Special Road Districts

Special road districts may be formed if approved by an election by two-thirds of the participating electors of the proposed district (Arizona Revised Statutes Section 48-1401, es.seq.) A district is limited in size to an area no larger than one mile by ten miles. A special road tax can be levied on all real property and mobile homes within the district; and for the purposes of construction, maintenance and repair of the roads, driveways, highways, and bridges within the district. This tax shall not exceed 75 cents per $100 of assessed valuation of the real property and mobile homes in the district, except through a special election approval process pursuant to Arizona Revised Statutes Section 48-1407. The funds raised through this revenue are kept in a special fund designated for the road district. A separate special election (also requiring 2/3 favorable vote) may be called to determine whether bonds can be issued.

11.1.8 Economic Development Administration (EDA)

Grants are provided to strengthen economic development planning and policy making capabilities to ensure a more effective use of available resources in addressing economic problems, particularly those resulting in high unemployment and low incomes. Grants also assist with the funding of public works and development of facilities that contribute to the creation or retention of private sector jobs and to the alleviation of unemployment and underemployment at the rate of one job per $10,000 in projects (i.e. water, sewer, industrial park site). EDA will provide grants with EDA participation for approximately 70 percent of the project cost.

11.1.9 USDA Rural Development

Previously called the Farmers Home Administration, this agency provides loan guarantees to public and private non-profit and for profit groups for business and industrial development projects in rural communities with populations less than 50,000.

They also provide loans or guarantees to fund the construction, enlargement or improvement of community facilities (e.g. healthcare, public safety, and public services) providing essential services to residents or rural communities with populations less than 20,000. Other grant programs are also available.

11.1.10 Greater Arizona Development Authority (GADA)

GADA was created to assist local communities and tribal governments in the development and financing of public infrastructure projects by providing technical and financial assistance to these communities.

11.1.11 Economic Strength Projects

This program provides grants for highway or road improvements that retain or create jobs, lead to capital investment and contribute to the state's economy. This very competitive program is based on the economic impact of the project on the community in which it will be located.

11.1.12 Federal Highway Enhancement Funds

Ten percent of each state's annual surface transportation program (STP) allocation is reserved for "transportation enhancement activities". This funding is intended to encourage activities and projects that go beyond traditional transportation improvements. Ten eligible enhancement activities include: provision of pedestrian or bicycle facilities, landscaping or other scenic beautification projects, historic preservation, "rails to trails" conversions, control or removal of outdoor advertising, archaeological planning and research, and mitigation of water pollution due to highway runoff. ADOT has retained 50 percent of Arizona's enhancement funds for use on the State Highway System, with the remainder available for projects recommended by councils of governments and metropolitan planning organizations. Statewide competition for the local share of the money (approximately $8 million per year) has been very keen. Under the federal legislation, the funding for this program may be increased.

The national highway system (NHS) funds are for improvement to the national highway system which consists of an interconnected system of principle arterial routes which serve major population centers, international border crossings, airports, public transportation facilities, and other intermodal transportation facilities as well as major travel destinations. The NHS funding level for Arizona over the three years is approximately 350 million dollars. Arizona's share is based on the state's lane miles of principal arterials, vehicle miles traveled on those arterials, diesel fuel used and per capita principal arterial lane miles.

11.2 Obtaining Funding

Given the wide variety of funding programs and the stiff competition for these funds, recommendations are as follows:

Customize the definition of each project to reduce overall construction costs and to take advantage of multiple funding programs. For example: Include a landscaped median island or gateway treatment on Business Route 10. This will reduce the overall pavement area to be reconstructed; and the landscaped median would be eligible for federal enhancement or national resource grants.
Piggyback several of the funding programs to cover various aspects of a project. Based on the information presented, no single grant program is usually able to cover the entire cost of the project.

Focus the City's efforts on a short list of programs that will offer the best potential for success.

11.3 Action Plan for Funding

Meet with Cochise County representatives to initiate cooperative funding agreements.

Meet with SEAGO staff to be certain that each desired project is included on the annual Transportation Improvement Plan. Also, information pertaining to Federal Highway Enhancement Funds (i.e. application format, timing, likely competition) should be reviewed.

Meet with ADOT District staff to discuss priorities and implementation procedures. Support from the ADOT District is very important in the scoring on competitive grant applications.

Meet with the Arizona Department of Commerce staff in Phoenix to discuss the economic grant programs administered by them. Specific guidelines and criteria need to be reviewed prior to initiating any applications.

Undertake a local effort at generating letters of support for each improvement project. Local civic groups, adjacent land owners, school districts, irrigation districts, and churches should all be contacted. These letters are very meaningful in the scoring on competitive grant applications.

Meet with the larger employers in Benson to identify their future needs for each project and employment related issues that could improve Benson's scoring on economic development grant programs.

Schedule information meetings with state and federal representatives to review the history of each project and clearly show the need for the project; to illustrate the broad based local support; and to demonstrate the City's pro-active approach to partnering for the project implementation.

Evaluate the City's fiscal situation to identify local funding sources that represent at least 10% of the total project budget, but more importantly, illustrate commitment. Most of the state and federal funding programs require some amount of matching monies; and most will allocate a higher score to applications which demonstrate a monetary commitment.

For those projects which don't qualify for federal or state funding, develop/enhance local funding mechanisms such as improvement districts, impact fees, transportation sales tax, developer participation, and local bonding to address the recommended short and long range improvements.

12.0 POLICIES AND GUIDELINES

Policies and guidelines are needed to implement the recommendations of this transportation study. Therefore, these policies and guidelines presented herein should be refined and adopted by the City Council as separate documents to this Small Area Transportation Study with oversight and approval by the City Engineer. Examples included in this report include roadway design standards, access management, and traffic impact analysis procedures. State routes within the area must meet all guidelines specified by Arizona Department of Transportation.

12.1 Roadway Design Standards

Table 32: Street Design Criteria present guidelines for the minimum street classification for each roadway cross section, or as approved by the City Engineer.

Table 32: Minimum Street Design Criteria**

Criteria	Major Arterial	Minor Arterial	Major Collector	Minor Collector
Right of Way Width (minimum)	140’	120’	80’	70’
Street Width to back of curb	104’	80’	50’	40’
Pavement Width	44’ (2)	32’ (2) or 78’	50’	40’
Median Width/TWLTL*	16’	16’	14’	-
Number of Lanes	6-7	5	3	2
Lane Widths (directional)	12’,12,14’	12’,14’	12’	12’
Edge Treatment	Curb/Gutter	Curb/Gutter	Curb/Gutter	Curb/Gutter
Bike Lanes	Yes	Yes	Yes	Yes
Sidewalk	6’	6’	5’	5’
Design Speed	60-55 mph	45 mph	40 mph	35 mph
Speed Limit	40-45 mph	35 mph	30 mph	25 mph
Design ADT	45,000	30,000	12,000	8,000
Street Purpose	Mobility	Mobility	Access	Access
On Street Parking	No	No	No	No
Property Access	Major Intersections and Driveways	Major Driveways	Driveways	Driveways

* TWLTL = Two Way Left Turn Lane

** Guidelines only, as approved by the City Engineer on a case by case basis.

If medians are proposed, the minimum median width should be four feet, or as approved by the City Engineer.

Figures 28 and 29: Desirable Cross-Sections recommend the lane widths and right of way needs for each functional classification roadway. These cross sections were developed in order to ensure a modern and consistent transportation system for the City of Benson as roads are improved over the next 25 years. These typical cross sections are based on a section line street grid system to allow traffic circulation from residential areas to the midsection and section line roadways.

12.2 Access Management

Access management seeks to limit and consolidate access along major routes, mostly arterials, while promoting a supportive street system and circulation for development. Access management retains the capacity of public highways, maintains safety on those roadways and retains access to private land. The result is a roadway that performs safely and efficiently while providing a more attractive corridor.

Access management for all state routes within the Benson Area will be based on the new statewide access management plan to be released in the Spring of 2008.

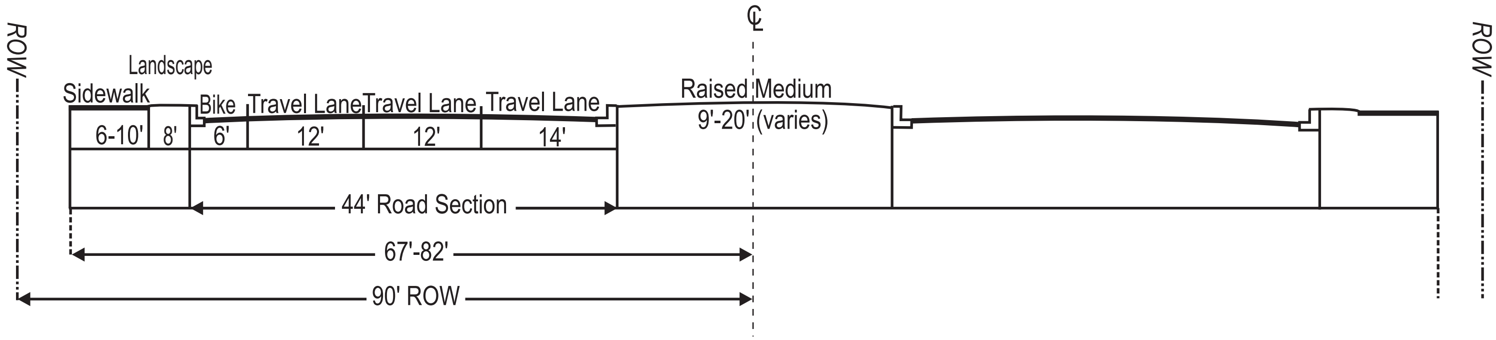
Benefits of a successful access management system include:

- a low accident rate,
- adequate driveway spacing,
- continued operation of the roadway as it was originally intended
- well landscaped corridor
- minimal construction activity on the corridor
- less commute time, fuel consumption and emissions due to traffic queues.

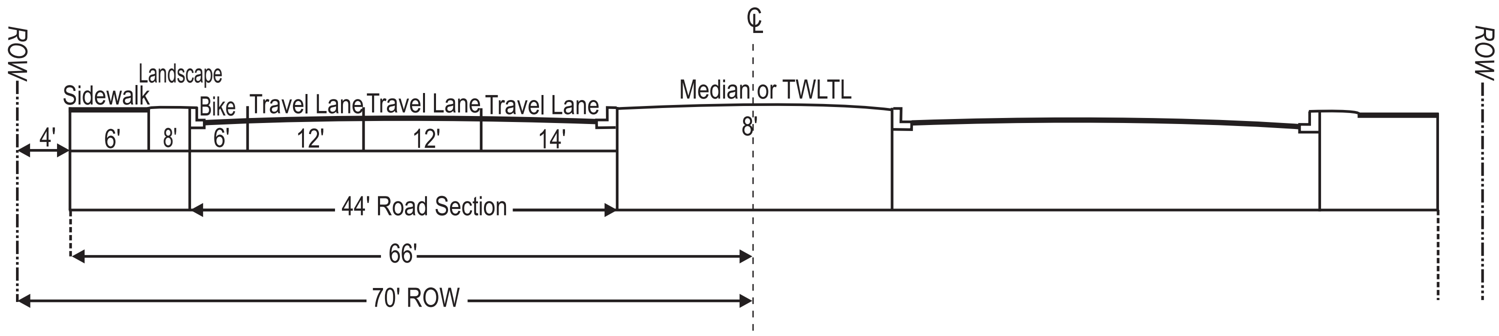
12.2.1 Background for Access Management

Major transportation corridors allow activities to take place through the safe and efficient movement of people and goods at high speeds over great distances. However, over time, traffic signals and curb cuts with the resulting turning movements degrade the transportation corridor from its intended function. The design of land use activities is heavily dependent upon vehicle access to the corridor. In addition, the individual land use activities are frequently isolated from adjacent land uses. Access to adjacent land uses is indirect via the transportation corridor. As a result, more trips are forced onto major transportation corridors due to uncoordinated internal access systems serving on-site land use activities. As the travel congestion increases, the level of service provided by the major transportation corridor decreases. In addition, accidents along such a corridor generally increase due to the large number of turning and other conflicts along the corridor.

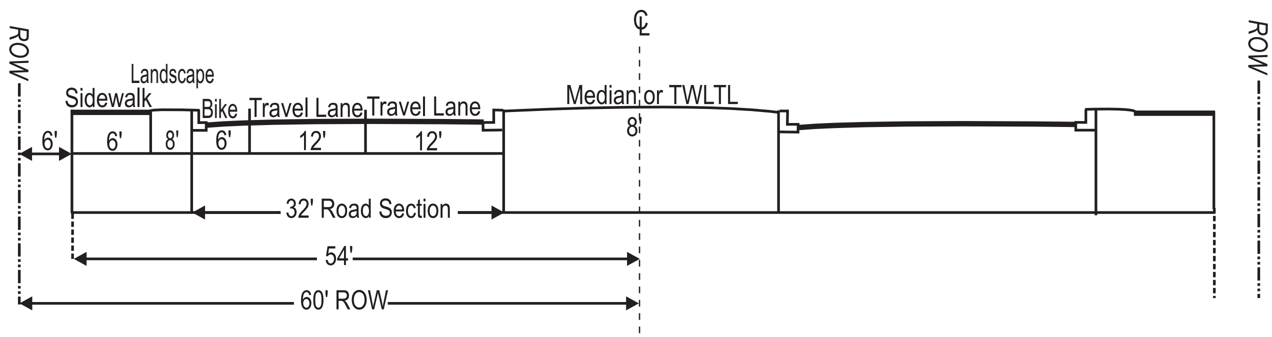
EXAMPLE



Principal Arterial



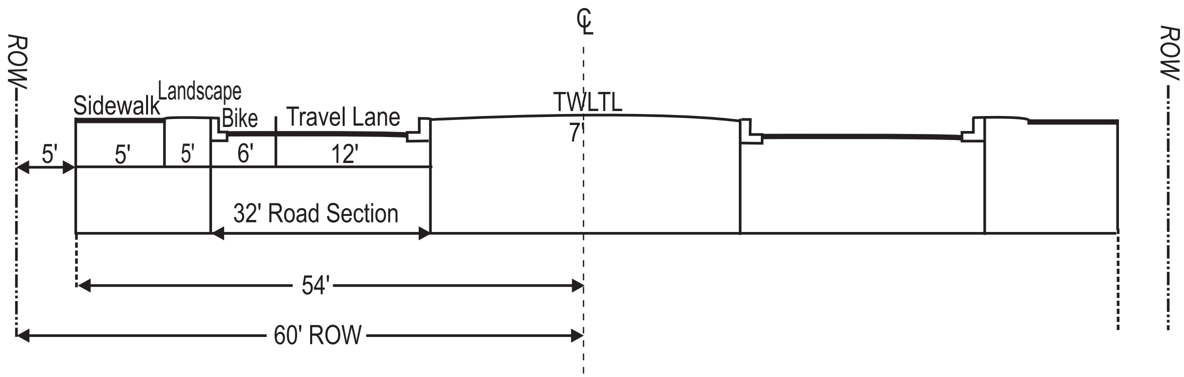
Major Arterial



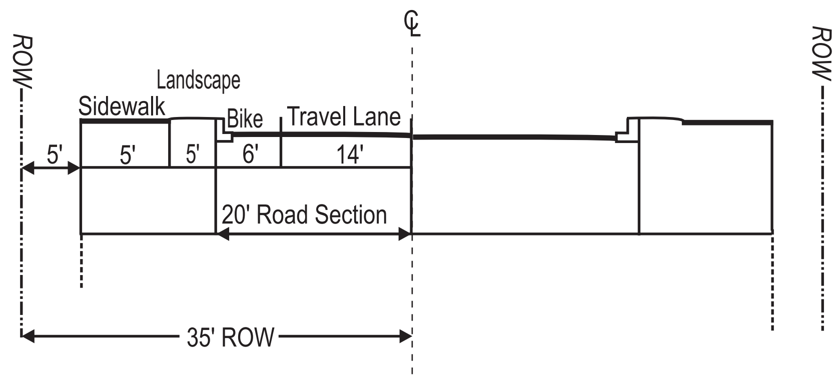
Minor Arterial

Figure 28: Desirable Cross Sections

EXAMPLE



Major Collector



Minor Collector

Figure 29: Desirable Cross Sections

With increasing travel delays experienced by the motoring public, requests for solutions are made to transportation officials. Typical solutions include adding more travel lanes and construction of raised medians. However, these retrofitting techniques are both expensive to implement and disruptive to the motoring public. If demand for the roadway continues to exceed the supplied roadway capacity, then business begins to feel the effects due to deterioration of access to the land use activities. Customers are not interested in visiting locations if they experience travel delays due to congested roadways and the safety risk of making difficult turning movements. In response, some businesses tend to relocate to areas that offer better accessibility. Frequently as economic activity declines in the traffic congested areas, so does the property value and tax base. As time progresses, the major transportation corridor has been transformed into a low speed, confusing mixture of signals and curb cuts which is no longer useful as a major transportation corridor.

12.2.2 Methods to Control Access

Access can be controlled through the use of planning and regulatory tools, and through the implementation of technical methods.

Land Division – Controlling lot dimensions has an impact on driveway spacing, on site circulation, and driveway lengths. Lot dimensions can be controlled through minimum lot size, minimum lot frontage, and setback requirements.

Site Review Process – The site plan review process can require documentation of all access points. Traffic signals, medians and on site circulation controls can be required to ensure that standards are followed.

Regulating Lot Splits and Further Subdivisions – Various types of lot configurations encourage inadequate spacing between access points. The regulation of lot splits by jurisdictions could help to ensure increased spacing between access points.

Subdivision Regulations – Regulations could orient lots and access points to local streets away from high traffic volume arterial streets

Location and Design – Control the number of access points in relation to road deceleration lanes to avoid conflict points.

Throat Distances at Driveways – Provide adequate design distances of driveway throat length to avoid conflict with flow of off-site traffic.

Retrofitting Non-Conforming Access – Make sure that new permitees provide the required conformance to access control guidelines, land use intensity changes and site improvements.

Overlay Zoning – Standards can be tailored by priority or intensity access, safety, and congestion problems with corridor overlays for access control problem areas.

Flexible Zoning – Flexible zoning can allow for alternative site design, buffering, and screening between incompatible uses.

Driveway Consolidation – Driveways are consolidated to limit the number of driveways per mile along a road and provide adequate spacing between driveways in order to reduce the number of conflicts.

Corner Clearance – Each access should have adequate corner clearance by keeping or moving driveway entrances away from intersections. Improving corner clearance reduces conflicts that caused rear-end accidents. In some cases, driveways are moved from the main streets to side streets to clear corners.

Continuous Two-Way Left Turn Lane – An additional dedicated left turn lane can be provided in the center of the street to separate left turning traffic from through traffic. Generally, these left turn lanes are used where moderate levels of turn occur.

Alternative Access Ways – Alternative access ways can be provided to sites adjoining the main road by either frontage or backage roads. These roads separate turning movements from the through traffic on the main street.

Raised Medians at Intersections – Raised medians at intersections provide a center barrier near intersections to prevent some turning movements into driveways near the intersection. This reduces conflicts near the intersection.

Full Raised Medians – Continuous medians are barriers the full length of the main roadway that prevent both left turns and cross traffic. Full raised medians eliminate conflict points along the stretch of the median where traffic volumes are high.

The City should form an internal access management team to formalize a continuous access management process including:

- the access permitting procedures,
- identifying responsibility,
- reviewing development plans,
- coordinating on planning new and relocated roadways, and
- preparing Access Management Plans.

12.2.3 General Access Control Guidelines

In Appendix C there are three access management plans that could be used for the City of Benson. Suggestive Access Management Plan #1 was developed with Benson in mind. Portions of this plan could be used as needed by the City Engineer to develop an Access Plan Specific to Bensons needs. Additionally, the City of Tucson's and the City of Mesa's access plans are attached. These are two examples of complete access management plans for use by the City Engineer. An access plan should be adopted by the City Council as a separate document to this Small Area Transportation Study with oversight and approval by the City Engineer.

12.3 Traffic Impact Analysis Guidelines

Traffic impact analysis (TIA) guidelines are used to provide information to the permit applicant concerning specific transportation requirements needed for development and to ensure consistency in preparation and review of all traffic impact analysis reports.

Appendix D presents suggestive traffic impact study guidelines that could be used by the City of Benson to develop Traffic Impact Study Guidelines for the City. Guidelines for TIAs should be adopted by the City Council as a separate document to this Small Area Transportation Study with oversight and approval by the City Engineer.

TIAs should be required for all new developments or additions to existing developments which generate 100 or more trips during the average weekday. The specific level of detail for a particular impact statement will vary according to the density of the proposed development, existing and planning development and the existing roadway conditions. The registered Civil Engineer with an emphasis in Traffic Engineering should prepare the TIA and must obtain agreement from the City on the specific requirements. *Table 33: TIA Report Guidelines* gives an indication of the report requirements depending on the number of trips estimated for the development.

Table 33: TIA Report Requirements

Report Chapters	Limited Report (100 or more trips per day)	Standard Report (500 or more trips per day)
Introduction	X	X
Proposed Development	X	X
Study Area		X
Analysis of Existing Conditions	X	X
Future Traffic Forecasts		X
Traffic and Improvement Analysis		X
Site Access	X	X
Level of Service		X
Improvement Analysis	X	X
Traffic Control Needs	X	X
Traffic Safety	X	X
Improvement Costs	X	X
Conclusions and Recommendations	X	X

The City makes the final decision on the requirements of the TIA. A developer will first estimate the number of vehicle trips generated by the development to determine if a TIA is required. The developer must obtain concurrence from the City on the number of trips generated by the development. The developer may request that the City assist in estimating the number of trips for the purpose of determining whether a TIA is required for the proposed development.

Traffic analysis for developments on state highways must be performed in accordance with *ADOT's Traffic Impact Analysis for Proposed Developments.* ADOT is responsible for TIAs along SR80 and SR90. In these cases, the preparer must coordinate with the ADOT District. In addition, the preparer must also coordinate with the City. The City and ADOT should also coordinate on the preparation of the TIA.

The TIA guidelines are not meant to be mandatory requirements for every site. The requirements may vary according to specific development type, land use intensity, site location, other surrounding activity, and other traffic impact analyses in the vicinity of the site. The City has complete discretion on the requirements for a TIA for city streets. Therefore, the preparer of the TIA must coordinate closely with the City from the inception of the project through completion of the TIA. The TIA requirements for a specific site must be agreed upon with the City before the TIA is undertaken. At least one meeting must be held with the City to review the scope of the analysis and to agree on specific requirements.

APPENDIX A

Public Involvement Summary Reports

PENTACOR

MEMORANDUM

TO: Sarah Simpson, United Civil Group

FROM: Jerry Mitchell, Pentacor Engineering LLC

DATE: October 24, 2005

SUBJECT: **Benson Small Area Transportation Study**
Public Involvement Summary Report No. 1

Sarah, this memo summarizes the first phase of public involvement for the Benson Small Area Transportation Study, which is identified as Task 3 in Technical Memorandum No. 1, Refined Work Plan. The first phase of public involvement was intended to introduce the Small Area Transportation Study to stakeholders, present findings on existing conditions and solicit comments from stakeholders.

Advance Publicity, Meeting Format and Attendance

Prior to the meeting Pentacor issued a press release which was published in the local newspaper and distributed flyers at several locations in Benson, including schools, the post office and stores. These materials announced the first public meeting and provided information on the study.

The first public meeting was held at 6:00 Tuesday, September 27, 2005 at the fire house on Seventh Street. The program included a brief slide presentation on the study approach and process. This was followed by an informal open house, with presentation boards on display and study team members responding to questions and comments from attendees.

The sign-in sheet shows 14 members of the general public in attendance, as well as members of the Technical Advisory Committee.

Comments

The following comments from stakeholders were recorded by study team members during the meeting.

Issues

- North / south roadways need to be planned for ad constructed between Jenella and Post Ranch Road.
- Residents have concerns about railroad crossings. An objective should be added to provide safe railroad crossings for the motoring public.
- A new route is proposed to connect SR 80 to SR 90 near I-10. Because this land is commercial, contact should be made with the developer to hear his plans.
- Airport Road and railroad crossing constraints – four total.
- Emergency vehicle delay concerns.
- Rail traffic forecast?
- Increased delay at crossings? This will affect whether to do under / over passes on railroads.

- Need bike and pedestrian access across rail tracks to Lion's Park.
- RV parks are coming. Need bike and pedestrian connections.
- Need town-wide pedestrian connections, e.g., from Skip's to downtown.
- Lack of capacity on SR 80 and Fourth Street when future developments come online.
- Concerns about nitrate truck traffic.
- Any ADOT interest in extending SR 90 north of I-10?
- Need to look at local street stubs lacking culdesacs.
- What is the study's approach to transit and elderly?

Solutions

- Construct a new roadway south from the Pomerene traffic interchange at Interstate 10. This new roadway would provide regional connectivity and connect to SR 82. Issues that would need to be addressed with the new route include the San Pedro riparian terrain and this route would not be developed as a state route.
- Pave Post Ranch Road, which will connect SR 90 to SR 80. If the above roadway is constructed, continue Post Ranch Road to the new roadway.
- Realign Jenella Road so a fire truck can get through from SR 80 to SR 90.
- A new connector route should be planned and constructed north from the SR 90 / I-10 interchange to the airport.
- Consider ITS.
- Bike and pedestrian route between SR 90 and downtown.
- Frontage road connection from SR 90 to downtown.
- Potential north – south pedestrian / horse connection on old railroad. Power company is considering.

Questionnaire Responses

Attendees were asked to fill out a questionnaire during the meeting that included potential criteria for evaluating alternative transportation improvements, ranking them by low, medium and high importance. Attendees also were asked to identify transportation issues and suggest solutions.

Eight questionnaires were completed. Four attendees identified themselves as both residents and property owners. None identified themselves as business owners. Four identified themselves as "other," i.e., non-residents or agency staff.

Questionnaire responses are presented on the following pages.

What specific transportation issue(s) are you most concerned about?	What solutions would you suggest?
Questionnaire No. 1	
▪ Highway 80 overcrowding.	
Questionnaire No. 2	
	▪ Long-range plan ▪ Type of vehicles / mass transportation: Light rail, express buses ▪ Sources of energy: alternative fuels ▪ Toll roads, impact fees.
Questionnaire No. 3	
▪ Return on investment – taxes ▪ Funding strategy – government dollars ▪ Economic development – what is making it grow? ▪ Neighborhood character – do people want to be there?	▪ Buses
Questionnaire No. 4	
▪ Include J6 / Mescal, Pomerene and St. David demographics and inflows into Benson – they shop in Benson. ▪ Railroad crossings. ▪ Bike / pedestrian [access] to / from Lion Park. ▪ Whetstone (Highway 90) is St. David school ▪ Need to look at whether railroad traffic will increase or decrease. This affects whether to do [grade separations] on railroads. ▪ Need to add Patagonia Street to list of streets to be monitored.	▪ Limited access to Highway 90 – don't allow everyone to have access. ▪ Have north-south routes between Jennella and Post Road. ▪ Have carpool lane on Highway 90 (to / from Sierra Vista). ▪ Have bike lanes on Highway 80 and Highway 90.
Questionnaire No. 5	
▪ Traffic	▪ Limit it
Questionnaire No. 6	
▪ Congestion on SR 80	▪ Suggest four lanes instead of two.
Questionnaire No. 7	
	▪ Having a plan that guides decision making as changes occur.
Questionnaire No. 8	
▪ Better access to eastside Tucson, Houghton Road, etc.	▪ I-10 to Tucson – extra lane both directions. ▪ Mass transit, rail passenger service to Tucson and return. ▪ Hydrogen powered vehicles, hydrogen from seawater. ▪ New atomic plant in Mexico.

Evaluation Criteria for Alternative Transportation Improvements	Ranking		
	Low	Medium	High
Financial			
▪ Cost of construction	3	1	4
▪ Return on investment	2	2	3
▪ Funding strategy	2	2	4
Community Impacts			
▪ Environmental	3	2	2
▪ Economic development	2	2	4
▪ Neighborhood character	1	4	3
Traffic Operations			
▪ Speed control	4	1	2
▪ Safety	0	2	6
▪ Traffic capacity	2	2	4
▪ Truck access	5	2	1
▪ Connectivity	2	2	4
Multi-modal Transportation			
▪ Transit access	2	2	1
▪ Pedestrian access	2	3	3
▪ Bicycle access	2	4	2

Attachments

The following public information materials were prepared and presented as part of Task 3; copies are attached.

- Press release
- Flyer
- Sign-in sheets
- Agenda
- Outline for slide presentation
- Six Powerpoint slides describing study approach and process.
- Four presentation boards including:
  - Study Area Boundary
  - Objectives
  - Preliminary Issue Identification
  - Average Daily Traffic Volumes

Press Release
City of Benson Small Area Transportation Study
September 13, 2005

City to Develop Road Map of Benson's Future Transportation System

The public is invited to comment on Benson's traffic and transportation issues at 6:00 PM, Tuesday, September 27, 2005, at the Benson Fire House, 375 E. Seventh Street.

It's no secret that Benson is growing. Between 1990 to 2001 the population increased by 24 percent, from 3,824 to 4,740. That already rapid growth rate is accelerating.

63 residential building permits were issued between 1996 and 2003. By contrast, the Benson City Council had approved 685 new subdivision lots as of June of this year. Another 1,356 lots are being reviewed by the city and a single developer is preparing conceptual plans for 13,750 lots. Most of the new subdivisions will be accessed from State Route 90.

With growth comes more traffic. How to best to deal with increased traffic has been an unanswered question for the City of Benson. To answer it the city has initiated a transportation study that will produce a plan to guide Benson's future transportation investments.

City staff needs to know where and when the traffic will be generated, when a given street will reach capacity, what are the highest priority street improvements and how they will be paid for. The city also needs to know the priorities of its residents.

Traffic delays must be avoided but building more and bigger streets will change the character of the community. What is the best trade-off between protecting Benson's classic small-town character and providing free-flowing traffic access to new developments? What is the future volume of traffic? How much will existing streets need to be widened? Where should they not be widened?

To answer these questions the transportation study first will look at existing conditions. Alert residents may have noticed traffic counters at key intersections over the past few weeks. Soon the city will have its first-ever accurate counts of existing traffic volumes. Additional counts may be taken after school begins or winter residents arrive.

The traffic consultants will use this baseline information to:

- Identify existing problems.
- Predict the location and volume of future traffic.
- Identify projects - and the timing of those projects - to meet Benson's future transportation needs.
- Develop alternative scenarios for implementing the projects.

At the public meeting on September 27, city and traffic consultants will discuss their approach and solicit input from citizens on potential transportation solutions. The public information process also will include a project website and a newsletter that will be mailed to residents.

In the next phase of the study, the consultants will evaluate alternative scenarios for transportation improvement projects, based partly on citizen input. After ranking potential projects by cost and effectiveness, they will recommend the highest-ranking projects, along with strategies for funding and implementing them. These recommendations will be presented at a second public meeting.

The consultants then will prepare a final report and present it at a third public meeting; it will include the following elements:

- Capital Improvement Program with specific projects, costs, schedule and priority.
- Funding Matrix to identify current and potential revenue sources.
- Implementation Plan.

The study is estimated to take nine months to complete. Funding comes partly from the Arizona Department of Transportation's Small Area Transportation Study program. Additional information on the transportation study is available by contacting: Kim Dimmett, City of Benson, 520-586-8834, e-mail, kdimmett@cityofbenson.com, or Carol Lazarescu, Pentacor Engineering, clazarescu@pentacoreng.com.

A Road Map to Benson's Future Transportation System

Learn about a new city-wide transportation plan, now in progress.

Come to a public meeting at 6:00 pm, Tuesday, September 27, 2005

At the Fire House, 375 East Seventh Street

It's no secret that Benson is growing. Today's population of less than 5,000 is projected to increase dramatically over the next 20 years.

With this growth will come more traffic and a need for more roads and bigger roads.

The city needs to plan now for a transportation system that works for current residents and newcomers.

City of Benson staff and a team of traffic engineers and planners are now conducting traffic counts, analyzing the existing street system, identifying traffic problems and developing potential solutions. On Tuesday, September 27, 2005 they will present their preliminary findings.

Your knowledge of neighborhood traffic issues and suggestions for solutions are important. Please share them on Tuesday, September 27, 2005.

This is the first of three public meetings. At the second meeting, potential transportation improvements will be discussed. At the third meeting, a final transportation plan and recommendations for projects will be presented.

Funding for this study comes in part from the Arizona Department of Transportation.

Sign In Sheets/Mailing Lists

Small Area Transportation Study | City of Benson | Public Meeting No. 1

Tuesday, September 27, 2005

	Name	Phone Number	Mailing Address	Email
City	Kim Dimmett			Kdimmett@cityofbenson.com
1	GARY ARNOLD	586-2976	796 HERMOSA PLAC BENSON 85602	garyarnold@cox.net
2 ADOT	Tom Engel	928-428-5470	2082 E US. HWY 70 SAFFORD AZ 85546	tengel@azdot.gov
3	WAYNE BONCOSKY	586-9210	423 W. Condiline Ln, Benson	
4 Electric company *	David Bryan	SSVEC 384-5462 586-3490	685 Foothills Dr, Benson	dbryan@ssvec.com
5	JAMES MELLENTINE	586-2749	221 FOOTHILL PL Box 702 BENSON, AZ	JFMELLENTINE @THERIVER.com
6	John F Lodzinski	586-3819	605 E Apache Circle Benson, AZ 85602	jlodzinski@cox.net
7	Nick Weaver	586-4780	1210 W. Bell Rd. Benson, AZ 85602	nicndor@theriver
8	Mark Goodman	720-9707	PO Box 794 St. David AZ 85630	Mgoodman@mail.stdavid.org

Small Area Transportation Study | City of Benson | Public Meeting No. 1

Tuesday, September 27, 2005

	Name	Phone Number	Mailing Address	Email
9	John L Whiteside	586-9085	1087 W Possum Ln Benson AZ 85602	
SEAGO	Eugene Weeks	432 - 5301	SEAGO	
10	Vanessa Weeks	458 6168	4897 Monarch Dr SV AZ 85635	
11	George Scott	265 6058	Box 907 Benson 85602	
12	Bob Iannarino	603 - 5288	2200 E. River Rd #115 Tuc, Az 85737	
13	Richard Smith	452. 9200		
14	Glenn Nichols Benson P.D.	586-2211	P.O. Box 2287 Benson 85602	

Benson Small Area Transportation Study
Public Meeting

September 27, 2005 – 6:00 pm to 7:30 pm

Benson Fire House
375 North 7th Avenue
Benson, Arizona

AGENDA

I. **6:15 pm** Introductions of City Staff and Benson Transportation Advisory Committee

II. **6:20 pm** 15 Minute Presentation – Jerry Mitchell, AICP, Pentacor Engineering
   a. Study Introduction
   b. Goal
   c. Vision
   d. Approach
   e. Conclusion

III. **6:40 pm** Workshop with Display Boards at 5 Stations
   a. Objectives of Study
   b. Study Boundary
   c. Development Map
   d. Traffic Count Map
   e. Known System Deficiencies

It is important that citizens give their input during the workshop. Therefore, citizens will be encouraged to write on display boards. Comment cards/questionnaires will be also be distributed.

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Power Point Presentation

Public Meeting No. 1

September 27, 2005
Small Area Transportation Study
City of Benson, Arizona

Slide 1, Introduction

Slide 2, Background

- Current population is expected to double several times over the next ten years.
- Proposed developments will create more traffic than the existing roadway network can accommodate.
- A study and plan are needed to:
  - Research transportation issues.
  - Evaluate alternative solutions.
  - Recommend transportation improvements.
  - Identify funding sources.

Slide 3, Project Team

- City of Benson
  - Boyd Kramer, City Manager
  - Kim Dimmett, Community Development Director

- Consultants
  - United Civil Group, lead consultant
    - Michael Simpson, PE, Project Manager
    - Sarah Simpson, PE, Traffic Engineer
  - Pentacor Engineering, public information
    - Jerry Mitchell, AICP, Transportation Planner
    - Carol Lazarescu, Project Coordinator
  - DKS Associates, traffic modeling

- Technical Advisory Committee
  - SEAGO (SouthEastern Arizona Governments Association)
  - ADOT (Arizona Department of Transportation)
  - Cochise County

Slide 4, Related Projects: ADOT's Southeast Arizona transportation study

- Looks at transportation issues throughout southeastern Arizona.
- Looks at state routes that run through the Benson study area, including Route 80 and Route 90.
- Takes the lead on Benson's regional transportation issues.

Slide 5, Vision

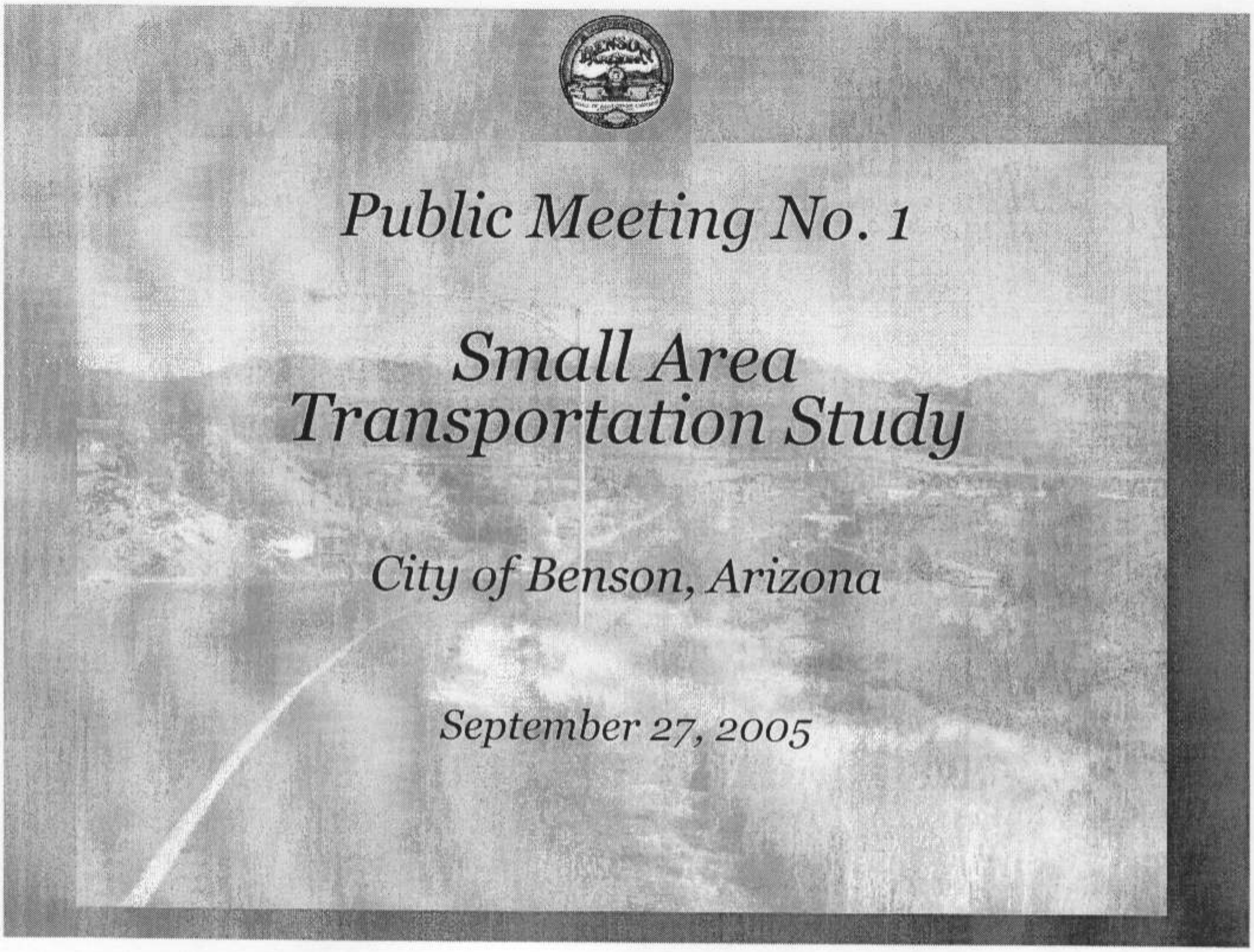
- Benson must guide rapid growth to provide careful, responsible management of natural resources; provide leadership to strengthen neighborhoods; and ensure that services and facilities meet the expectations and needs of residents.

- As an established community Benson ensures that today's quality of life can be enjoyed by many in future generations.

Slide 6, Study Goals

- Guide short, mid and long range transportation decisions.
- Guide land use decisions that will affect traffic and transportation issues.
- Recommend transportation improvements that will accommodate current and projected traffic volumes.
- Develop funding and implementation strategies.

Slide 7, Approach


Public Meeting No. 1
Small Area
Transportation Study
City of Benson, Arizona
September 27, 2005

Background

- Current population is expected to increase dramatically over the next ten years, based on residential developments that are now being proposed.
- Proposed developments will create additional traffic.
- A study and plan are needed to:
  - Research transportation issues and determine if/where road capacity needs to be increased.
  - Evaluate alternative solutions.
  - Recommend transportation improvements.
  - Identify funding sources.

Project Team

City of Benson

Boyd Kramer
City Manager

Kim Dimmett
Community Development Director

Technical Advisory Committee

SEAGO (South Eastern Arizona Governments Association)

ADOT (Arizona Department of Transportation)

Cochise County

Consultants

United Civil Group
Lead Consultant

Michael Simpson, PE
Project Manager

Sarah Simpson, PE,
Traffic Engineer

Pentacor Engineering
Public information

Jerry Mitchell
Transportation Planner

Carol Lazarescu
Project Coordinator

DKS Associates
Traffic Modeling

Related Projects

ADOT's Southeast Arizona Regional Transportation Study

- Looks at transportation issues throughout southeastern Arizona.
- Looks at state routes that run through the Benson study area, including Route 80 and Route 90.
- Takes the lead on Benson's regional transportation issues.

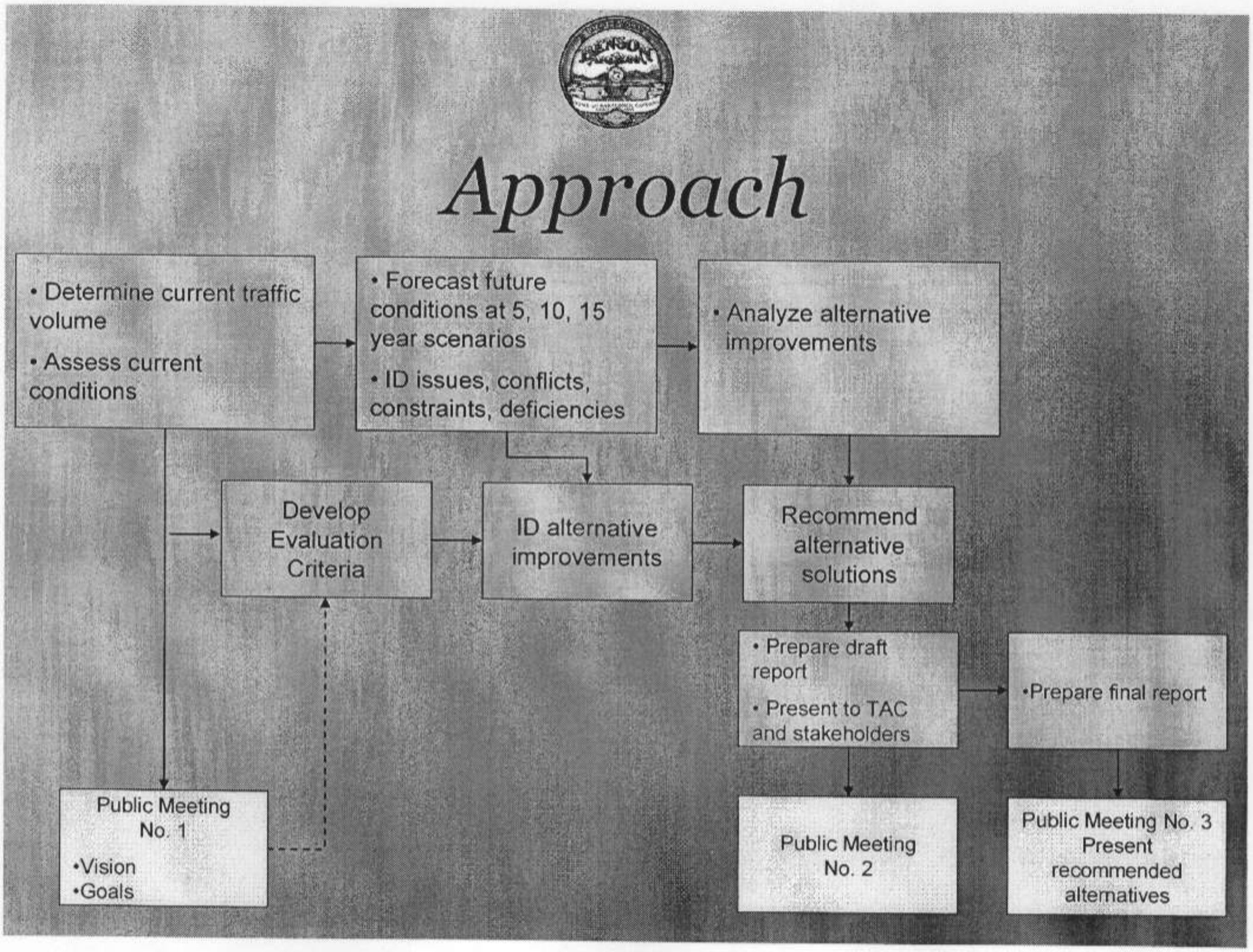
Vision

- Benson must guide rapid growth to provide careful, responsible management of natural resources; provide leadership to strengthen neighborhoods; ensure that services and facilities meet the expectations and needs of residents.

- As an established community Benson ensures that today's quality of life can be enjoyed by many in future generations.

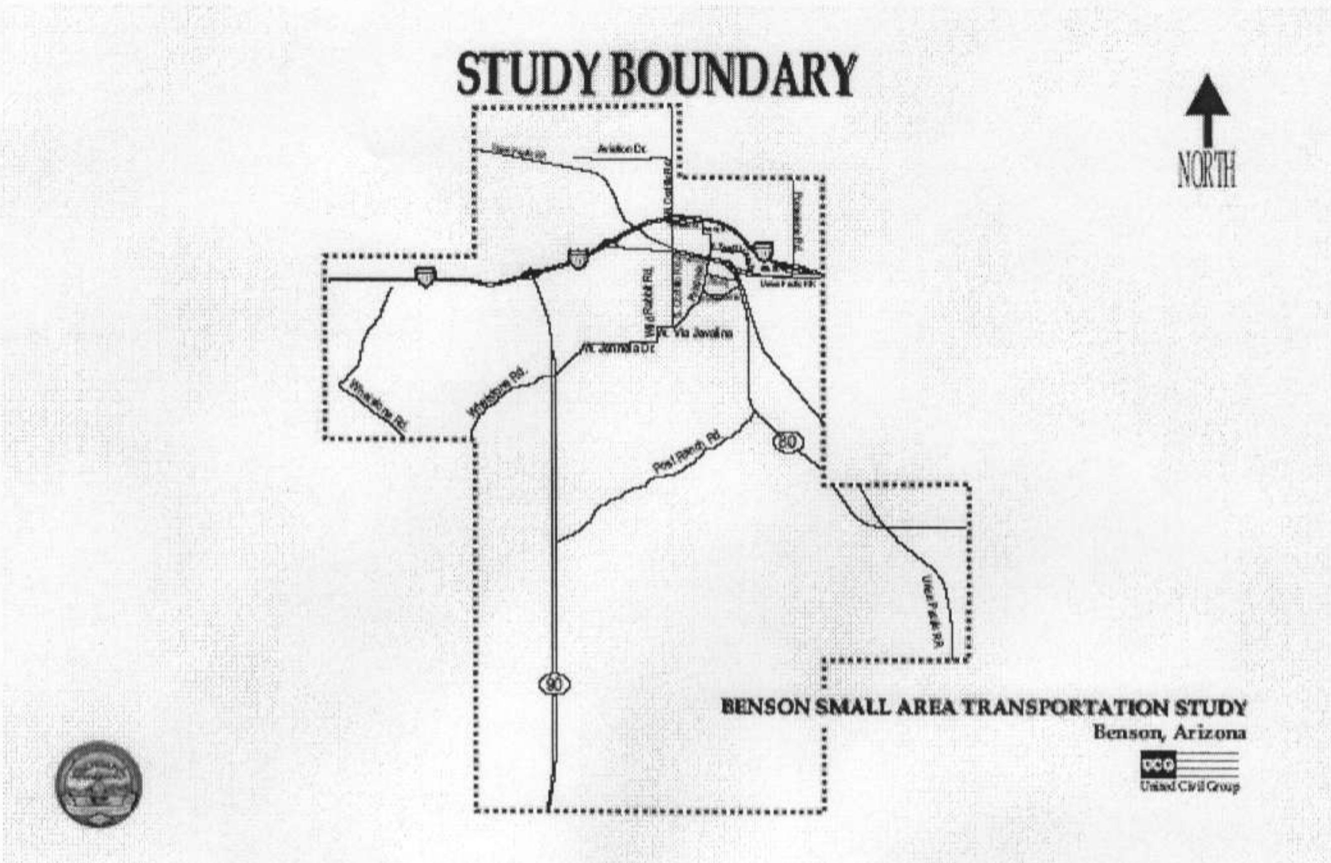
Study Goals

- Guide short, mid and long range transportation decisions.
- Provide traffic and transportation information that will be useful in making land use decisions.
- Recommend transportation improvements that will accommodate current and projected traffic volumes.
- Develop funding and implementation strategies.



Approach
• Determine current traffic volume
• Assess current conditions
• Forecast future conditions at 5, 10, 15 year scenarios
• ID issues, conflicts, constraints, deficiencies
• Analyze alternative improvements
Develop Evaluation Criteria
ID alternative improvements
Recommend alternative solutions
• Prepare draft report
• Present to TAC and stakeholders
•Prepare final report
Public Meeting No. 1
•Vision
•Goals
Public Meeting No. 2
Public Meeting No. 3 Present recommended alternatives

Presentation Boards



OBJECTIVES

Provide a safe roadway network system in Benson with regional accessibility.

Provide a roadway network system for year 2030 with minimal congestion.

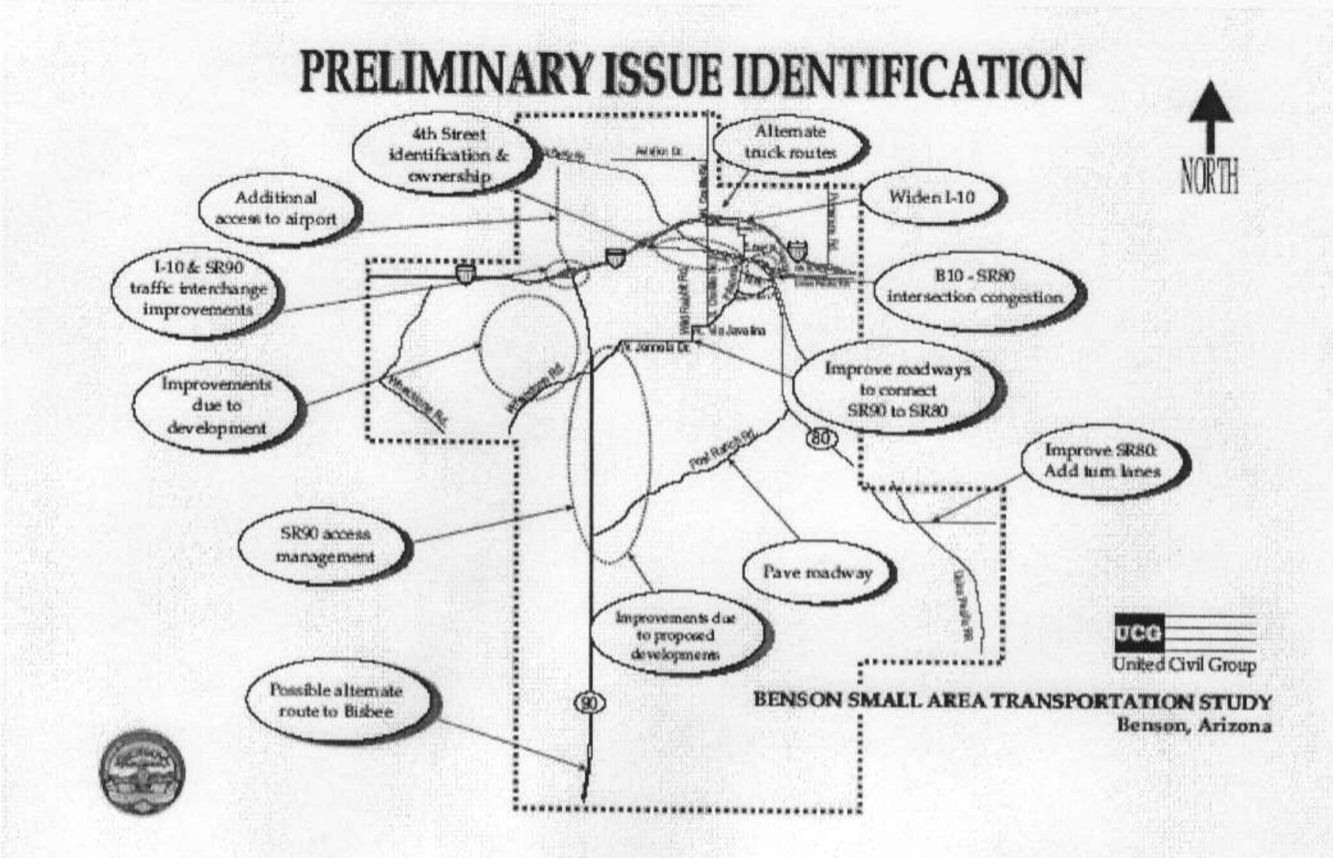
Develop a street network for Benson that incorporates bike lanes, sidewalks and off street trail systems.

Promote multi-modal services capable of accommodating current, proposed and future land use plans.

Provide for a regional public transportation system in areas where unmet transportation needs will exist at build-out.

Establish consistent landscape standards for roadways to develop a community that is cohesive, clean and presentable.

Develop short term, mid range and long term transportation plans for the City of Benson, with projects that can be constructed within the funding budgets.


PRELIMINARY ISSUE IDENTIFICATION
NORTH
4th Street identification & ownership
Alternate truck routes
Additional access to airport
Widen I-10
I-10 & SR90 traffic interchange improvements
B10 - SR80 intersection congestion
Improvements due to development
Improve roadways to connect SR90 to SR80
Improve SR80: Add turn lanes
SR90 access management
Pave roadway
Improvements due to proposed developments
Possible alternate route to Bisbee
80
90
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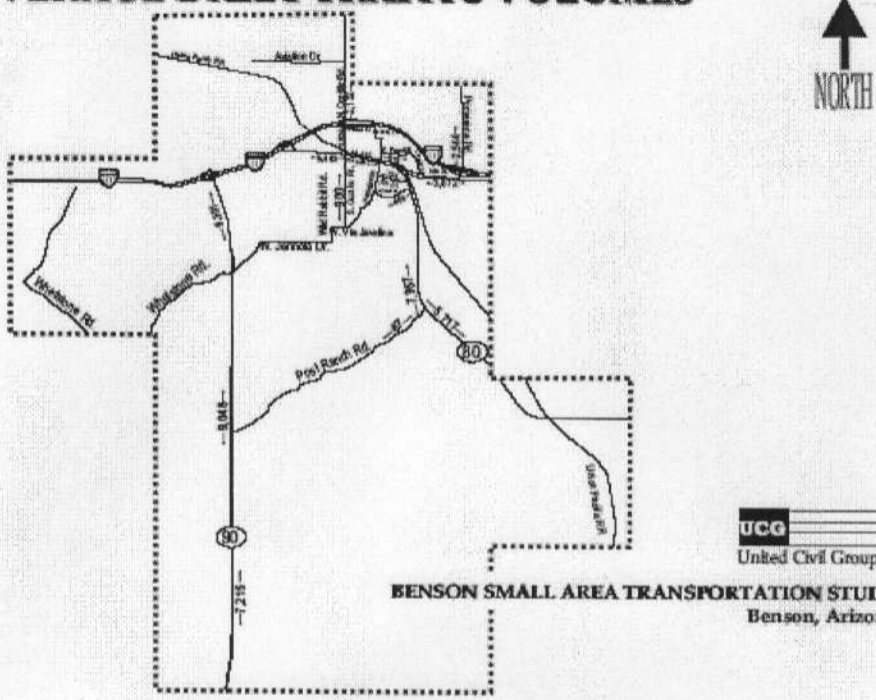
BENSON SMALL AREA TRANSPORTATION STUDY
Benson, Arizona

AVERAGE DAILY TRAFFIC VOLUMES



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BENSON SMALL AREA TRANSPORTATION STUDY
Benson, Arizona

Benson Small Area Transportation Study

Public Meeting Summary Report #2

March 16, 2007

The second public meeting was held at 6:00 pm, Wednesday, February 28, 2007, in the City Council Chambers 120 West 6th Street in Benson, Arizona. The public meting was set as an open house with presentation boards on display and study team members responding to questions and comments from the attendees. Because of the low turnout, a formal presentation was not given.

The sign in sheet shows that 8 members of the general public were in attendance as well as members for the Technical Advisory Committee. Because this is a City election year for Benson, a candidate's forum was held on the same night which may have drawn some of the general public from the SATS open house.

Advance Publicity

Prior to the second public meeting, United Civil Group issued a press release that was published in the local newspaper, San Pedro Valley News-Sun. Additionally, flyers were distributed at several locations in Benson, including schools, the post office and stores. These materials announced the second public meeting and provided information on the study.

Comments

The following comments from the public were recorded by the study team members during the meeting:

- The study should emphasize the need for pedestrian access to Lion's Park across the railroad tracks. Most of the kids that live in the City can't get to the Park without crossing the railroad tracks – not a safe situation.

- Residents are concerned about the railroad. New railroad crossings should be provided.

- Residents are concerned about emergency response times throughout the city, especially due to the railroad.

- The traffic projections on Ocotillo Road north of I-10 seem high. Are there plans for this area that are not being discussed at this time?

- What are the rail road traffic projections over the next few years? There have been discussions that trains trips will substantially increase throughout the Benson Area.

- Another north-south access road from Jennella to Post Ranch needs to be done in the future. Having just Hwy 90 and Hwy 80 is too far of a difference at the southern end of Benson.

- Bike paths and sidewalks are needed in Benson.

- What are the City's plans for downtown revitalization?

- Vicap is a volunteer non profit organization within Benson that provides transportation services to the elderly, handicapped, and disabled. In 2006, Vicap made 226 trips for Benson citizens. Vicap and our services should be included in the transit portion of the study.

Comment Card Responses

Comment response cards were provided during the meeting, and attendees were asked to write down comments they may have regarding the study recommendations. No comment cards were completed or received in the mail from attendees.

Attachments

The following public information materials were prepared and presented as part of the second public meeting. Copies are attached.

Agenda
Press Release
Flyer
Sign In Sheet
Comment Card
Presentation Boards

Benson Small Area Transportation Study
Public Meeting

February 28, 2007 – 6:00 pm to 7:30 pm

City of Benson
Council Chambers
120 West 6th Street
Benson, Arizona

AGENDA

I. 6:10 pm Introductions of City Staff and Benson Transportation Advisory Committee

II. 6:15 pm Study Presentation – Brad Hamilton, P.E. City of Benson

III. 6:30 pm Workshop with Display Boards at 6 Stations

   a. Objectives of Study
   b. Study Boundary
   c. Traffic Count Map
   d. Known System Deficiencies
   e. Mid Term Recommendations
   f. Long Term Recommendations

It is important that citizens give their input during the workshop. Therefore, citizens are encouraged to write comments on display boards. Comment cards will also be distributed.

Press Release
February 12, 2007

City to Develop a Road Map to Benson's Future Transportation System

The public is invited to comment on Benson's traffic and transportation system at 6:00 Wednesday, February 28, 2007, at the City of Benson Council Chambers, 120 West 6th Street.

It's no secret that Benson is growing. Between 1990 and 2001, the population has increased by 24 percent. This growth is projected to continue at an accelerated rate.

With growth comes more traffic. How to best deal with increased traffic has been an unanswered question for the City of Benson. To answer it, the City initiated a transportation study that will produce a plan to guide Benson's future transportation investments.

At the first public meeting held last September, the City and traffic consultants discussed their approach to potential traffic issues and concerns through out the area. This second meeting will be held to present the recommendations of the highest ranking projects to the public.

The consultants will then prepare the final report which includes the following elements:

- Capital Improvement Program with specific projects, costs, schedule and priority,
- Funding matrix to identify current and potential revenue sources, and
- An implementation plan.

Funding comes partly from the Arizona Department of Transportation's Small Area Transportation Study Program. Additional information on the transportation study is available by contacting Brad Hamilton, P.E., City of Benson, 520-586-8834 or Sarah Simpson, P.E., United Civil Group Corporation, 602-265-6155.

A Road Map to Benson's Future Transportation System

Learn about a new city-wide transportation plan, now in progress.
Come to a public meeting at 6:00 p.m. - 7:30 p.m. Wednesday, February 28, 2007
at the Town Hall Council Chamber on 120 West 6th Street
(presentation begins 6:15 p.m.)

It's no secret that Benson is growing. Today's population of less than 5,000 people is projected to increase dramatically over the next twenty years.

With this growth will come an increase in traffic and a need for more and wider roads.

The city needs to plan now for a transportation system that works for current residents and newcomers.

Over the last year, City of Benson staff, along with a team of traffic engineers and planners, conducted traffic counts, analyzed the existing street system, and identified traffic problems. On February 22nd, they will present potential transportation improvements for the City.

**Your knowledge of neighborhood traffic issues and suggestions for solutions are important.
Please share them on Wednesday, February 28, 2007.**

This is the second public meeting. During the first meeting, held on
September 27th, 2005, traffic issues were discussed.

Funding for this study comes in part from the Arizona Department of Transportation.

Please Sign In:

Name	Phone	E-mail	Address
Brad Hamilton	586-2245	bhamilton@cityofbenson.com	
VICAP Judith Wise-Ray	586-2387	—	539 N. WARREN BENSON
David Bryan	384-2221	dbryan@ssvec.com	685 Foothills Benson AZ
Eugene Weeks	432-5301	eweeks@seago.org	118 A 2 St Bisbee, AZ
Dick Shaffer	432-9332	RShaffer@cochise.az.us	1415 Melody Lane Bldg E Bisbee 85603
John L. Whiteside	586-9085		1082 W Possum Benson
Tom Engel	928-428-5470	tengel@azdot.gov	Safford.
RICHARD CUNNINGHAM	586-8872	RC51829@MSN.COM	BENSON
Mildred Cunningham	"	"	"

United Civil Group

If you have any comments regarding the Benson Small Area Transportation Study, please let us know:

Name: ______________________________

Address: ______________________________

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Email: ______________________________

Comments: ______________________________

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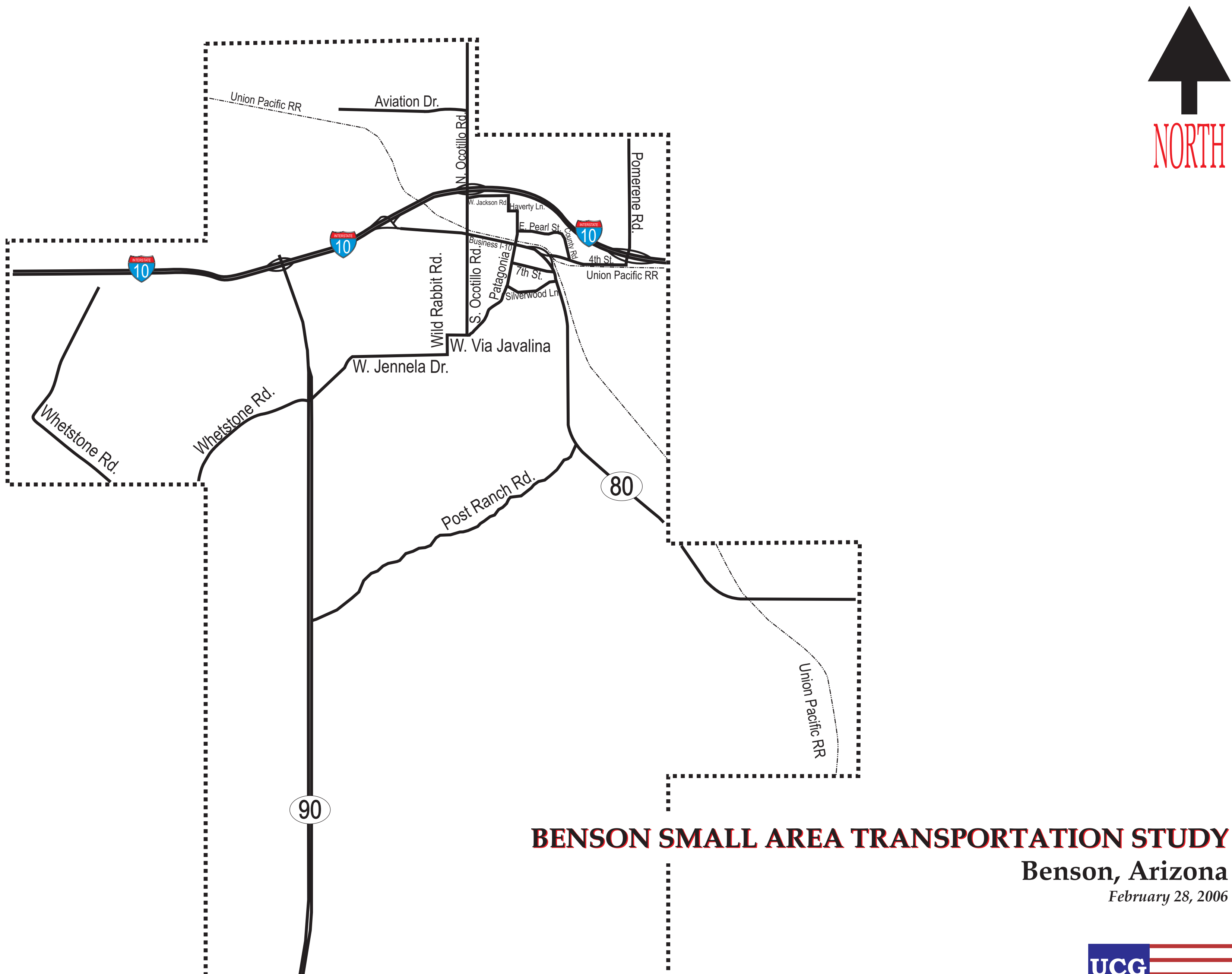
United Civil Group

STUDY BOUNDARY



BENSON SMALL AREA TRANSPORTATION STUDY

Benson, Arizona

February 28, 2006

UCG United Civil Group

OBJECTIVES

Provide a safe roadway network system in Benson with regional accessibility.

Provide a roadway network system for year 2030 with minimal congestion .

Develop a street network for Benson that incorporates bike lanes, sidewalks and off street trail systems.

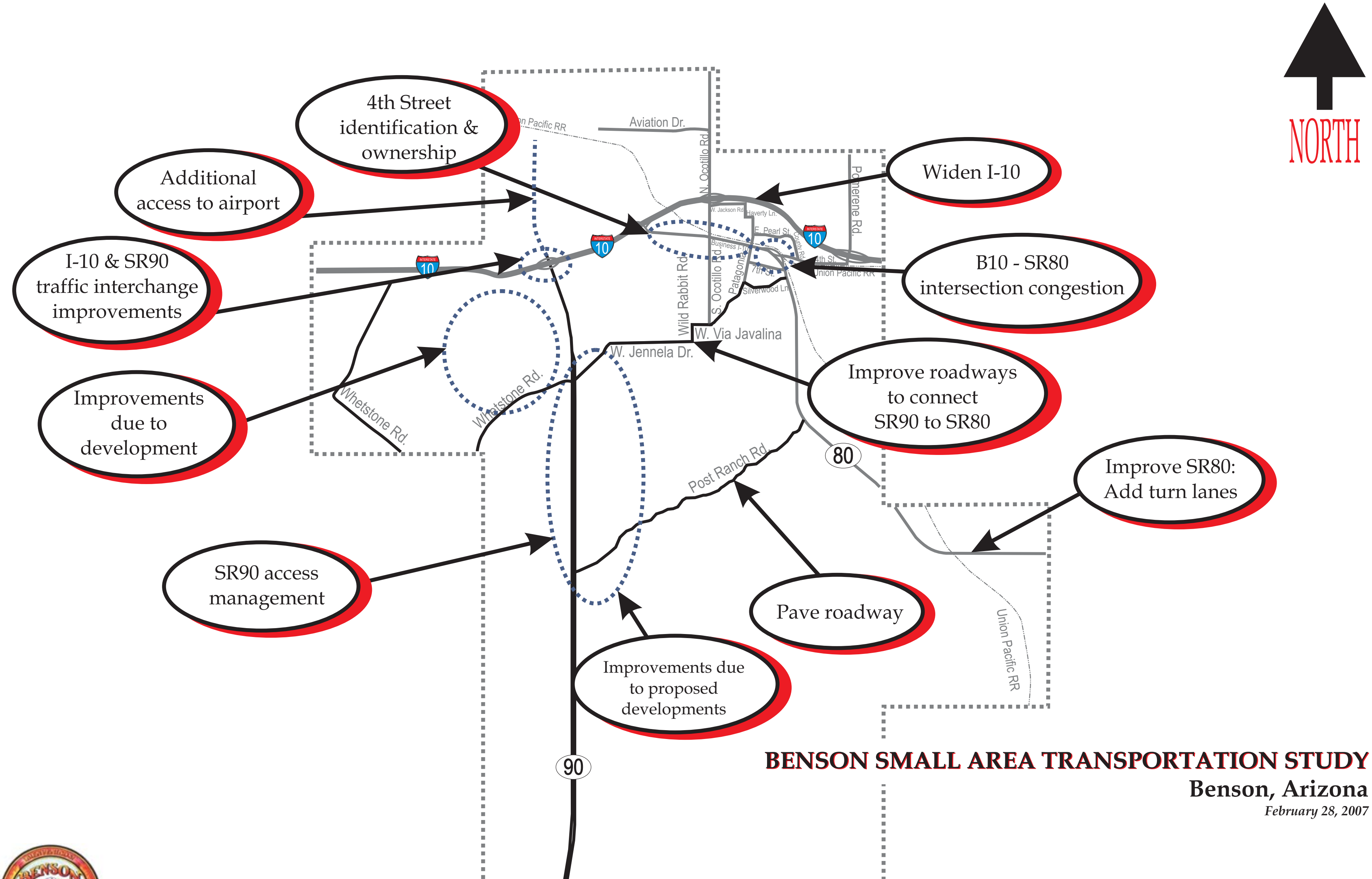
Promote multi-modal services capable of accommodating current, proposed and future land use plans.

Provide for a regional public transportation system in areas where unmet transportation needs will exist at build-out.

Establish consistent landscape standards for roadways to develop a community that is cohesive, clean and presentable.

Develop short term, mid range and long term transportation plans for the City of Benson, with projects that can be constructed within the funding budgets.

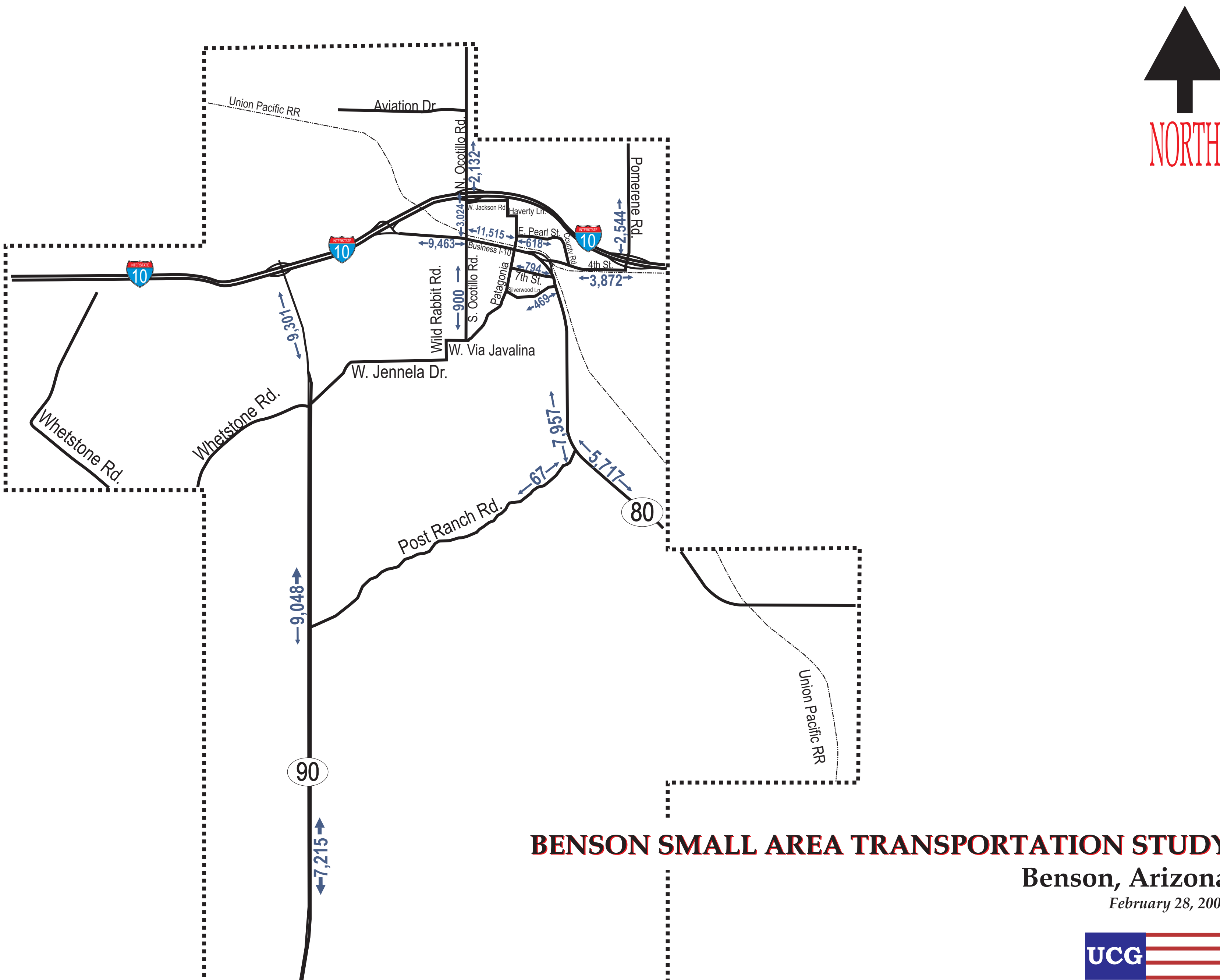
PRELIMINARY ISSUE IDENTIFICATION



BENSON SMALL AREA TRANSPORTATION STUDY
Benson, Arizona
February 28, 2007

United Civil Group

AVERAGE DAILY TRAFFIC VOLUMES



BENSON SMALL AREA TRANSPORTATION STUDY

Benson, Arizona

February 28, 2007

UCG
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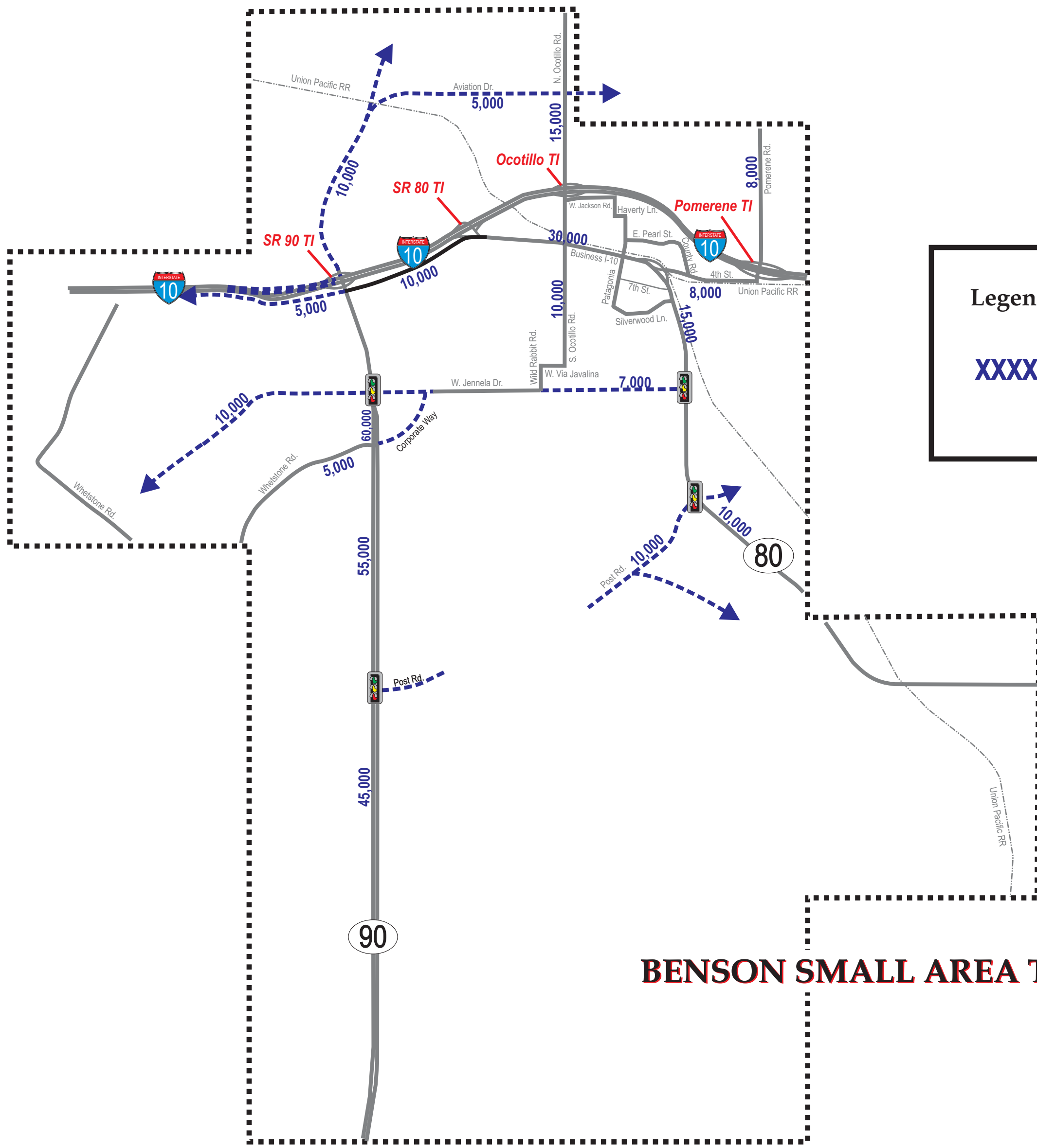
MID RANGE PLAN 2020

NORTH



Legend:

XXXX - Projected Average Daily Traffic Volumes in year 2020

BENSON SMALL AREA TRANSPORTATION STUDY

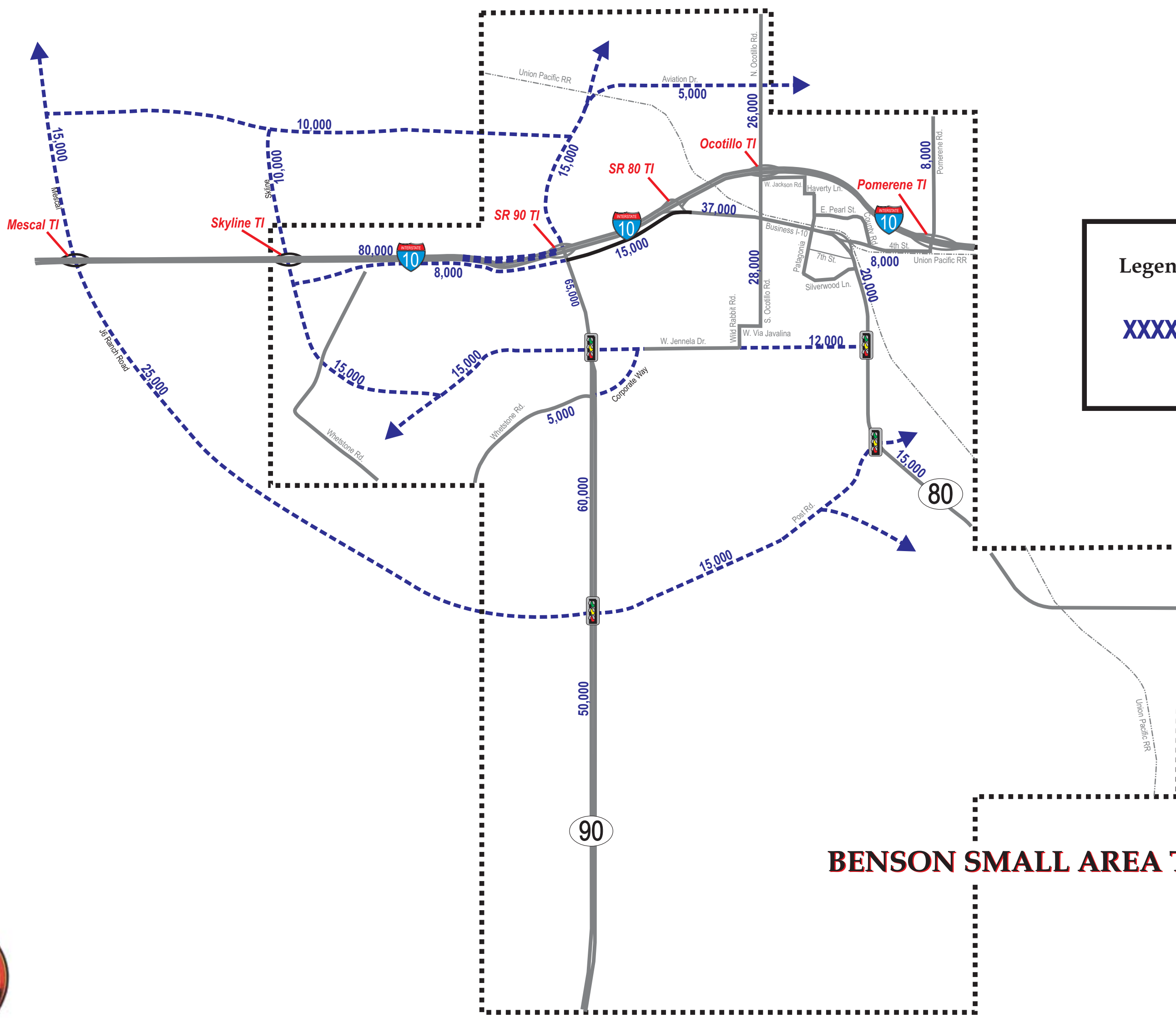
Benson, Arizona

February 28, 2007

UCG
United Civil Group

LONG RANGE PLAN 2030

NORTH



Legend:

XXXX - Projected Average Daily Traffic Volumes in year 2030

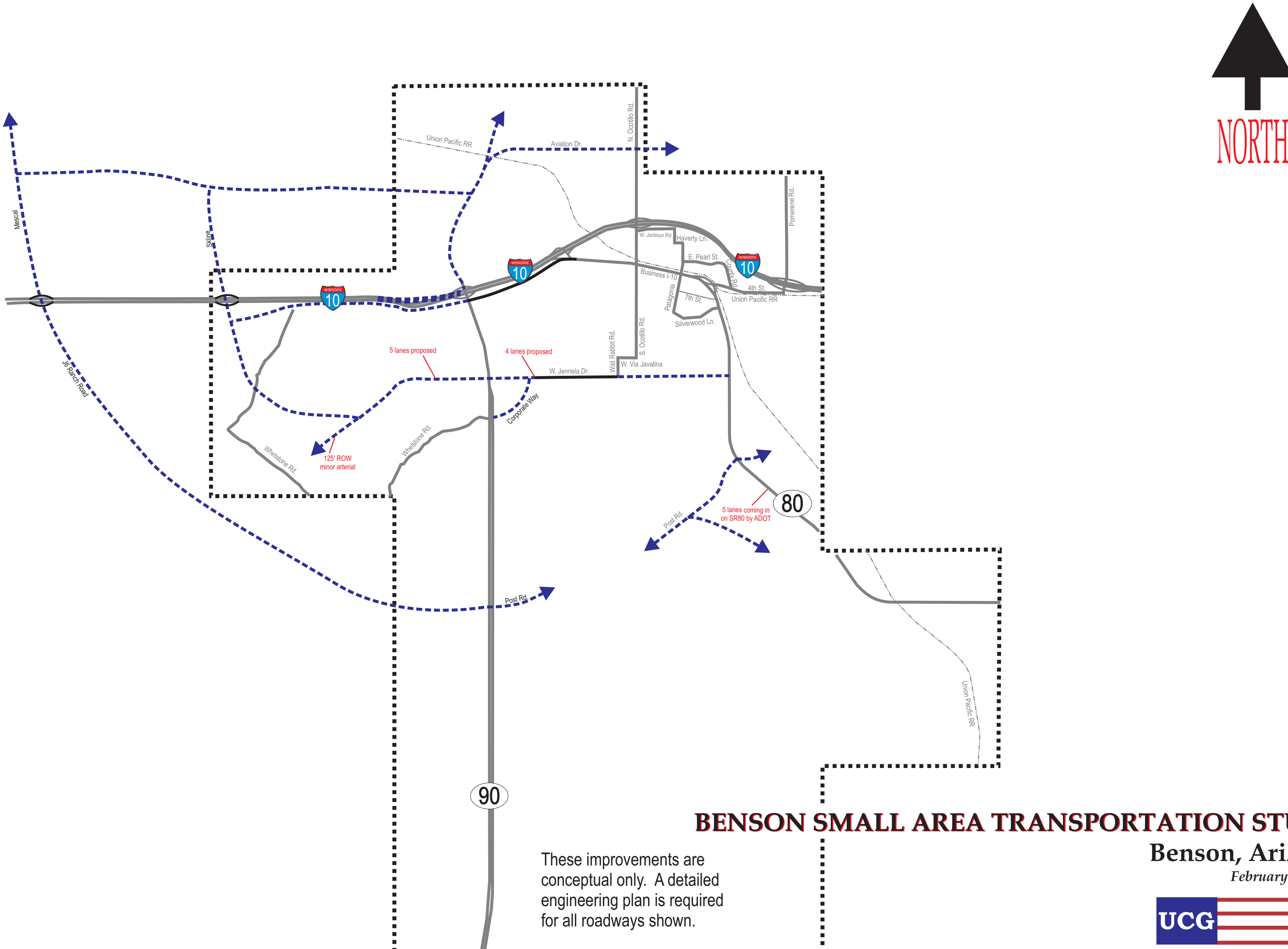
BENSON SMALL AREA TRANSPORTATION STUDY

Benson, Arizona

February 28, 2007

UCG
United Civil Group

RECOMMENDATIONS



These improvements are conceptual only. A detailed engineering plan is required for all roadways shown.

BENSON SMALL AREA TRANSPORTATION STUDY

Benson, Arizona

February 28, 2007

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APPENDIX B

Priority Matrix

Proposed Projects for Focus Area SR90

Proposed Project	Traffic Safety	Congestion Reduction	Cost Effectiveness	Design Conformity	Economic Impact	Total
Improve I-10/SR 90 Interchange	3	3	2	3	2	13
Jenella Design Concept Report						N/A
Post Road Design Concept Report						N/A
Signalization at Post Road/SR90	3	1	1	0	2	7
Reserve adequate right of way on SR90 with proposed development						N/A
Prepare conceptual access design plans for SR90	1	3	3	1	2	10
Conduct an access management plan for SR90 from I-10 to Karchner Caverns						N/A
Jenella Road west of SR90	2	2	3	3	3	13
Post Road from SR90 to SR80	2	3	3	3	3	14
Jenella Road from SR90 to SR80	2	3	3	3	3	14
Signalize Jenella Road/SR90	3	1	1	0	2	7
SR90 North to Airport Design Concept Report						N/A
Skyline Design Concept Report						N/A
Skyline TI Design Concept Report						N/A
Design and construct SR90 north to Airport	2	1	2	3	3	11
I-10 Connector west from SR90	3	3	3	2	2	13
Aviation Drive						N/A

Design Concept Report						
Widen Aviation Drive	1	2	1	2	3	9
Signalize Aviation Drive/Ocotillo	3	1	1	0	2	7
Modify Skyline TI	3	3	2	3	2	13
Design and construct new N/S route from Skyline TI	2	3	2	1	3	11
Widen SR90	2	3	3	2	3	13

Proposed Projects for Focus Area SR80

Proposed Project	Traffic Safety	Congestion Reduction	Cost Effectiveness	Design Conformity	Economic Impact	Total
Prepare conceptual design plans for SR80						N/A
Conduct an access management plan for SR80						N/A
Signalize Jenella/SR80	3	1	1	0	2	7
Signalize Post/SR80	3	1	1	0	2	7
Widen SR80	2	3	3	2	3	13
New East Route Design Concept Report N and S of I-10 (SR80 Reliever)						N/A

Proposed Projects for Focus Area Downtown

Proposed Project	Traffic Safety	Congestion Reduction	Cost Effectiveness	Design Conformity	Economic Impact	Total
B-10 and SR80 intersection	3	3	2	2	2	12
I-10 Frontage Design Concept Report						N/A
4th Street Revitalization Report						N/A
4th Street Revitalization (road improvements and landscape)	2	2	2	2	3	11
Street Pavement Study and Analysis Report						N/A
Pavement Rehabilitiation	1	1	2	2	2	8
Bike and Trails Master Plan						N/A
Design Concept Report for Ocotillo Road						N/A

Design Concept Report for Pomerene Road						N/A
I-10 Connector from Exit 303 to Exit 302	3	3	3	2	2	13
I-10/Ocotillo Road TI Design Concept Report						N/A
I-10/Pomerene Road TI Design Concept Report						N/A
I-10 Pomerene Road TI Improvements	3	2	2	2	2	11
Improve Ocotillo Road	2	2	2	2	2	10
Improve Pomerene Road	2	2	2	2	2	10
I-10/Ocotillo Road TI Improvements	3	2	2	2	2	11

APPENDIX C

Suggestive Access Management Plans

CITY OF TUCSON

Adopted by Mayor and Council
March 17, 2003

Transportation Access Management Guidelines for the City of Tucson, Arizona

Table of Contents

List of Figures

List of Tables

1.0 Introduction

In response to the need for more consistent and effective access management policies within metropolitan areas, various information has been compiled from many sources in the preparation of Access Management Guidelines for the City of Tucson. These guidelines define the overall concept of access management, review current practice, and set forth basic policy, planning, and design guidelines. The concepts presented are consistent with guidelines established by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), and the Institute of Transportation Engineers (ITE). For purposes of this report, "access" means the direct physical connection of adjoining land to a roadway via a street or driveway, including median openings. These guidelines will be adopted as ordinance and will become applicable to all new public and private developments.

2.0 Principles of Access Management

Constantly growing traffic congestion, concerns over traffic safety, and the ever increasing cost of upgrading roads have generated interest in managing the access to not only the roadway system, but to surface streets as well. Access management is the process that provides access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed. Access management attempts to balance the need to provide good mobility for through traffic with the requirements for reasonable access to adjacent land uses.

The most important concept in understanding the need for access management is that *through movement of traffic and direct access to property are in mutual conflict*. No facility can move traffic effectively and provide unlimited access at the same time. The extreme examples of this concept are the freeway and the cul-de-sac: The freeway moves traffic very well with few opportunities for access, while the cul-de-sac has unlimited opportunities for access, but doesn't move traffic very well. In many cases, accidents and congestion are the result of street operations attempting to serve both mobility and access at the same time. Figure 2-1 shows the relationship between mobility, access, and the functional classification of streets.

An effective access management program will accomplish the following:

1) ***Limit the number of conflict points at driveway locations.*** Conflict points are indicators of the potential for accidents. The more conflict points that occur at an intersection, the higher the potential for vehicular crashes. When left turns and cross street through movements are restricted, the number of conflict points are significantly reduced.

2) ***Separate conflict areas.*** Intersections created by streets and driveways represent basic conflict areas. Adequate spacing between intersections allows drivers to react to one intersection at a time, and reduces the potential for conflicts.

3) ***Reduce the interference of through traffic.*** Through traffic often needs to slow down for vehicles exiting, entering, or turning across the roadway. Providing turning lanes, designing driveways with large turning radii, and restricting turning movements in and out of driveways allows turning traffic to get out of the way of through traffic.

4) ***Provide sufficient spacing for at-grade, signalized intersections.*** Good spacing of signalized intersections reduces conflict areas and increases the potential for smooth traffic progression.

5) ***Provide adequate on-site circulation and storage.*** The design of good internal vehicle circulation in parking areas and on local streets reduces the number of driveways that businesses need for access to the major roadway.

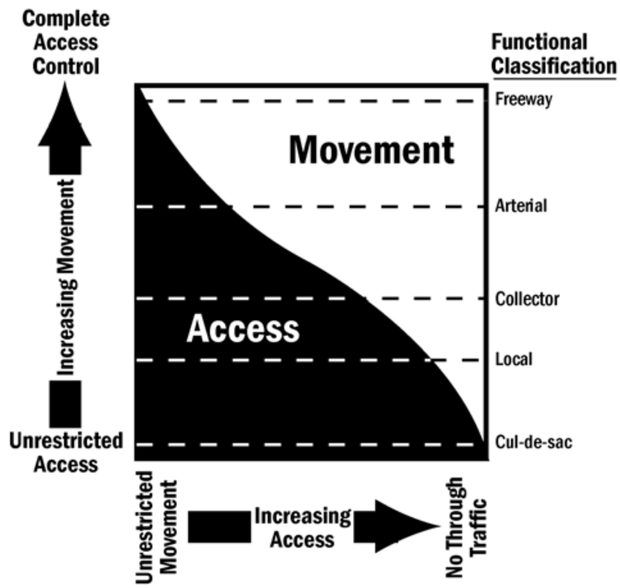
The typical "vicious cycle" of traffic congestion found in many areas of the country is shown in Figure 2-2. Access management attempts to put an end to the seemingly endless cycle of road improvements followed by increased access, increased congestion, and the need for more road improvements.

Poor planning and inadequate control of access can quickly lead to an unnecessarily high number of direct accesses along roadways. The movements that occur on and off roadways at driveway locations, when those driveways are too closely spaced, can make it very difficult for through traffic to flow smoothly at desired speeds and levels of safety. The American Association of State Highways and Transportation Officials (AASHTO) states that "the number of accidents is disproportionally higher at driveways than at other intersections...thus their design and location merits special consideration." Additionally, recent research documented in the *5th Edition ITE Traffic Engineering Handbook* confirms a direct relationship between crash frequency and driveway frequency, driveway activity, and median access.

Fewer direct access points, greater separation of driveways, and better driveway design and location are the basic elements of access management. When these techniques are implemented uniformly and comprehensively, there is less occasion for through traffic to brake and change lanes in order to avoid turning traffic.

Consequently, with good access management, the flow of traffic will be smoother and average travel times lower. There will definitely be less potential for accidents. According to the Federal Highway Administration (FHWA), before and after analyses show that routes with well managed access can experience 50% fewer accidents than comparable facilities with no access controls.

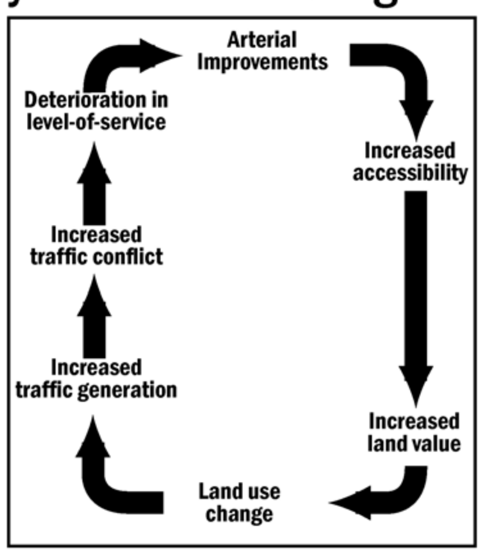
Movement vs. Access



Adapted from: NCHRP Report 348 "Access Management Policies and Guidelines for Activity Centers," Metro Trans Group, TRB Washington DC, 1992.

Figure 2-1

Cycle of Traffic Congestion



Adapted from: Vergil G. Stover and Frank J. Koepke, Transportation and Land Development, Institute of Transportation Engineers, 1988.

Figure 2-2

3.0 Roadway Functional Classification

3.1 Concepts

Access and mobility are competing functions. This recognition is fundamental to the design of roadway systems that preserve public investments, contribute to traffic safety, reduce fuel consumption and vehicle emissions, and do not become functionally obsolete. Suitable functional design of the roadway system also preserves the private investment in residential and commercial development.

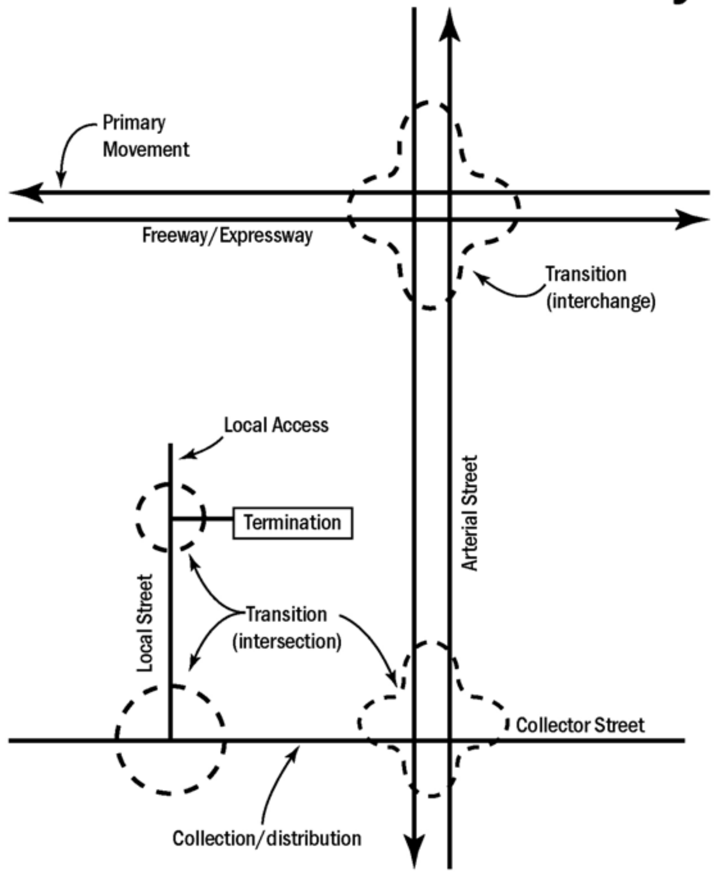
The *2001 AASHTO Policy on Geometric Design of Highways and Streets* ("Green Book") recognizes that a functionally designed circulation system provides for distinct travel stages. It also indicates that each stage should be handled by a separate facility and that "the failure to recognize and accommodate by suitable design each of the different stages of the movement hierarchy is a prominent cause of roadway obsolescence." The AASHTO policy also indicates that the same principles of design should be applied to access drives and comparable street intersections.

A typical trip on an urban street system can be described as occurring in identifiable steps or stages as illustrated in Figure 3-1. These stages can be sorted into a definite hierarchy with respect to how the competing functions of mobility and access are satisfied. At the low end of the hierarchy are roadway facilities that provide good access to abutting properties, but provide limited opportunity for through movement. Vehicles entering or exiting a roadway typically perform the ingress or egress maneuver at a very low speed, momentarily blocking through traffic and impeding the movement of traffic on the roadway. At the high end of the hierarchy are facilities that provide good mobility by limiting and controlling access to the roadway, thereby reducing conflicts that slow the flow of through traffic.

A transition occurs each time that a vehicle passes from one roadway to another and should be accommodated by a facility specifically designed to handle the movement. Even the area of transition between a driveway and a local street should be considered as an intersection and be treated accordingly. However, design of these intersections pose few problems since speeds and volumes are low. Many urban circulation systems use the entire range of facilities in the order presented here, but it is not always necessary or desirable that they do so.

The functional classification system divides streets into three basic types identified as arterials, collectors, and local streets. The function of an arterial is to provide for mobility of through traffic. Access to an arterial is controlled to reduce interference and facilitate through movement. Collector streets provide a mix for the functions of mobility and access, and therefore accomplish neither well. The predominate purpose of local streets is to provide direct access to adjoining property.

Hierarchy of Movement in a Functional Circulation System



Adapted from: A Policy on Geometric Design of Highways and Streets, Chapter 1, Washington DC, AASHTO, 2001.

Figure 3-1

Each class of roadway has its own geometric, traffic control, and spacing requirements. The general types of facilities and their characteristics are summarized in Table 3-1. This table provides a broad guide in setting access spacing standards that are keyed to functional classes of roadways.

TABLE 3-1
Functional Route Classification

Characteristic	Functional Classification: Arterial	Collector	Local
Function[1]	traffic movement, land access	traffic movement, land access, collect & distribute traffic between streets and arterials	land access
Continuity	continuous	not necessarily continuous	none
Spacing	1-2 miles	½ mile or less	as needed
Typical % of Surface Street System Travel Volume Carried[2]	65-80%	5-20%	10-30%
Direct Land Access[2]	limited: major generators only	restricted: some movements prohibited; number and spacing of driveways controlled	safety controls only
Speed Limit[1]	35-55 mph in fully developed areas	30-40 mph	25 mph
Parking[1]	prohibited	prohibited	Permitted
Bicycle Space in Lane Width	Yes	Yes	No

[1] Source: Transportation Research Board, (2000)

[2] Source: Institute of Transportation Engineers (ITE), (1999)

4.0 Access Spacing

Access spacing guidelines should be keyed to allowable access levels, roadway speeds, and operating environments. They should apply to new land developments and to significant changes in the size and nature of existing developments. They do not have to be consistent with existing practices. Because of historical conditions, access to land parcels that do not conform to the spacing criteria may be necessary when no alternative reasonable access is provided; however, the basis for these variances should be clearly indicated and approved by the City's Representative.

4.1 Signalized Intersections

In order to insure efficient traffic flow and safety, signalized intersections should be limited to locations along the city arterial and collector streets, where the progressive movement of traffic will not be significantly impeded. Uniform, or near uniform, spacing of traffic signals is critical for the progression of traffic in all directions. The spacing of traffic signals is fixed by the design of the city's street system and results in the mathematical ability to progress traffic signal operations. Failure to gain proper spacing will result in severe degradation to the system's operation. The spacing between traffic signals, pedestrian crossing needs, and the use of left-turn arrows, dictate two critical factors for good progression – traffic signal cycle length and resulting vehicle speed.

The optimum spacings are detailed in Table 4-1. In the Tucson street system, the traffic signal spacing is fixed or given at ½ mile increments (2640 feet). This spacing results in an operating speed of 40 miles per hour (mph) and a 90-second cycle to properly serve pedestrians and left-turn arrows. If the desire is to allow 45 mph speeds, the cycle length should be lowered to 80 seconds, thus reducing or eliminating the green time for pedestrians and left-turn arrows. If additional green time is desired for pedestrians and left-turn arrows, the only option remaining is a 120-second cycle length, however, the driver must only travel at approximately 30 mph. This lower speed is often unacceptable to drivers and can lead to disregard of speed limits and rushing from red light to red light.

As a guideline, traffic signal cycle lengths should be kept as short as possible and cycle lengths of 150 seconds or more should be avoided. Excessively long cycle lengths result in long vehicle queues, unreasonable delays, and potential air quality problems. Special protected turn only operations should be avoided.

The Mayor and Council may approve deviations in the spacing of signals as conditions change.

If non-standard traffic signal spacing is under consideration by the Mayor and Council, the following actions should be taken to mitigate the associated problems:

1) The group proposing the installation or retention of the traffic signal shall pay for its installation, operation and maintenance.
2) The group shall indemnify and insure the City and its personnel against any legal action as a result of the installation of the traffic signal at an unwarranted or improperly spaced location.
3) When side street traffic is present, the traffic signal should be actuated only every other cycle so that mainline traffic is interrupted half of the time between the hours of 6am and 11pm, Monday through Friday, if possible.
4) The actual or proposed traffic levels shall meet 1.5 times the volume requirements given in the latest edition of the MUTCD for traffic signal warrants. Warrants other than eight-hour volume warrants and accident warrants should be carefully evaluated before being accepted.
5) In order to mitigate negative effects of non-standard signal spacing, PELICAN or Florida "T" intersections/operations should be installed if possible.
6) These non-standard spaced traffic signals should be designed to operate in a two-phase mode. Additional phases and protected left-turn arrow movements are to be avoided whenever possible.

TABLE 4-1[1]
Optimum Spacing of Signalized Intersections

Cycle Length (sec)	Operating Speed (mph)					
	30	35	40	45	50	55
	Distance in feet					
60	1320	1540	1760	1980	2200	2430
70	1540	1800	2050	2310	2560	2830
80	1760	2050	2350	2640	2930	3230
90	1980	2310	2640	2970	3300	3630
100	2200	2570	2930	3300	3670	4030
110	2420	2830	3220	3630	4040	4430
120	2640	3080	3520	3960	4400	4840
150*	3300	3850	4400	4950	5500	6050

* = Represents maximum cycle length for actuated signal if all phases are fully used. This cycle length or greater cycle lengths should be avoided.

4.2 Unsignalized Intersections

Unsignalized intersections are far more common than signalized intersections. They affect all kinds of activity, not merely large activity centers. From a spacing perspective, driveways should be treated the same as unsignalized street intersections. Traffic operational

[1] Source: Transportation Research Board, (1992)

factors leading toward wider spacing of driveways (especially medium- and higher-volume driveways) include weaving and merging distances, stopping sight distance, acceleration rates, and storage distance for back-to-back left turns.

Strict application of traffic engineering criteria may push spacing requirements to 500 feet or more, however, such spacing may be unacceptable for economic development in many suburban and urban environments, where development pressures opt for 100- to 200-foot spacing.

Unsignalized intersection spacing standards should be used to determine the minimum acceptable distance between driveways and public streets. These minimum acceptable standards will also be affected by the surrounding land uses. It is necessary to consider adjacent land use in computing the generator size, including development across the street. It is not good practice to look at generators in isolation.

The standards should apply to both private driveways and unsignalized public streets where there is little likelihood for future signalization. Where signalization is imminent or likely, the signal spacing guidelines should govern activity.

There should be no direct residential lot access to arterials. Direct residential lot access to collectors should be minimized and avoided in new roadway development.

The spacing of right-turn only access points on each side of a divided roadway can be treated separately. However, where left turns at median breaks are involved, the access on both sides should line up or be offset from the median break by at least 300 feet.

Driveways adjacent to major signalized intersections, should be located a minimum of 300 feet from the intersection.

On undivided roadways, access on both sides of the road should be aligned. Where this is not possible, driveways should be offset by at least 150 feet minimum when two minor traffic generators are involved, and 300 feet minimum when two major traffic generators are involved.

4.3 Median Openings

Median openings are provided at all signalized at-grade intersections. They are also generally provided at unsignalized junctions of arterial and collector streets. They may be provided at driveways only where they will have minimum impact on roadway flow.

Minimum desired spacing of unsignalized median openings at driveways as functions of speed are given in Table 4-2. These spacings best apply to retrofit situations. Ideally, spacing of breaks should be conducive to signalization. Median openings for left-turn entrances (where there is no left-turn exit from the activity center) should be spaced to allow sufficient storage for left-turning vehicles.

TABLE 4-2[1]
Minimum Spacing Between Unsignalized Median Openings

Speed Limit(mph)	Minimum Spacing (feet)
30	370
35	460
40	530
45	670
50	780
55	910

Guidelines for the spacing of median openings as functions of street classification are given in Table 4-3. This spacing should reflect traffic signal coordination requirements, storage space needed for left turns, bay tapers, and roadway aesthetic and landscaping goals.

TABLE 4-3[2]
Guidelines for Spacing Median Openings

Street Functional Classification	Spacing of Median Openings (in feet)		
	Urban	Suburban	Rural
Arterial	660	660	1320
Collector	330	660	1320

Median openings at driveways can be subject to closure where volumes warrant signals, but signal spacing would be inappropriate. Median openings should be set far enough back from nearby intersections to avoid possible interference with intersection queues. In all cases, storage for left turns should be adequate.

[1] Source: Koepke, Frank J., and Stover, Vergil G., (1988)
[2] Adapted from: Koepke, Frank J., and Stover, Vergil G., (1988)

Moreover, all median spacing guidelines are to be considered minimums and are not automatic. In determining if a median break request should be approved, the following issues should be considered:

1) The proposed median break is necessary for adequate access to an abutting property and must improve access and circulation without increasing accidents or accident rates.
2) The proposed median break will not cause a significant problem elsewhere (e.g. increased traffic in neighborhoods, increased accidents in another location, etc.)
3) If requested for development access, full consideration should be given to adjacent and opposite properties. Median break locations for individual developments should be coordinated with other affected property owners.
4) The location and design of any proposed median break meets acceptable engineering design standards for expected traffic speeds and volumes.
5) The proposed median break will not interfere with the continuity of traffic flow at or between intersections.
6) Before approving any median break request, the City may require a traffic engineering analysis by a professional traffic engineer. Such an analysis should address the issues stated in 1 through 5, and should be at the sole expense of the requestor.
7) The proposed median break will not be at a location where driveways on opposite sides of the roadway do not align.
8) Emergency vehicle access should be reviewed to provide adequate police and fire vehicle entry.
9) The group proposing the median opening is responsible to pay for the design and construction of improvements.
10) The City may require cross-access for adjacent developments/properties if a median opening request is granted.

4.4 Arterial Grade Separations

Interchanges and grade-separated intersections provide several important access management functions. They enable the signal green time to be maximized along expressways and arterials. They also allow access to large activity centers where such access might be precluded by traffic signal spacing criteria.

More specifically, a grade-separated intersection may be appropriate in the following situations:

1) Where two expressways cross, or where an expressway crosses arterial roads;
2) Where arterials cross and the resulting available green time for any route would be significantly decreased because of high demands for left turn arrow green time;
3) Where an existing at-grade signalized intersection along an arterial roadway operates at level of service (LOS) F, and there is no reasonable improvement that can be made to provide sufficient capacity;

4) Where a history of accidents indicates a significant reduction in accidents can be realized by constructing a grade separation;
5) Where a new at-grade signalized intersection would result in LOS E in urban and suburban settings and LOS D in rural settings;
6) When the location to be signalized does not meet the signal spacing criteria and signalization of the access point would impact the progressive flow along the roadway, and there is no other reasonable access to a major activity center;
7) Where a major public street at-grade intersection is located near a major traffic generator, and effective signal progression for both the through and generated traffic cannot be provided; and
8) The activity center is located along an arterial, where either direct access or left turns would be prohibited by the access code, or would otherwise be undesirable.

4.5 Guidelines for Consideration of Pedestrian and Bicycle Crossing Devices

The guidelines for evaluating location for the installation of various types of pedestrian and bicycle traffic control devices are set forth in the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) and the Traffic Control Device Handbook, published by the Federal Highway Administration. These guidelines are intended to assist the developer with evaluation of crosswalk location and determination of whether to consider installing the following types of devices. Final approval of all devices and locations will be by the City of Tucson Department of Transportation.

4.5.1 Marked Crosswalks

The developer shall use the Arizona Department of Transportation policy PGP-3B-3, February 1998 as a guide to decide whether or not to mark a crosswalk. The policy acknowledges that legally defined crosswalks exist at the intersection of all streets and highways. Locations considered for the installation of a painted crosswalk should meet the following criteria:

1) Meet the State of Arizona warrant for the consideration of a marked crosswalk, and
2) Recognize the use of a painted median lane as a safe haven for crossing pedestrians, except for school crossings, and
3) Placed at locations with adequate sight distance, and
4) No other marked crosswalk or STOP sign or traffic signal within 600 feet, and
5) The installation can be expected to reduce total accidents and not result in a greater number of rear-end and associated collisions due to pedestrians not waiting for adequate gaps in traffic.

4.5.2 School Crosswalks

The developer shall follow the Arizona Revised Statutes 28-797, the State of Arizona, "School Safety Program Guidelines" with additions by the Mayor and Council in Mayor and Council Policy 950-02.1, .2, .3.

*4.5.3 HAWK – **H**igh Intensity **A**ctivated Cross**W**al**K***

Locations considered for the installation of marked crosswalks with pedestrian actuated beacon signal lights and signage should generally meet the following criteria:

1) Meet the Arizona State warrant for consideration of marked crosswalk, and
2) Meet the FHWA Traffic Control Devices Handbook guidelines for beacons at school crossings, i.e. Pedestrian volume of 40 to 60 pedestrians crossing during a 2-hour period of a normal day; Where the 85th percentile vehicle speed is in excess of 35 mph (Note: Vehicle speed refers to the speed of vehicles approaching the beacon), and
3) There is no other crossing controlled by a traffic signal, stop sign or crossing guard within 600 feet of the proposed location, and
4) If a school crossing, the intersection is identified on the "School Route Plan" and/or has a significant number of special needs pedestrians

*4.5.4 TOCAN – **T**wo Gr**O**ups **CAN** Cross*

(Bicycle/Pedestrian Crossing - This crossing is designed specifically to facilitate bicycle access.)

Locations considered for the installation of this combination of devices should generally meet the following criteria:

1) Meet the State of Arizona warrant for the consideration of a marked crosswalk, and
2) Meet an MUTCD warrant for consideration of a traffic signal installation: Warrant 1 – Eight-Hour Vehicular Volume, Warrant 2 – Four-Hour Vehicular Volume, Warrant 3 – Peak–Hour, Warrant 4 – Pedestrian Crossing, or Warrant 5 – School Crossing, and
3) Installation is in conformance with the Tucson Roadway Development Policy Ordinance, and
4) Ability to install barrier islands to prohibit all motor vehicle traffic crossing the street and only right turns are permitted

*4.5.5 PELICAN – **PE**destrian **LI**ght A**C**tu**A**tio**N***

Locations considered for the installation of this combination of devices should generally meet the following criteria:

1) Meet the State of Arizona warrant for the consideration of a marked crosswalk, and

2) Meet an MUTCD warrant for consideration of a traffic signal installation: Warrant 4 – Pedestrian Crossing or Warrant 5 – School Crossing, and
3) Spacing is not in violation of the Tucson Roadway Development Policy Ordinance, and
4) If designed as a school crossing the location is on the “School Route Plan”, and
5) The proposed location is not within 600 feet of another signalized crossing or STOP sign or flashing beacon and sign crossing.

5.0 Design Standards

5.1 Street Cross Sections

(Refer to Tucson Major Streets & Routes for specific cross sections of Roadways)
Cross sections are the combination of the individual design elements that typify the design of the roadway. Cross section elements include the pavement surface for driving and parking lanes, curb and gutter, bike lanes, alternate mode facilities, sidewalks and additional buffer/landscape areas. Right-of-way is the total land area needed to provide for all of the cross section elements.

The design of the individual roadway elements depends upon the facility’s intended use. Roads with higher design volumes and speeds require more travel lanes and wider right-of-way than low volume, low speed roads. Furthermore, the high-use roadway type should include wider shoulders and medians, separate turn lanes, dedicated bicycle lanes, elimination of on-street parking and control of driveway access. For most roadways, an additional buffer area is provided beyond the curb line. This buffer area accommodates the sidewalk area, landscaping, and local utilities. Locating the utilities outside the traveled way can minimize traffic disruption if utility repairs or service changes are required.

Typical elements of the roadway cross sections are identified in the following sections. However, few of the dimensions used in street design have been precisely determined by research. Instead, the cross sections usually represent a consensus of opinion based upon engineering judgment and operating experience. Therefore, each of the elements of roadway design can be altered to better accommodate various conditions found in Tucson.

5.1.1 Local Streets Local streets provide direct access to abutting land uses and accommodate local traffic movement. Local streets should be designed to provide slow speeds and relatively low traffic volumes. On-street parking is usually permitted and bicycles can be accommodated without a separate travel lane.

5.1.2 Collectors Collector streets provide for traffic movement between local streets and arterial streets. Collector streets also provide access to abutting land uses. There is no parking allowed on collector streets. Adequate bicycling space is provided in each 17-foot travel lane. On major bicycle routes, this lane is to be striped as a 5-foot bicycle lane with a travel lane.

Individual driveway openings onto collectors should be designed to eliminate backing movements onto the street.

5.1.3 Arterials Arterial streets provide for major through traffic movement between geographic areas. These roadways typically have some form of access control that limits the locations of driveways.

The maximum width of an arterial street should be no more than six lanes in the midblock, except where the additional lanes are designated for buses, bicycles, and high-occupancy vehicles. Where traffic volumes create the need for additional capacity, intersection modifications should be pursued prior to further widening. A curbed median of no less than 20-feet should be included in the design of all arterial streets where the curb to curb width exceeds 75-feet.

Due to potential conflicts with through traffic, there are no lanes allowed for on-street parking. On-street bus stops may interfere with through traffic and bus turnouts may be needed for this design. Any needed right-turn lanes can also be provided with roadway widening into the buffer area. Additional buffer beyond the curb line should be provided on principal arterial streets for turnouts and future widening.

5.2 Sight Distance

It is essential to provide sufficient sight distance for vehicles using a driveway. They should be able to enter and leave the property safely with respect to vehicles in the driveway and vehicles on the intersecting roadway. See the City of Tucson Development Standards for Sight Visibility Triangle Requirements.

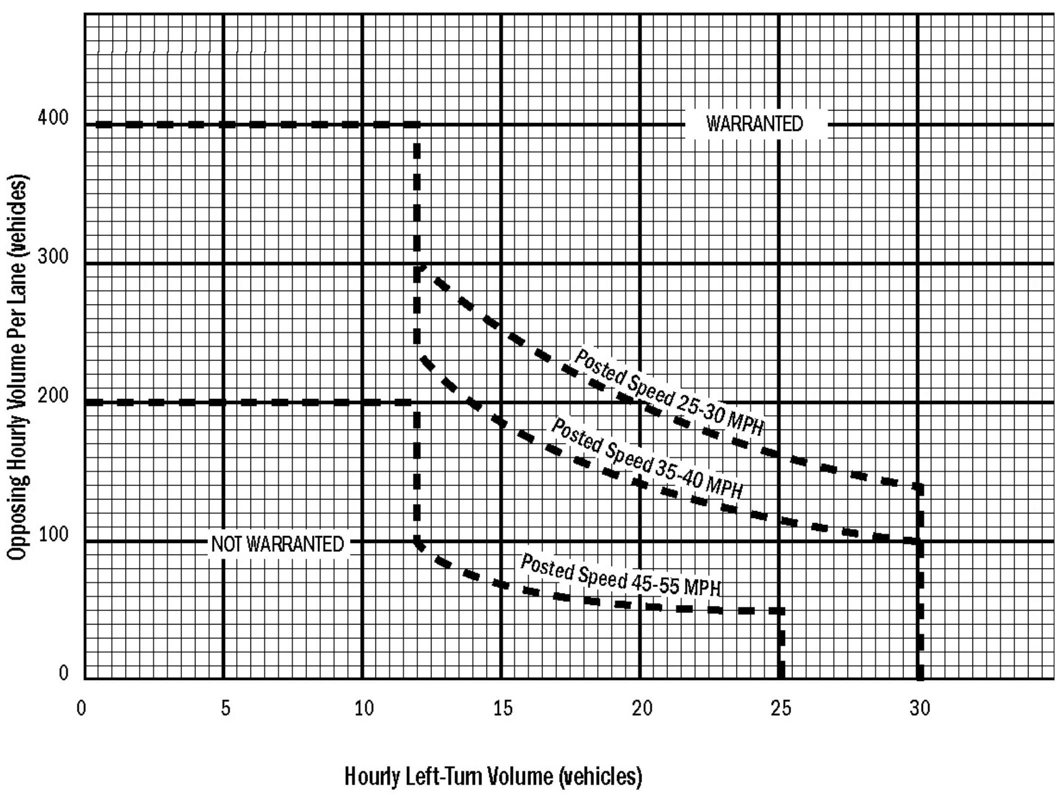
5.3 Turning Lanes

5.3.1 Need It may be necessary to construct turning lanes for right and left turns into an access drive for safety or capacity reasons where roadway speeds or traffic volumes are high, or if there are substantial turning volumes. The purpose of a separate turning lane is to expedite the movement of through traffic, increase intersection capacity, permit the controlled movement of turning traffic, and promote the safety of all traffic.

The provision of left-turn lanes is essential from both capacity and safety standpoints where left turns would otherwise share the use of a through lane. Shared use of a through lane will dramatically reduce capacity, especially when opposing traffic is heavy. One left turn per signal cycle delays 40 percent of the through vehicles in the shared lane; two turns per cycle delays 60 percent.[1]

Right-turn lanes remove the speed differences in the main travel lanes, thereby reducing the frequency and severity of rear-end collisions. They also increase capacity of signalized intersections and may allow more efficient traffic signal phasing. Figures 5-1 and 5-2 illustrate typical warrants for left- and right-turn lanes, based on posted speed and traffic volumes.

Left-Turn Lane Warrant

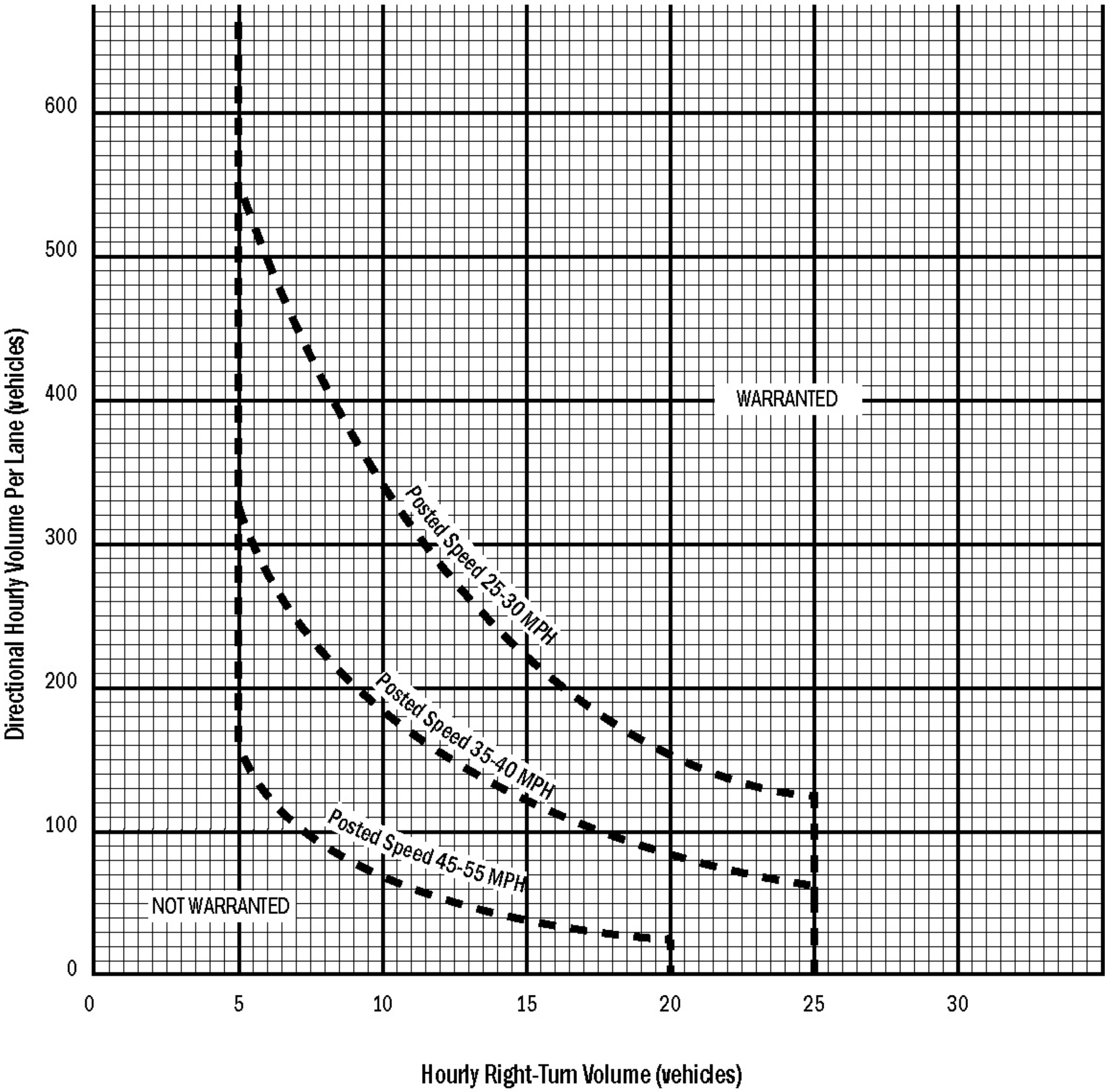


Sources: Idaho Transportation Department "Traffic Manual"
Transportation Research Board, NCHRP Report 348, Access Management Guidelines for Activity Centers.

Figure 5-1

[1] Source: Transportation Research Board, (1989)

Right-Turn Lane Warrant



Sources: Idaho Transportation Department "Traffic Manual;"
Transportation Resarch Board, NCHRP Report 348, Access Managment Guidelines for Activity Centers.

Figure 5-2

Rear-end accidents can be severe on shared lanes. Research has found that accident rates increase exponentially as the speed differential in the traffic stream increases.[1] While the accident rates may change over time and by location, the ratio of the accident rates is expected to provide a good indication of the relative accident potential at different speed differentials, as shown in Table 5-1. As shown, on an arterial street, a vehicle traveling 35 mph slower than other traffic is 180 times more likely to become involved in an accident than a vehicle traveling at the same speed as other traffic.

TABLE 5-1[1]
Relative Accident Involvement Rates

Speed Differential (mph)	Relative Accident Potential as Compared to:	
	At-Grade Arterials	Freeways
	0-mph Differential	0-mph Differential
0	1	1
-10	2	3.3
-20	6.5	20
-30	45	67
-35	180	N/A

N/A = not available

Vehicular lanes for right turn movements and/or acceleration may be required adjacent to driveways on streets having a posted speed limit of 35 mph or greater or where the Average Daily Traffic (ADT) of the driveway exceeds 1,000 vehicles/day. Left turn lanes, with appropriate transitions, may be required on streets that exist at less than full future width or where significant turning movements will occur. The minimum turn lane width is 12-feet unless approved by the Director of Transportation or designated staff.

The Tucson Department of Transportation will determine when right turn and/or left-turn lanes are required, based on a traffic analysis supplied by the developer. The analysis must comply with the procedures detailed in the Highway Capacity Manual, latest edition, or with procedures supplied by the Tucson Department of Transportation.

5.3.2 Total Length A separate turning lane consists of a taper plus a full width auxiliary lane. The design of turn lanes is based primarily on the speed at which drivers will turn into the lane, the speed to which drivers must reduce in order to turn into the driveway after traversing the lane, and the amount of vehicular storage that

[1] Source: Institute of Transportation Engineers, (1988)

should be required. Other special considerations include the volume of trucks that will use the turning lane and the steepness of an ascending or descending grade.

Although vehicular storage is a principal factor used to establish the full length of a separate turn lane, it may not be the actual determining factor. At off-peak traffic periods on higher-speed roads, the lane will function as a right turn lane.

The distance required for storage length will vary, depending on traffic volumes, the type of traffic control, and traffic signal timing and phasing (if applicable). Required storage lengths should be calculated by traffic engineering analysis on a case-by-case basis.

The total length of the separate turning lane and taper should be determined by either:

1) Right turn lane requirements; or
2) The combination of turn lane or through lane queue storage plus the distance necessary to maneuver or transition into the separate lane, whichever is greater.

It is recommended that a minimum 10:1 bay taper be used to provide a full-width separate turning lane for all posted speed limits. If a two-lane turn lane is to be provided, it is recommended that a minimum 7.5:1 bay taper be used to develop the dual lanes. The bay taper will allow for additional storage during short duration surges in traffic volumes.

It is sometimes necessary to transition through traffic lanes around left-turn lanes. In such cases, larger transition rates should be used. The transition rate for through traffic should be approximately equal to the operating speed, but never less than half the operating speed (e.g., for a 40-mph operating speed and a 12-foot offset, the minimum taper would be 20:1 or 240 feet, and the desirable taper would be 40:1 or 480 feet).

5.3.2.1 Calculation of Total Length

A. Pavement Taper

Pavement tapers are to be designed based upon the following formulas. (From the *Manual on Uniform Traffic Control Devices [MUTCD*] 1988 or approved subsequent editions).

1) For a posted speed (d) less than or equal to forty mph, the length (L) of the taper in feet is:

$$L = \frac{([d]^2 \text{ x offset } \{\text{ft.}\})}{60}$$

2) For a posted speed (d) greater than forty mph, the length (L) of the taper in feet is:

$$L = ([d] \text{ x offset } \{\text{ft.}\})$$

B. Storage Length

The formulas contained in the 1973 AASHO Design Manual should be used to calculate the average queue storage length. The formulas differ slightly depending on the intersection traffic control.

1) Signalized Intersection with Protected Turn Phases

$$L_{Queue} = f * V * (C/3600) * [(C-g)/C] * I_{veh}$$

2) Signalized Intersection with Permissive Turn Phases

$$L_{Queue} = f * V * (C/3600) * I_{veh}$$

3) Unsignalized Intersection and Driveways With Stop Control

$$L_{Queue} = f * V * (120/3600) * I_{veh}$$

Where:

L_{Queue} = required storage length (feet)
f = storage length factor, 1.25 to 2.0 (see below)
V = hourly turning volume in vehicles per hour
C = cycle length in seconds
g = protected green time for turning movements in seconds
I_{veh} = average vehicle length in feet (assume 20 feet)

Storage Length Factor:
f = 2.0, for $V<300$vph
f = 1.75, for $300 <= V<= 500$vph
f = 1.5, for $500 <= V<= 1000$vph
f = 1.25, for $V>1000$vph

4) Minimum storage spacing at a signalized intersection is approximately 75 feet for a right-turn and 150 feet for a left-turn.

5) Minimum storage spacing at an unsignalized intersection is approximately 75 feet for both a right-turn and left-turn.

5.4 Driveway Locations

Design requirements for driveway locations onto arterial and collector roadways in all new development are as follows:

1) Entrance and exit drives crossing arterials and collectors are limited to two per three hundred feet of frontage along any major roadway. The nearest pavement edges spaced at least eighty feet apart.
2) A minimum of one hundred and fifty feet, measured at curbline, shall separate the nearest pavement edge of any entrance or exit driveway and the curbline to any signalized intersection with arterial and collector roadways.
3) All new development should promote cross access agreements to limit the number of driveways crossing arterial and collector roadways.

5.5 Driveway Curb Radius

The preferred curb radii will depend on the type of vehicles to be accommodated, the number of pedestrians crossing the access road, and the operating speed of the accessed roadway. Table 5-2 presents the minimum curb return radius for connection between two-types of streets, i.e. the minimum curb return for an arterial street to an arterial street is 30-feet.

TABLE 5-2[1]
Minimum Curb Return Radius

	Arterial Street	Collector Street	Local Street	Driveway/ PAAL
Arterial Street	30’	25’	25’	25’
Collector Street	25’	25’	25’	25’
Local Street	25’	25’	18’	18’
Driveway/PAAL	25’	25’	18’	18’

5.6 Driveway Entry Width

The entry width is the approximate width needed at the driveway throat to accommodate the swept path of the turning design vehicle. The return radii given in Table 5-2 represent the minimums developed from design vehicles turning into a driveway from the right-most lane. The entry width will differ from the driveway’s overall width, depending on how the driveway is expected to operate. Driveway entries should be placed outside of erosion control, treated slopes, no access/access control or restricted utility easements.

All curb cuts, curb returns, and curb depressions should be located in accordance with the City of Tucson Code, Chapter 25 (see guidelines below in Table 5-3). The Director of Transportation or designated staff may grant written permission from the minimum and maximum guidelines shown below if the area has peculiar visible conditions, the nature of the business is exceptional, the nature of the abutting property is exceptional, and the variance is not against the public interest, safety, convenience or general welfare.

TABLE 5-3[2]
Driveway Entry Widths

	Residential Districts	Business Districts	Industrial Districts[1]
Driveway width (min./max.)	**10’ / 20’**	**35’ max**	**35’ max**
Max. driveway width for two adjoining properties	**30’**	**n/a**	**n/a**
Max. driveway width at the property line	**n/a**	**30’**	**30’**
Note: 1) The provisions established for curb cuts and driveways for business zoned district shall prevail in all industrial zoned districts for properties fronting on a through street, as defined in the City of Tucson Code, or on a major street as shown on the latest MS&R Plan on file with the Director of Transportation or designated staff.			

[1] Source: City of Tucson Development Standard No. 3-01.10 Figure 6, City of Tucson, Arizona, (1998)
[2] Source: Tucson Code, City of Tucson Adopted (1964) Enacted August 6, 2002

5.7 Driveway Profiles

The slope of a driveway can dramatically influence its operation. Usage by large vehicles can have a tremendous effect on operations if slopes are severe. The profile, or grade, of a driveway should be designed to provide a comfortable and safe transition for those using the facility, and to accommodate the storm water drainage system and reduce erosion or not impact erosion control, of the roadway.

Driveways should also be designed in compliance with ADA guidelines.

5.8 Driveway Throat Length[1]

The driveway throat should be of sufficient length to enable the intersection at the access connection and abutting roadway, and the on-site circulation to function without interference with each other. Drivers entering the site should be able to clear the intersection of the roadway and access connection before encountering the intersection of the access connection and on-site circulation. Inadequate throat length results in poor access circulation in the vicinity of the access drive. This produces congestion and high crash rates on the abutting streets as well as on site. Pedestrian vehicular conflicts are also especially critical because of the confusion caused by the complex pattern of over-lapping conflict areas.

The exit side of an access connection should be designed to enable traffic leaving the site to do so efficiently. Stop-controlled connections should be of sufficient length to store three passenger cars (one passenger car = 20-feet).

5.9 Truck Loading Area

Truck loading areas should be designed in such a way as to minimize conflict with on-site traffic and circulation. Drop-off/loading areas should not be located where they will have an effect on vehicle operations on City right-of-way.

5.10 Median Openings

Left-turn ingress or egress requires a median opening when traffic traveling in opposing directions is separated by a barrier median. Median widths commonly vary from 4 feet to over 30 feet. Widths ranging from 14 to 20 feet are desirable for providing separate left-turn lanes.

Design elements include the median width, the spacing of median openings (see Section 4.3), and the geometrics of median noses at openings. The design of the median nose can vary from semicircular, usually for medians in the 4-foot to 10-foot range, to bullet nose design, for wider medians and for intersections that will accommodate semi-trailer trucks.

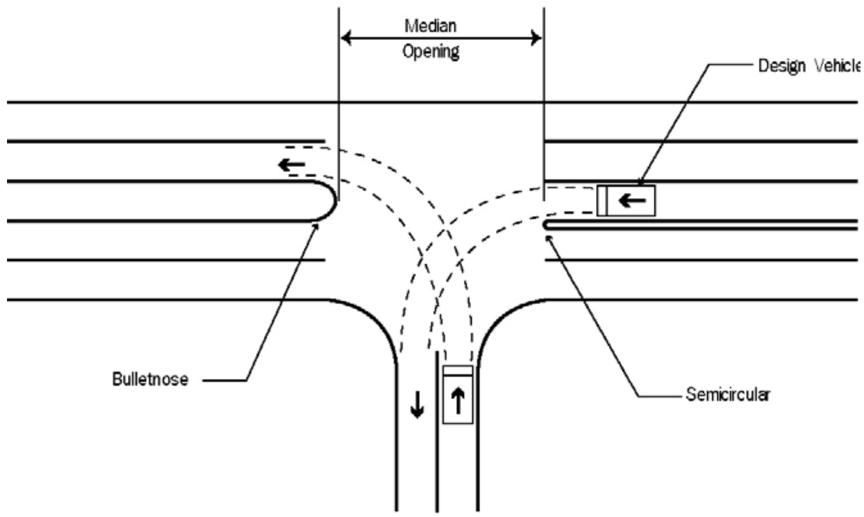
The bullet nose is formed by two symmetrical portions of control radius arcs that are terminated by a median nose radius that is normally one-fifth the width of the median (e.g., a

[1] Source: Federal Highway Administration. (1998)

bullet nose design for a median opening in a 20-foot-wide median would have a small nose radius of 4-feet that could connect two 50-foot radii).

The large radii should closely fit the path of the inner rear wheel of the selected design vehicle. The advantages are that the driver of the left-turning vehicle, especially a truck, has a better guide for the maneuver. The median opening can be kept to a minimum, and vehicle encroachment is minimized. Figure 5-3 indicates the various elements of a median opening design.

Minimum Median Openings



Median Openings Design Controls		
Control Radius (feet)	Design Vehicles Accomodated	
	Predominant	Occassional
40	P	SU
50	SU	WB-40
75	WB-40	WB-50

Median Width (feet)	Minimum Median Opening (feet)	
	Semicircular	Bullet Nose
12	88	58
18	82	47
20	80	44
30	70	40 minimum
40	60	40 minimum
50	50	40 minimum
60	40 minimum	40 minimum

Source: A Policy on Geometric Design of Highways and Streets - 4th Edition, American Association of State Highway & Transportation Officials, 2001.

Figure 5-3

5.11 Pedestrian Facilities[1]

Pedestrian facility improvements on major roadway projects should utilize all applicable City of Tucson Department Standards, City of Tucson Specifications and Details, and Arizona Department of Transportation (ADOT) Standards, and should be compliant with the transportation and public accommodation provisions of the ADA.

All major roadway projects should include sidewalks on both sides of the improved roadway section. When adequate right-of-way is available, consideration should be given to providing sidewalks of greater width than minimum Development Standard Specifications. Consideration should be given to extending sidewalks to local and regional activity centers up to one-quarter mile beyond the project limit, in order to create a convenient, safe, and attractive pedestrian network. Consideration should be given to the utilization of alternative paving materials and designs, such as brick pavers and meandering sidewalks that enhance the overall aesthetic value of the project and complement existing urban design.

5.12 Bicycle Facilities[1]

To promote the use of bicycles as an alternative mode of transportation, and to provide for bicyclist safety, major roadway projects should be designed with outside vehicle lanes that accommodate five-foot wide on-street bicycle routes with painted edgelines when adequate right-of-way is available.

Bicycle facility improvements on major roadway projects should utilize all appropriate AASHTO Design Guidelines, Arizona Bicycle Facility Design Guidelines, MUTCD, City of Tucson Development Standards, and the City of Tucson Specifications and Details.

All major roadway projects involving the reconstruction of intersections should provide for painted edgeline bicycle routes or additional outside vehicle lane width as part of the intersection improvement when adequate right-of-way is available. Actuated signal detection or video camera detection should be provided so that the bicyclist can actuate the traffic signal.

5.13 Transit Facilities[2]

In order to provide convenient access to public transit, bus stops should be placed every one-quarter mile on major roadway projects located along existing local transit routes, and every one-half mile to one mile along express or limited routes. Additional stops may be considered to serve major trip generators. Unless otherwise warranted by overriding safety concerns for passenger convenience issues, bus stops should be located on the far side of the intersections.

Bus shelters should be provided at all bus stops located along major roadway projects to provide for passenger comfort and safety.

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[1] Source: City of Tucson Department of Transportation. (1998)
[2] Source: City of Tucson Department of Transportation. (1998)

Major roadway projects should include bus pullouts at high activity bus stops when warranted by peak hour traffic, peak hour bus frequency, passenger safety concerns, and when adequate right-of-way is available. Bus pullouts should be located on the far side of intersections in order to utilize signal protection for re-entry into the stream of traffic. Consideration should be given to far-side open bus bays, coupled with a permitted through movement for buses in the right-turn lane at the intersection. This bus bay design enables transit vehicles to by-pass traffic queues at intersections thus assisting in on-time performance and providing additional passenger convenience. Bus pullouts should be carefully planned and designed to minimize transit vehicle delay in re-entering the stream of traffic. Bus pullouts should include shelters and other passenger amenities to provide for customer safety and convenience.

For the design of a bus bay, it is recommended that a minimum 6:1 bay taper be used to provide a twelve-foot minimum width bus bay. The bus bays should provide for 95-feet of storage length, unless it is a layover location, and if necessary a 4:1 exit taper. Figure 5-4 provides the bus bay details for two types of design.

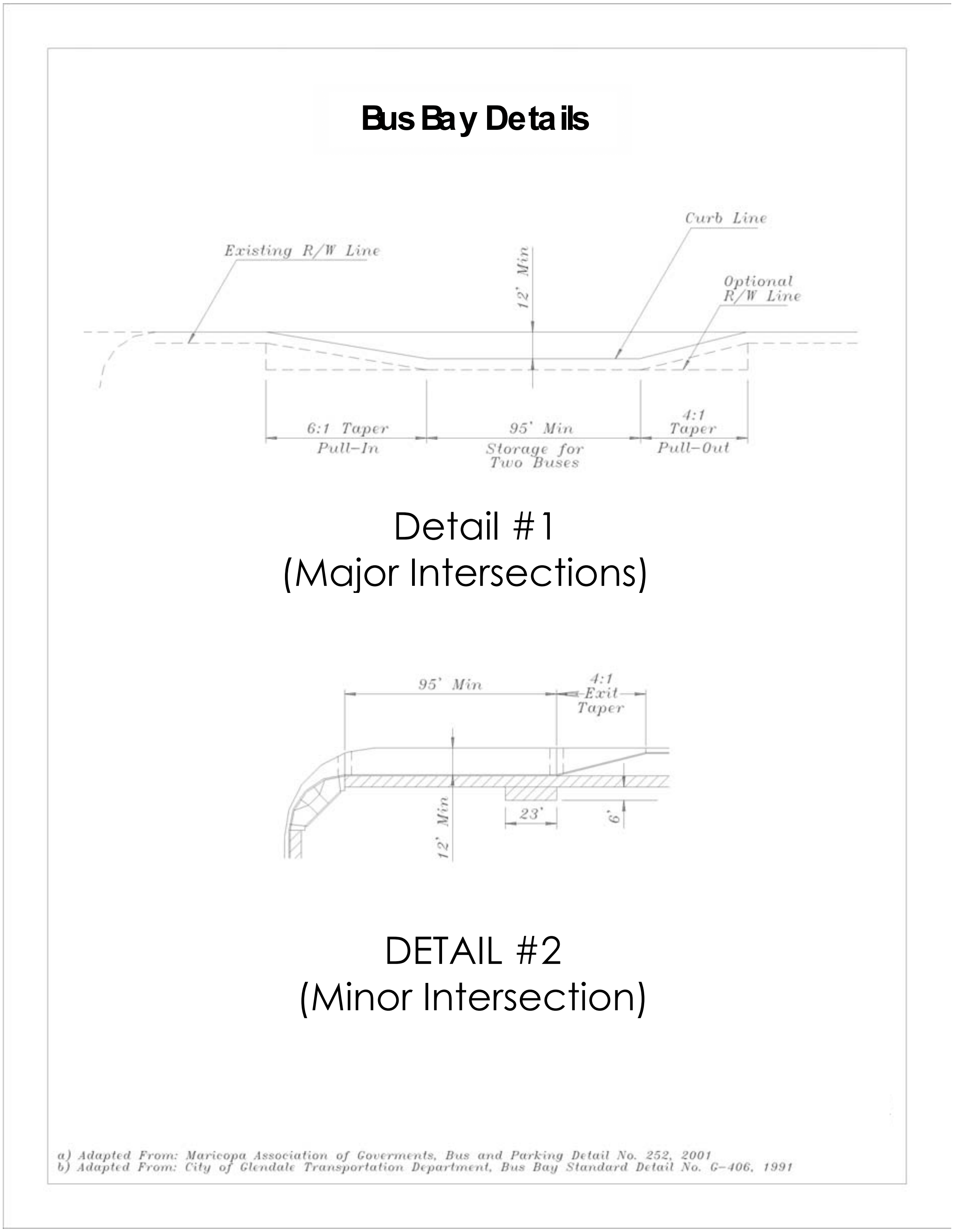

Figure 5-4 Bus Bay Detail

6.0 Methods of Application

6.1 Traffic Impact Analysis

The City may request that a traffic impact Analysis (TIA) be prepared for proposed developments consistent with its policies. A detailed description of the methodology and necessary data is presented in Section 6.3.2.

6.2 Variances

Where the City of Tucson finds that extraordinary hardships or practical difficulties may result from strict compliance with approved requirements, the City may approve variations to the requirements, provided that safety standards are met, so that the public interest is served. The agency may require that a traffic impact analysis (TIA) or other information or studies be submitted when reviewing a request for a variation. Variances may be necessary for exceptions to turning restrictions or spacing standards where it can be demonstrated that no other reasonable options are available.

Economic development factors may be considered for development projects that will bring new job opportunities into the area. However, safety standards should not be compromised for purely economic reasons.

A petition for any variation should be submitted in writing to the City by the developer. The developer must prove that the variation will not be contrary to the public interest and that unavoidable practical difficulty or unnecessary hardship will result if not granted. The developer should establish and substantiate that the variation conforms to the City's requirements and standards.

Care should be taken in issuing variances. No variation should be granted unless it is found that the following relevant requirements and conditions are satisfied. The City may grant variations whenever it is determined that all of the following criteria have been met:

1) The granting of the variation should be in harmony with the general purpose and intent of the regulations and should not result in undue delay or congestion or be detrimental to the safety of the motoring public using the roadway.
2) There should be proof of unique or existing special circumstances or conditions where strict application of the provisions would deprive the developer of reasonable access. Circumstances that would allow reasonable access by a road or street other than a primary roadway, circumstances where indirect or restricted access can be obtained, or circumstances where engineering or construction solutions can be applied to mitigate the condition should not be considered unique or special.
3) There should be proof of the need for the access and a clear documentation of the practical difficulty or unnecessary hardship. It is not sufficient to show that greater profit or economic gain would result if the variation were granted. Furthermore, the hardship or difficulty cannot be self-created or self-imposed; nor

can it be established on this basis by the owner who purchases with or without knowledge of the applicable provisions. The difficulty or hardship must result from strict application of the provision, and it should be suffered directly and solely by the owner or developer of the property in question.

Upon receipt of relevant information, facts and necessary data, the governmental agency should review the information and render a decision in writing to the developer. Materials documenting the variance should be maintained in the agency's permit files.

6.3 Site Design

This sub-section sets forth criteria for access control and traffic impact analyses, as they apply to individual developments.

6.3.1 Access Control Typical access control requirements for arterials and collectors are provided as follows:

1) No driveway access to an arterial street should be allowed for any residential lot. Driveway access to collectors from residential lots should be discouraged and approved on a case-by-case evaluation.
2) No driveway access should be allowed within 300 feet of the nearest right-of-way line of an intersecting street.
3) Driveways giving direct access may be denied if alternate access is available.
4) When necessary for the safe and efficient movement of traffic, access points may be required to be designed for right turns in and out only.
5) When approved, or directed by the City's representative, a driveway access design may be a "street type intersection" with curb returns.

6.3.2 Traffic Impact Analysis A Traffic Impact Analysis (TIA) is a specialized study of the impacts that a certain type and size of development will have on the surrounding transportation system. A TIA is essential for many access management decisions, such as spacing of driveways, traffic control devices, and traffic safety issues. It is specifically concerned with the generation, distribution, and assignment of traffic to and from new development. A TIA should also be used as part of the site planning process, not merely justification of the site plan. The purpose of this sub-section is to establish uniform guidelines for when a TIA is required and how the study is to be conducted.

6.3.2.1 Requirements A complete TIA should be performed if any of the following situations are proposed:

1) All new developments, or additions to existing developments, which are expected to generate more than 100 new peak-hour vehicle trips

(total in and out vehicular movements). The peak-hour will be determined by the City's representative.

2) In some cases, a development that generates less than 100 new peak hour trips may require a TIA if it affects local "problem" areas. These would include high accident locations, currently congested areas, or areas of critical local concern. These cases will be based on the City representative's judgment.
3) All applications for rezoning or special exception (e.g. big box).
4) All applications for annexation.
5) Any change in the land use or density that will change the site traffic generation by more than 15 percent, where at least 100 new peak-hour trips are involved.
6) Any change in the land use that will cause the directional distribution of site traffic to change by more than 20 percent.
7) When the original TIA is more than 2 years old, access decisions are still outstanding, and changes in development have occurred in the site environs.
8) When development agreements are necessary to determine "fair share" contributions to major roadway improvements.

The specific analysis requirements, and level of detail, are determined by the following requirements.

- **CATEGORY I TIA** -- Developments which generate from 100 up to 500 peak hour trips. The study horizon should be limited to the opening year of the development. The minimum study area should include site access drives and adjacent signalized intersections and/or major unsignalized street intersections.

- **CATEGORY II TIA** -- Developments that generate from 500 up to 1,000-peak hour trips. The study horizon should include both the opening year of the development and five years after opening. The minimum study area should include the site access drives and all signalized intersections and/or major unsignalized street intersections within one-half mile of the development.

- **CATEGORY III TIA** -- Developments that generate 1,000 or more peak hour trips. The study horizon should include the opening year of the development, five years after opening and ten years after opening. The minimum study area should include the site access drives and all signalized intersections and/or major unsignalized street intersections within one mile of the development.

6.3.2.2 Qualifications for Preparing Traffic Impact Analysis Documents. The TIA should be conducted and prepared under the direction of a Professional Traffic Engineer. The subject engineer should have special training and experience in traffic engineering.

6.3.2.3 Analysis Approach and Methods. The traffic study approach and methods should be guided by the following criteria.

6.3.2.3.1 **STUDY AREA**. The minimum study area should be determined by project type and size in accordance with the criteria previously outlined. The extent of the study area may be either enlarged, or decreased, depending on special conditions as determined by the City's representative.

6.3.2.3.2 **STUDY HORIZON YEARS**. The study horizon years should be determined by project type and size, in accordance with the criteria previously outlined.

6.3.2.3.3 **ANALYSIS TIME PERIOD**. Both the morning and afternoon weekday peak hours should be analyzed, unless the proposed project is expected to generate no trips, or a very low number of trips, during either the morning or evening peak periods. If this is the case, the requirement to analyze one or both of these periods may be waived by the City's representative.

Where the peak traffic hour in the study area occurs during a different time period than the normal morning or afternoon peak travel periods (for example mid-day), or occurs on a weekend, or if the proposed project has unusual peaking characteristics, these additional peak hours should also be analyzed.

6.3.2.3.4 **SEASONAL ADJUSTMENTS**. When directed by the City's representative, the traffic volumes for the analysis hours should be adjusted for the peak season, in cases where seasonal traffic data is available.

6.3.2.3.5 **DATA COLLECTION REQUIREMENTS**. All data should be collected in accordance with the latest edition of the ITE Manual of Traffic Engineering Studies, or as directed by the City of Tucson's Traffic Engineer.

6.3.2.3.5.1 **Traffic volumes.** Manual turning movement counts should be obtained for all existing cross-street intersections to be analyzed during the morning and afternoon peak periods. Turning movement counts may be required during other periods as directed by the City's representative.

6.3.2.3.5.2 **Daily traffic volumes.** The current and projected daily traffic volumes should be presented in the report. If available, daily count data from the City of Tucson, Pima County, or the Pima Association of Governments (PAG) may be used. Where daily count data is not available, mechanical counts will be required at locations agreed upon by the City's representative.

6.3.2.3.5.3 **Accident data.** Traffic accident data should be obtained for the most current three-year period available.

6.3.2.3.5.4 **Roadway and intersection geometrics.** Roadway geometric information should be obtained. This includes, but is not limited to, roadway width, number of lanes, turning lanes, vertical grade, and location of nearby driveways, pedestrian facilities, and lane configuration at intersections.

6.3.2.3.5.5 **Traffic control devices.** The location and type of traffic controls should be identified.

6.3.2.3.5.6 **Bicycle and pedestrian volumes.** When directed by the City of Tucson's Traffic Engineer, bicycle and pedestrian volumes should be collected.

6.3.2.3.6 **TRAFFIC VOLUME FORECASTS**. Future traffic volumes should be estimated using information from transportation models, or applying an annual growth rate to the base-line traffic volumes. The future traffic volumes should be representative of the horizon year for project development. If the annual growth rate method is used, the City's representative must give prior approval to the growth rate.

In addition, any nearby proposed "on-line" development projects should be taken into consideration when forecasting future traffic volumes. The increase in traffic from proposed "on-line" projects should be compared to the increase in traffic by applying an annual growth rate. This information should be provided by the City's representative.

If modeling information is unavailable, the greatest traffic increase from either the "on-line" developments, the application of an annual growth rate, or a combination of an annual growth rate and "on-line" developments, should be used to forecast the future traffic volumes.

6.3.2.3.7 **TRIP GENERATION**. The latest edition of *Institute of Transportation Engineers (ITE) Trip Generation Handbook* should be used for selecting trip generation rates. Other rates may be used with the approval of the City's representative in cases where the *ITE Trip Generation Handbook* does not include trip rates for a specific land use category, or includes only limited data, or where local trip rates have been shown to differ from the ITE rates.

Site traffic should be generated for daily, AM and PM peak hour periods. Adjustments made for "passer-by" and "mixed-use" traffic volumes should follow the methodology outlined in the latest edition of the *ITE Trip Generation Handbook.* A "passer-by" traffic volume discount for commercial centers should not exceed twenty five percent unless approved by the City's representative.

A trip generation table should be prepared showing proposed land use, trip rates, and vehicle trips for daily and peak hour periods and appropriate traffic volume adjustments, if applicable.

6.3.2.3.8 **TRIP DISTRIBUTION AND ASSIGNMENT.** Projected trips should be distributed and added to the projected non-site traffic on the roadways and intersections under study. The specific assumptions and data sources used in deriving trip distribution and assignment should be documented in the report and approved by the City's representative.

Category III TIA's may require the use of a travel demand model based on direction from the City's representative.

The site-generated traffic should be assigned to the street network in the study area based on the approved trip distribution percentages. The site traffic should be combined with the forecasted traffic volumes to show the total traffic conditions estimated at development completion. A "figure" will be required showing daily and peak period turning movement volumes for each traffic study intersection. In addition, a "figure" should be prepared showing the base-line volumes with site-generated traffic added to the street network. This "figure" will represent site specific traffic impacts to existing conditions.

6.3.2.3.9 **CAPACITY ANALYSIS**. Level of service (LOS) should be computed for signalized and unsignalized intersections in accordance with the latest edition of the Highway Capacity Manual. The intersection

LOS should be calculated for each of the following conditions (if applicable):

1) Existing peak hour traffic volumes ("figure" required).
2) Existing peak hour traffic volumes including site-generated traffic ("figure" required).
3) Future traffic volumes not including site traffic ("figure" required).
4) Future traffic volumes including site traffic ("figure" required).
5) LOS results for each traffic volume scenario ("table" required).

The LOS table should include LOS results for AM and PM peak periods if applicable. The table should show LOS conditions with corresponding vehicle delays for signalized intersections, and LOS conditions for the critical movements at unsignalized intersections. For signalized intersections, the LOS conditions and average vehicle delay should be provided for each approach and the intersection as a whole.

Unless otherwise directed by the City's representative, the capacity analysis for existing signalized intersections should be conducted using the Highway Capacity Manual Operational Method for each study horizon year. When directed by the City's representative, the capacity analysis should be conducted using the Planning Analysis Method.

When the operational capacity analysis method is used for existing signalized intersections, it should include existing phasing, timing, splits, and cycle lengths during the peak hour periods when available from the City's representative.

For unsignalized intersections, the Highway Capacity Manual methodology should be used.

If the new development is scheduled to be completed in phases, the TIA will, if directed by the City's representative, include a LOS analysis for each separate development phase in addition to the TIA for each horizon year. The incremental increases in site traffic from each phase should be included in the LOS analysis for each preceding year of development completion. A "figure" will be required for each horizon year of phased development.

***6.3.2.3.10* QUEUE ANALYSIS.** If directed by the City's representative, a queue analysis should be completed using the following methods outlined in Section 5.3.2.1 to determine appropriate storage lengths for right turn and left turn lanes into and out of the site.

6.3.2.3.11 **TRAFFIC SIGNAL WARRANT ANALYSIS.** A traffic signal warrant study should be conducted if directed by the City's representative. The analysis will be required for each horizon year.

Traffic signal warrant studies should be conducted by a method pre-approved by the City's representative.

6.3.2.3.12 **ACCIDENT ANALYSIS**. If directed by the City's representative, an analysis of three-year accident data should be conducted to determine the level of safety of the study area and any possible mitigation efforts.

6.3.2.3.13 **SPEED ANALYSIS**. Vehicle speed is used to estimate safe stopping and cross corner sight distances. In general, the posted speed limit is representative of the 85th percentile speed and may be used to calculate safe stopping and cross corner sight distances. If directed by the City's representative, speed counts should be taken in the study area.

6.3.2.3.14 **TRAFFIC SIMULATION**. For a major development, a simulation using SYNCHRO or other approved software should be done to show existing traffic flows and future traffic flows if directed by the City's representative.

6.3.2.3.15 **MITIGATION REQUIREMENTS**. The roadways and intersections within the study area should be analyzed, with and without the proposed development to identify any projected impacts in regard to level of service and safety.

Where the roadway will not operate at Level of Service D or better with the development, the traffic impact of the development on the roadways and intersections within the study area shall be mitigated to Level of Service D.

6.3.2.3.16 **INTER-AGENCY COORDINATION**. When a new development falls within the boundaries of more than one government agency jurisdiction, the TIA should be distributed as an informational report to all affected agencies. The agency with governing powers over the development site will have final approval of the TIA.

6.3.2.4 Report Format. This sub-section provides the format requirements for the general text arrangement of a TIA. Deviations from this format must receive prior approval of the City's representative.

6.3.2.4.1 TABLE OF CONTENTS

6.3.2.4.2 TABLE OF FIGURES

6.3.2.4.3 LIST OF TABLES

6.3.2.4.4 EXECUTIVE SUMMARY

Purpose of Report and Study Objectives
Site Location and Study Area
Development Description
Principal Findings
Conclusions

6.3.2.4.5 PROJECT DESCRIPTION

Site Location
Land Use and Intensity
Proposed Development Details
Site Plan (readable version should be provided)
Access Geometrics
Development Phasing and Timing

6.3.2.4.6 EXISTING CONDITIONS

Study Area
- Roadway System
- Pedestrian/Bicycle Facilities
- Transit
- Sight Distance
- Existing Land Use

6.3.2.4.7 EXISTING TRAFFIC DATA

- Traffic Counts
- Pedestrian Counts (if necessary)
- Bicycle Counts (if necessary)
- Times Collected
- Locations
- Types - Daily, Morning, and Afternoon Peak Periods (two hours minimum, and others as required)

6.3.2.4.8 **TRIP GENERATION**

Trip Generation
Pass-by Traffic (if applicable)

6.3.2.4.9 **TRIP DISTRIBUTION AND ASSIGNMENT**

Trip Distribution
Trip Assignment

6.3.2.4.10 **ACCESS**

Site Access
Driveways

6.3.2.4.11 **ACCIDENT ANALYSIS**

Analysis Years
Types of Accidents
DUI
Injury
Non-injury
Fatalities

6.3.2.4.12 **EXISTING TRAFFIC OPERATIONS**

Level of Service
Morning Peak Hour, Afternoon Peak Hour
(and others as required)

6.3.2.4.13 **FUTURE TRAFFIC OPERATIONS WITHOUT PROJECT**

Projections of non-site traffic (Methodology for projections should receive prior approval of City's representative)
Roadway Improvements
Improvements Programmed to Accommodate Non-site Traffic
Additional Alternative Improvements to Accommodate Site Traffic
Level of Service Analysis Without Project (for each horizon year including any programmed improvements)

6.3.2.4.14 **TRAFFIC SIGNAL WARRANT ANALYSIS**

Warrant Analysis should be performed for each horizon year with and without project (Methodology for analysis should receive prior approval of City's representative)

6.3.2.4.15 **FUTURE TRAFFIC OPERATIONS WITH PROJECT**
Level of Service Analysis With Project (for each horizon year, including any programmed improvements)

6.3.2.4.16 **SUGGESTED TRAFFIC MITIGATIONS**
Pedestrian/Bicycle Considerations
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6.3.2.4.17 **TURN LANE ANALYSIS**
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6.3.2.4.18 **CONCLUSION**
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Trip Impacts
- Vehicular
- Pedestrian
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Recommendations
Other

6.3.2.4.19 **APPENDICIES**
Traffic Volume Counts
Capacity Analyses Worksheets
Traffic Signal Warrant Analysis
Accident Data and Summaries
Miscellaneous Addendum

6.4 Existing Problem Areas

Introducing a "retrofit" program of access control to an existing roadway is often difficult. Land for needed improvements is often unavailable, making certain access management techniques impossible to implement and requiring the use of minimum rather than desirable standards. Rights of property access should be respected. Social and political pressures will emerge from abutting property owners who perceive that their access will be unduly restricted and their business hurt. The needed cooperation of proximate, sometimes competitive, developments in rationalizing on-site access and driveway locations may be difficult to achieve. And it may also be difficult to compare the cost of economic hardship to an individual to the benefits accruing to the general public. Accordingly, the legal, social, and political aspects of access management are particularly relevant in retrofit situations and should be thoroughly understood by public agencies and private groups responsible for implementing access control programs for retrofit projects.

The general reasons underlying retrofit actions include the following:

1) Increased congestion and accidents along a given section of road that are attributed to random or inadequate access;
2) Major construction or design plans for a road that make access management and control essential;
3) Street expansions or improvements that make it practical to reorient access to a cross street and remove (or reduce) arterial access; and
4) Coordinating driveways, on one side of a street, with those planned by a development on the other side.

6.4.1 Types of Action. Most retrofit actions involve the application of accepted traffic engineering techniques that limit the number of conflict points, separate basic conflict areas, limit speed adjustment problems, and remove turning vehicles from the through travel lanes. Tables 6-1 through 6-4 presents the various access management techniques that achieve each of these objectives and mainly apply to retrofit situations.

TABLE 6-1[1]
Retrofit Techniques – Category A

CATEGORY A – Limit Number of Conflict Points	
No.	Description
A-1	Install median barrier with no direct left-turn access
A-2	Install raised median divider with left-turn deceleration lanes
A-3	Install one-way operations on the roadway
A-4	Install traffic signal at high-volume driveways
A-5	Channelize median openings to prevent left-turn ingress and/or egress maneuvers
A-6	Widen right through lane to limit right-turn encroachment onto the adjacent lane to the left
A-7	Install channelizing islands to prevent left-turn deceleration lane vehicles from returning to the through lanes
A-8	Install physical barrier to prevent uncontrolled access along property frontages
A-9	Install median channelization to control the merge of left-turn egress vehicles
A-10	Offset opposing driveways
A-11	Locate driveway opposite a three-leg intersection or driveway and install traffic signals where warranted
A-12	Install two one-way driveways in lieu of one two-way driveway
A-13	Install two two-way driveways with limited turns in lieu of one standard two-way driveway
A-14	Install two one-way driveways in lieu of two two-way driveways
A-15	Install two two-way driveways with limited turns in lieu of two standard two-way driveways
A-16	Install driveway channelizing island to prevent left-turn maneuvers
A-17	Install driveway channelizing island to prevent driveway encroachment conflicts
A-18	Install channelizing island to prevent right-turn deceleration lane vehicles from returning to the through lanes
A-19	Install channelizing island to control the merge area of right-turn egress vehicles
A-20	Regulate the maximum width of driveways

[1] Adapted from: Federal Highway Administration. (1998)

TABLE 6-2[1]
Retrofit Techniques – Category B

CATEGORY B – Separate Basic Conflict Areas	
No.	Description
B-1*	Regulate minimum spacing of driveways
B-2	Regulate minimum corner clearance
B-3	Regulate minimum property clearance
B-4*	Optimize driveway spacing in the permit authorization stage
B-5*	Regulate maximum number of driveways per property frontage
B-6	Consolidate access for adjacent properties
B-7	Require roadway damages for extra driveways
B-8	Purchase abutting properties
B-9	Deny access to small frontage
B-10	Consolidate existing access whenever separate parcels are assembled under one purpose, plan, entity, or usage
B-11*	Designate the number of driveways regardless of future subdivision of that property
B-12	Require access on collector street (when available) in lieu of additional driveway on arterial

* = not directly applicable for retrofit

TABLE 6-3[1]
Retrofit Techniques – Category C

CATEGORY C – Limit Speed-Adjustment Problems	
No.	Description
C-1	Install traffic signals to slow roadway speeds and meter traffic for larger gaps
C-2	Restrict parking on the roadway next to driveways to increase driveway turning speeds
C-3	Install visual cues of the driveway
C-4	Improve driveway sight distance
C-5	Regulate minimum sight distance
C-6*	Optimize sight distance in the permit authorization stage
C-7	Increase the effective approach width of the driveway (horizontal geometrics)
C-8	Improve the driveway profile (vertical geometrics)
C-9	Require driveway paving
C-10	Regulate driveway construction (performance bond) and maintenance
C-11	Install right-turn acceleration lane
C-12	Install channelizing islands to prevent driveway vehicles from backing onto the arterial
C-13	Install channelizing islands to move ingress merge point laterally away from the arterial
C-14	Move sidewalk-driveway crossing laterally away from the arterial.

* = not directly applicable for retrofit

[1] Adapted from: Federal Highway Administration. (1998)

TABLE 6-4[1]
Retrofit Techniques – Category D

CATEGORY D – Remove Turning Vehicles from the Through Lanes	
No.	Description
D-1	Install two-way left-turn lane
D-2	Install continuous left-turn lane
D-3	Install alternating left-turn lane
D-4	Install isolated median and deceleration lane to shadow and store left-turning vehicles
D-5	Install left-turn deceleration lane in lieu of right-angle crossover
D-6	Install median storage for left-turn egress vehicles
D-7	Increase storage capacity of existing left-turn deceleration lane
D-8	Increase the turning speed of right-angle median crossovers by increasing the effective approach width
D-9	Install continuous right-turn lane
D-10	Construct a local service road
D-11*	Construct a bypass road
D-12*	Reroute through traffic
D-13	Install supplementary one-way right-turn driveways to divided roadway (non-capacity warrant)
D-14	Install supplementary access on collector street when available (non-capacity warrant)
D-15	Install additional driveway when total driveway demand exceeds capacity
D-16	Install right-turn deceleration lane
D-17	Install additional exit lane on driveway
D-18	Encourage connections between adjacent properties (even when each has arterial access)
D-19	Require two-way driveway operation where internal circulation is not available
D-20	Require adequate internal design and circulation plan

* = not directly applicable for retrofit

[1] Adapted from: Federal Highway Administration. (1998)

7.0 Guideline References (Effective January 2003)

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PUBLIC STREET ACCESS GUIDELINES

CITY OF MESA TRANSPORTATION
February 15, 2005

These guidelines have been prepared for use as a guide in providing access for newly developed commercial, industrial, and multi-family properties. Driveway location and design are closely tied to the site plan and specific conditions for a given development. It is recognized that there will be instances where it may be impractical to meet these guidelines. In such cases, careful judgment must be used in granting variances. Traffic Engineering must approve all variances.

These guidelines were developed primarily for access from major streets. It is important that the minimum design features of driveway type and width not be compromised. To do so would adversely affect traffic flow on the major street. In general, these guidelines also should be applied to lower volume streets, although more latitude and flexibility are possible on lower volume streets.

The guidelines generally provide minimum standards. They should not be used to discourage engineers, architects, and designers from proposing innovative design solutions that vary from the minimum standards described here. Nor should they be applied arbitrarily when specific site conditions warrant something different.

Any questions about these guidelines, driveway and site layout in general, or specific problems should be directed to Traffic Engineering.

<u>Controlled Vehicular Access Easement</u>

Early in the zoning or subdivision review process for commercial sites, a Controlled Vehicular Access Easement (CVAE) should be placed along the site's major street frontages. See Figure 1. This easement has the effect of requiring review and approval by Traffic Engineering for the proposed driveway and access plan. A Non Vehicular Access Easement (NVAE) is sometimes placed to prevent access along certain roadways. City Council action is necessary to abandon a NVAE.

<u>Number of Driveways</u>

At least one driveway per abutting street will be allowed.

One additional driveway may be allowed for a site with continuous frontage of 300 feet or more.

Two additional driveways may be allowed for a site with continuous frontage of 600 feet or more.

An additional service type driveway may be allowed for a site with continuous frontage of 600 feet or more, where the site layout is such that the service driveway is unlikely to be used by customers of the businesses on the site. For example, a large corner shopping center may have a service driveway near the property line for service truck access to the rear of the buildings.

Additional emergency driveways may be provided if they are gated and it is clear that they are restricted to emergency use only.

Driveway location must be evaluated with respect to the particular site layout and location. Variations may be permitted where a traffic analysis justifies a departure from these guidelines.

<u>Driveway Design</u>

For low to moderate volume driveways where only one entrance and one exit lane are needed, the minimum design is a City of Mesa Standard M-42 driveway, 30 feet wide. See Figure 2.

For higher volume driveways where two exit lanes are to be provided, the driveway should be 40 feet wide. This will provide a 16 foot wide entrance and two 12 foot wide exit lanes. This design offers the advantage of preventing drivers who exit by turning left from blocking those who turn right.

An alternative to the 40 foot wide driveway is to provide a divided driveway with a median. For divided driveways, the minimum widths should be 20 feet for the entrance and 24 feet for the two lane exit. If only a single exit lane is desired, the width should be 20 feet. See Figure 2.

One-way driveways must be a minimum of 20 feet wide, and should be designed to discourage inadvertent use as two-way driveways.

Driveway Location

Driveways near a corner must be located with a minimum of 100 feet between the driveway and the extension of the curb of the intersecting street. This may be reduced for unusual circumstance if approved by Traffic Engineering.

Where the adjacent parcel is undeveloped or has a driveway within 10 feet of the property line, there should be a minimum of 10 feet between a new driveway and adjacent property line. This is to avoid the possibility of adjacent driveways meeting at the property line. If however the adjacent property has been developed such that there will be no conflict, it is not necessary to keep the new driveway 10 feet from the property line.

There should be a minimum of 60 feet between adjacent driveways serving the same development. See Figure 3.

Joint Use Driveways

The joint use of a single driveway to serve adjoining parcels should be encouraged wherever possible. An access easement shall be recorded when the parcels are developed.

When larger corner sites are developed with small corner pads reserved for future construction, or vice versa, provision should be made for the corner pads to have access via the driveways for the larger development, and not require separate driveways for the pads. See Figure 4.

Reuse of Existing Driveways

Where a property is being converted to a new use, such as residential to commercial, or where a new commercial development is being built on an old commercial site with existing driveways, the current driveway design standard should be applied to the new development. If the old driveways are not appropriate according to the current standard, they should be removed and new driveways installed.

Sight Distance

Adequate sight distance shall be provided at all intersections and driveways.

The determination of whether an object constitutes a sight obstruction shall consider both the horizontal and vertical alignment of both intersecting roadways, as well as the height and position of the object. In making this determination, it should be assumed that the driver's eye is 3.5 feet above the roadway surface for passenger vehicles and that the object to be seen is 3.5 feet above the surface of the intersecting roadway. In cases where the typical vehicle is a truck, visibility is to be provided for a driver eye height of 7.6 feet as well as 3.5 feet. The driver's eye is assumed to be positioned 15 feet back from the face of the adjacent street curb, at the centerline.

The sight distance required varies according to traffic speeds on the through road and widths of the intersecting streets or driveways. The most common street conditions are shown on Figure 5. Alternate cases, as well as supporting documentation for these values can be found on the Transportation Division website at /transportation/trans design guidelines.asp. A designer may provide sight distance from their own calculations as long as they are based on the 2004 AASHTO Policy on Geometric Design of Highways and Streets and submitted with the plans. Please note that Figure 5 is to be used for straight portions of roadway only. For curved portions of roadway use calculations based on AASHTO guidelines, or contact the City of Mesa Transportation Division.

Visibility must also be provided for traffic control devices, such as STOP signs at intersections. Sight distance required for STOP sign visibility is shown on Figure 6.

There shall be no fence, wall, shrubbery, sign, or any other obstruction to vision between a height of three feet (3') and eight feet (8') above the centerline grades of the intersecting streets or within the sight triangle. There should not be interference with the line of sight of a driver to an object, such as the overgrowth of a plant that is placed on the edge of the sight triangle. Figures 2.1 through 2.12 in the City of Mesa Engineering and Design Standards provide additional guidance for roadside development including objects within the sight triangles.

The designer must consider that other vehicles such as opposing left-turn vehicles in a median can block sight distance, and the design must account for this possibility. This is particularly evident along curves.

Deceleration Lanes

A deceleration lane added at an entrance is beneficial in that it allows entering vehicles to slow down and complete a right turn out of the through traffic flow, reducing the disruption to through traffic caused by driveway activity, and reducing the potential for rear-end accidents. A typical deceleration lane provides at least 150 feet of storage, a 100-foot taper or reverse curve, and a 12-foot wide lane. Please note that longer storage or tapers may be necessary depending on the site. See Figure 7.

Deceleration lanes may be provided at retail, multi-family, industrial or commercial sites depending on the size of the site. Generally, deceleration lanes should be provided at retail sites with 40,000 gross square feet or more of building area. Multi-family and private street residential developments should provide deceleration lanes if there are 100 or more units per access point for the site. Industrial parks with 200,000 gross square feet or more of building area, business parks and general office buildings with 100,000 gross square feet or more, and medical office buildings with 40,000 gross square feet or more should provide deceleration lanes. Smaller developments may need deceleration lanes also, based on site-specific conditions. Institutional sites such as hospitals and colleges are large enough to warrant deceleration lanes in most cases. Deceleration lanes should be provided for all of the driveways along a site where the lanes are required. If a driveway is mainly used for service and delivery vehicles, and it is separated from the main parking area, it may not require a deceleration lane.

Internal Site Circulation

Driveway design is intimately related to the site plan and internal traffic circulation. All must be evaluated as a whole.

Parking lots for larger developments with 200 or more parking spaces should be designed to limit the first point of entry to parking aisles to a distance of at least 40 feet behind the sidewalk. This removes conflicts from the immediate vicinity of the driveway, making entry and exit smoother and safer. See

Figure 8. Each site should be evaluated to determine the best layout for the conditions and planned development.

At drive-through service developments such as fast food restaurants and drive-in banks, the site should be designed to maximize storage space for vehicles using the drive-through services, and the drive-through entrances and exits should not create conflicts with other traffic on the site.

Median Openings

Raised medians on major streets are provided to reduce conflicts and improve traffic flow. Careful consideration should be given to requests for median openings to insure that the purpose of the median is not defeated by a proliferation of indiscriminate median openings.

There are two (2) types of median openings used in Mesa. The full access opening allows left turns from the street into a site as well as left turns from a site onto the street. The partial access opening allows left turns from the street into a site, but it prohibits left turns from a site onto the street. The partial access opening allows fewer traffic conflicts and has a lower potential for accidents than the full access opening. Median openings shall be designed per City of Mesa Standard Detail M-16. The following criteria govern median openings.

- Median opening spacing is measured from the center of the median opening to the center of the adjacent median opening or intersection.
- In general, full access median openings may be provided at sixth-mile or eight hundred eighty feet (880') points along an arterial street. Additional median openings are allowed but should be the partial access type.
- A median opening closer than eight hundred eighty feet (880') to an arterial-to-arterial intersection shall be the partial access type.
- Median openings less than six hundred sixty feet (660') from an arterial-to-arterial intersection are not allowed.
- Median openings less than six hundred sixty feet (660') from any signalized intersection or an intersection likely to be signalized are not allowed.
- Median openings less than eight hundred eighty feet (880') from a freeway interchange generally are not permitted, although each case will be evaluated based on the configuration of the particular interchange.
- Adjacent median openings should not be so closely spaced as to eliminate all of the area available for landscaping in the median.
- Left turn storage shall be provided for both directions on the major street where appropriate.
- There may be unique geometric conditions at some locations that would affect the ability to provide a median opening. Variations from these guidelines may be appropriate depending on the particular design features of the street under consideration. The Traffic Engineer shall approve variations.

The design and construction of median openings for private businesses shall be the responsibility of those establishments, subject to approval by the City of Mesa.

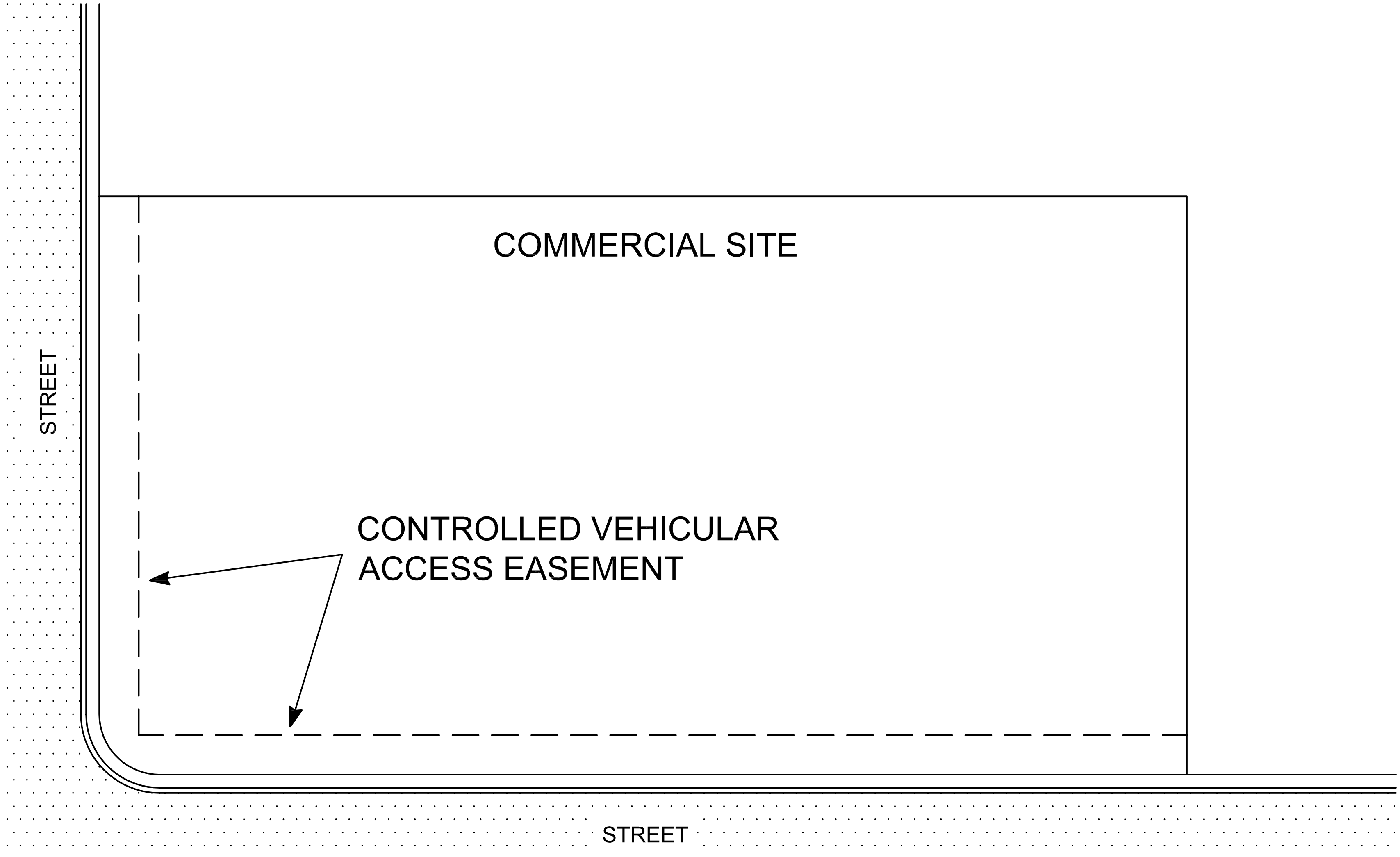
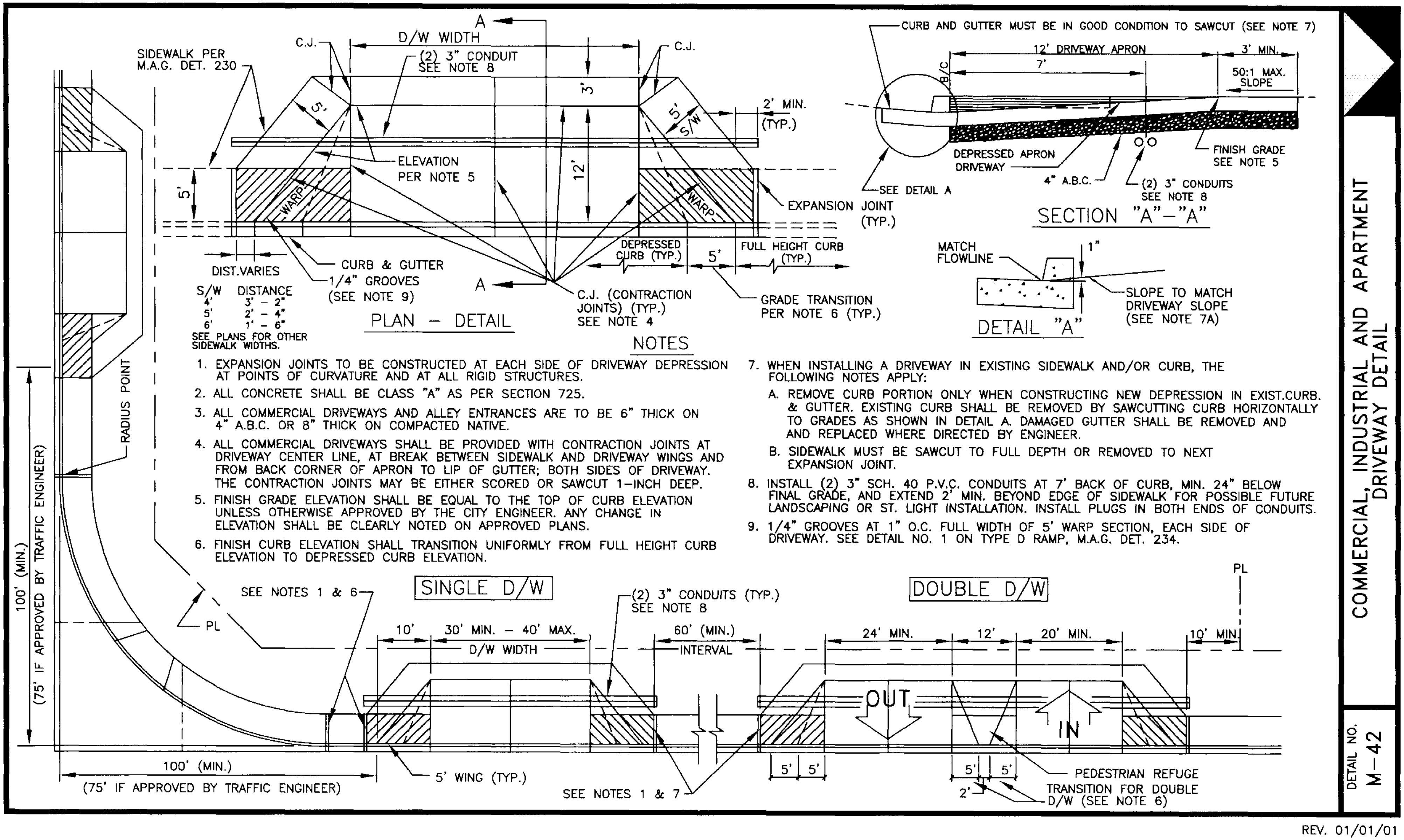


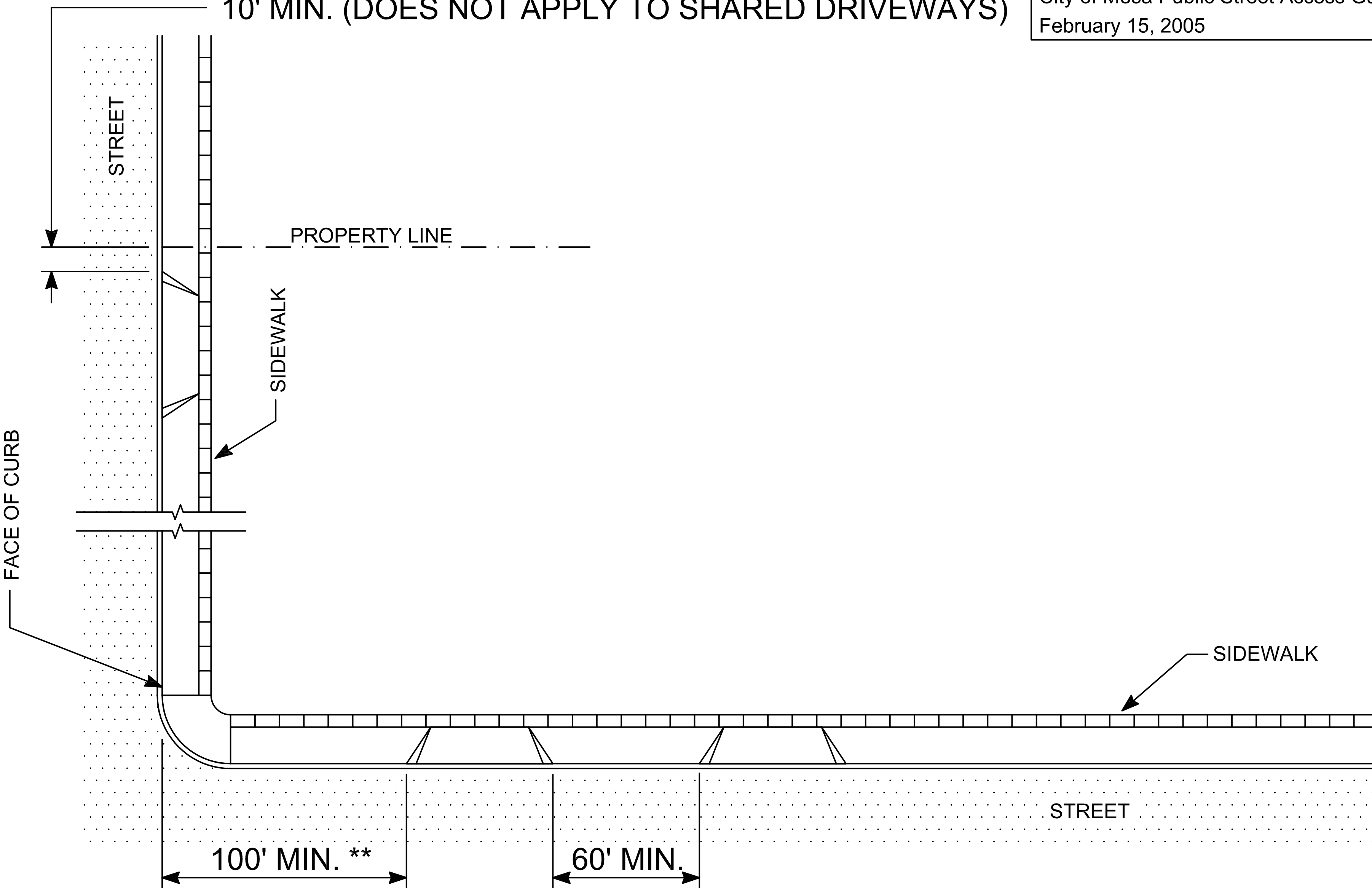
FIGURE 1 CONTROLLED VEHICULAR ACCESS EASEMENT



NOTES

1. EXPANSION JOINTS TO BE CONSTRUCTED AT EACH SIDE OF DRIVEWAY DEPRESSION AT POINTS OF CURVATURE AND AT ALL RIGID STRUCTURES.
2. ALL CONCRETE SHALL BE CLASS "A" AS PER SECTION 725.
3. ALL COMMERCIAL DRIVEWAYS AND ALLEY ENTRANCES ARE TO BE 6" THICK ON 4" A.B.C. OR 8" THICK ON COMPACTED NATIVE.
4. ALL COMMERCIAL DRIVEWAYS SHALL BE PROVIDED WITH CONTRACTION JOINTS AT DRIVEWAY CENTER LINE, AT BREAK BETWEEN SIDEWALK AND DRIVEWAY WINGS AND FROM BACK CORNER OF APRON TO LIP OF GUTTER; BOTH SIDES OF DRIVEWAY. THE CONTRACTION JOINTS MAY BE EITHER SCORED OR SAWCUT 1-INCH DEEP.
5. FINISH GRADE ELEVATION SHALL BE EQUAL TO THE TOP OF CURB ELEVATION UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER. ANY CHANGE IN ELEVATION SHALL BE CLEARLY NOTED ON APPROVED PLANS.
6. FINISH CURB ELEVATION SHALL TRANSITION UNIFORMLY FROM FULL HEIGHT CURB ELEVATION TO DEPRESSED CURB ELEVATION.
7. WHEN INSTALLING A DRIVEWAY IN EXISTING SIDEWALK AND/OR CURB, THE FOLLOWING NOTES APPLY:
   A. REMOVE CURB PORTION ONLY WHEN CONSTRUCTING NEW DEPRESSION IN EXIST.CURB. & GUTTER. EXISTING CURB SHALL BE REMOVED BY SAWCUTTING CURB HORIZONTALLY TO GRADES AS SHOWN IN DETAIL A. DAMAGED GUTTER SHALL BE REMOVED AND AND REPLACED WHERE DIRECTED BY ENGINEER.
   B. SIDEWALK MUST BE SAWCUT TO FULL DEPTH OR REMOVED TO NEXT EXPANSION JOINT.
8. INSTALL (2) 3" SCH. 40 P.V.C. CONDUITS AT 7' BACK OF CURB, MIN. 24" BELOW FINAL GRADE, AND EXTEND 2' MIN. BEYOND EDGE OF SIDEWALK FOR POSSIBLE FUTURE LANDSCAPING OR ST. LIGHT INSTALLATION. INSTALL PLUGS IN BOTH ENDS OF CONDUITS.
9. 1/4" GROOVES AT 1" O.C. FULL WIDTH OF 5' WARP SECTION, EACH SIDE OF DRIVEWAY. SEE DETAIL NO. 1 ON TYPE D RAMP, M.A.G. DET. 234.

FIGURE 2 — CITY OF MESA M-42 DRIVEWAY DETAIL



** MAY BE REDUCED TO 75' FOR UNUSUAL CONDITIONS IF APPROVED BY TRAFFIC ENGINEERING

MINIMUM 300' FRONTAGE FOR TWO DRIVEWAYS

FIGURE 3	DRIVEWAY LOCATION

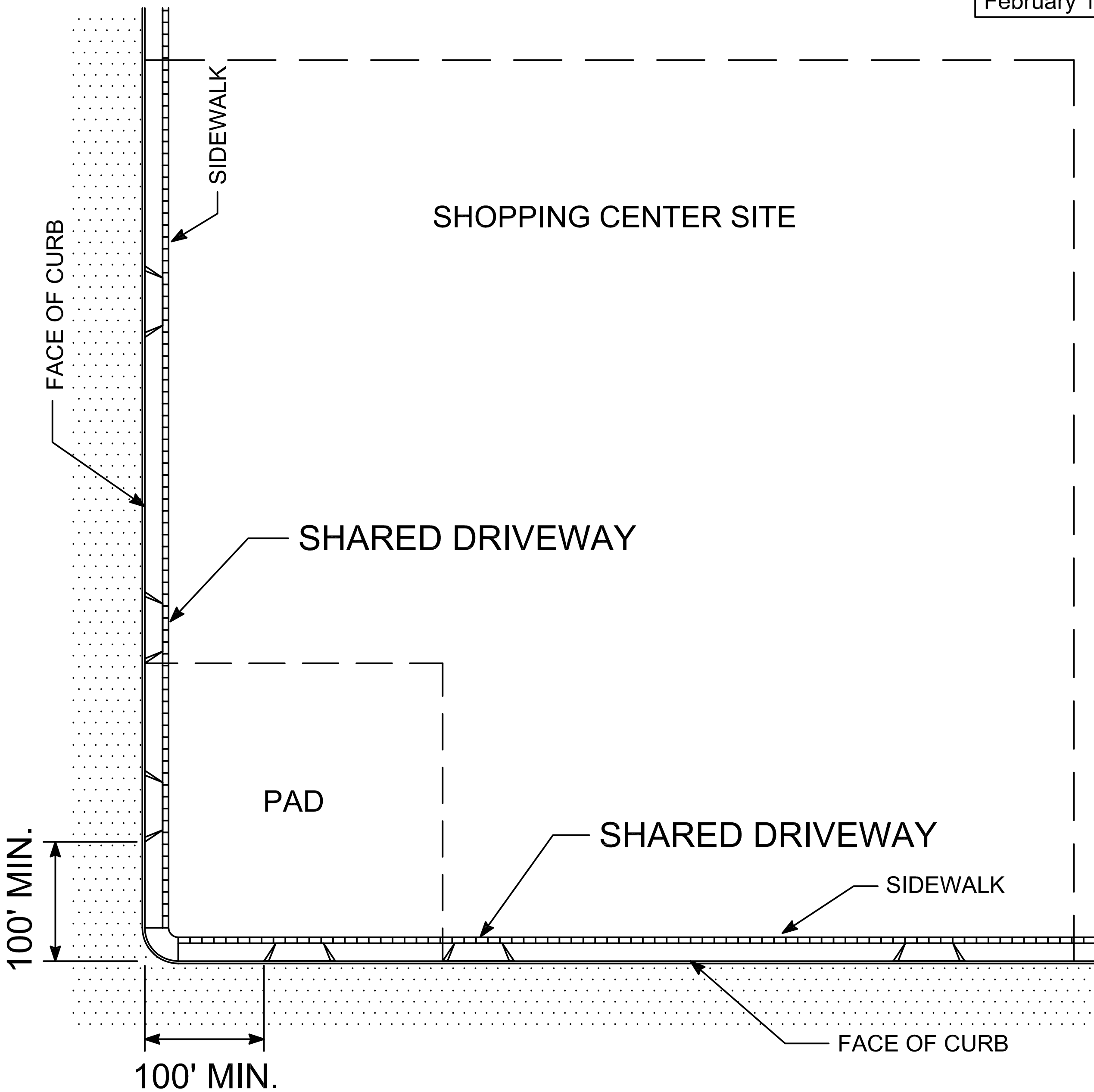
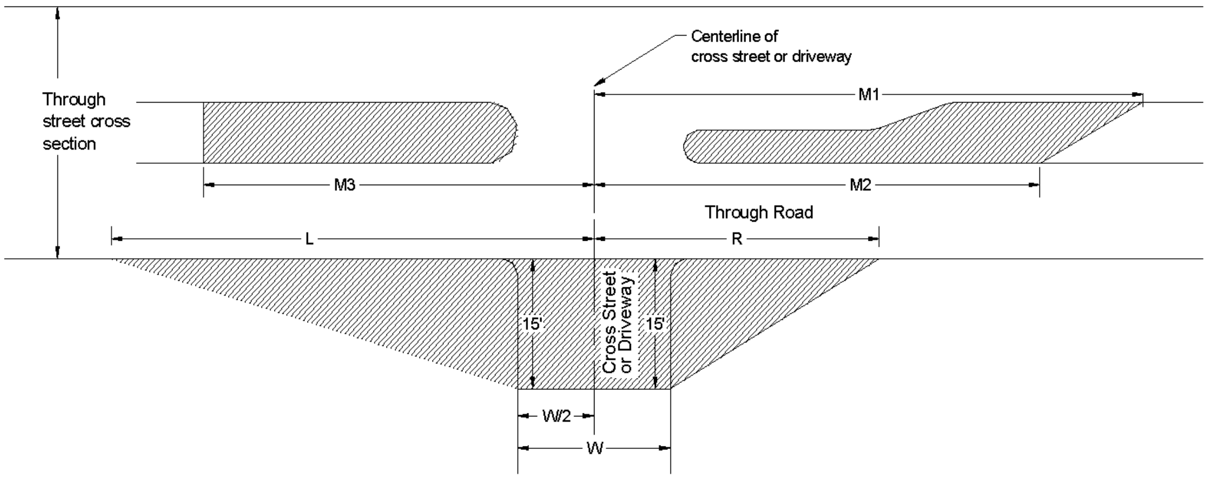


FIGURE 4	JOINT USE DRIVEWAYS



LU = lanes undivided (i.e., road without a raised center median) LD = lanes divided (i.e., road with raised center median)

Speed Limit of Through Road	Cross-Section of Through Road	L (feet)	R (feet)	M1 (feet)	M2 (feet)	M3 (feet)
25	2LU (34')	245	135	-	-	-
	2LU (40')	190	125	-	-	-
35	2 LU (40')	250	165	-	-	-
	3LU (46' & 48')	270	145	-	-	-
40	5LU (68')	315	145	-	-	-
	4LD (72')	325	140	515	380	255
	7LU (88')	345	130	-	-	-
	6LD (94')	340	120	555	430	275
45	5LU (68')	350	160	-	-	-
	4LD (72')	355	145	575	420	280
	7LU (88')	385	145	-	-	-
	6LD (94')	375	135	615	475	305

Values of "L", "R", "M1" and "M2" are based on 2001 AASHTO Intersection Sight Distance Guidelines for Case B1 – Left Turn Maneuver From STOP, Level Grade, Passenger Car.

Values of "M3" are based on 2001 AASHTO Intersection Sight Distance Guidelines for Case F – Left Turns From Major Road Level Grade, Passenger Car.

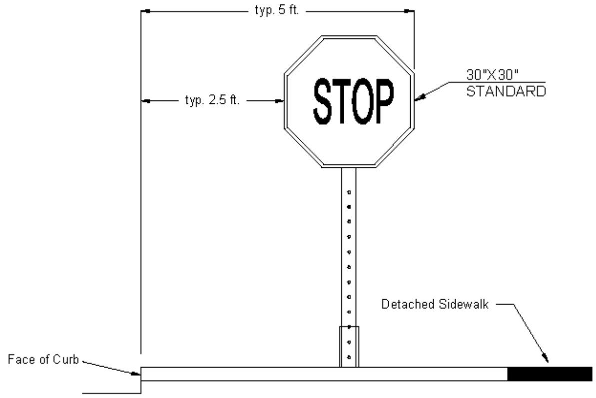
Reductions to the values of "L", "R", "M1", "M2", and "M3" should be made to account for the cross-street width ("W") by subtracting one-half the cross-street width ("W"). For example, if the cross-street is 30 ft. wide, a reduction equal to 15 ft. (i.e., 30'/2 = 15') can be made to the values of "L", "R", "M1", "M2", and "M3" in each case.

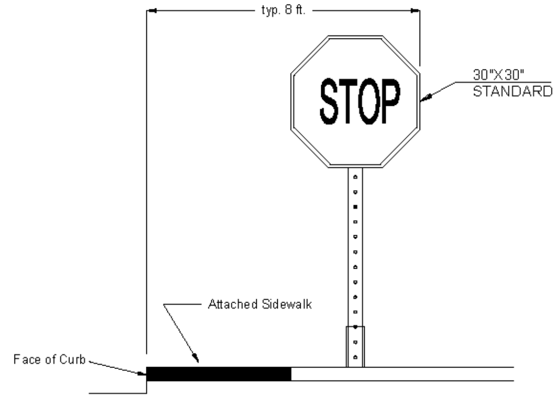
Values reflect a driver's eye position 15 ft. back from face of through road curb, and on the centerline of the approach/cross-street. Values for "M3" are for a left turning through road driver's eye position at the centerline of the cross-street and 5.5 feet off of the through road median.

Values in the table are based on sight distances calculated for 5 mph over the posted speed limit.

FIGURE 5	SIMPLIFIED SIGHT DISTANCE DESIGN GUIDELINES

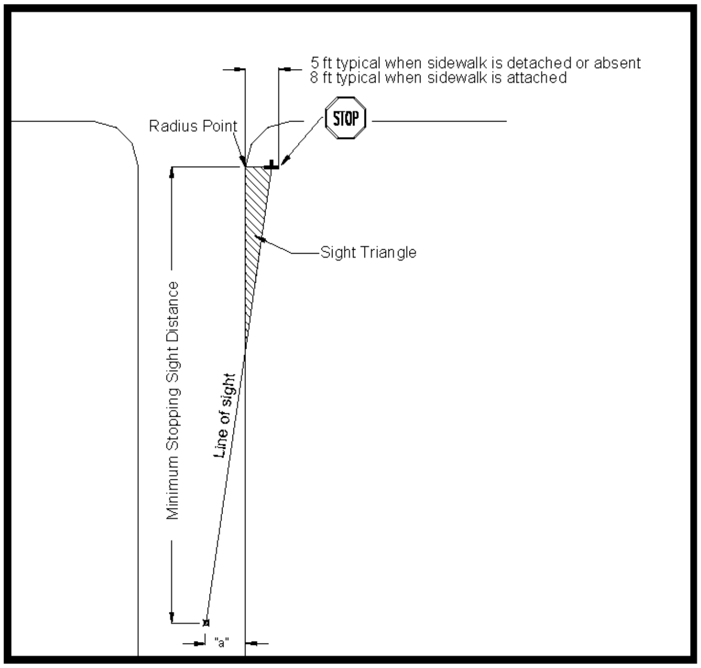
NOTE: This is the same as Figure 2.15 of the Engineering & Design Standards, 2005





Speed Limit of street approaching STOP sign (mph)	Minimum Stopping Sight Distance (feet)
25	200
30	250
35	305
40	360
45	425
50	495

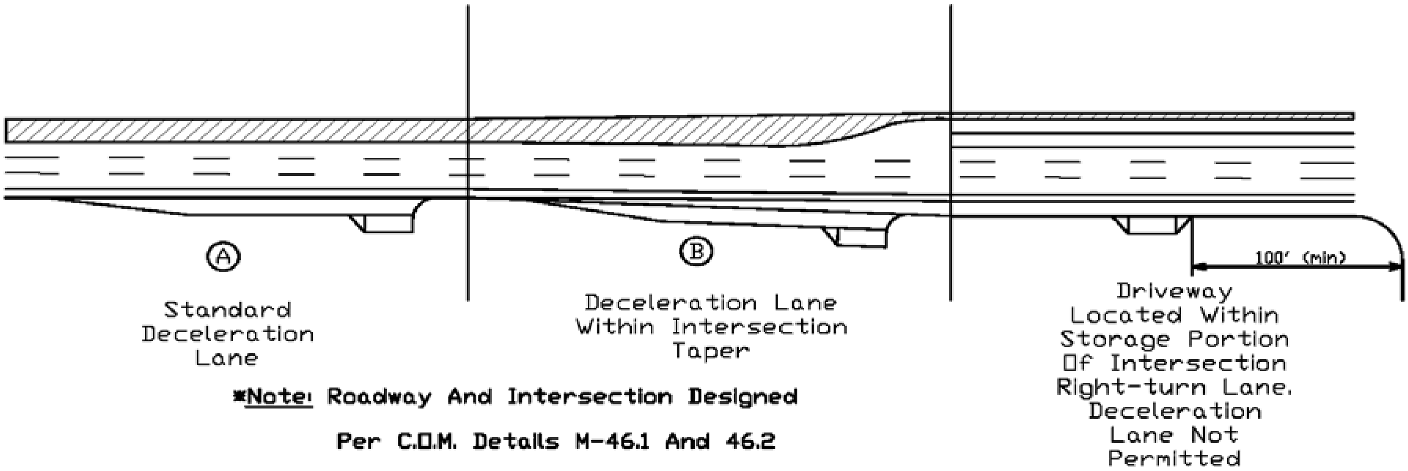
Minimum Stopping Sight Distances in this table are for 5 mph over the posted speed limit.

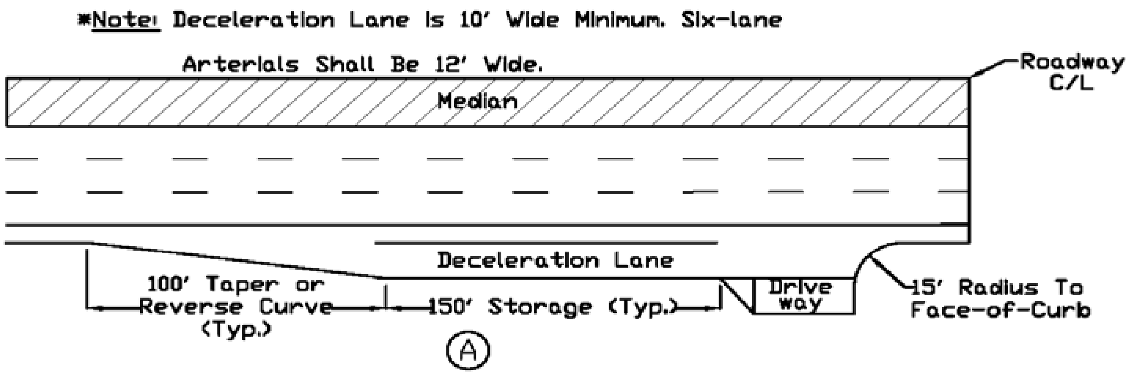


Cross-section of STOP controlled road	"a" (feet)
2LU (34')	12
2LU (40')	11.5
2LU (48')	18
3 LU (46')	11.5
3 LU (48')	11.5
4LD (68')	11
4LD (72')	11.5
5LU (68')	12
6LD (88')	10
6LD (94')	11.5
7LU (88')	11
2LU with curb extensions narrowing travelway to single lane in each direction	5

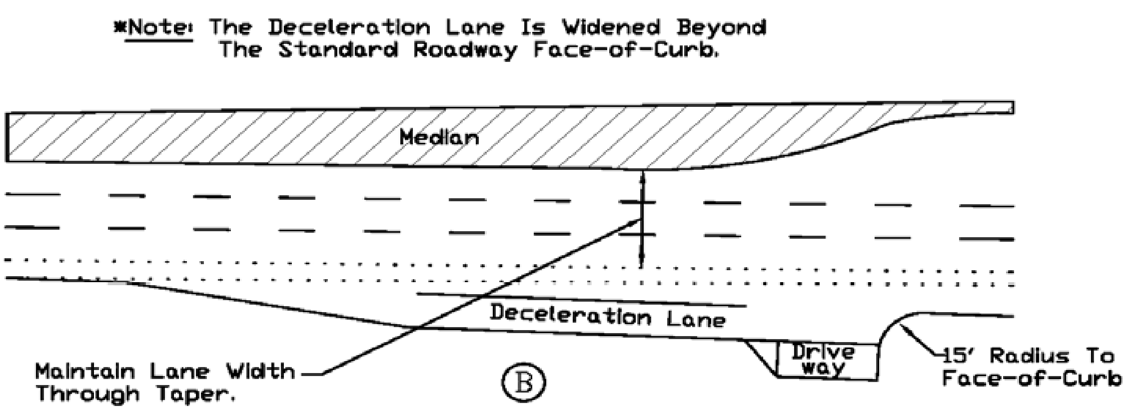
FIGURE 6	SIGHT DISTANCE REQUIREMENTS FOR STOP SIGNS

NOTE: This is the same as Figure 2.16 of the Engineering & Design Standards, 2005





Standard Deceleration Lane



Deceleration Lane Within Intersection Taper

FIGURE 7	DECELERATION LANE TREATMENTS

NOTE: This is the same as Figure 2.14 of the Engineering & Design Standards, 2005.

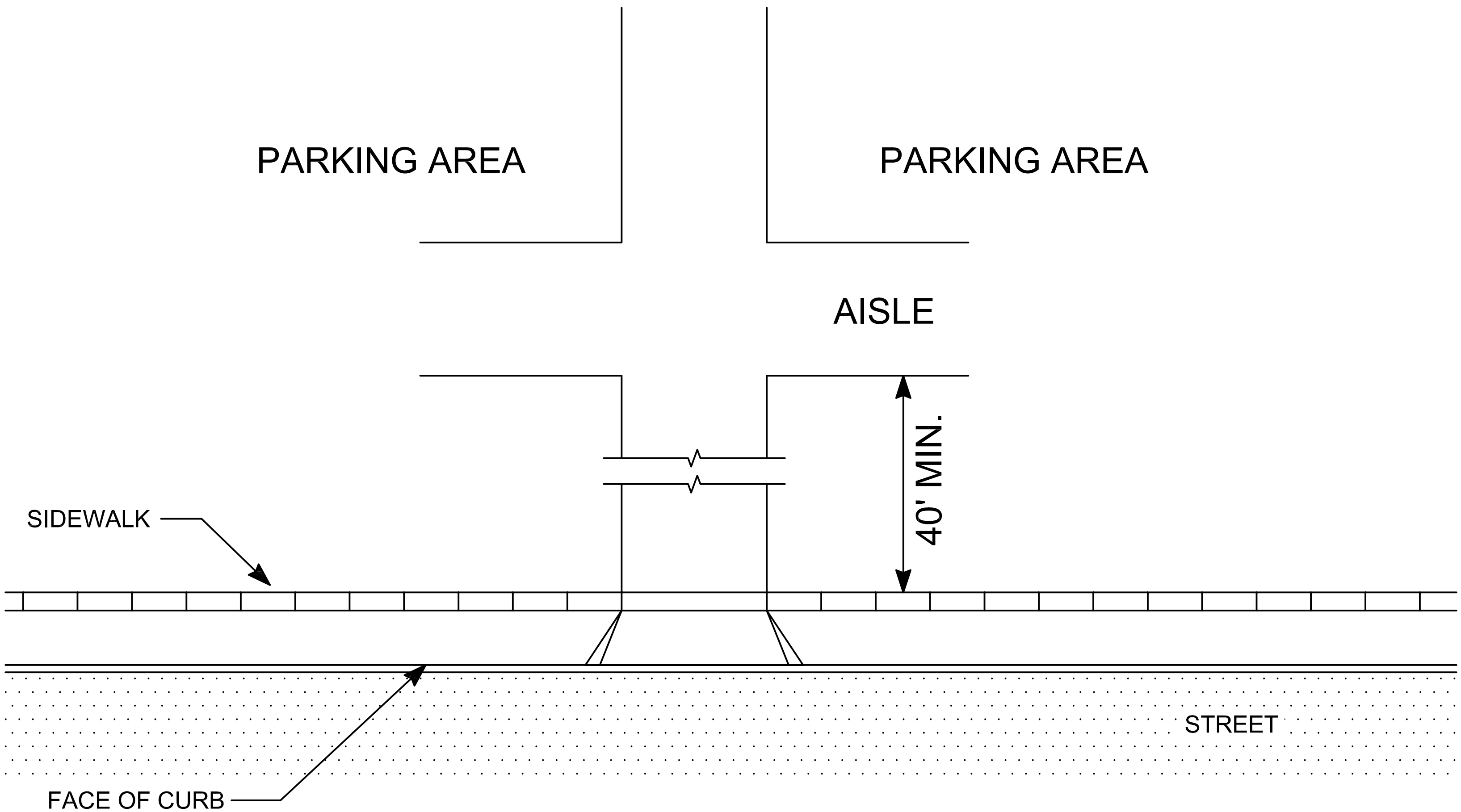


FIGURE 8

INTERNAL PARKING LOT AISLE

SUGGESTIVE ACCESS MANAGEMENT PLAN 1

Driveway Spacing – The distance between adjacent driveways should be adequately spaced to allow vehicles to safely queue, accelerate, decelerate, and cross conflicting traffic without interference to through traffic or other adjacent driveways. The width and the radii of the driveway should be designed to accommodate entering and exiting vehicles efficiently and safely. Sight distance must be adequate at each driveway. The number of driveways should be limited to minimize traffic conflicts. Table *1: Driveway Spacing* presents the driveway spacing recommended for the City of Benson.

Table 1: Driveway Spacing

Land Use	Posted Speed	Driveway Type	Arterial and Collector Minimum Spacing (ft)
Single Family	25	S-1 (Single Family)	65
Single Family	30	S-1 (Single Family)	85
Single Family	40+	S-1 (Single Family)	105
Multi-Family	Low Volume	M-1(Low Volume Residential	65
Multi-Family	High Volume	M-2 (High Volume Residential)	330
Commercial	All	CL-1 (Low Volume Commercial)	165
Commercial	All	CH-2 (High Volume Commercial)	330
Industrial	All	CL-1 (Low Volume Commercial)	165

In addition, a new driveway or a driveway with changed access should not be allowed under the following conditions:

- Within 20 feet of any commercial property line, except when it is a joint use driveway serving two abutting commercial properties and access agreements have been exchanged and recorded by the two abutting property owners.

- Within 25 feet of guardrail ending

- Within 150 feet of a bridge or other structure, except canal service roads, as long as the sight distance requirements are met.

- Within the minimum driveway spacing as presented in this section.

- When adequate sight distance cannot be provided for vehicles on the driveway attempting to access the street, because those movements will be prohibited.

- When the nearest edge of any driveway flare or radius must be at least 2 feet from the nearest projection of a fire hydrant, utility pole, drop inlet, traffic signal, or light standards.

- For parking loading areas that require backing maneuvers in a public right of way except for single family or duplex residential uses on local roadways.

- If a property has frontage on more than one street, access will be permitted only on those street where standards contained in this manual and other City regulations can be met.
- Exceptions may be made by the City in cases where the application of these standards would create an undue hardship to the abutting property owners and good traffic engineering practice can be maintained.

Driveway Location – The location of access for properties on opposite sides of the highway shall be coordinated so that they do not interfere with each other.

- Driveways should be located directly across from each other to ensure that they share a single access location.

- Where lots are not large enough to allow accesses on opposite sides of the street to be aligned, the center of driveways not in alignment will normally be offset a minimum of 165 feet on all collector roads, and 330 feet on all industrial, major, and arterial roads. Greater distances may be required if left turn storage lengths require them.

- Joint accesses will be required for two adjacent developments where a proposed new access will not meet the spacing requirements set forth in this section. The City must approve joint accesses.

Driveway Corner Clearance - Each access should have adequate corner clearance by keeping driveway entrances away from intersections. The following figures present recommended corner clearance lengths for local roads. The corner clearance for state routes vary, and are determined according to ADOT. Therefore, traffic impact studies must be prepared and approved by ADOT for all access points onto state routes.

APPENDIX D

Suggestive Traffic Impact Analysis Guidelines

TIA Report Contents
The report chapters listed in table 33 provide guidance to the developer as to what needs to be included in a final report for the City of Benson.

Proposed Development
The TIA report should include a description of the proposed site location, proposed site plan, land use, and development phasing. A map of the study area is required. The description of the proposed development should provide as much details as possible including specific tenants, if known; specific types of uses such as banks, fast food restaurants; intensity of each land use in terms of number of dwelling units, or square footage of gross building area. The proposed opening data for the proposed development must be included.

Study Area
A description of the existing and future land uses in the study area must be described. The study area will vary depending on the extent of the proposed development. A large development will generate more traffic and influence a larger geographical area than a smaller development. The minimum study area will be determined by the project type and size as illustrated in the table *TIA Study Requirements below*. The consultant should contact the City of Benson to obtain approval and/or agreement on the study map.

TIA Study Requirements

Ultimate Development Characteristics	Study Horizons*	Minimum Study Area***
Small Development (<500 peak hour trips)	Opening Year	• Site access driveways • Adjacent signalized intersections and major unsignalized street intersections
Moderate Development (Single Phase) (500-1000 peak hour trips)	Opening Year 2-5 Years After Opening	• Site access driveways • All signalized intersections and major unsignalized street intersections within ½ mile
Large Development (Single Phase) (>1000 peak hour trips)	Opening Year 5 Years After Opening** 3-10 Years After Opening	• Site access driveways • All signalized intersections and major unsignalized street intersections within 1 mile
Moderate or Large Development (Multi-Phase)	Opening Year 5 Years After Opening** 3-10 Years After Opening	• Site access driveways • All signalized intersections and major unsignalized street intersections within 1 mile

* Assume full occupancy and build-out
** Not required if the traffic impacts of the project are fully mitigated 10 to 15 years after opening with exiting conditions plus 5 year programmed improvements.
*** An enlarged study area may be required for certain developments.

Analysis of Existing Conditions

The report must include analysis and traffic conditions of the existing roadway including:

- Physical roadway conditions
    - Roadways serving the site
    - Roadway cross section and lane configuration
    - Lane configuration of intersection approaches
    - Posted speed limit
    - Location of existing driveways
    - Existing traffic signal timing and phasing
- Traffic volumes
- Traffic control of roadway and intersections
- Roadway and intersection levels of service
- Safety conditions

Information on 24-hour traffic volumes on the major roads in the study area should be provided. Estimated 24 hour traffic volumes may be used, with approval from the City, in the case of low volume roads. Recent counts may be used if they are less than 1 year old and available, several factors can be used to adjust the traffic volumes. The peak hour turning count should be taken at all major intersections within the study area. Capacity analysis will be conducted for all required locations using the latest Highway Capacity Manual (HCM) procedures. The three year accident history should be analyzed to identify accident problems and patterns.

Future Traffic Forecasts

Estimation of future traffic volumes include

- Generation of site traffic
- Estimation of non-site traffic including pass-by trips, if applicable
- Distribution of site traffic to other land uses and activity centers
- Assignment of site traffic to the study area roadway

Site traffic estimation will be completed for each horizon year. Traffic volumes will be estimated using the trip generation rate or equations published in the latest edition of the ITE Trip Generation Manual. The distribution of site traffic to and from potential destinations must be estimated and should be indicated in a tabular form or illustrated in a figure as percentages of total site traffic. The projected site traffic volumes will be assigned to the roadways using the estimated distribution and added to the non-site traffic. The non-site or background traffic is the traffic that would be on the roadways if the site was not developed. The non-site traffic may be estimated using one of the following methods.

- Trend growth rates
- Combination of trends and estimation of other proposed land uses

Site and non-site volumes will be combined to show the total estimated traffic volumes on the roadways at build-out of the site.

Traffic and Improvement Analysis
Total traffic will be projected to analyze the roadways in the study area. Analysis includes:

- Site access
- Level of service of the roads and intersections
- Traffic control needs
- Improvement analysis
- Traffic safety
- Improvement costs

Site Access
Access driveways should be analyzed with respect to capacity, traffic operation and safety. Driveways should be designated and located in accordance with the City's access management guidelines.

Level of Service
Level of service analysis should be conducted on all major intersections with the following conditions:

- Base roadway conditions without site traffic for the horizon year(s)
- Base roadway conditions with total traffic (site plus non-site traffic) for the horizon year(s)
- Roadway and intersection improvements for horizon(s), if required

The base roadway conditions include the existing conditions plus any programmed improvements. The level of service analysis for signalized and unsignalized intersections should be conducted using procedures from the latest edition of the Highway Capacity Manual (HCM).

Improvement Analysis
The roadways and intersections within the study area will be analyzed with and without the proposed development to identify any projected impacts in regard to level of service and safety. The following conditions need to be noted:

Where the roadway will operate at LOS C or better without the development, the traffic impact of the development on the highway will be mitigated to LOS C.

Where the highway will operate below LOS C in the horizon year(s) without the development, the traffic impact of the development will be mitigated to provide the same LOS at the horizon year(s).

Roadway improvements will be required if the roadway or intersections will operate at LOS C or better without the improvement, but will operate at LOS C or worse with the improvement. For a limited TIA the improvement analysis should focus on whether the existing surface type/condition is appropriate for the proposed development.

Traffic Control Needs

The analysis will indicate the appropriate type and location of traffic control such as stop signs or traffic signals. A proposed traffic signal must meet traffic signal warrants. If a signal is warranted, the analysis will discuss:

- Location of the signal related to the intersection and access driveways
- Traffic signal actuation and phasing
- Traffic signal progression, if needed

Traffic Safety

The report will include a review of roadways and access driveways for safety including:

- Access driveways designed to permit vehicle to enter the site without impeding traffic
- The need for auxiliary speed change lanes
- Adequate storage length for turning vehicles
- Adequate sight distance at intersections and access driveway
- Alignment of intersections and driveways opposite the site's access drives where possible
- Analysis of three years of accident data

Improvement Costs

The report will include estimated costs for the proposed improvements.

Certification

The TIA report will be prepared under the supervision of a Professional Civil Engineer registered in the State of Arizona. The final TIA report will be signed and sealed by a Professional Civil Engineer.