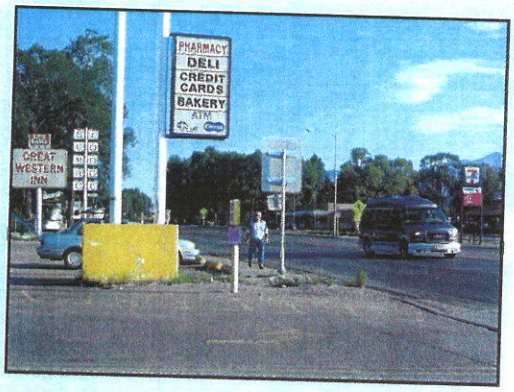

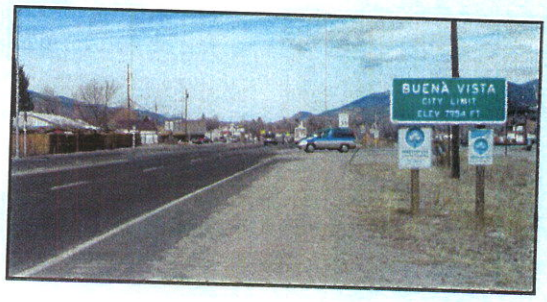

Final

TRANSPORTATION MASTER PLAN

TOWN OF BUENA VISTA
210 E. MAIN STREET
BUENA VISTA, CO 81211

MARCH 10, 2004

PREPARED BY:

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1.0 INTRODUCTION

The ability to move about in the Buena Vista area is an important factor influencing quality of life for residents and visitors of the community. Traffic along the existing roadway system, and on State Highway (SH) 24 in particular, is growing. The existing railroad and the adjacent SH 24 provide real physical limits to accessibility in the Town today due to limited crossings and protected access (signalization) at intersections with the highway. This Transportation Master Plan looks at all modes of traffic and accessibility in the Town to help insure that the future transportation needs of the community are met.

1.1 Background for the Transportation Master Plan

In November 1999, the **Town of Buena Vista Comprehensive Plan** was adopted. The Comprehensive Plan was developed to provide a framework for shaping the future of the Town development and surrounding areas. Planned land use zoning and anticipated development for vacant land in the Town are identified in the Comp Plan. The Town is currently updating its Comprehensive Plan to create a more specific set of data to guide future development and growth in the area. This Transportation Master Plan is intended to address the specific local transportation needs of the Buena Vista community based on current and future land use growth projections. In preparing this Master Plan, meetings with Town staff to identify existing circulation deficiencies for all modes of traffic were conducted, as well as to coordinate future traffic growth projections with the ongoing efforts of the Comprehensive Plan update. Drafts of the transportation master plan were presented to the Town Planning Board and Council. Any comments made on the draft plans are addressed in this final Plan.

1.2 Goals and Objectives

The primary goal of the Transportation Master Plan can be stated as: to facilitate a safe, efficient, integrated, and appealing transportation system in the Buena Vista community.

Objectives of the Plan include:

- expand mobility by all modes of travel;
- improve connections between travel modes;
- expand and enhance pedestrian and bicycle facilities;
- reduce traffic congestion and associated negative impacts;
- complete missing links;
- support community vision and goals regarding future land use development and growth;
- facilitate connections with regional transportation systems.

This Plan focuses on the existing and future transportation issues confronting the Buena Vista as defined above. It is not intended to reproduce, replace, or supercede any of the existing Town, Arkansas valley-wide, county-wide, or regional transportation plans recently developed. Rather, this Plan is intended to supplement any broader scope plans with a focused look on the pressing issues in the Town area.

2.0 EXISTING CONDITIONS

2.1 Land Use Pattern, Population Growth, and Seasonal Influences

The Town of Buena Vista has a current population of approximately 2,500 people. Historic population statistics indicate that the Town grew at approximately 3.7% per year between 1995 and 2000, and that the growth rate will reduce to an average of approximately 1.5% per year in the next 20 years. This growth rate may be higher in the next 5 years based on current development plans proposed, but should level out over the 20-year period. The existing land use pattern in Buena Vista contributes to the current emphasis of automobile travel, particularly as it relates to the Main Street or SH 24 corridor.

2.2 Automobile Traffic, Roadway Capacity, and Congestion

Prior to developing future transportation needs in the Town, existing summer traffic data at various locations throughout the area were collected in July 2003 on a peak Friday and Saturday. According to staff, traffic is higher on Town roadways in July than other months of the year, hence the traffic data was collected during this month. In addition, existing transportation and planning documents were reviewed to evaluate the existing transportation system. Current weekday average daily traffic (ADT) counts were collected on a 48-hour basis to determine peak summer Friday and Saturday traffic variations. During the Friday count day, both morning (7:30 - 8:30 AM) and evening peak hour (4:30 - 5:30 PM) periods were analyzed at four intersections. The count locations and traffic volume results are shown on Figure 1, as well as supplementary traffic count data collected in June 2003 for Rancho Rodeo residential project traffic study. The figure illustrates the existing roadway system, intersection control, and lane configuration. The community activity centers are illustrated on Figure 2.

The data on Figure 1 shows that only a couple roadway sections experience higher traffic on a summer Saturday as compared to a summer Friday. The section of SH 24 south of Steele Drive and CR 319 south of Steele Drive at the airport experience slightly higher traffic on Saturdays. This is due to the increase in airport flight activity and visits on weekends. Traffic volumes on roadways in the community have been steadily increasing over time. CDOT traffic count data from year to year indicates that traffic on SH 24 increased from 1990 to 1996 at the south end of Buena Vista at approximately 5% per year and the north end of SH 24 increased at approximately 7.5% per year.

The highest existing traffic volumes in town are experienced at the intersections of SH 24 with Main Street and at the City Market access intersection (also intersects with 7-11 access on the east). A review of how these higher volume intersections are operating was conducted. In determining the operational characteristics of an intersection, "Levels of Service" (LOS) A through F are applied, with LOS A indicating very good operations and LOS F indicating congested operations. The intersection LOS is represented as a delay in seconds per vehicle for the intersection as a whole and for critical turning movements. Further discussion of LOS definitions is attached in the Appendix. Criteria contained in the Highway Capacity Manual (HCM)[1] was applied to the study area intersections in order to determine existing levels of service during peak hour periods. Existing peak hour operations of these locations are described below. Intersection capacity worksheets for the P.M. peak hour period at the two intersections are attached in the Appendix for reference.

- SH 24 / Main Street Intersection: This is the only signalized intersection in Town with timing allowing for minimal pedestrian crossing and permitted only left-turn movements at each approach (no left-turn arrow). Because of this permitted left-turn condition, the over 200 northbound left-turning vehicles during the P.M. peak hour period must yield to all oncoming southbound traffic. The northbound left-turning vehicles experience delays in the LOS D-E range and extensive queuing. In addition, the east ane westbound approaches on Main Street have shared left-through lanes which causes delays when considering the approach volumes and no left-turn phasing. This existing level of service rating warrants further review of the intersection to determine how best to minimize vehicle delays and maximum throughput on the corridors. It would be ideal to widen the eastbound and westbound approaches on Main Street to provide for a separate through lane, and eliminate the shared through-left-turn lane. With this widening, modifications to the signal timing to allow for protected/permitted left-turn movements would significantly improve the operations at this location. In addition to vehicular traffic movements, the east-west green time should be increased to allow for a longer pedestrian crossing phase as this is a major pedestrian crossing area. Currently, the minimal pedestrian crossing time of 4 feet/second seems to be applied to this location. This is the only existing protected crossing of SH 24 for pedestrian and vehicles in the Town.

- SH 24 / City Market-7-11 Intersection: Existing observations of this intersection during the peak summer traffic conditions revealed several safety concerns due to the left-turn conflicts at the closely spaced driveways along SH 24. One of the primary issues at this location appears to be inadequate parking supplies on the City Market site. This inadequacy causes vehicle queuing on the highway both in the center left-turn lane

[1] Highway Capacity Manual, Highway Research Board Special Report 209, Transportation Research Board, National Research Council, 2001. Synchro v. 6 (2003) software utilized.

and in the southbound outside through lane where right-turning vehicles queue to access the parking lot. When considering the P.M. peak hour volumes traveling through this intersection and the 7-11 access, the side street approaches to the intersection experience excessive delays. It is recommended that the parking supplies on the City Market site be increased to meet existing demands and reduce any vehicle queuing on the highway. If parking can not be increased on site, restricting left-turn outbound turning movements from the City Market and 7-11 access driveways onto SH 24 would significantly improve the overall circulation and access in this area. This turn restriction could be accomplished by constructing a raised median section either in the site driveways or on SH 24. Further study of this location is recommended prior to implementing circulation and access enhancements. Construction of any physical medians along SH 24 in this area would have an effect on adjacent property accessibility as nine driveways exist in this 300-foot section of SH 24.

2.3 Pedestrian and Bicycle Facilities

The community is currently served by a system of sidewalks and trails (hard and soft surfaced) but there are many discontinuities that make travel as a pedestrian challenging. Sidewalks typically only exist in the downtown area within one block of Main Street, along portions of SH 24, and along isolated roadways. Marked pedestrian crossings of SH 24 are located at Oak Street, Mill Street, Main Street, and south of Crossman Avenue. Although these are well signed crossing locations, the only crossing that allows for protected access to the SH 24 roadway is at the Main Street signalized intersection.

On-street bike lanes do not exist along SH 24. Wide shoulders provide for bike travel along sections of W. Main Street and Crossman Avenue. Where there are no formal on-street bicycle facilities, the Town should consider initiating a policy of posting "share the road" signs to encourage motorists to anticipate and safely interact with bicyclists that do travel on area roadways. Bicycle racks are only available in isolated locations. The 1999 Comprehensive Plan notes that the Community Trails Plan (1996) identifies five existing and proposed trails. The Community Plan identifies the following trails within the Town area.

- *Barbara Whipple Trail* - connection between River Park to Trout Creek Pass via BLM's Midland Rail Trail
- *Cottonwood Creek-Arkansas River Loop Trail* - partially completed with an ultimate link between McPhelemy Park with River Park along Cottonwood Creek and Arkansas Street
- *Crossman Trail* - proposed along portions of Crossman Avenue and Cottonwood Creek to link McPhelemy Park to the mountains on the valley's west side
- *Heart of the Rockies Trail* - should the UPRR ever abandon its rail line, there is a grant in place with Great Outdoors Colorado Legacy Project that would help construct a

proposed 178-mile trail ultimately planned to extend from Gypsum over the Tennessee Pass through the Arkansas River valley to Canon City

These potential trails and any other future trail location opportunities are illustrated on Figure 3 for reference.

3.0 PROJECTED LAND USE CHANGE AND GROWTH IN TRAFFIC

3.1 Residential Growth In And Around Buena Vista

This analysis focuses on the new residential growth potential in the Town. It is understood that additional non-residential facilities and services would be developed to serve the "other end" of the residential travel demand and will help determine the trip distribution patterns. But it is the increase in residential development that will shape the future of roadway needs. Areas of potential future residential and other growth corresponding to the Comprehensive Plan are shown on Figure 3.

Many of the residential growth areas are related to large lots (low density), and should not have a significant effect on traffic increases in the Town. The area south of Connie Drive is planned for up to 500-600 dwelling units. Approximately 300-400 dwelling units may also be added in north section of Town along Crossman Avenue. The Selby Mixed-Use project located south of E. Main Street may develop 200-300 multi-family residential dwelling units. Given this, there is the potential for an additional 1,000 - 1,300 dwelling units in and directly surrounding the Town. As a comparison, it is estimated that there are 1500 dwelling units within the Town limits today which would equate to an increase in housing of 1.7 times existing figures.

3.2 Future Traffic Volume Additions

The traffic additions associated with the new residential growth anticipated in the Town was estimated based on average residential traffic characteristics as contained in the Institute of Transportation Engineers (ITE) trip generation manual (7th Edition, 2003). Average daily trip rates for residential development are listed below.

Residential Type	Average Daily Trip Rate
Single Family (attached or detached)	9-10 one-way trips / unit
Multi-Family (condo, townhome, or apart.)	5-6 one-way trips / unit

When considering the daily traffic rates for residential units, the new travel demand that would be generated by the potential new residential development identified above could result in approximately 8,500 - 10,500 added vehicle trips in Town if residences are occupied year

round. Employment-based land uses are also planned within the Town which would be market driven according to demand. The residential land use traffic includes trips made to employment in the Town. New employment areas in Town are primarily limited to areas along Gregg Drive in the southern portion of town. Any roadway upgrades or connections anticipated to serve future residential and employment areas are identified in the following section.

4.0 IMPROVING MOBILITY AND CIRCULATION FOR ALL MODES OF TRAVEL

4.1 Pedestrian Facilities Plan

One of the foundations of this Plan is pedestrian facility improvements. Nearly all trips begin and end as pedestrian trips, and it is the intent of this Transportation Master Plan to encourage and allow more trips to be completed as pedestrian trips in their entirety. Part of the decision to make a trip as a pedestrian (and to leave one's automobile parked) is governed by the proximity of the destination and the availability of safe and convenient facilities.

Buena Vista has a group of active vision impaired pedestrians that have difficulty accessing the community. A major issue is the SH 24 corridor separating the east and west portions of the community and only one protected pedestrian crossing located at Main Street / SH 24. Providing audible pedestrian crossing devices at any existing or future signalized intersections would enhance vision impaired pedestrian accessibility. The land use decisions discussed above will help insure proximity of pedestrian destinations and this Plan will help insure that the facilities to support the trips are in place. Guidelines for pedestrian accessibility and enhancements are listed below.

- sidewalks should be incorporated into the existing street system;
- minimum sidewalk width should be 5 feet (where feasible);
- sidewalks should be constructed of concrete;
- bicycle racks are to be strategically placed throughout activity areas;
- lighting of sidewalks should be provided (via street lights or pedestrian scale lighting);
- where practical, intersection curb extensions should be provided to minimize pedestrian crossing distances;
- intersections with traffic signals should be equipped with pedestrian actuated pedestrian crossing signals;
- marked crosswalks should be provided
- consider installing flashing yellow warning lights at pedestrian crossing areas along SH 24 or pedestrian actuated signals (this option would need to go through CDOT approval)

The downtown area will continue to be a focus of pedestrian activity. Additional features of this area include sidewalks on both sides of every street, as well as an emphasis on providing curb extensions at key intersections to shorten pedestrian crossing distances and increase pedestrian visibility at crossing areas. Installing curb extensions at intersections along the SH 24 and Main Street corridors will shorten the pedestrian crossing distance and reduce the "side street" green time needed to serve pedestrians crossing. However, development on the corners of the SH 24 / Main Street intersection affects any widening or improvement issues. Examples of pedestrian median refuge design and curb extensions at an intersection are attached in the Appendix for reference. Vehicle and truck turning paths should be reviewed and included in the design of any curb extensions at intersections.

Buena Vista has a system of missing sidewalk links. The result has been that portions of the community are not easily accessible to pedestrians. This Plan represents a departure from that approach and recommends that sidewalks be constructed along roadways throughout the community unless physical or environmental issues are extremely prohibitive. Figure 3 shows approximate locations of existing or potential trail connections/alignments. Where practical, sidewalks along both sides of all arterial and collector roadways are recommended. The following goals for pedestrian access in the Plan are:

- complete missing links in the existing system
- provide access to schools
- improve connections between travel modes
- utilize additional funding sources

4.2 Bicycle Facilities

It is anticipated that the network of sidewalks and trails that serve pedestrians will also serve bicyclists. Many bicyclists will travel between their origin and destination with at least part of the trip on an off-street sidewalk, path, or trail. Therefore, off-street bicycle facilities are the same as the sidewalk and trail system. In this context, design standards (grades, curvature, sight distance etc.) for sidewalks and trails should reflect the needs of bicyclists as well as pedestrians.

Bicyclists may also travel with all or part of their trip along a roadway. Buena Vista has historically not provided designated on-street bicycle lanes. Many of the existing roadways that are not on the state system have narrow cross-sections, but bicyclists can be observed using them when no alternatives exist. West Main Street has wide paved shoulders that serve as both accessibility for pedestrians and bicyclists. It is recommended that the on-street bicycle system be a bicycle route marking system. Corridors that are important for connectivity should be signed with "share the road" messages to alert motorists to the potential to encounter bicyclists and to help facilitate their safe passing of each other.

4.3 Vehicular Accessibility

Roadway system enhancements or expansion alternatives were developed in this Plan based on future growth areas and existing deficiencies. The road network shown on Figure 3 includes the future major road improvement plan for the Town. All new roads are assumed to be two-lane roadways with auxiliary lanes as needed at intersections. Some of the roadways in the downtown area will include curb, gutter, and sidewalk to enhance pedestrian access and mobility. There will be additional road connections needed to provide access to or within the growth areas. All alignments of new or improved roadways shown in this Plan are conceptual. A Public Works Manual containing standard cross-sections for various types of Town roadways is nearing completion and should be referenced when identifying future roadway alignments and designs.

Improvement 1: *Steele Street - Gregg Drive Enhancements* - To provide additional east-west access on the southern portion of Town where greatest amount of land development is anticipated and relieve potential future congestion on SH 24 and Main Street, an east-west collector is proposed along Gregg Drive extending from SH 24 to County Road 306. The route is planned as a two to three-lane collector type roadway with a rural cross-section (paved 4-foot shoulders for bike access with no curb and gutter). This route will also provide for alternative pedestrian/bicycle access. The Town may want to consider developing a cross-section to include either on-street or off-street pathways for bike/ped travel. The proposed collector would ideally begin at the Buffalo Peaks Drive (CCR 317) east of SH 24 and extend across the railroad west to West Main Street (CCR 306). Construction of the east side of this roadway is dependent upon the Railroad allowing for a future additional crossing in Town. Should the UPRR abandon the rail line, this crossing will provide a beneficial access to the southeast area of Town. If this crossing is allowed, the new east leg of Steele Dr. at SH 24 will provide for direct access to the Mountain View subdivision and other areas located on the south east portions of Town including the Department of Corrections Facility. Signalization of this intersection with SH 24 may be necessary in the future if the east leg is allowed.

Improvement 2: *De Paul Avenue Enhancements* - This roadway currently is misaligned to the south with the SH 24 and Baylor Drive intersection. Reconfiguring this location to move the alignment and Railroad crossing slightly south to the De Paul Avenue section would allow for better east-west access in the future, especially if the east leg of the Steele Drive enhancement listed above is not an option. Extending this roadway as a 2 to 3-lane collector west from SH 24 to Westwinds Place will serve future development areas along this southern corridor. Signalization of the SH 24 / De Paul Avenue intersection would most likely occur if this enhancement is realized. If the Steele Drive extension east of SH 24 is realized, signalization of the DePaul Avenue / SH 24 intersection may not be necessary as a diversion in traffic to the Steele Drive intersection will occur.

Improvements 3-9, 13, and 15-16: Enhancements to Existing or Future Roadways - These roadway connections are either planned for in the Town or are recommended to serve future development areas. All roadways would be 2- to 3-lane collector type roadways. The reconfiguration of the Rodeo Road and Westwinds Place intersections with Main Street should occur to correct the existing offsets or angle approaches. An alternative to the Westwinds Place collector would be an extension of Susan Drive to the south from its current southern terminus. Further study of the Westwinds Place-Susan Drive extensions is recommended to determine the most appropriate alignment of future collector roadways to best serve the adjacent development patterns and planned internal roadway networks. All roadway alignments shown are conceptual, as actual alignments should be further reviewed prior to any design or construction.

Improvement 10: Signalization of SH 24 / Crossman Avenue - If volumes are realized at this intersection, signalization would be warranted to facilitate not only vehicular, but pedestrian/bicycle accessibility on the north end of Town. CDOT recently studied this intersection and recommended improvements. However, these improvements included reconfiguring the intersection. This reconfiguration may not be necessary, depending on development along the adjacent corridors in the future.

Improvement 11: Modify SH 24 / Main Street Signal/Geometry – As noted in the existing conditions section, this intersection experiences vehicular and pedestrian delays with its current signal timing and lane geometry. Widening of the eastbound and westbound approaches on Main Street to provide for a separate through lane, and eliminate the shared through-left-turn lane is recommended. With this widening, modifications to the signal timing to allow for protected/permitted left-turn movements would significantly improve the operations at this location. In addition to vehicular traffic movements, the east-west green time should be increased to allow for a longer pedestrian crossing phase.

Improvement 12: Enhance Pedestrian Crossing at SH 24 / Mill Street – To facilitate pedestrian travel along the SH 24 corridor, enhancements to this existing pedestrian crossing area are recommended. This crossing area is used by a variety of pedestrians, including students, elderly, and visually impaired persons. Enhancements to this crossing area would increase pedestrian visibility and safety. There are several options that could be considered at this location including installing yellow flashing lights, pedestrian actuated illumination of signs, lights in the crosswalk pavement section, elimination of left-turn movements in the northbound direction to provide a raised pedestrian crossing area, pedestrian actuated signalization, or even signalizing the entire intersection for vehicular access enhancements. Options at this location should be evaluated further prior to moving forward on enhancing this location to determine the most beneficial improvement.

Improvement 14: Pleasant Ave./Princeton Ave./San Juan Ave./W. Arkansas St. Intersection – Several streets come to intersect at this location which increases driver confusion as to whom

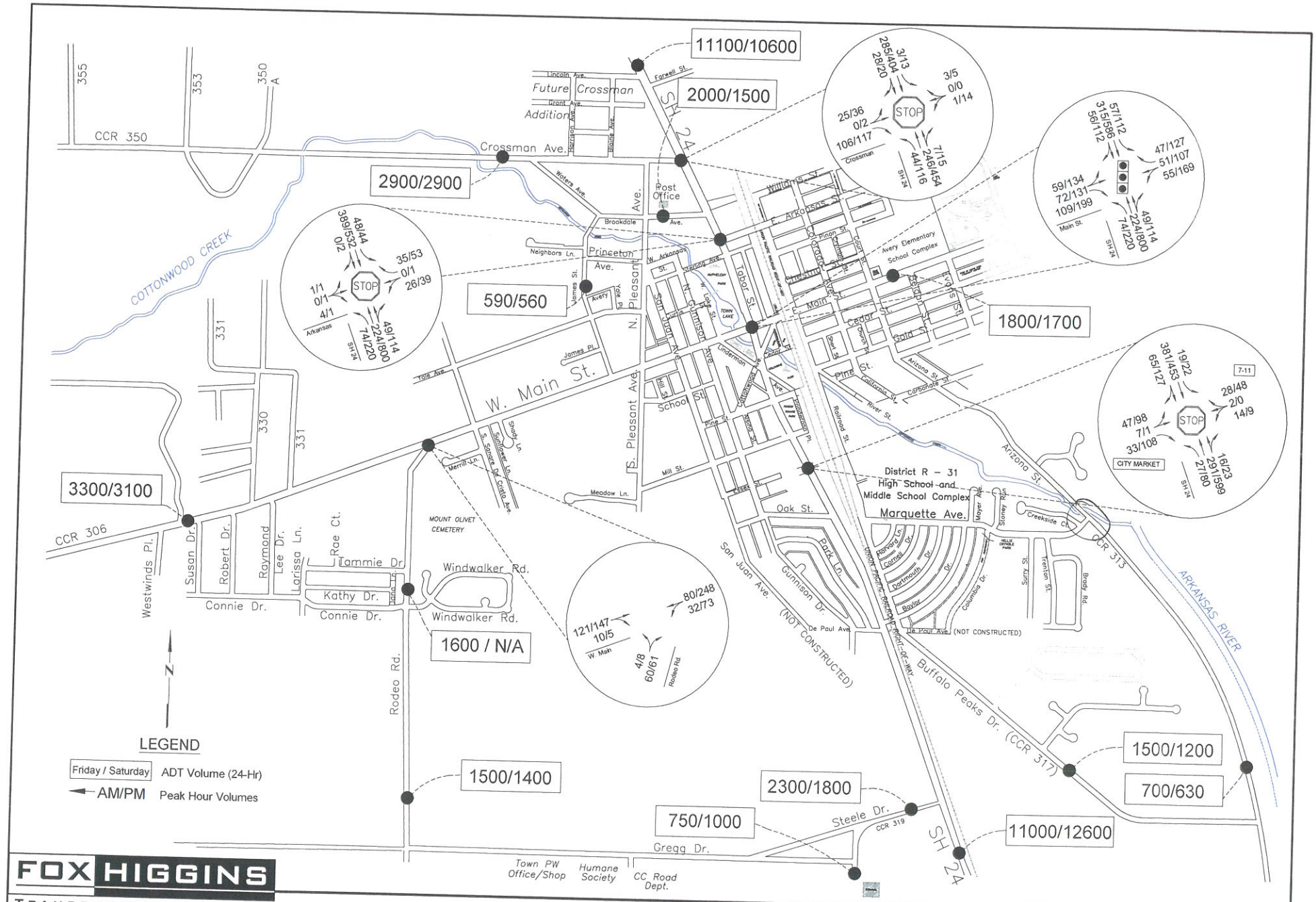
as the right of way. Residential uses exist adjacent to all streets at this intersection and limits the opportunities for improving circulation through this location. Improvements to help alleviate driver confusion may include realigning roadway approaches, limiting access, etc. This complex intersection may be a good candidate for an oval type roundabout. A roundabout would allow all existing roadways to access the intersection, but provide better circulation and reduce conflicts through the intersection. Further review of potential improvements at this intersection should be undertaken.

4.4 Transportation System Costs

Preliminary cost estimates for generalized improvements have been made to assist in the assessment of potential roadway improvements in the future. These cost estimates are very general and should only be used as a rule of thumb method in determining initial costs of a roadway project. Once a specific improvement and alignment is identified, a more detailed cost estimate should be made to determine the real cost of a project. General improvements and approximate costs for these improvements are listed below.

Improvement	Approximate Cost
– new 2-3 lane paved roadway section (w/o ROW)	$300 / linear foot
– Right-of-Way acquisition	$0.75-$1.00 / square foot
– new signal at 4-way approach intersection	$200 - 300,000 / intersection
– curb extensions (4-way intersection)	$30,000 / intersection
– median refuge (assuming median width exists)	$15,000 / location

A consideration for the Town may be to pursue the implementation of a traffic impact fee program. The purpose of a traffic impact fee program would be to provide adequate transportation facilities within the community to serve existing traffic and promote orderly development and growth by requiring new development to pay its share of future needs.



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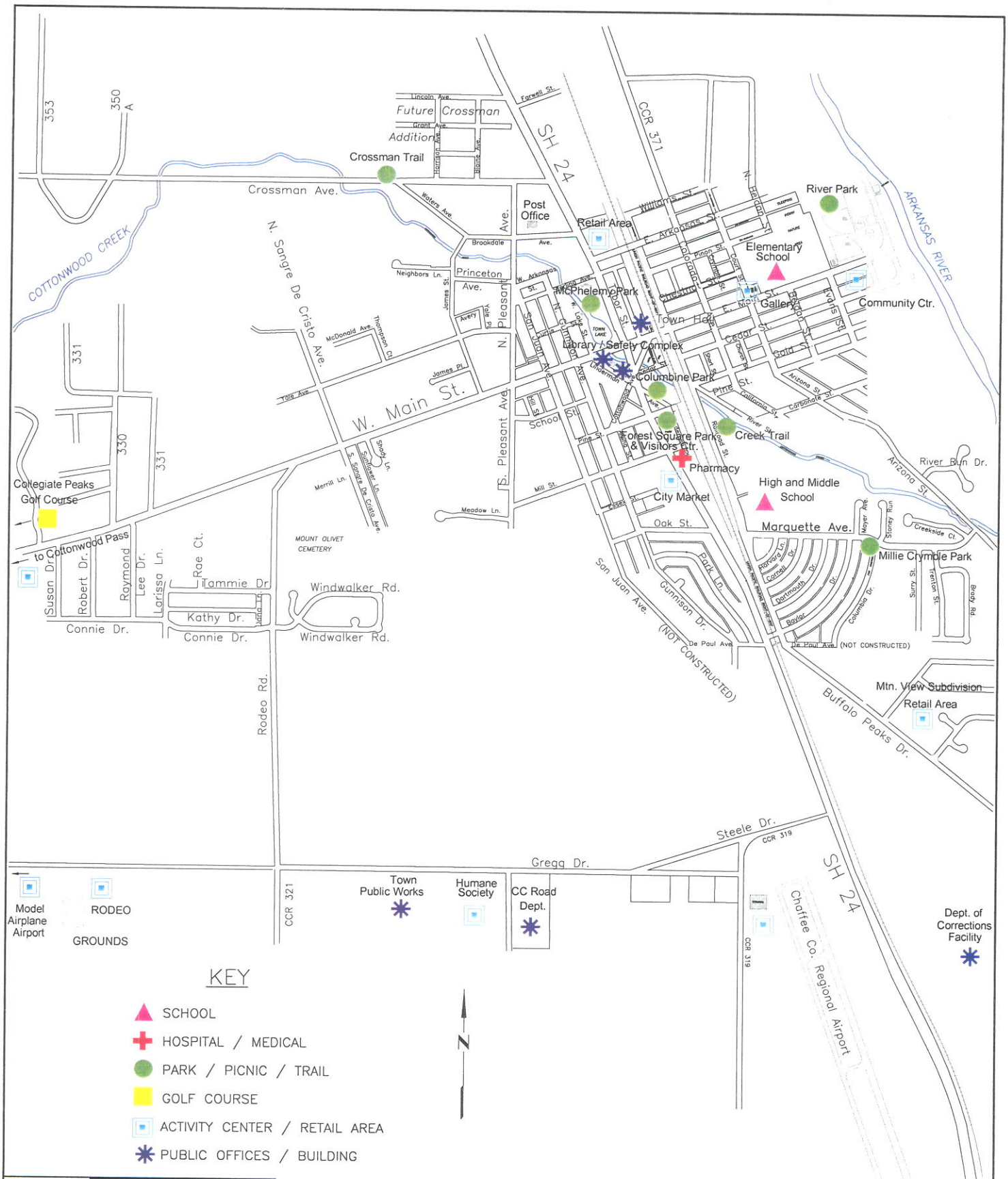
BUENA VISTA TRANSPORTATION MASTER PLAN

EXISTING TRAFFIC VOLUMES

FH Project #	03034	Original Scale	1"=1500'	Date	03/10/04	Drawn by	JAH	Figure #	1



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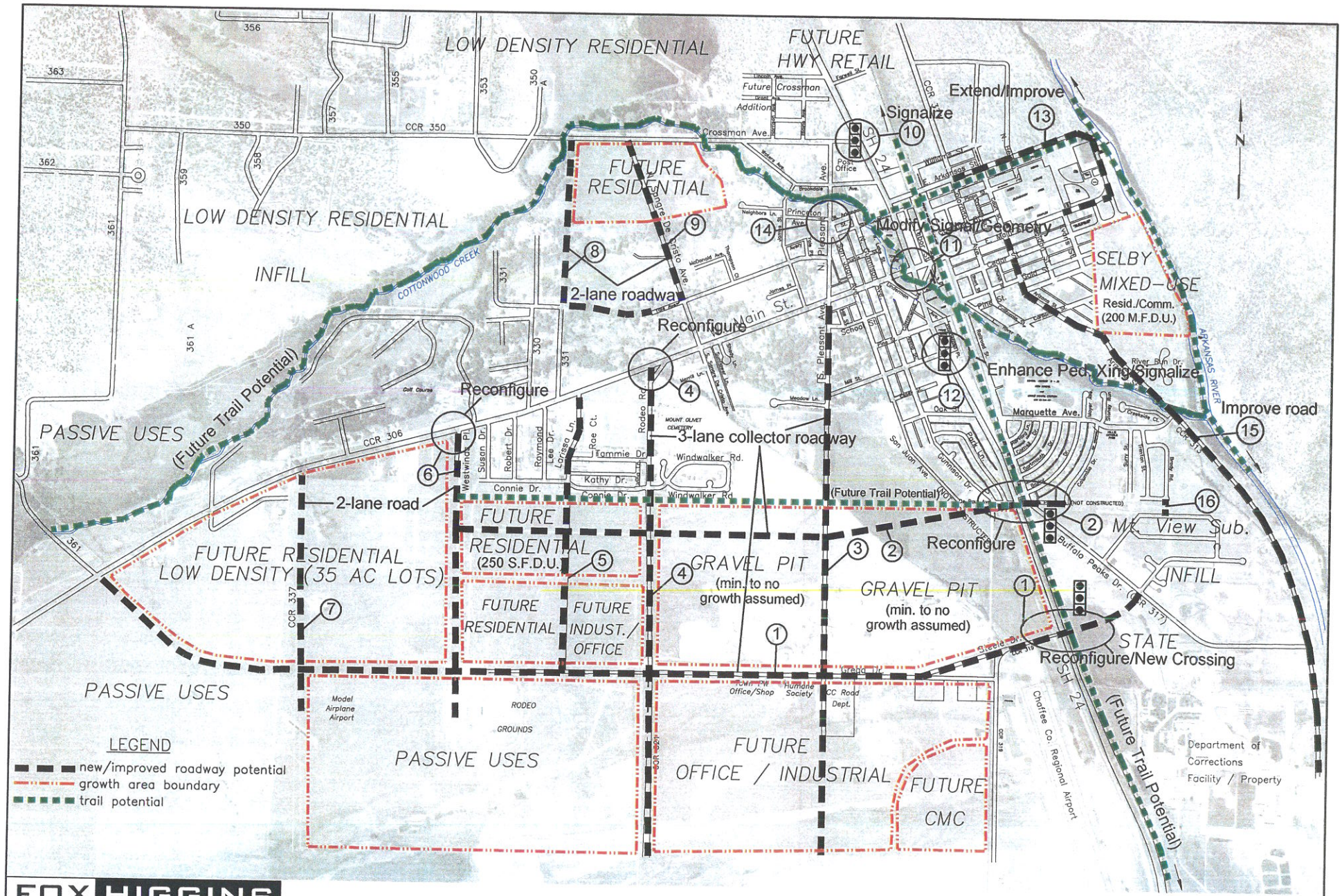
BUENA VISTA TRANSPORTATION MASTER PLAN

COMMUNITY ACTIVITY CENTERS

FH Project #	03034	Original Scale	1"=1500'	Date	03/10/04	Drawn by	JAH	Figure #	2



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BUENA VISTA TRANSPORTATION MASTER PLAN

FUTURE GROWTH AREAS AND CIRCULATION ENHANCEMENTS

FH Project #	03034	Original Scale	1"=2000'	Date	03/10/04	Drawn by	JAH	Figure #	3

APPENDIX

1. Level of Service Definitions

2. SH 24 Intersection Capacity Worksheets
   - SH 24 / Main Street
   - SH 24 / City Market - 7-11

3. Examples of Pedestrian Median Refuge and Intersection Treatments

LEVEL OF SERVICE DEFINITIONS

FOX HIGGINS
TRANSPORTATION GROUP

LEVEL OF SERVICE DEFINITIONS

In rating roadway and intersection operating conditions with existing or future traffic volumes, "Levels of Service" (LOS) A through F are used, with LOS A indicating very good operation and LOS F indicating poor operation. Levels of service at signalized and unsignalized intersections are closely associated with vehicle delays experienced in seconds per vehicle. More complete level of service definitions and delay data for signal and stop sign controlled intersections are contained in the following table for reference.

Level of Service Rating	Delay in seconds per vehicle *(a)*		Definition
	Signalized	Unsignalized	
A	0.0 to 10.0	0.0 to 10.0	Low vehicular traffic volumes; primarily free flow operations. Density is low and vehicles can freely maneuver within the traffic stream. Drivers are able to maintain their desired speeds with little or no delay.
B	10.1 to 20.0	10.1 to 15.0	Stable vehicular traffic volume flow with potential for some restriction of operating speeds due to traffic conditions. Vehicle maneuvering is only slightly restricted. The stopped delays are not bothersome and drivers are not subject to appreciable tension.
C	20.1 to 35.0	15.1 to 25.0	Stable traffic operations, however the ability for vehicles to maneuver is more restricted by the increase in traffic volumes. Relatively satisfactory operating speeds prevail, but adverse signal coordination or longer vehicle queues cause delays along the corridor.
D	35.1 to 55.0	25.1 to 35.0	Approaching unstable vehicular traffic flow where small increases in volume could cause substantial delays. Most drivers are restricted in ability to maneuver and selection of travel speeds due to congestion. Driver comfort and convenience are low, but tolerable.
E	55.1 to 80.0	35.1 to 50.0	Traffic operations characterized by significant approach delays and average travel speeds of one-half to one-third the free flow speed. Vehicular flow is unstable and there is potential for stoppages of brief duration. High signal density, extensive vehicle queuing, or corridor signal progression/timing are the typical causes of vehicle delays at signalized corridors.
F	> 80.0	> 50.0	Forced vehicular traffic flow and operations with high approach delays at critical intersections. Vehicle speeds are reduced substantially and stoppages may occur for short or long periods of time because of downstream congestion.

(a) Delay ranges based on 2000 Highway Capacity Manual criteria.

SH 24 INTERSECTION CAPACITY WORKSHEETS

SH 24 / Main Street

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95		1.00	0.95	
Frt		1.00	0.85		1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected		0.98	1.00		0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1817	1583		1807	1583	1770	3473		1770	3454	
Flt Permitted		0.52	1.00		0.50	1.00	0.32	1.00		0.23	1.00	
Satd. Flow (perm)		974	1583		930	1583	597	3473		423	3454	
Volume (vph)	134	131	199	169	107	127	220	800	114	112	586	112
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	142	216	184	116	138	239	870	124	122	637	122
RTOR Reduction (vph)	0	0	147	0	0	94	0	15	0	0	21	0
Lane Group Flow (vph)	0	288	69	0	300	44	239	979	0	122	738	0
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		24.0	24.0		24.0	24.0	43.0	43.0		43.0	43.0	
Effective Green, g (s)		24.0	24.0		24.0	24.0	43.0	43.0		43.0	43.0	
Actuated g/C Ratio		0.32	0.32		0.32	0.32	0.57	0.57		0.57	0.57	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		312	507		298	507	342	1991		243	1980	
v/s Ratio Prot								0.29			0.22	
v/s Ratio Perm		0.30	0.14		c0.32	0.09	c0.40			0.29		
v/c Ratio		0.92	0.14		1.01	0.09	0.70	0.49		0.50	0.37	
Uniform Delay, d1		24.6	18.1		25.5	17.8	11.4	9.5		9.6	8.7	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		34.6	0.6		53.8	0.3	11.3	0.9		7.2	0.5	
Delay (s)		59.2	18.7		79.3	18.2	22.7	10.4		16.8	9.2	
Level of Service		E	B		E	B	C	B		B	A	
Approach Delay (s)		41.9			60.1			12.8			10.3	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM Average Control Delay	23.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1739	1863	1546	1750	1863	1539	1766	3442		1767	3415	
Flt Permitted	0.68	1.00	1.00	0.51	1.00	1.00	0.24	1.00		0.19	1.00	
Satd. Flow (perm)	1249	1863	1546	947	1863	1539	446	3442		354	3415	
Volume (vph)	134	131	199	169	107	127	220	800	114	112	586	112
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	142	216	184	116	138	239	870	124	122	637	122
RTOR Reduction (vph)	0	0	105	0	0	99	0	12	0	0	16	0
Lane Group Flow (vph)	146	142	111	184	116	39	239	982	0	122	743	0
Confl. Peds. (#/hr)	20		20	20		20	20		20	20		20
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt			pm+pt		
Protected Phases	7	4	5	3	8	1	5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	17.9	12.4	22.1	20.9	13.9	20.7	45.8	36.1		40.0	33.2	
Effective Green, g (s)	19.9	13.4	24.1	22.9	14.9	22.7	47.8	37.1		42.0	34.2	
Actuated g/C Ratio	0.24	0.16	0.29	0.28	0.18	0.28	0.58	0.45		0.51	0.42	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	341	303	528	342	337	499	431	1552		315	1419	
v/s Ratio Prot	0.03	0.08	0.05	c0.05	0.06	0.03	c0.07	c0.29		0.04	0.22	
v/s Ratio Perm	0.07		0.09	c0.10		0.06	0.25			0.16		
v/c Ratio	0.43	0.47	0.21	0.54	0.34	0.08	0.55	0.63		0.39	0.52	
Uniform Delay, d1	25.8	31.2	21.9	24.0	29.4	22.1	9.9	17.4		11.7	18.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.9	1.1	0.2	1.6	0.6	0.1	1.5	2.0		0.8	1.4	
Delay (s)	26.7	32.4	22.1	25.7	30.0	22.1	11.4	19.3		12.5	19.3	
Level of Service	C	C	C	C	C	C	B	B		B	B	
Approach Delay (s)		26.3			25.7			17.8			18.4	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	20.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	82.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	98	1	108	9	0	48	80	599	23	22	453	127
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	107	1	117	10	0	52	87	651	25	24	492	138
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			1									
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1120	
pX, platoon unblocked												
vC, conflicting volume	1161	1459	315	1191	1516	338	630			676		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1161	1459	315	1191	1516	338	630			676		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	16	99	83	91	100	92	91			97		
cM capacity (veh/h)	126	113	681	107	105	658	948			911		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	225	62	87	434	242	24	328	302
Volume Left	107	10	87	0	0	24	0	0
Volume Right	117	52	0	0	25	0	0	138
cSH	230	363	948	1700	1700	911	1700	1700
Volume to Capacity	0.98	0.17	0.09	0.26	0.14	0.03	0.19	0.18
Queue Length (ft)	221	15	8	0	0	2	0	0
Control Delay (s)	98.4	16.9	9.2	0.0	0.0	9.1	0.0	0.0
Lane LOS	F	C	A			A		
Approach Delay (s)	98.4	16.9	1.0			0.3		
Approach LOS	F	C						

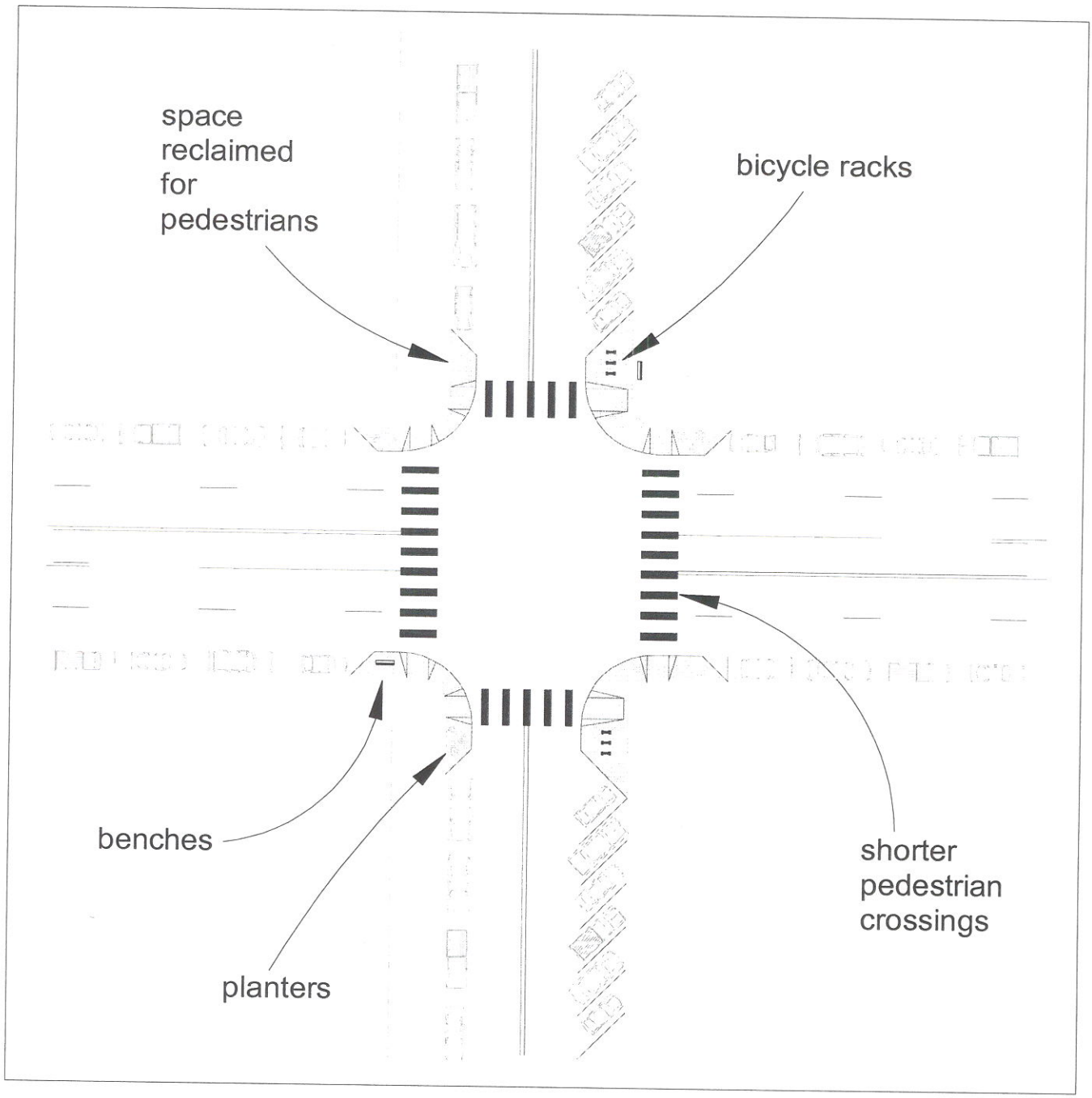
Intersection Summary			
Average Delay	14.2		
Intersection Capacity Utilization	43.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	0	207	0	0	57	80	599	23	22	453	127
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	225	0	0	62	87	651	25	24	492	138
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1120	
pX, platoon unblocked												
vC, conflicting volume	1171	1459	315	1357	1516	338	630			676		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1171	1459	315	1357	1516	338	630			676		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	67	100	100	91	91			97		
cM capacity (veh/h)	122	113	681	66	105	658	948			911		

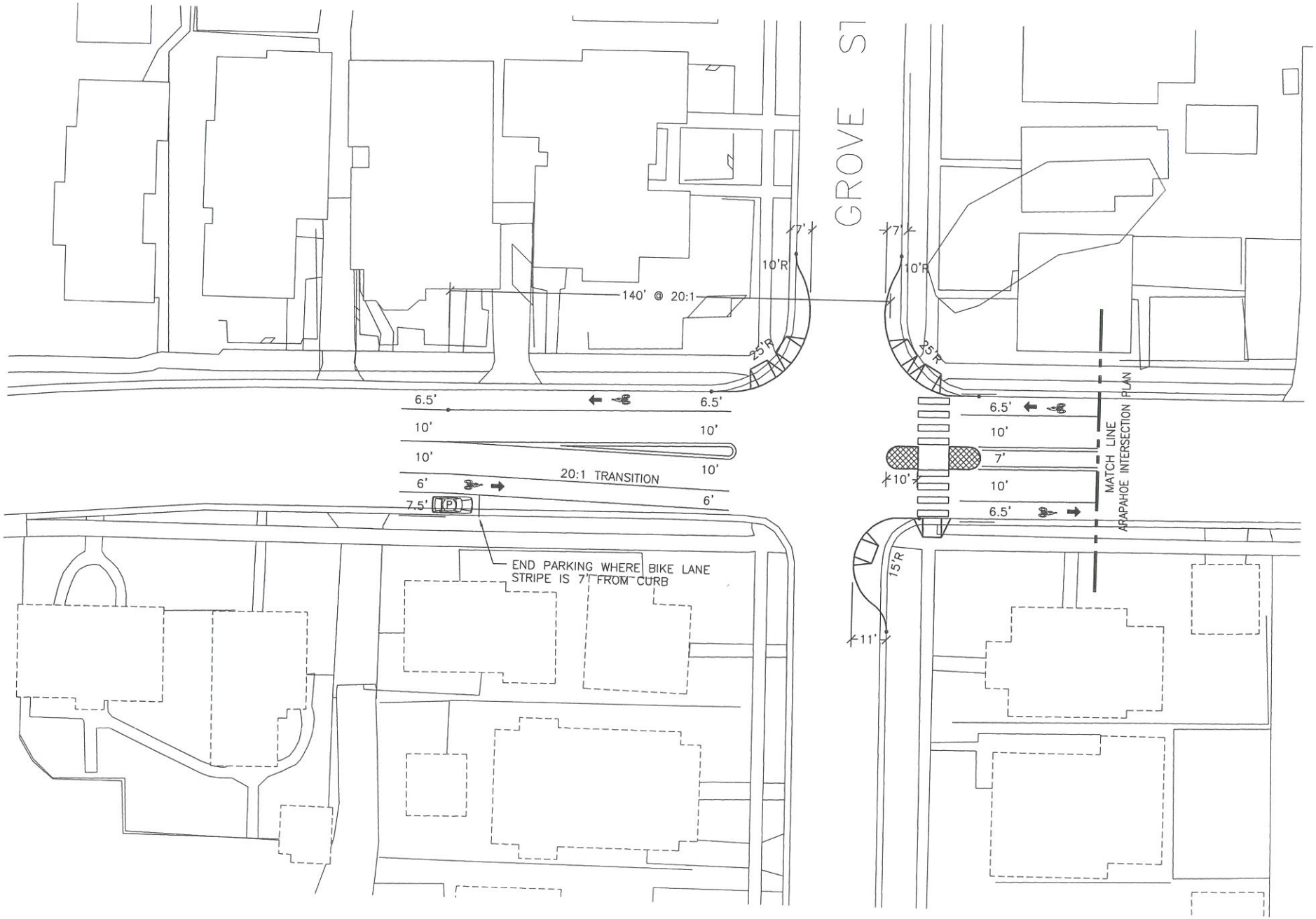
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	225	62	87	434	242	24	328	302
Volume Left	0	0	87	0	0	24	0	0
Volume Right	225	62	0	0	25	0	0	138
cSH	681	658	948	1700	1700	911	1700	1700
Volume to Capacity	0.33	0.09	0.09	0.26	0.14	0.03	0.19	0.18
Queue Length (ft)	36	8	8	0	0	2	0	0
Control Delay (s)	12.9	11.0	9.2	0.0	0.0	9.1	0.0	0.0
Lane LOS	B	B	A			A		
Approach Delay (s)	12.9	11.0	1.0			0.3		
Approach LOS	B	B						

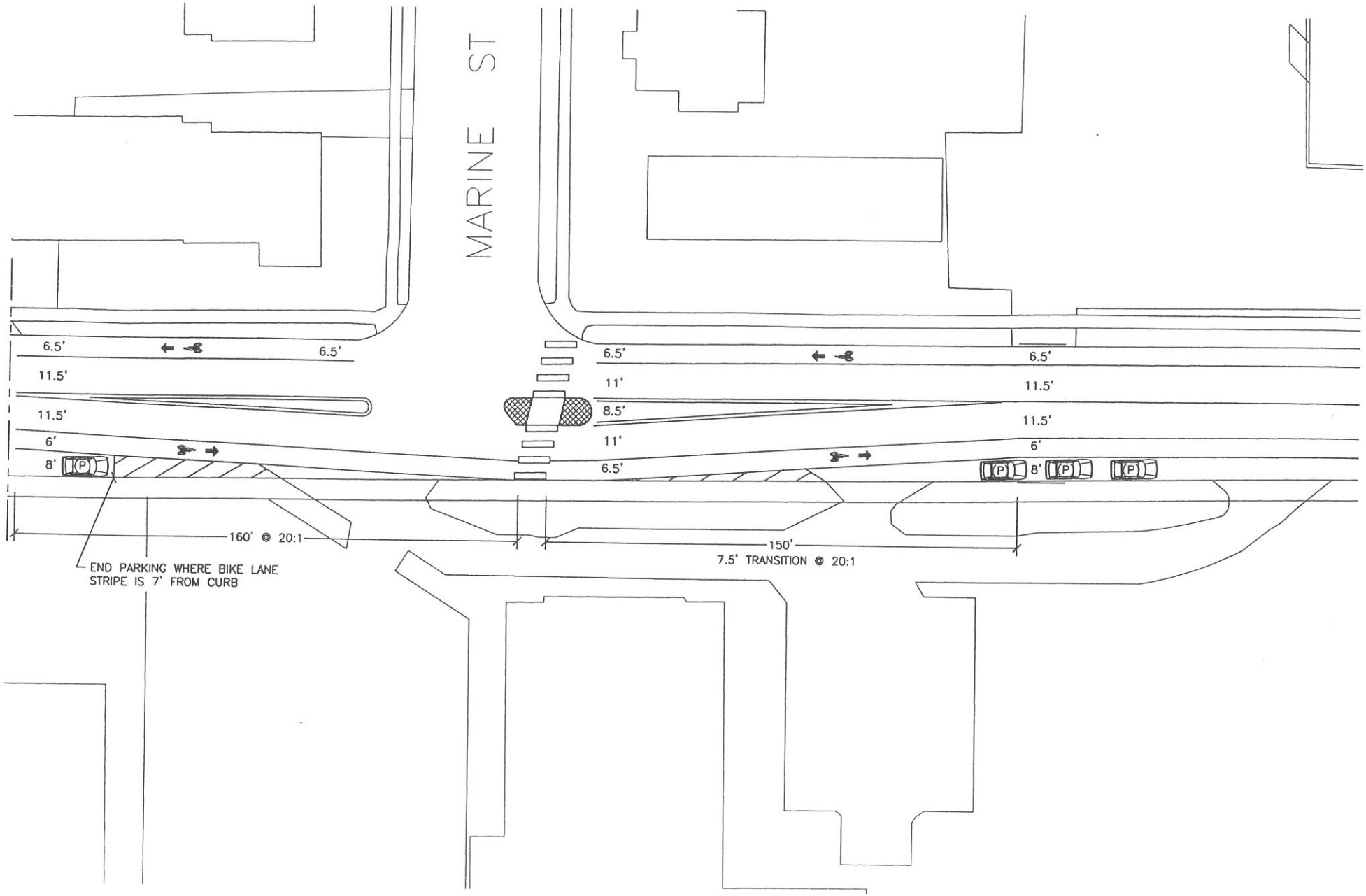
Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	36.1%	ICU Level of Service	A
Analysis Period (min)	15		

EXAMPLES OF PEDESTRIAN MEDIAN REFUGE AND INTERSECTION TREATMENTS



CURB EXTENSION TREATMENT EXAMPLE


GROVE ST
7'
10'R
140' @ 20:1
25'R
6.5'
10'
20:1 TRANSITION
6'
7.5'
(P)
END PARKING WHERE BIKE LANE STRIPE IS 7' FROM CURB
MATCH LINE
ARAPAHOE INTERSECTION PLAN
15'R
11'
40
20
0
20
60
(IN FEET)
1 inch = 20 ft.
N


MARINE ST
6.5'
11.5'
11.5'
6'
8'
6.5'
11'
8.5'
11'
6.5'
6.5'
11.5'
11.5'
6'
8'
160' @ 20:1
150'
7.5' TRANSITION @ 20:1
END PARKING WHERE BIKE LANE
STRIPE IS 7' FROM CURB


40
20
0
20
60
(IN FEET)
1 inch = 20 ft.