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Westminster
Comprehensive Roadway Plan Update

March 2008
Westminster, Colorado

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Chapter 1 - Introduction

Purpose of Study

The 1994 City of Westminster Comprehensive Roadway Plan has guided the development of the transportation system in Westminster for the last 13 years. Much of the plan has already been implemented. The land development that has driven the need for transportation improvements is now limited to mainly infill opportunities. The 2004 Westminster Comprehensive Land Use Plan estimates a build-out population for the city of 123,900. The 2006 population estimate was 108,710. This would indicate a potential population growth, and consequential traffic growth, of 14 percent. This could significantly affect the level of service on specific streets. Also the growth in neighboring cities will increase traffic on Westminster streets. It is therefore of value to be able to tie estimates of traffic growth on specific streets to specific land development and redevelopment initiatives. The resulting forecasts for full development infill of the city will indicate where additional street capacity will be required.

Objectives of the Comprehensive Roadway Plan

This study provides an assessment of existing traffic conditions and identifies short-term improvements needed to mitigate safety and traffic operation deficiencies. These include specific recommendations for capacity improvements at key intersections or enhancements to specific corridors. The plan also considers strategies for more effectively managing the transportation system that is already in place. These types of recommendations include addressing the city's request for evaluating appropriate speed limit postings on specific streets. The plan also identifies the long-range transportation improvements needed to support full development of the city. Opinions of probable construction costs are provided.

One of the components in the plan update that differs from the 1994 plan is the emphasis on local interface with the Regional Transportation District (RTD) public transportation system. This system will provide the opportunity for efficient movement between Westminster and other parts of the Denver metro community. The city has a desire to explore and develop opportunities to enhance the linkage between the RTD system and the pedestrian/bicycle generators within the City.

Overview of the Study Area

While the study area is the City of Westminster in its entirety, there is focus given to the areas that have known operational deficiencies and areas that were identified early by city staff as known operational problem areas. Information was collected included traffic count and speed information on both State and City facilities. The bicycle and trail facilities were studied and focus was provided where the largest impacts could be made in the areas of the RTD Park and Ride facilities and their integration to pedestrian and bicycle facilities.

Chapter 2 – Existing Transportation System

Introduction

Recent and continued growth in Westminster and the surrounding areas has placed new traffic demands on the existing street system. In many ways, the City has kept pace with the changes in traffic patterns through adding new roadways, traffic signals and signal coordination. While the basic street system in most of Westminster is already established, several major streets can still be widened to add additional traffic capacity. This chapter describes the existing traffic operations conditions in the City and identifies opportunities for improving traffic flow in Westminster for the immediate future.

The Denver Regional Council of Governments (DRCOG) cited in the 2006 Annual Report on Traffic Congestion in the Denver Region, that the Denver area is the nations 17th most congested region based on 2003 Texas Transportation Institutes study. The report noted key congested corridors locations included Federal Boulevard, 120th Avenue, US 36 and key locations including 88th Avenue and Sheridan Boulevard, US 36 and Sheridan Boulevard, 92nd Avenue and Federal Boulevard, and the interchanges on I-25 at 104th Avenue and 120th Avenue.

Traffic Volumes

The study area for existing traffic conditions in Westminster included the major streets within the current city limits. The average annual daily traffic (AADT) volumes were compared to the street system's ability to handle traffic efficiently. Projects were identified city-wide that would enhance the operation of the existing traffic system for current traffic conditions.

Daily traffic volumes on a street can be indicative of traffic congestion. The actual traffic volume that can be carried on a street depends on several considerations, such as the number of driveways, whether left turns lanes are present, and most importantly, whether through traffic will be required to stop at stop signs or traffic signals. For instance, traffic at a signal must share its right of way with cross street traffic. This means that under average circumstances, approximately half of the through traffic's movement time must be shared with the cross street traffic and as a result the traffic carrying capacity of a street with traffic signals is only about half of that of the same street with no signals. The general traffic carrying capacities of average streets with traffic signals or multi-way stop signs are summarized in Table 2-1. It should be emphasized that these numbers represent the maximum traffic volume that can accommodated and that the threshold of congestion first begins to occur at a lower traffic volume.

Table 2-1 General Street Daily Traffic Capacities

Type of Street	General Daily Traffic Capacity	Threshold of Congestion
6-7 lane street	53,000	46,000
4-5 lane street	36,000	31,000
2-3 lane street	18,000	13,000

The City of Westminster provided 2007 daily traffic volumes for the major street system. The Colorado Department of Transportation (CDOT) provided 2006 daily traffic volumes on the state highway system within Westminster. Those traffic volumes are reflected in Figure 2-1.

Daily traffic counts are generally of interest for broad level transportation planning. Typically, daily traffic counts may be used to determine the appropriate number of lanes needed on a major street to accommodate the daily traffic demand. The daily traffic counts available through the City and CDOT indicate the immediate need for widening several important street corridors in the City. This is only an indication of the immediate need for widening and does not include the traffic growth projections which will be covered later in the report.

The major corridors that are currently exceeding the daily traffic capacities based on the AADT are summarized in Table 2-2, ranked by congestion in Table 2-3 and ranked by volume in Table 2-4.

Type of Street	General Daily Traffic Capacity	Threshold of Congestion
6–7 lane street	53,000	46,000
4–5 lane street	36,000	31,000
2–3 lane street	18,000	13,000

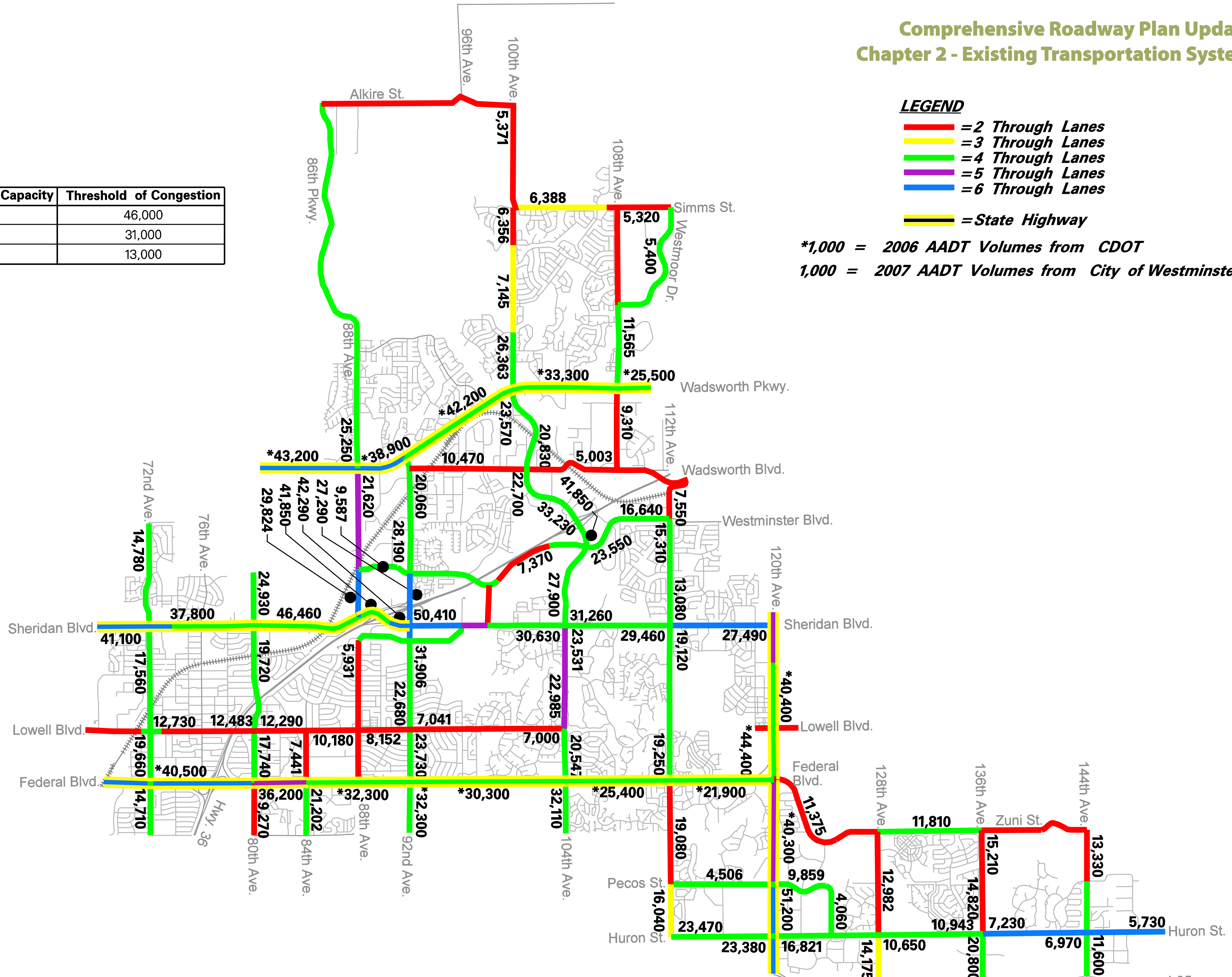

Figure 2–1 Average Daily Traffic Volumes

Table 2-2 Major Corridors Daily Traffic Capacities

Route	Segment	Existing No. of Lanes	Threshold of Congestion	Average Daily Volume[1]	Approx. Percent over Threshold[3] / Volume Over
Federal Blvd	US 36 to 80th	6	46,000	40,500[2]	Under threshold
	80th to 84th	5	31,000	36,200	17 / 5,200
	84th to 92nd	4		32,300	4 / 1,300
	92nd to 104th	4		30,300	Under threshold
Federal Parkway / Zuni St	120th Ave to 128th Ave	2	13,000	11,375	Under threshold
Lowell Blvd	72nd Ave to 84th Ave	2	13,000	12,500	Under threshold
Sheridan Blvd	69th to 72nd	6	46,000	41,100	Under threshold
	72nd to 80th	4	31,000	37,800	22 / 6,800
	80th to 88th	4	31,000	46,460	50 / 15,460
	88th to US 36	4	31,000	41,850	35 / 10,850
	US 36 to City Center Dr	6	46,000	50,410	10 / 4,410
	104th to 112th	4	31,000	31,264	1 / 264
Wadsworth Parkway	92nd Ave to 100th Ave	4	31,000	42,200[2]	36 / 11,200
	100th Ave to 108th Ave	4	31,000	33,300[2]	7 / 2,300
112th Ave	Federal Blvd to Pecos St	2	13,000	19,082	47 / 6,082
	Pecos to Huron	3	13,000	16,041	23 / 3,041
120th Ave	East of Sheridan to Lowell	4	31,000	40,400[2]	30 / 9,400
	Lowell to Federal	4	31,000	40,300[2]	30 / 9,300
	Federal to Pecos	5	31,000	40,300[2]	30 / 9,300
128th Ave	Zuni St. to Huron St	2/3	13,000	12,982	Under threshold
136th Ave	Zuni St. to Huron St	2	13,000	15,000	15 / 2,000
144th Ave	Zuni St. to Huron St	2	13,000	13,330	3 / 330
104th Avenue / Church Ranch Blvd	103rd to US 36	4	31,000	33,230	7 / 2,230
	US 36 to Westminster Blvd	4		41,850	35 / 10,850
	Westminster Blvd to Sheridan Blvd	4		27,900	Under threshold
	Sheridan Blvd to Lowell Blvd	5		23,531	Under threshold
	Lowell Blvd to Federal Blvd	4		20,547	Under threshold
	Federal to Zuni	4		32,110	4 / 1,110

1 – 2007 City Daily Traffic Volumes 2 – 2006 CDOT Daily Traffic Volumes

Table 2-3 Major Corridors Ranked by Congestion

Route	Segment	Existing No. of Lanes	Threshold of Congestion	Average Daily Volume[1]	Percent over Threshold
Sheridan Blvd	80th to 88th	4	31,000	46,460	50
112th Ave	Federal Blvd to Pecos St	2	13,000	19,082	47
Wadsworth Parkway	92nd Ave to 100th Ave	4	31,000	42,200[2]	36
Sheridan Blvd	88th to US 36	4	31,000	41,850	35
104th Avenue / Church Ranch Blvd	US 36 to Westminster Blvd	4	31,000	41,850	35
120th Ave	East of Sheridan to Lowell	4	31,000	40,400[2]	30
120th Ave	Lowell to Federal	4	31,000	40,300[2]	30
120th Ave	Federal to Pecos	5	31,000	40,300[2]	30
112th Ave	Pecos to Huron	3	13,000	16,041	23
Sheridan Blvd	72nd to 80th	4	31,000	37,800	22
Federal Blvd	80th to 84th	5	31,000	36,200	17
136th Ave	Zuni St to Huron St	2	13,000	15,000	15
Sheridan Blvd	US 36 to City Center Dr	6	46,000	50,410	10
Wadsworth Parkway	100th Ave to 108th Ave	4	31,000	33,300[2]	7
Church Ranch Blvd	103rd to US 36	4	31,000	33,230	7
104th Avenue	Federal to Zuni	4	31,000	32,113	4
Federal Blvd	84th to 92nd	4	31,000	32,300	4
144th Ave	Zuni St. to Huron St	2	13,000	13,330	3
Sheridan Blvd	104th to 112th	4	31,000	31,264	1

1 – 2007 City Daily Traffic Volumes 2 – 2006 CDOT Daily Traffic Volume

Table 2-4 Major Corridors Ranked by Volume

Route	Segment	Existing No. of Lanes	Threshold of Congestion	Average Daily Volume[1]	Volume over Threshold
Sheridan Blvd	80th to 88th	4	31,000	46,460	15,460
Wadsworth Parkway	92nd Ave to 100th Ave	4	31,000	42,200[2]	11,200
Sheridan Blvd	88th to US 36	4	31,000	41,850	10,850
104th Avenue / Church Ranch Blvd	US 36 to Westminster Blvd	4	31,000	41,850	10,850
120th Ave	East of Sheridan to Lowell	4	31,000	40,400[2]	9,400
120th Ave	Lowell to Federal	4	31,000	40,300[2]	9,300
120th Ave	Federal to Pecos	5	31,000	40,300[2]	9,300
Sheridan Blvd	72nd to 80th	4	31,000	37,800	6,800
112th Ave	Federal Blvd to Pecos St	2	13,000	19,082	6,082
Federal Blvd	80th to 84th	5	31,000	36,200	5,200
Sheridan Blvd	US 36 to City Center Dr	6	46,000	50,410	4,410
112th Ave	Pecos to Huron	3	13,000	16,041	3,041
Wadsworth Parkway	100th Ave to 108th Ave	4	31,000	33,300[2]	2,300
Church Ranch Blvd	103rd to US 36	4	31,000	33,230	2,230
136th Ave	Zuni St to Huron St	2	13,000	15,000	2,000
Federal Blvd	84th to 92nd	4	31,000	32,300	1,300
104th Avenue	Federal to Zuni	4	31,000	32,113	1,100
144th Ave	Zuni St. to Huron St	2	13,000	13,330	330
Sheridan Blvd	104th to 112th	4	31,000	31,264	264

Recommended Street Improvements

Based on the operations analysis and the corridors that exceed the current threshold, the following recommended roadway improvements are needed now to accommodate existing roadway deficiencies:

- Widen Federal Boulevard to six through lanes from 80th Avenue to 104th Avenue
- Widen Federal Parkway to four through lanes from 120th Avenue to 128th Avenue
- Widen Sheridan Boulevard to six through lanes from 72nd Avenue to 104th Avenue
- Widen Wadsworth Parkway to six through lanes from 92nd Avenue to 108th Avenue
- Widen 144th Avenue to four through lanes from Zuni Street to Huron St. (in progress)
- Widen 136th Avenue to four lanes from Zuni Street to Huron Street (in progress)
- Widen 128th Avenue to four through lanes from Federal Boulevard/Zuni Street to I-25
- Widen 120th Avenue to six through lanes from Sheridan Boulevard to Pecos Street
- Widen 112th Avenue to four lanes from Federal Boulevard to Huron Street

While daily traffic volumes provide a general indication of the number of lanes that are appropriate for an entire street for planning purposes, peak hour intersection analysis provides a more accurate assessment of the operating capacity of a street. Signals control the flow of traffic and the analysis of signalized intersections provides a detailed consideration of the number of through lanes, and the length and numbers of auxiliary lanes that are required to maintain traffic flows. The morning and afternoon peak hours on a typical weekday are generally selected as the periods representing the heaviest traffic flows. Morning and afternoon peak hour traffic counts were conducted at significant intersections in the City.

Traffic Operation

How well traffic operates at an intersection can be evaluated through a method developed by the Transportation Research Board which has been described in the Highway Capacity Manual (HCM). This analysis method, called capacity analysis, requires peak hour traffic volumes, the number of lanes for each approach to the intersection, and detailed traffic signal timings, or designation of stop sign or traffic signal control, as inputs to the analysis. The outputs from the analysis are the average vehicle delay that can be expected at the intersection, and the distance vehicles are expected to back up from the intersection, called the queue length.
Based on the average length of vehicle delay, a grade, or level of service (LOS), is assigned to the intersection operation, A through F. LOS A is considered to be excellent, LOS C is the design level, or that level at which it is time to consider reinvestment for improved operations, LOS E is considered to represent the absolute capacity of the intersection, and LOS F means that the intersection has failed, which is evident through long vehicle delays and queue lengths.

A summary of the LOS for the individual traffic movements for the key intersections is included in the appendix. Opportunities for improvement in traffic control were made based in part on the results of the capacity analysis. In some instances, improvements targeted to improve the level of service for some traffic movements may not be practical. An example would be where heavy traffic volumes on a through street do not provide an opportunity for a few vehicles on a side street to cross the through street. A small volume of traffic wanting to cross the through traffic would not justify the expense of the signal or the disruption and increased delay to the majority of the vehicles, so no practical solution may be feasible to improve the LOS for the side street traffic.

The results of the capacity analysis is shown in Table 2-4.

Table 2-4 Intersection Analysis Results

Location	***Intersection LOS***	
	A.M.	***P.M***
Federal Boulevard and 84th Avenue	C	E*
Federal Boulevard and 92nd Avenue	C	E*
Federal Boulevard and 104th Avenue	E*	F*
Federal Boulevard and 120th Avenue	F*	F*
Sheridan Boulevard and 88th Avenue	C	F*
Sheridan Boulevard and US 36 westbound off ramp	C	E*
Sheridan Boulevard and US 36 eastbound off ramp	E*	E*
Wadsworth Parkway and 100th Avenue	D	E*
120th Avenue and Lowell Boulevard	C	C
128th Avenue and Zuni St.	D	D
104th Avenue and US 36 westbound off ramp	B	B
104th Avenue and US 36 eastbound off ramp	B	D
Simms St. and 100th Avenue	F*	C

* Intersections that require mitigation

Table 2-5 compares the calculated maximum vehicle queue for each traffic movement approach at the study intersections with the available turn bay storage. The highlighted cells in the table indicate where existing turn bays are of insufficient length. Vehicle turn bay lengths may be insufficient for two reasons. The first reason is where the length of the turning vehicle queue may be longer that the turn bay length, causing turning vehicles to queue back into the through lanes, blocking them for through traffic. The second reason may be where the through vehicle queues are longer than the turn bay, so that the through vehicles block left turn vehicles from reaching the turn bay. Either of these conditions may warrant the extension of the turn bay or addition of a turn lane where physically feasible to do so.

Table 2-5 Vehicle Queue Analysis Summary

Approach	Turn Bay Storage	95th % Queue Length
84th Ave and Federal Blvd - WBL	160	177
84th Ave and Federal Blvd - EBL	160	116
84th Ave and Federal Blvd - SBL	300	283
84th Ave and Federal Blvd - NBL	300	173
92nd Ave and Federal Blvd - EBL	200	233
92nd Ave and Federal Blvd - WBL	200	137
92nd Ave and Federal Blvd - NBL	320	152
92nd Ave and Federal Blvd - SBL	320	191
104th Ave & Federal Blvd - NBL	200	200
104th Ave & Federal Blvd - EBL	380	211
104th Ave & Federal Blvd - SBL	200	298
104th Ave & Federal Blvd - WBL	360	261
120th Ave & Federal Blvd - EBL	480	446
120th Ave & Federal Blvd - WBL	360	221
100th Ave & Wadsworth Pkwy - SBL	140	197
100th Ave & Wadsworth Pkwy - NBL	390	161
100th Ave & Wadsworth Pkwy - EBL	285	138
100th Ave & Wadsworth Pkwy - WBL	340	174
88th Ave & Sheridan Blvd - NBL	240	277
120th Ave & Lowell Blvd - EBL	260	143
120th Ave & Lowell Blvd - WBL	160	44
128th Ave. & Zuni – WBL	200	124
128th Ave. & Zuni – EBL	300	184
128th Ave. & Zuni – NBL	200	49
128th Ave. & Zuni – SBL	250	49

Source: Synchro Analysis of 95% queue, p.m. volumes

The intersections shown in the table that indicate needing extensions of the left turn bay all have existing driveways or geometric limitations such that extending the turn lane could interfere with vehicles entering from the side street onto the mainline or cause other operational problems. Thus, the extension of the left turn bays are not recommended as significant intersection improvement will not result. Rather the table is an indication what operational problems the intersections are experiencing.

Recommended Intersection Improvements

The City has kept up with growth at many of the intersections by providing dual left turns and right turn lanes where needed. While there are some turning movement geometric improvements that can be made, generally the intersections addressed in the study were in need of through lane capacity to make any significant improvement to the service level of the intersections.

Based on the operations analysis, the following recommended intersection improvements are needed to accommodate existing roadway deficiencies. The basis for the improvements is to improve intersections that currently experience LOS worse than D and to provide action to bring the intersection to LOS of D or better. The addition of through lanes at an intersection when the roadway has fewer lanes would require a minimum of a quarter mile of lane improvements on either side of the intersection. While this will provide additional intersection capacity, drivers may not fully utilize a lane that is not continuous. Estimated costs for the intersection improvements are show in Table 2-3.

Federal Boulevard and 84th Avenue

Both Federal Boulevard and 84th Avenue are considered principal arterials. This intersection operates currently in the evening peak with an overall LOS of E. Federal Boulevard carries the majority of the traffic that contributes to the intersection's poor LOS. The westbound dual left turns carry 450 vehicles per day and contributes to the poor LOS. The southbound left turn while currently at LOS of D by providing a dual left it helps the intersections overall LOS. The additional northbound through lane should be carried north to 86th Avenue, or approximately 1,200 feet. The southbound through lane should be carried 1,200 feet to 81st Avenue. A combination of adding the dual lefts turn for north and southbound movement and the addition of a northbound and southbound lane will provide the intersection a LOS of D.

- Add a third northbound and southbound through lane, southbound, eastbound and northbound dual left turns.

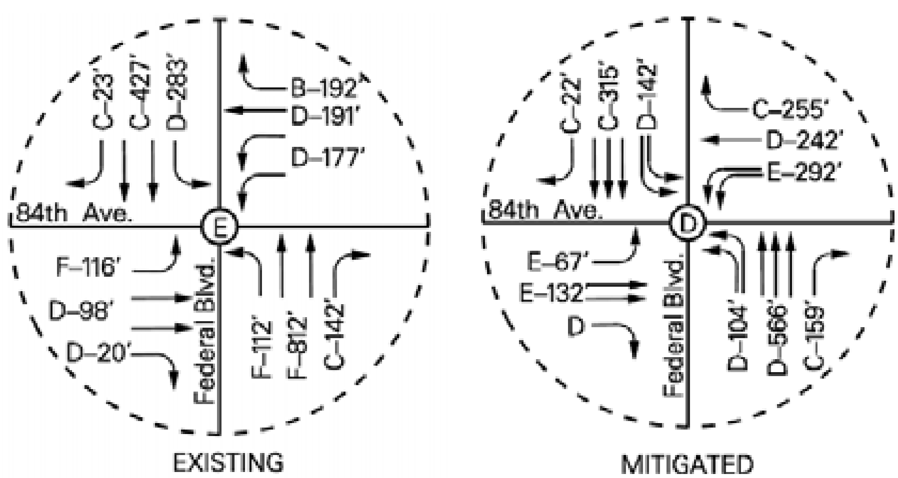

Figure 2-2 Federal Blvd and 84th Ave LOS and Queuing

Federal Avenue and 92nd Avenue

Both Federal Boulevard and 92nd Avenue are considered principal arterials. This intersection operates currently in the pm peak with a LOS of E. Federal Boulevard carries the majority of the traffic that contributes to the intersections poor LOS. However, the eastbound left turns during the peak hour contribute to the poor LOS and should be a dual left turn. An additional northbound lane should be added for approximately 1,200 feet and merge within that distance. Also recommended is an additional southbound through lane addition on Federal Boulevard for approximately 1,200 feet which would extend to 90th Avenue. The northbound and southbound through lane additions will provide for an intersection LOS of D.

- Adding a third northbound and southbound through lane and dual lefts for all directions provides the intersection a LOS of C.

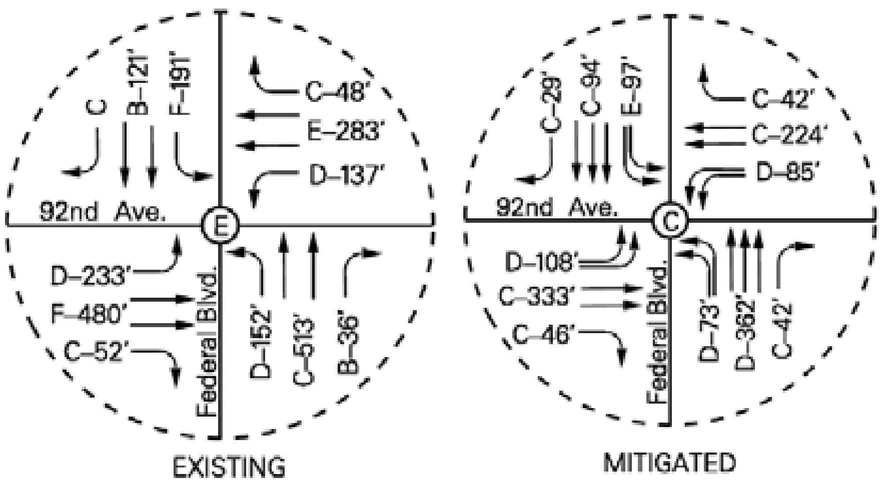

Figure 2-3 Federal Blvd and 92nd Ave LOS and Queuing

Federal Avenue and 104th Avenue

This intersection currently operates in the pm with a LOS of F. To achieve an acceptable LOS requires the addition of a third through lane in all directions and dual left turns in all directions.

- Adding a third northbound and southbound through lane and dual lefts for all directions provides the intersection a LOS of D.

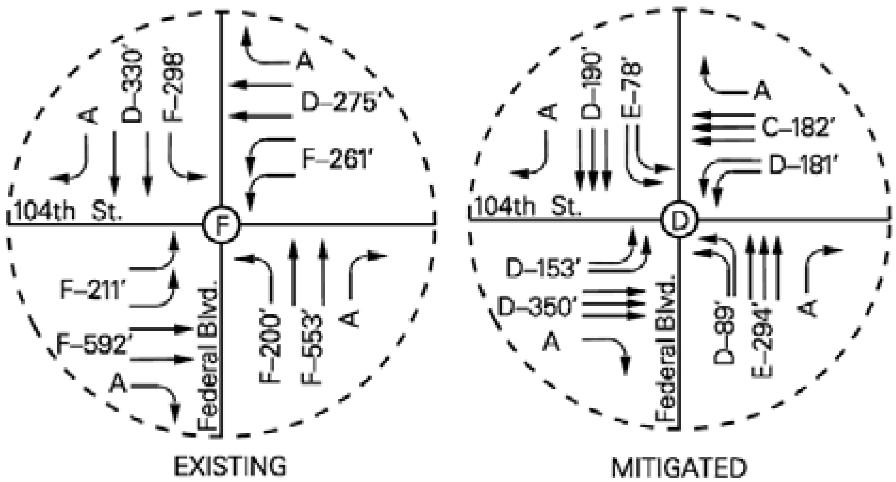

Figure 2-4 Federal Blvd and 104th Ave LOS and Queuing

Federal Boulevard and 120th Avenue

This intersection currently operates at a LOS of F in the morning and evening peak hours. Eastbound dual left turns at Federal Boulevard and 120th Avenue are warranted due to left turns greater than 300 vehicles turning left during the evening peak hour. The addition of an additional eastbound and westbound lane will provide an intersection LOS of E. Due to the high cost of widening the bridge on 120th Avenue bridge over the Big Dry Creek, reconfiguration of the lane geometry such as use of existing shoulders across the bridge and reduction of lane widths should be considered. The additional eastbound lane can be developed east of the bridge and should extend 1,200 feet beyond the intersection.

- Add a northbound through and right turn lane, a third through lane for eastbound and westbound. Add eastbound and southbound dual left turn lanes.

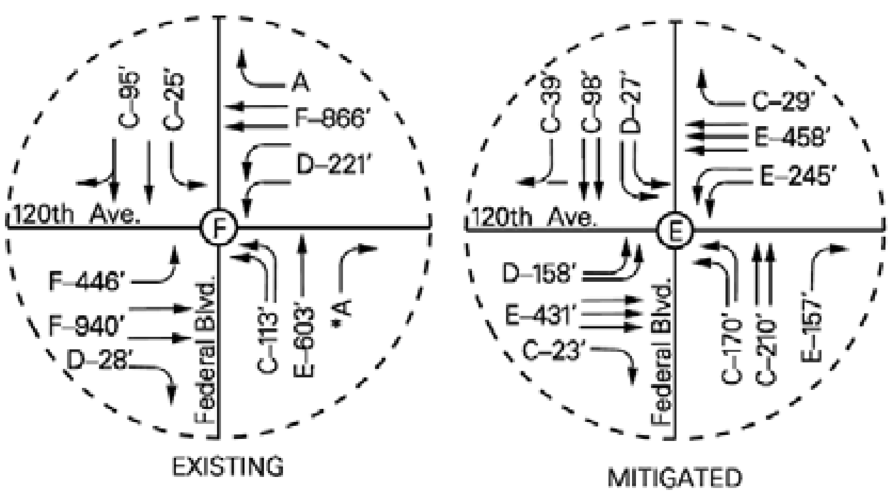

Figure 2-5 Federal Blvd and 120th Ave LOS and Queuing

Zuni Street and 128th Avenue

This intersection currently operates at an acceptable LOS of D in the evening peak hour. Upon further study of the intersection, to provide a LOS of C would require the addition of a second through lane for northbound, southbound and eastbound movements. While the intersection would operate at an LOS of C, the eastbound left is only a LOS of E and would need dual left turn lanes.

- ➢ This intersection currently operates at an acceptable level.

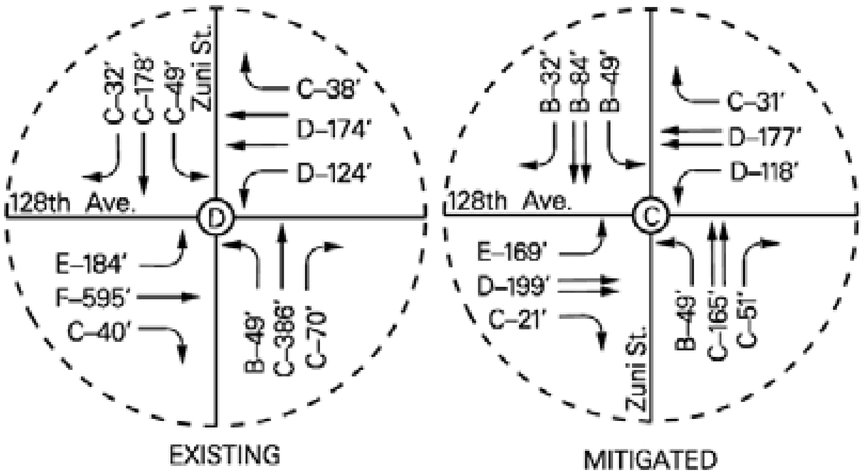

Figure 2-6 Zuni Street and 128th Ave LOS and Queuing

Lowell Boulevard and 120th Avenue

This intersection currently operates at an acceptable LOS of C in the evening peak hour. No individual turning movements operation less than an LOS of D. Mitigating the eastbound and westbound through directions by adding a third through lane provides a better LOS but does not improve the total intersection LOS.

- ➢ This intersection currently operates at an acceptable level.

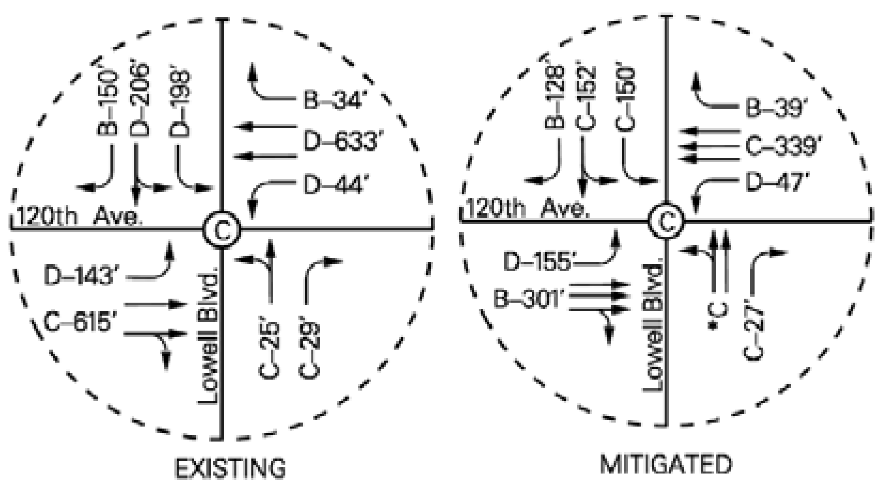

Figure 2-7 Lowell Blvd and 120th Ave LOS and Queuing

Church Ranch Boulevard/104th Avenue and the US 36 interchange

Both intersections at this interchange currently operate at an acceptable intersection LOS. However the eastbound off ramp left turns currently operate at an LOS of F for the pm peak hour. The addition of a third through lane should be considered as part of corridor improvements on Church Ranch Boulevard and 104th Avenue and widening of the lanes on the bridge over US 36.

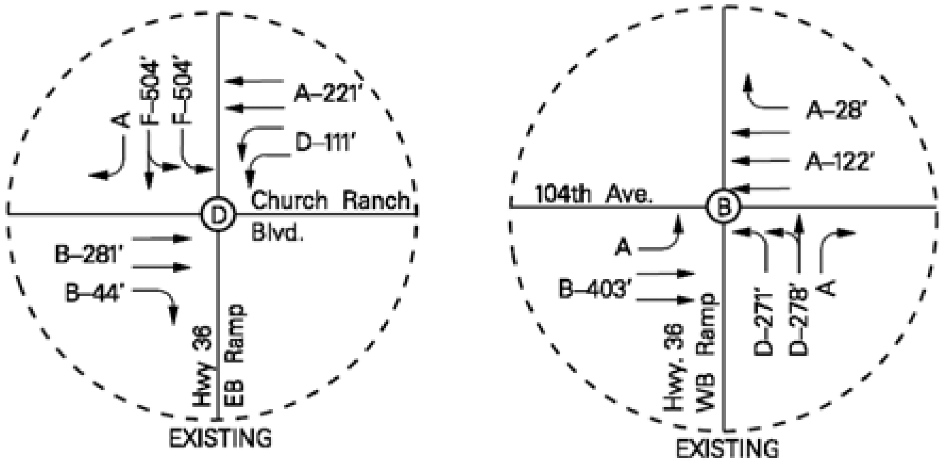

Figure 2-8 Church Ranch Boulevard/104th Street and US 36 LOS and Queuing

Simms Street and 100th Avenue
This intersection currently operates with a morning LOS of F. Realignment of the intersection will provide an improved LOS.

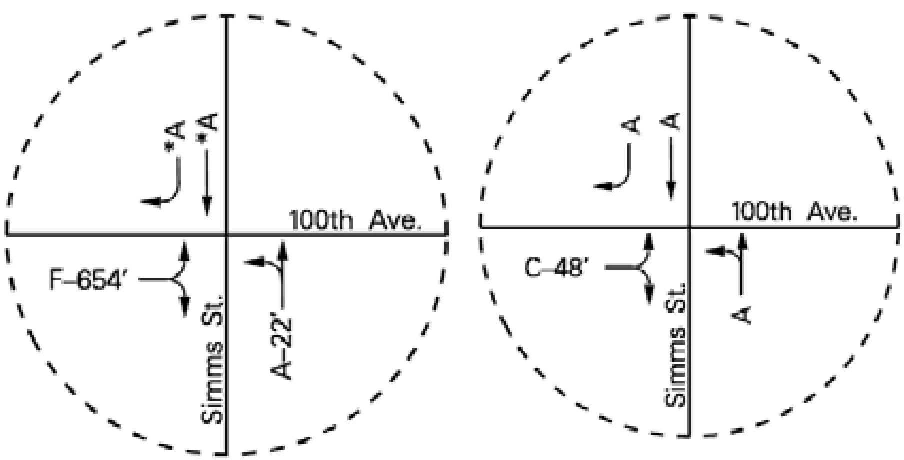

Figure 2-9 Simms Street and 100th Ave LOS and Queuing

Sheridan Boulevard and 88th Avenue
This intersection currently operates at a LOS of F during evening peak hours due to a high volume of through traffic on Sheridan Boulevard. The addition of a third northbound and southbound through lane will provide an intersection LOS of C. Due to these improvements being directly tied to the US 36 interchange, these improvement should be combined with the interchange improvements and are show here for illustration of what the changes additional through lanes can provide.

- Add a third northbound and southbound through lane.

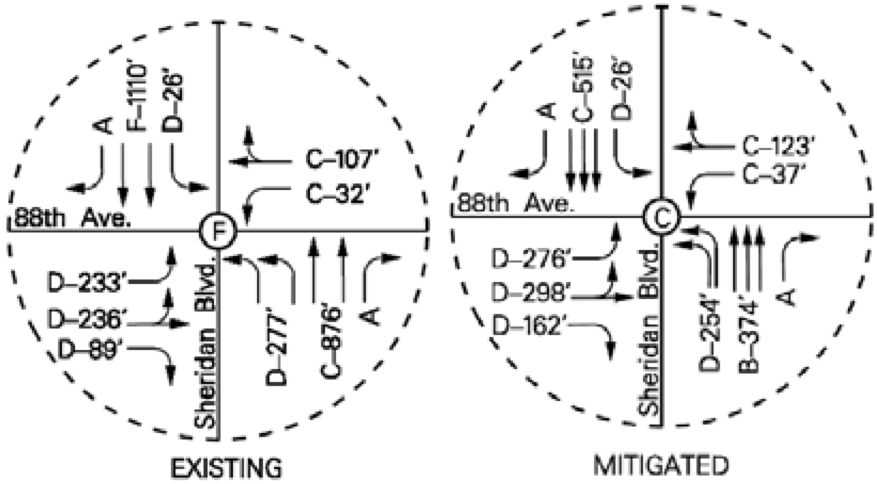

Figure 2-10 Sheridan Boulevard and 88th Ave LOS and Queuing

Sheridan Boulevard and 88th Avenue and the US 36 interchange

Currently, Sheridan Boulevard and 88th Avenue operates at a pm LOS of E primarily due to the need for additional southbound through capacity.

The eastbound and westbound US 36 off ramp intersections both operate during the evening peak hour at a LOS E. Multiple factors contribute to the low LOS such as a lack of adequate through lanes on Sheridan Boulevard and left turn lanes onto US Highway 36. Simple improvements at this location are not going to alleviate the congestion on Sheridan Boulevard. Major improvements including bridge widening and intersection capacity improvements will be required. The US Highway 36 Draft Environmental Impact Statement (DEIS) has plans for major improvements at this location and should be what guides any improvements. This interchange and area is currently programmed in the regional *Fiscally Constrained 2030 Regional Transportation Plan* (DRCOG 2005) for US 36 corridor improvements. From the DEIS, Chapter 5, Financial Analysis, Table 5.3-1, the improvements at the Sheridan interchange are listed as $41.7 million.

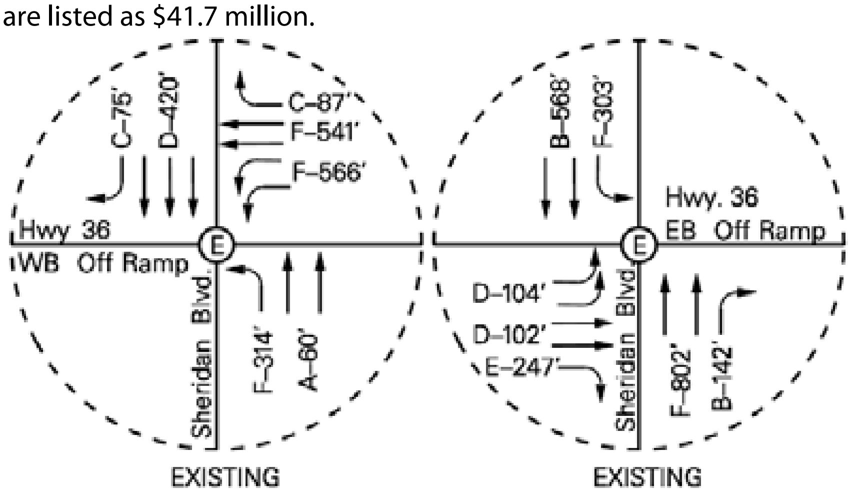

Figure 2-11 Sheridan Blvd and US 36 LOS and Queuing

Wadsworth Parkway and 100th Avenue

This intersection currently operates during the evening peak period at a LOS E. The through traffic on Wadsworth Parkway is the main contributor to the poor level of service. The addition of northbound and southbound through lanes will greatly improve the LOS. The northbound through lane would extend approximately 1,200 feet to the north to 102nd Avenue. The southbound lane would extend south approximately 1,200 feet to Independence Drive. Also, the addition of southbound and eastbound dual left turns will provide the intersection with and LOS of D.

- Add a third northbound and southbound through lane, southbound and eastbound dual left turn lanes.

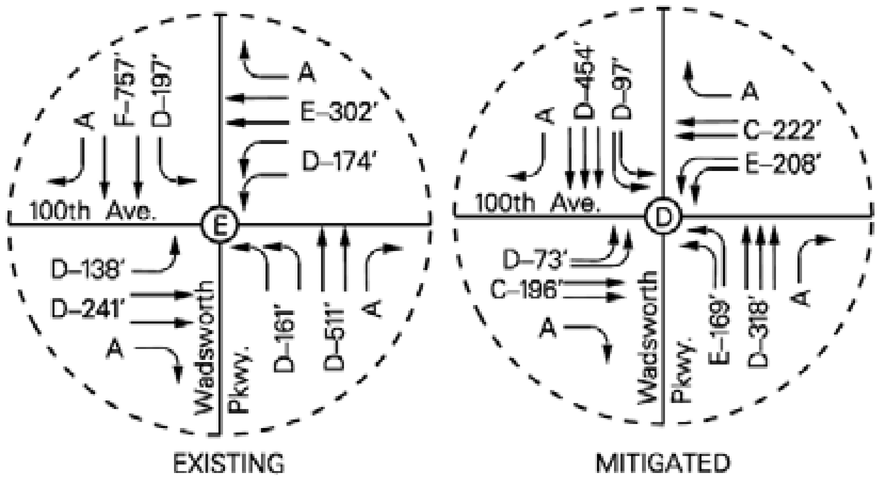

Figure 2-12 Wadsworth Pkwy and 100th Ave LOS and Queuing

The estimate of construction costs for the intersection improvements listed above are shown in Table 2-6.

Table 2-6 Estimates of Costs

Intersection	Improvement	PM LOS Increase	Cost (x$100k)
Federal Blvd and 84th Ave	Add NB, SB through lanes, SB, EB and NB dual left turn lanes	E to D	$4,911
Federal Blvd and 92nd Ave	Add NB and SB through lanes, dual lefts for all directions	E to C	$5,056
Federal Blvd and 104th Ave	Add dual left turns in all directions and a third NB and SB through lane	F to D	$4,672
Federal Blvd and 120th Ave	Add NB through lane, EB and SB dual left turn lane and EB and WB through	F to E	$4,613
Wadsworth Pkwy & 100th Ave	Add NB and SB through lanes, SB and EB dual left turn lanes	E to D	$4,338
Sheridan Blvd at 88th Ave and US 36	Reconstruct Interchange, Dependent on DEIS	*	$54,000*
Simms St. and 100th Ave	Realign intersection for improved operations	F to C	$2,400

Note: Corridor improvements should be considered in conjunction with intersection improvements when adding only through lanes.
* Source: 2035 Metro Vision Plan – Appendix 4

Traffic Safety

The City provided vehicle collision diagram summaries for several intersections in the City that have experienced the greatest number of collisions in the three year period between July 1, 2003 and June 30, 2006. The intersections and the number of vehicle collisions associated with each during that time period are summarized in Table 2-7. The collision diagram summaries have been included in the technical appendix.

Table 2-7 Number of Collisions

Intersection	Collisions
92nd Ave and Sheridan Blvd	73
84th Ave and Federal Blvd	68
104th Ave and Sheridan Blvd	59
72nd Ave and Federal Blvd	56
120th Ave and Huron St	51
104th Ave and Federal Blvd	50
80th Ave and Federal Blvd	47
72nd Ave and Sheridan Blvd	47
88th Ave and Sheridan Blvd	38
120th Ave and I-25	27
92nd Ave and Wadsworth Pkwy	25

At locations where vehicles change speed and direction, such as at intersections, collisions can be expected as a normal occurrence. Generally, the greater the traffic volume is, the greater the number of collisions that can be expected. Certain types of traffic control tend towards certain collision patterns. For example, multi-way stop controlled intersections tend to experience right angle collisions as the collision pattern, while signalized intersections tend to experience rear end collisions as the predominate collision pattern. The rear end collision pattern is the predominate pattern at all the intersections identified above except at 84th Avenue and Federal Boulevard, where the pattern is left turn collisions.

Rear end collisions at signalized intersections are most often related to one or more of three factors: poor recognition of the signals, inadequate signal timing, or general traffic congestion. The effective countermeasures to reduce the number of rear end collisions at signalized intersections include:

- Improving signal head visibility: This can include installing light emitting diode (LED) signal heads, which have improved optical quality compared to bulb-lit signal heads. It also includes verifying that the signal heads are located clear of sight obstructions such as trees.
- Reviewing the signal timings: Collisions can occur when the signal clearance timings are insufficient. Clearance timings must provide an opportunity for motorists to respond to the change from green to yellow indications by either stopping or proceeding through the intersection. When the front motorist decides to stop, and the motorist behind him decides to continue through the intersection, a rear end collision may occur. The Institute of Transportation Engineers (ITE) recommends yellow intervals progressively longer between 3.0 seconds at 25 mph or less, up to 5.0 seconds for 55 mph. Red clearance times should be sufficient for a vehicle traveling at the posted speed to pass entirely through an intersection during the all red interval.
- Relieving traffic congestion: Where traffic is highly congested, motorists tend to experience higher levels of frustration and may follow too close to the vehicle in front of them. The stop and go characteristics of congested traffic flow provides greater opportunities for rear end collisions. Improving capacity at these locations can reduce the collision rates.

At 84th Avenue and Federal Boulevard, from July 2003 to June 2006, the most common accident is left turn collisions. The majority of the left turn collision experience at this intersection from the southbound movement has resulted from permitting left turns at the intersection that are not protected exclusively with a green left turn arrow. This does allow more efficient operation of the intersection over a protected movement. The left turn accident pattern could be reduced by restricting left turns for the southbound movement to the left turn green arrow interval only.

Posted Speed Limit Study

A traffic speed survey was conducted at 19 select locations in the City and the results were used to evaluate the posted speed limits at those locations in Westminster. The 85th percentile speed is the speed at or below which 85 percent of the traffic was observed to be traveling. The 85th percentile speed is generally accepted as the speed most drivers consider reasonable and prudent and is the primary basis for establishing the posted speed. In many of the locations the speeds are over the acceptable 5 mph range over the 85th percentile speeds.

According to the *Manual on Uniform Traffic Control Devices* (MUTCD), when a speed limit is to be posted, it should be within 5 mph of the 85th percentile speed of free flowing traffic. Other factors that may be considered in establishing a speed limit are:

1. Road characteristics, shoulder condition, grade, alignment, and sight distance;
2. The pace speed;
3. Roadside development and environment;
4. Parking practices and pedestrian activity; and
5. Reported crash experience for at least a 12-month period.

A Policy on Geometric Design of Highways and Streets published by the American Association of State Highway and Transportation Officials (AASHTO) makes a distinction between high speed highways (50 mph or above) and low speed urban streets (45 mph or below). One of the distinctive characteristics between high speed and low speed is the presence of curb and gutter versus shoulder only. The use of a curb and gutter street section (without shoulder) is not compatible with high speed road design, in that a high speed vehicle striking curb and gutter is more likely to get out of control than a low speed vehicle would.

The posted speed limits and the 85th percentile speeds are illustrated in Figure 2-13. The speed limits are not all within five miles per hour of the 85th percentile speed in the studied locations. Arterial streets that are experiencing 85th percentile speeds greater than five miles per hour above than the posted speed limit might warrant changing the posted speed limit. Careful consideration of collision history and additional speeds studies should be completed prior to increasing or lowering the speed limit to verify speed trends in the corridor. Speed samples in locations that are residential or collector streets where speeds are also in excess of the 85th percentile should consider implementing strategies to slow traffic such as speed advisory boards, and enforcement prior to posted speed revisions. Additional studies may be warranted to confirm the findings.

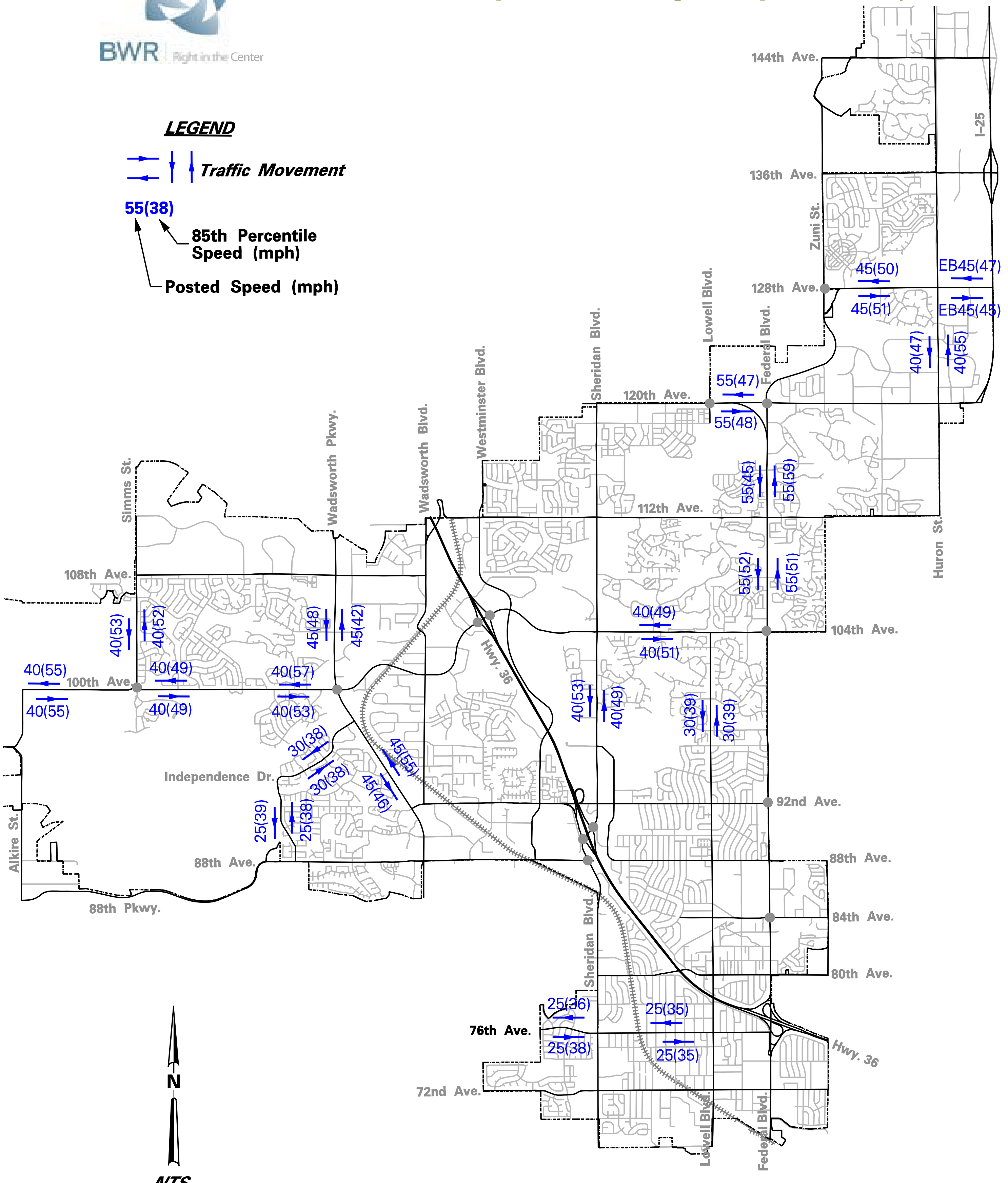

Figure 2–13 Posted Speed Limit Study

Chapter 3 – Travel Demand Model Development

Introduction

The objective of the Westminster transportation plan study is to evaluate the future conditions of the major streets and identify the future transportation needs in the City of Westminster. The travel demand model of the Denver Regional Council of Governments (DRCOG) covers an area of 9096 square miles in the Denver metropolitan area, including the City of Westminster, and can be used to produce the future traffic projections for the evaluation. The DRCOG model was developed and calibrated to replicate the 2005 base year traffic conditions at the regional level. For a city-level transportation plan study, the DRCOG model needs to be refined and calibrated in the study area to replicate the local traffic conditions before using it for the evaluation. Based on the requirement of the Westminster transportation plan study, the 2005 model includes the refinement of roadway network and transit route, the check and update of socioeconomic and demographic data, and the further model calibration in the City of Westminster. The 2030 model is refined as well and the 2030 model run is performed to provide future traffic projections.

Travel Demand Model Background

The existing travel demand model was used by permission of the Denver Regional Council of Governments. The DRCOG Travel Model User's Guide was the guide for establishing and following the appropriate steps to run the model.

The process began with coding the land use types and densities by zones throughout the City. The program estimates the number of trips going to and originating from each zone, and assigns them to the street network identified in the program. By comparing actual traffic conditions to those predicted by the model, the model can be fine-tuned to simulate actual traffic movements for existing conditions. The model can then be used to test the impacts of future land development, or the benefits of future street improvements.

The data collected by the city in 2007 was used in the model to baseline the existing traffic model. Colorado DOT traffic counts were also used as needed to provide as much detail in the base year for accurate calibration of the model.

2005 Base Year Model Refinement

In the Westminster transportation plan study, the travel demand model of the Denver Regional Council of Governments (DRCOG) was used and refined. The model refinement includes the following steps,

- Socio-economic and demographic updates in the study area
- Network refinement in the study area
- Transit route refinement in the study area
- Calibration

The refined DRCOG model was run by TransCAD Version 4.8, build 540. It is recommended to perform the model runs using the same version and build of TransCAD, as different model results may be obtained if other versions and builds of TransCAD are used. Additional data on running the model and inputs is available in the appendix.

DRCOG Model

The travel demand model of the Denver Regional Council of Governments (DRCOG) uses a traditional "four-step" framework. A conceptual flow chart of this framework as implemented in the DRCOG model is shown in the appendix. The inputs include a detailed description of the highway infrastructure, a detailed description of the transit service and the socioeconomic activity (households and employment) for each Traffic Analysis Zone (TAZ). Two auxiliary models are run outside of the normal model flow. These models are the area type model and the parking cost model.

The area type model places each TAZ into one of five categories: Central Business District (CBD), Fringe, Urban, Suburban or Rural. Each TAZ's classification is determined based on its employment density and its population density. The area types are used in determining the free-flow speeds and capacities of highway links and in calculating trip generation rates. The parking cost model predicts the parking cost in each TAZ within the CBD and within other areas with paid parking. The cost is predicted from the supply of parking spaces and the demand for parking. As the demand is directly related to the number of vehicle trips to the CBD, the parking cost model iterates with the mode choice model. The trip generation model predicts the number of trips produced by households and attracted to employment in each TAZ. Trip productions and attractions are generated by three trip purposes: home-based work (HBW), home-based non-work (HNW) and non-home based (NHB).

The transit skimming and highway skimming steps determine the shortest path via highway or transit between each pair of TAZs. The procedures calculate the time and cost to traverse those paths and store them in a matrices. For each trip purpose, the trip distribution models connect the productions and attractions from trip generation to determine where each trip goes. A gravity model is used for trip distribution, whereby the number of trips exchanged between two TAZs is proportional to the size of those TAZs (as measured by the number of productions and attractions) and inversely proportional to the time it takes to travel between those TAZs. Next, the mode choice models predict the mode of travel for each trip among the following choices: drive-alone, shared ride two, shared ride three and greater, and walk to transit or drive-to-transit. Multinomial logit (MNL) models determine this split probabilistically based on the relative travel times and costs of the modes. Time-of-day split is performed following mode choice. The transit trips are segmented into those occurring during the peak versus those occurring during the off-peak. The highway trips are split into ten time periods throughout the day. The assignment models predict the actual paths taken by each trip. TransCAD's pathfinder algorithm is used for transit assignment. The pathfinder is a multi-path algorithm where the trips are split among several good paths rather than a single best path. The paths are calculated to minimize a generalized cost where walking time and waiting time are penalized more heavily than in-vehicle time.

A multi-modal multi-class equilibrium highway assignment algorithm is used to determine the highway link volumes and speeds by commercial and non-commercial vehicles. The algorithm calculates the shortest path between each pair of zones for each vehicle class, assigns its trips to that path, then calculates a congested travel time based on total volumes. The process is repeated with the new congested travel time until no vehicle can unilaterally improve its travel time by changing paths. The last step is the travel speed feedback and model iteration. Because the highway assignment results in new congested travel speeds, the travel times calculated during the skimming process could be inconsistent with these speeds. If this inconsistency occurs, the new congested speeds are fed back to the networks and the whole model process is started again from skimming. These iterations continue until the starting and ending speeds are consistent.

Socio economic and Demographic Data Check and Update

Number of households by income group and household size and employment data by categories were used as inputs to trip generation. At first the population and number of households were checked within the city limits. The Westminster resident and household numbers in the DRCOG model were further estimated for each TAZ by using a factor method. The factor is assumed to be the percentage of city land area in each of TAZs. For example, if 50 percent land area of a TAZ belongs to the City of Westminster, it is assumed that the Westminster resident number in the TAZ is equal to 50 percent of its total population. The results are shown in Table 3-1. The demographic data in the DRCOG model is very close to the census data and can be used for this study without any updates.

Table 3-1 Population and Household Data

DRCOG Model		Census Data	Difference
Study Area (90 TAZs)	City (Est.)	City	
122,679	108,616	103,471	4.97%
45,421	40,256	39,539	1.81%

In the DRCOG model, the employment is categorized as,

- Production/Distribution, including Agriculture, Forestry, Fishing, Mining & Mineral Extraction, Construction & Construction Services, Manufacturing, Transportation, Communications & Other, Non-manufacturing Industrial and Wholesale Trade
- Retail, including Commercial Retail
- Service, including Commercial, Personal, and Public Services.

From the 2004 Westminster Comprehensive Land Use Plan, the total employment in the city is about 45,500. Since all most all employment activity centers are within city limits, the DRCOG employment numbers in the study are is check directly against the city employment number. In the DRCOG model, the total employment in 2005 is 34,577 for the study area, and it is 23 percent lower. Therefore the employment data needs to be updated. In this study, the only available resource for estimating employment is the 2007 city parcel data with building area information. For each parcel, the building area number was converted to the employment number based on the following factors,

- Commercial use, 500 square feet per one employee
- Office use, 350 square feet per one employee
- Industrial use, 1000 square feet per employee
- Other, no sufficient information to calculate it.

Then the estimate was aggregated to the TAZ level by two categories, the industrial (Production and Distribution) category and the commercial plus office category. The commercial plus office category was further split into retail and service by specific split rate of each TAZ. These split rates were obtained from the original DRCOG data and revisions were made. If the employment estimate of each employment category in a TAZ is larger than that in the original DRCOG database, the estimate is used as an update to the original DRCOG number. Otherwise, the DRCOG number is kept to be used in the model. The summary of employment data update is listed in Table 3-2, and the detail population and employment data by TAZ can be found in the appendix.

Table 3-2 Employment Data Updates

Employment	City Land Use Plan	DRCOG Model	Update
Production/ Distribution	N/A	5,773	5,914
Retail	N/A	10,040	13,916
Service	N/A	18,764	21,441
Total	45,500	34,577	41,271

The DRCOG model assumes lower free-flow speeds for some links. Based on the posted speed limit information from the City of Westminster, the free-flow speeds were adjusted to replicate the current conditions. Links with adjusted free-flow speeds are shown in the appendix.

There are also some other network updates and corrections in the study area. Zuni Street from 128th Avenue to 136th Avenue is a four-lane roadway instead of a four-lane roadway in the DRCOG model network. In the DRCOG model network, there is an on-ramp from 92nd Avenue to Highway 36 on-ramp; however, it is an off-ramp to westbound 92nd Avenue.

Transit Route Refinement

Transit routes and stops are built on the roadway network in the modeling process. After base network is refined and import of transit routes, transit routes and stops are reshaped to the refinement network, roadway centerline files. However, there are broken transit routes and lost stops in the study area because the network conflation, collector road adding and centroid connector changes broke the original links and generated new link id. Those were fixed manually. The refined transit routes and stops in the study area are included in the appendix.

2005 Base Year Model Run

Before the 2005 base year model run, area-type and parking cost were calculated as the preprocessing step. Then the 4-step model with feedback loop was run on a Quad-core PC with 2GB ram. The total running time is about 13 hours. Multiple model runs were performed in the model calibration.

2006 Existing Street Network with 2030 Trips

The 2006 existing network was built on the 2005 refined network and added the I-25/144th Avenue interchange. The 2005 refined transit route was used and the updates were made in the area around the I-25/144th Avenue interchange.

In the study, the 2006 existing street network is proposed to be analyzed by loading the 2030 projected trips onto it, and the results can be used to assess the existing street system's ability to carry future traffic flows and to identify where the existing system will be deficient at full land use build-out. This involves projecting what the traffic volumes will be on the 2006 existing major streets in the City for the year 2030 (assumed planning horizon for full land use build-out). In other words, it requires running the refined DRCOG model with the 2006 network and the 2030 socio-economic data as model inputs.

The 2030 DRCOG demographic and updated employment data was used as socio-economic inputs to trip generation. The summary information of 2030 population and employment is given in the Tables 3-3 and 3-4. The 2030 population and employment data by TAZ can be found in appendix.

Before the model run, area-type and parking cost were calculated as the preprocessing step. Then the four-step model with feedback loop was run on a Quad-core PC with 2GB ram. The total running time is about 66 hours. The 2030 projected daily trips on the 2006 existing street network in the study area, i.e. 2030 daily vehicle trips on the 2006 existing street network are included in the appendix.

2030 Model Refinement and Results

The 2030 model refinement followed the similar processes to the 2005 model refinement.

There is no change in the 2030 DRCOG demographic data and the summary information is given in the Table 3-3. The 2003 employment data was updated based on the changes made in the 2005 employment data and Table 3-4 summarizes employment updates. The detail population and employment data by TAZ can be found in the appendix.

Table 3-3 2030 Population and Households

	Model Study Area (90 TAZs)[1]	City
Population	151,119	135,214
Households	58,486	52,396

1 – Due to DRCOG model area larger than city limits

Table 3-4 2030 Employment Data Updates

Employment	DRCOG Model	Update
Production/ Distribution	12,416	12,530
Retail	15,819	19,246
Service	38,116	38,778
Total	66,351	70,554

The 2030 network were reshaped to roadway centerlines that have more accurate shapes. The network refinement area is larger the study area. The roadway network refinement follows the changes made in the 2005 network.

Number of Trips by Mode

The total number of person trips by transportation mode in the study area, i.e. 90 TAZs, is summarized in Table 3-4. Only person trips with at least one trip end in the study area are included in the summary table. In other words, through trips, i.e. without trip end in the study area are excluded. Transit share is increased in 2030 due to the addition of light rail in the scenario network.

Table 3-4 Summary of Number of Person Trips by Mode

Person Trips	2005	2006 Net w/ 2030 Demand	2030	2030 Alternative
Car	326,101	456,810	454,965	454,975
Transit	4,178	5,373	7,588	7,573

Chapter 4 – Long Range Transportation Improvements

Introduction

From the utilization of the travel demand modeling, there are areas of the City that will still perform well beyond the year 2030. However, other areas show that should the population and land use develop as predicted, street improvements will be needed before 2030.

2035 Metro Vision

The 2035 Metro Vision Regional Transportation Plan (2035 MVRTP) addresses the challenges and guides the development of a multimodal transportation system for the region. The Metro Vision 2035 Plan is the region's long range plan for growth and development. Table 4-1 shows projects from the 2035 MVRTP, appendix 4, which have been included in the 2030 model development.

Table 4-1 2035 Metro Vision Plan

Project Location / Name	Description	Length (miles)	New Lanes	Plan Cost Estimate ('08 $Millions)
US-36: Sheridan Blvd Interchange	Interchange Reconstruction	0.0	2	$54.0
Wadsworth Pkwy: 92nd Ave to SH-128/new 120th Ave Widening	Add through Lanes	3.7	2	$30.5
72nd Avenue and Sheridan Blvd Widening[1]	Add through lanes	0.7	2	$5.0
136th Ave: Zuni St. to Huron St Widening[1]	Add through lanes	1.0	2	$4.9
Simms Street: 108th Ave to 112th Ave Widening	Add through lanes	0.5	2	$3.3

Source: 2035 Metro Vision Plan – Appendix 4
1 – Project under construction

Methodology

Using the street capacities and threshold of congestion shown in Table 2-1, the streets were examined for their volumes and the continuity of the volumes between major streets. Once the volume for the streets reached the threshold of congestion, the street was considered for expansion. If the volume exceeded the general daily traffic capacity, it was considered for added capacity. Circumstances in which the facility would be on the verge for adding capacity, the general rule was to provide the added capacity.

Recommendations

The following summarizes the proposed street improvements and Figure 4-1 displays the 2030 street network in the study area and projected 2030 daily vehicle trips.

Wadsworth Parkway
The threshold of congestion for a four lane facility is currently exceeded from 92nd Avenue to 108th Avenue. It is recommended to widen Wadsworth Parkway to six lanes from 92nd Avenue to 108th Avenue. While the 2030 volumes exceed the six lane capacity it is not recommend to plan for an eight lane facility but rather to assure Wadsworth Parkway continues with strong access management. As these traffic volumes increase, methods to help with the high volumes should include assuring full turning movements at the intersections, strong access management controls and signal coordination much of which is current used on this corridor.

Federal Boulevard
The model shows that 2030 traffic volumes range from 39,560 to 50,850 vehicles per day. This volume exceeds the capacity for a four lane street and approaches the threshold of congestion for a six lane street in several areas. The traffic capacity of a six lane street is exceeded between 72nd Avenue and 80th Avenue. Federal Boulevard is recommended as a six lane street from south of 72nd Avenue to 112th Avenue.

Sheridan Boulevard
The model shows that 2030 traffic volumes range from 41,300 to 58,010 vehicles per day which exceed the capacity of 36,000 vehicles per day for a four lane street From the Draft DEIS, the reconstruction of the Sheridan Boulevard and US 36 interchange will provide future relief to this interchange. A six lane street is recommended from south of 72nd Avenue to 112th Avenue.

Huron Street
The 2030 forecast for Huron Street north of 120th Avenue produces volumes of 38,590 to 40,230. The capacity of a four lane street is generally considered to be 36,000 vehicles per day. Huron is recommended for a six lane street from 120th to 136th Avenue.

Wadsworth Boulevard

The current traffic conditions indicate the street is operating under capacity. However the 2030 forecast indicates the need for a six lane street from 92nd Avenue to Church Ranch Boulevard due to volumes of 36,800 vehicles per day. North of Church Ranch Boulevard the projections do not exceed the threshold of capacity for a four lane street but do exceed the threshold to the south. It is recommended to widen the street to a four lane street from 92nd Avenue to Church Ranch Boulevard. A two lane street is adequate from Church Ranch Boulevard to 112th Avenue.

Simms Street

While currently operating under capacity, 2030 projections approach the threshold of congestion south of 108th Avenue. North of 108th Avenue, the projected 19,470 vehicles per day exceed the capacity for a two lane street. Since Simms Street is already three lanes from 100th Avenue to 108th Avenue, it is recommended to widen Simms Street to a four lane street from 100th Avenue to 112th Avenue.

Alkire Street

This street is projected by 2030 to have a volume of 17,730 vehicles per day which exceed the threshold for congestion of a two lane street. It is recommended to widen the street to a four lane street from 86th Parkway to 100th Avenue.

Federal Parkway / Zuni Street

Currently, Federal Parkway is approaching the threshold of congestion for a two lane street between 120th Avenue and 128th Avenue. The 2030 projections show daily volumes of 18,580 which indicate a need for a four lane street.

92nd Avenue

The 2030 traffic forecasts for the 92nd Avenue corridor range from 30,180 to 36,210 vehicles per day. The threshold of congestion is reached on some segments and exceeds the traffic capacity between Federal Boulevard and Wadsworth Parkway. It is recommended to allow 92nd Avenue to operate at this level of service and look to widen in the years beyond 2030.

100th Avenue

The current street west of Wadsworth Parkway is adequate for the current traffic. The 2030 traffic indicates future traffic at the threshold of congestion for a four lane street and widening to a four lane from Garland to Alkire Street is recommended.

104th Avenue / Church Ranch Boulevard

The 2030 traffic forecast for this corridor approaches 35,000 vehicles per day between Wadsworth Boulevard and US 36. The areas in which the volumes exceed the threshold indicate a need for widening from a four lane street to a six lane street from Wadsworth Boulevard to just past Sheridan Boulevard terminating at Wolff Street. 104th Avenue from Sheridan east to Federal Boulevard will approach the threshold of congestion for a four lane but is not recommended for widening.

108th Avenue
The 2030 forecast indicates a volume that is nearly at the threshold of capacity for a four lane. It is recommended to widen the current two lane street to a four lane street to be extended from Westmoor Drive to Simms Street.

112th Avenue
The current daily traffic of 19,080 vehicles exceeds the threshold of capacity for a two lane street from Federal Boulevard to Huron Street. The 2030 projections 31,490 also confirm the need for a four lane street.

120th Avenue
This street varies its number of lanes from four and six between Sheridan Boulevard and I-25. The current volume of 40,400 vehicles per day exceeds a four lane capacity. The 2030 traffic projections of over 52,000 vehicles per day indicate a need for a 6 lane facility from I-25 to Sheridan Boulevard.

128th Avenue
The section between Zuni Street and Huron Street is at the threshold of congestion and exceeds the threshold between Huron Street and I-25. This street is projected by 2030 to have a volume of 14,550 vehicles per day which exceeds the threshold for congestion of a two lane street and is recommended to expand 128th Avenue to four lanes between Zuni Street and I-25.

136th Avenue
The section between Zuni Street and Huron Street exceeds the threshold of congestion for a two lane. This street is projected by 2030 to have a volume of 22,680 vehicles per day. The current widening project will provide this capacity.

144th Avenue
The section between Zuni Street and Huron Street currently exceeds the threshold of congestion for a two lane street. Future traffic projections of 40,050 vehicles per day indicate a need for a six lane street. It is recommended to expand 136th Avenue to six lanes between Zuni Street and Huron Street.

Figure 4-1 displays the 2030 proposed street network in the study area and projected 2030 daily vehicle trips.

BWR Right in the Center

N
NTS

Type of Street	General Daily Traffic Capacity	Threshold of Congestion
6–7 lane street	53,000	46,000
4–5 lane street	36,000	31,000
2–3 lane street	18,000	13,000

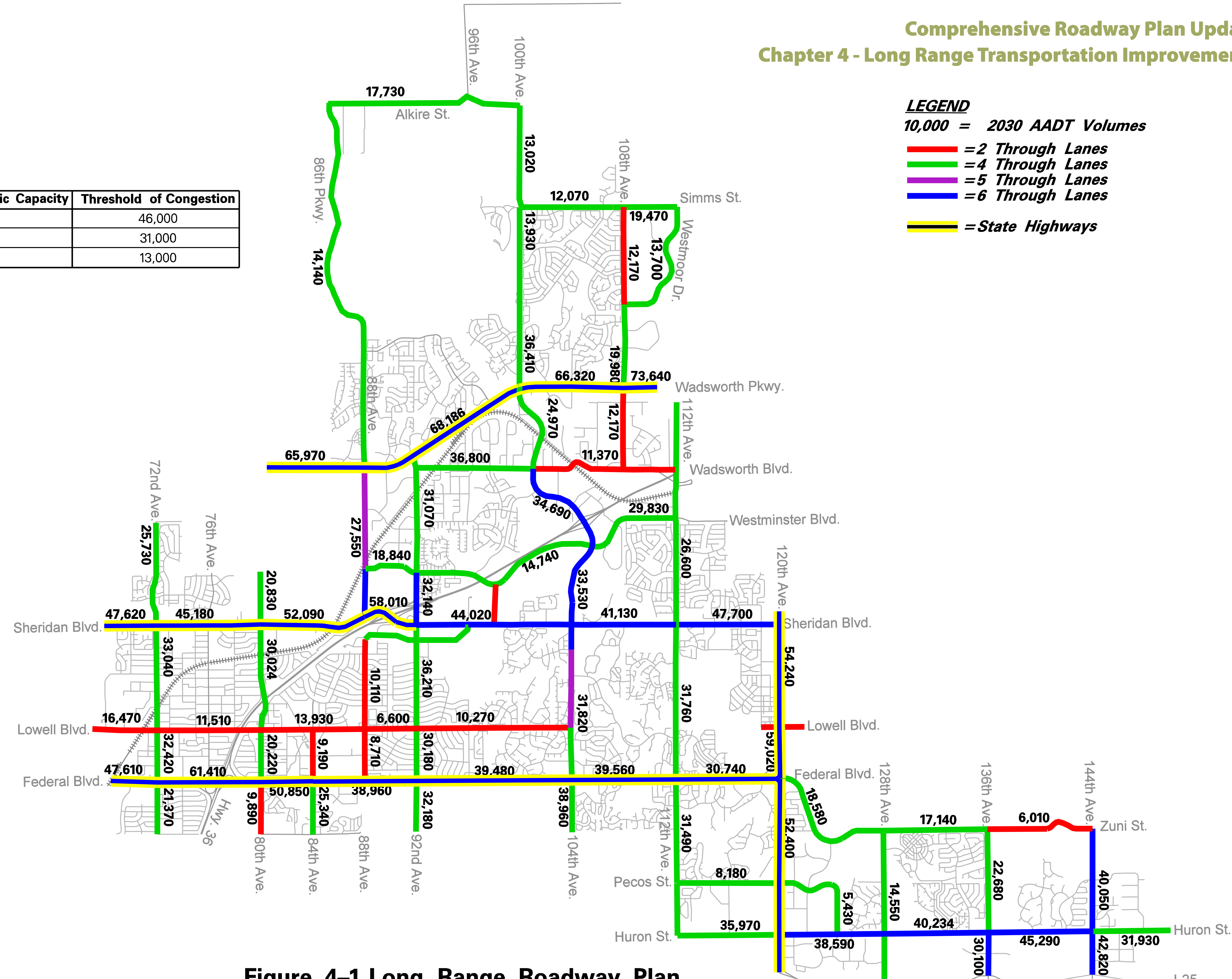

Figure 4–1 Long Range Roadway Plan

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Chapter 5 – Improvement Prioritization

Introduction

The estimated improvement costs as a ratio of the existing daily traffic benefited to arrive at a cost per benefited vehicle is summarized in Table 5-1 for intersection improvements and 5-2 for corridor improvements. Table 5-3 shows the corridor improvements without the CDOT highway projects included and thus only city streets improvement are shown. The general assumption is the least cost per benefited vehicle provides the largest benefit not considering other factors such as accident history. This matrix is intended as a tool to assist decision makers in evaluating projects for the development of the city capital improvement program. A detailed cost estimate can be found in the appendix.

Table 5-1 Transportation Enhancement Projects Decision Matrix - Intersections

No.	Project Description	Cost	Daily Traffic Benefited	Type of Benefit	Cost per Vehicle Index
1	**Wadsworth Parkway and 100th Avenue** Add NB and SB through lanes, SB and EB dual left turn lanes	$4,338,000	62,710	safety, capacity	69
2	**Federal and 92nd Ave** Add NB and SB through lanes, dual lefts for all directions	$5,056,000	67,300	safety, capacity	75
3	**Federal and 120th** add NB through lane, EB and SB dual left turn lanes and EB and WB through lanes	$4,613,000	58,672	safety, capacity	79
4	**Federal and 104th** add dual left turns in all directions and a third NB and SB through lane	$4,672,000	58,257	safety, capacity	80
5	**Federal and 84th** add SB, EB and NB dual left turns, and northbound and southbound through lanes	$4,911,000	46,480	safety, capacity	106
6	**Simms St. and 100th Avenue** Intersection realignment	$2,400,000	12,744	safety, capacity	188

Table 5-2 Transportation Enhancement Projects Decision Matrix - Corridors

No.	Project Description	Cost	Daily Traffic Benefited	Type of Benefit	Cost per Vehicle Index/mile
1	Widen **Sheridan Blvd** to 6 lanes from 74th to 84th and from 96th to104th, 2.5 miles	$15,022,000[1]	50,414	capacity	120
2	Widen **120th Ave** to 6 lanes from Sheridan to Pecos, 2.3 miles	$11,194,200[2]	40,300	capacity	121
3	Widen **Federal Blvd** to 6 lanes from 80th Ave to 112th Ave. 4 miles	$22,961,000	25,400 to 40,500	capacity	142 - 226
4	Widen **Wadsworth Pkwy** to 6 lanes from 92nd to 108th, 2.2 miles	$13,708,000	42,200	capacity	148
5	Widen **112th Ave** to 4 lanes from Federal to Huron, 1.5 miles	$5,173,000	19,080	capacity	180
6	Widen **104th Ave** from Wadsworth Blvd to Wolff St., 2.8 miles	$19,510,000	33,230	capacity	210
7	Widen **128th Avenue** to 4 lanes from Zuni to Huron, 1 mile	$4,451,000	12,982	capacity	343
8	Widen **136th Ave** to 4 lanes from Zuni to Huron, 1 mile	$5,222,000[3]	15,015	capacity	347
9	Widen **Huron St.** to 6 lanes from 120th Ave to 136 Ave., 2 miles	$14,029,000	10,650 – 19,780	capacity	355 - 658
10	Widen **Federal Parkway** to 4 lanes from 120th Ave. to 128th Ave., 1.3 miles	$7,906,000	14,844	capacity	410
11	Widen **108th Ave** to 4 lanes from Westmoor Dr to Simms St., 1 mile	$4,941,000	11,565	capacity	427
12	Widen **144th Ave** to 6 lanes from Zuni to Huron, 1 mile	$5,909,000	13,330	capacity	443
13	Widen **Simms St** to 4 lanes from 108th Ave to 112th Ave., 1.5 miles	$5,277,000	6,388	capacity	550
14	Widen **100th Ave** to 4 lanes from Garland to Alkire St, 2.4 miles	$9,985,000	6,290	capacity	661
15	Widen **Westminster Blvd** from north of US 36 to south of 104th Ave., 0.7 miles	$3,465,000	7,370	capacity	672
16	Widen **Wadsworth Blvd** to 4 lanes from 92nd Ave to Church Ranch Blvd., 1.2 miles	$9,547,000	10,470	capacity	760
17	Widen **Alkire St** to 4 lanes from 86th Pkwy to 100th Ave, 1.8 miles	$6,771,000	See note 4	capacity	See note 4

Notes:
1 – Excludes US 36 and Sheridan interchange reconstruction - DEIS and US 36 Mobility partnership, $41.7 million.
2 – Requires cost sharing with the City of Broomfield
3 – Requires cost sharing with the City of Broomfield. Currently programmed for construction,
4 – Requires cost sharing with City of Arvada. Current traffic count unavailable

Table 5-3 Transportation Enhancement Projects Decision Matrix – Corridors City Projects Only

No.	Project Description	Cost	Daily Traffic Benefited	Type of Benefit	Cost per Vehicle Index/mile
1	Widen **112th Ave** to 4 lanes from Federal to Huron, 1.5 miles	$5,173,000[1]	19,080	capacity	180
2	Widen **Sheridan Blvd** from 96th to104th, 1 mile	$6,351,000	30,630	capacity	207
3	Widen **104th Ave** from Wadsworth Blvd to Wolff St., 2.8 miles	$19,510,000	33,230	capacity	210
4	Widen **136th Ave** to 4 lanes from Zuni to Huron, 1 mile	$5,222,000[2]	14,817	capacity	274
5	Widen **128th Avenue** to 4 lanes from Zuni to Huron, 1 mile	$4,451,000	12,982	capacity	343
6	Widen **Huron St.** to 6 lanes from 120th Ave to 136 Ave., 2 miles	$14,029,000	10,650 – 19,780	capacity	355 - 658
7	Widen **Federal Parkway** to 4 lanes from 120th Ave. to 128th Ave., 1.3 miles	$7,906,000	14,844	capacity	410
8	Widen **108th Ave** to 4 lanes from Westmoor Dr to Simms St., 1 mile	$4,941,000	11,565	capacity	427
9	Widen **144th Ave** to 6 lanes from Zuni to Huron, 1 mile	$5,909,000	13,330	capacity	443
10	Widen **Simms St** to 4 lanes from 108th Ave to 112th Ave., 1.5 miles	$5,277,000	6,388	capacity	550
11	Widen **100th Ave** to 4 lanes from Garland to Alkire St, 2.4 miles	$9,985,000	6,290	capacity	661
12	Widen **Westminster Blvd** from north of US 36 to south of 104th Ave., 0.7 miles	$3,465,000	7,370	capacity	672
13	Widen **Wadsworth Blvd** to 4 lanes from 92nd Ave to Church Ranch Blvd., 1.2 miles	$9,547,000	10,470	capacity	760
14	Widen **Alkire St** to 4 lanes from 86th Pkwy to 100th Ave, 1.8 miles	$6,771,000	See note 3	capacity	See note 3

Notes: 1 – Requires cost sharing with City of Northglenn
2 – Requires cost sharing with City of Broomfield
3 – Requires cost sharing with City of Arvada. Current traffic count unavailable

Chapter 6 – Multimodal Integration

Introduction

The City of Westminster requires consideration of pedestrians and bicyclists within the function of the existing street network. Using the methodologies outlined in the Kansas City, Missouri Walkability Plan, this study documents the pedestrian and bicyclist impact analysis for Wagon Road, Church Ranch, and the Westminster Center Park-n-Rides and surrounding areas. Since there are few methodologies for study of pedestrian walkability criteria, the Kansas City adopted methodology was followed. The methodologies for the Kansas City Walkability Plan are included in the appendix.

Walkability

There are three key destinations for consideration of walkability in this study as it relates to transit. The Wagon Road Park-n-Ride is located on the southwest corner of W. 120th Ave and North Huron St. The Church Ranch Park-n-Ride is located ¼ mile northwest of the Church Ranch Boulevard and US 36 interchange. The Church Ranch Park-n-Ride began operating in this new location on May 27th, 2007 and includes spaces on the east and west side of US 36. The Westminster Center Park-n-Ride is located ¼ mile south of the Sheridan Boulevard and US 36 interchange. Park and Ride destination influence areas are show in Figure 6-1. Detailed drawings of the influence areas are included in the appendix.

Type of Pedestrian Areas

The first step in the preparation of a pedestrian impact study is to establish the type of pedestrian area encompassing the site which will be the basis on which the City will want to establish a minimum required Level of Service (LOS). Level of Service is given to five categories: directness, continuity, street crossings, visual interest and amenity, and security. These minimum standards should reflect reasonable directness, a continuous set of sidewalks, safe street crossings, a relatively pleasing environment, and a secure route.

The studied areas will be defined as a Mixed Use and Multimodal Transportation Centers, Transit Impact Zones. This type of zone identifies a number of existing and potential mixed-use and transit regional and community locations. Since all transit trip ends involve walking, areas near transit stops should provide for a high level of service in the categories of directness, continuity and street crossings. All areas within the City should promote pedestrian mobility and provide adequate levels of service.

Identification of Destination Areas

The impact study area was defined as the ½ mile radius from each of the transit stops. Destinations considered were residential, commercial, industrial, and recreational. The destination influence areas are illustrated in Figure 6-1.

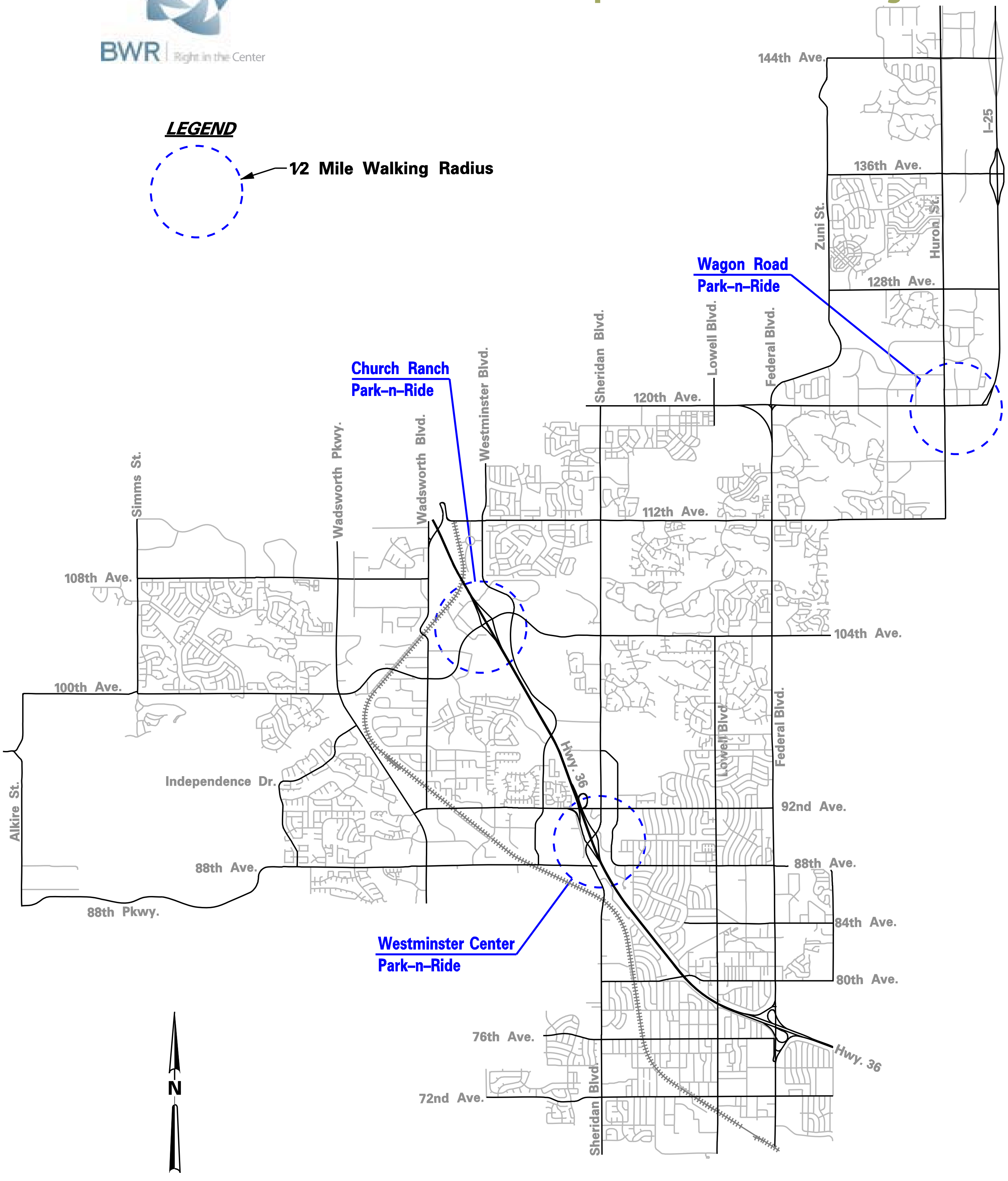


Figure 6–1 Park and Ride Destination Influence Areas

Level of Service Analysis

The criteria for determining the level of service is outlined below. Level of service is determined for both existing and proposed connections from each transit area to the publicly accessible edge of the off site destinations identified. Elements noted included nearby destinations, sidewalk connections surrounding the site, landscape amenities, lighting, and pedestrian crossings. The consultant conducted a field reconnaissance of the sites during July 2007.

Directness

Directness addresses the issue of whether the pedestrian network provides the shortest possible route, but it is also dependent on continuity, or completeness of the pedestrian route. For this project the level of service for directness was assessed along major corridors leading to city Park-n-Ride facilities. The level of service was determined by a directness ratio that was developed by taking the actual walking distance divided by the minimum potential walking distance assuming a right angle grid overlay. LOS was based on the outcome of this ratio calculation as shown in Table 6-1.

Table 6-1 Directness Level of Service

LOS	Actual/Measured Distance Ratio
A	<1.2
B	1.2-1.4
C	1.4-1.6
D	1.6-1.8
E	1.8-2.0
F	>2.0

The overall directness for the areas surrounding the Park-n-Ride facilities studied would currently be rated A. The directness LOS for each site is summarized in Table 6-2. The individual directness LOS ratings can be found in the appendix.

Table 6-2 Directness Level of Service Summary

Trip	Average A/M Ratio (LOS)
Wagon Road Park-n-Ride	1.0 (A)
Church Ranch Park-n-Ride	1.2 (A)
Westminster Center Park-n-Ride	1.1 (A)

The area surrounding the Park-n-Ride facilities throughout the City of Westminster are currently sufficient in regards to directness. Most major walking routes lead directly to the Westminster Park-n-Ride facilities. While, the Church Ranch Park-n-Ride facility is currently sufficient in regards to directness, the route that is the least direct starts at the corner of Westminster Boulevard and 104th Ave and ends at the Church Ranch Park-n-Ride. This route is currently at a level of service C since it goes around the Promenade shopping center and is not direct.

Continuity

Continuity addresses the issue of whether the pedestrian network provides a complete network without gaps. For this analysis the level of service for continuity is addressed along major corridors leading to Westminster Park-n-Ride facilities.

The area surrounding the Park-n-Ride facilities throughout the City of Westminster are currently sufficient in regards to continuity with the exception of a few sections of sidewalk in the influence areas of the Park-n-Ride facilities.

- The west side of North Huron Street from 121st Avenue to 123rd Avenue is missing 1,200 linear feet of sidewalk.
- The west side of Westminster Boulevard 500 feet north of Promenade Drive is missing 350 linear feet of sidewalk.
- The northeast corner of Sheridan Boulevard and 88th Avenue is missing 200 linear feet of sidewalk.

Once these sections of sidewalk are completed it would raise the level of service of C to a level of service of A. The individual continuity LOS ratings can be found in the appendix.

Street Crossings

The level of service measurements for street crossings set different standards for different types of crossings, depending on whether the crossings are signalized or unsignalized, and whether they occur across a major street, minor street, or mid block. The level of service also takes into account crossing width, parking lanes, vehicle travel speed, crosswalk markings, lighting, median (pedestrian refuge), intersection sight distance, ADA ramps and pedestrian signal activation.

The area surrounding the Park-n-Ride facilities throughout the City of Westminster are currently sufficient in regards to street crossings. Most major walking routes have acceptable street crossings near Westminster Park-n-Ride facilities with the exception of the intersection of West 123rd Avenue and North Huron Street which should have a crosswalk across West 123rd Avenue to increase safety. The individual street crossing LOS ratings can be found in the appendix.

Visual Interest and Amenity

The essence of visual interest and amenity is whether the pedestrian environment is attractive and comfortable and offers protection from the harsh elements. The area surrounding the Park-n-Ride facilities throughout the city of Westminster are currently sufficient in regards to visual interest and amenities.

All major walking routes have acceptable visual interest and amenities near Westminster Park-n-Ride facilities. All the Park-n-Ride areas are fairly new and components such as buildings, walkways, roads and structures within the area are designed to complement one another esthetically. All the Park-n-Ride facilities are equipped with up to date equipment. Bus waiting stations often have equipment such as bike lockers, bike racks, benches and newspaper stands. The Park-n-Ride facilities are also ADA compliant containing ramps and six foot sidewalks. The individual visual interest and amenity LOS ratings can be found in the appendix.

Security

The essence of security is the provision of a walking environment with adequate lighting, pedestrian visibility by autos, and adequate separation between pedestrian paths and traffic to provide a sense of safety to the pedestrian. A buffer of at least five feet is recommended to provide the spacing between pedestrians and automobiles in order for the site to meet the required rating. The photo to the right is an example of multiple deficiencies.

W. 88th Ave Looking West Toward Yates

Most major walking routes are secure near the Westminster Park-n-Ride facilities. All facilities have acceptable lighting, pedestrian visibility by autos. However there are routes where pedestrians are secure with respect to adjacent traffic.

The Westminster Park-n-Ride facility has routes where pedestrians are not secure with respect to adjacent traffic. Such a location is along the east side of Sheridan Boulevard and West 88th Place from West 92nd Avenue to the Westminster Center Park-n-Ride facility. These are arterial streets and the sidewalk situated close to the roadway. Pedestrians should be separated from traffic along the south side of W 88th Ave from Rutgers Street to the Westminster Center Park-n-Ride facility. This is a four lane road and the sidewalk is situated close to the roadway. Pedestrians should also be separated from traffic along the west side of Sheridan Boulevard from west 84th Avenue to the Park-n-Ride facility. This is a busy 4 lane road and the sidewalk is situated close to the roadway. The individual security LOS ratings can be found in the appendix.

System Deficiencies

System deficiency encompasses a number of items including missing multi-modal elements, improvements and corrections. Along with an analysis of the existing conditions at the Wagon Road, Church Ranch, and Westminster Center Park-n-Rides, a list of improvements was devised to improve walkability.

The suggested improvements at the Church Ranch Park-n-Ride include:

- Construct 350 linear feet of sidewalk on the west side of Westminster Boulevard 500 feet north of Promenade
- Construct 800 linear feet of sidewalk on the east side of Westminster Boulevard 775 feet north of Big Dry Creek Trail
- Add a multi-modal trail along the north side of Lower Church Lake to facilitate easier access to residential areas located northwest of the lake
- Add trail along adjacent to the railroad to facilitate easier access to residential areas to the southwest

The suggested improvements at the Westminster Center Park-n-Ride include:

- Construct 200 linear feet of sidewalk on the northwest corner of Sheridan Boulevard and 88th Avenue
- Update the existing sidewalk for improved pedestrian separation from traffic for Sheridan Boulevard from West 84th Avenue to the Park-n-Ride facility
- Update the existing sidewalk for improved pedestrian separation from traffic for West 88th Avenue from Rutgers Street to the Park-n-Ride facility
- Update the existing sidewalk for improved pedestrian separation from traffic for West 88th Avenue and Sheridan Boulevard from West 92nd Avenue to the Park-n-Ride facility
- Add a multi use trail parallel to US 36 from the Westminster Center Park-n-Ride south side to connect to the residences to the south.

A summary of the walkability study along with system deficiencies can be found in the appendix.

Bicycle and Trail Facilities

Open spaces and trails are some of the most valued assets in Westminster which has preserved more than 2,700 acres of open space in all parts of Westminster. The interconnected trail system winding through the City's open space features more than 63 miles of off-road trails, more than 40 pedestrian/bike underpasses, allowing trail users to safely pass under busy streets and enhancing the overall experience. The City of Westminster Trails Master Plan is a working document designed to show existing and future development of trails, trail heads and other elements of the citywide trail system. A plan is a guide for improvements from 2002 through 2007.

The area of study for the bicycle facilities was expanded beyond just the park-n-ride facilities to take a general view of the city systems ability to provide a continuous network of bicycle facilities that could enhance the multimodal transportation and feed the park-n-ride facilities. A city's bicycle system has the ability to provide connectivity from the home or business and with connective to transit facilities can reduce the dependence on the automobile.

Types of Bicycle Facilities

There are five typical classifications of bicycle facilities:

- Shared Roadway
- Signed Shared Roadway
- Bike Lanes
- Shared Use Paths
- Other designs (Additional Bicycle Amenities)

Shared roadways reflect locations where bicycles are permitted such as roads, streets and highways excluding interstates and expressways. These facilities may or may not include features to enhance ride-ability such as bicycle-safe drainage grates and expansion joints, improved railroad crossings, smooth pavements, adequate site distances, and signal timing and detector system that respond to bicycles. Other more costly amenities include shoulder improvements and wide curb lanes.

Signed shared roadways are similar to shared roadways; however, signed shared roadways have signs to denote the presence of bike routes and have been maintained as bicycle routes. Routes must provide continuity with other adjacent biking facilities, be a common route for bicyclists and be located near neighborhood streets, collectors leading to those streets, parks, schools and commercial districts.

Bike lanes are delineated road space designed to create a more predictable path for bicyclists. They also create a greater sense of security for cyclists and prevent motorist from straying into their path.

Shared use paths, also known as trails, are similar to sidewalks; however, these are designed for the use of bicyclists, in-line skaters, roller skaters, wheelchair users and pedestrians. Shared use paths are at eight to ten feet wide and have minimal cross flow conflicts by motor vehicles.

Additional bicycle amenities include the existence of bike racks in high bike traffic areas, rest areas along long interrupted paths, buses converted to accommodate bicycles, or rapid rail facilities and ferries that can accommodate bicycles.

Existing Conditions

Review of the current trail guides from the fall of 2005, regional bicycle maps from the summer of 2006 and field data collected July of 2007, the City of Westminster was found to have all types of facilities including shared roads, signed shared roads, bike lanes, shared use paths and additional bicycle amenities. The current bicycle system was evaluated using the following criteria; abundance, continuity, condition, visual interest and additional amenities.

Abundance

Abundance is an evaluation of the quantity of trails and the locations of trails throughout the area. The bicycle trails in Westminster are in abundance and located throughout the entire geographic area of the City of Westminster.

Continuity

Continuity considers the network that those trails have with each other to create one unit. Most of the trails are continuous throughout the City of Westminster. However, there are trails located within parks around the city that are isolated from the whole network. These are few and far between and are mostly used for recreational purposes only.

Condition

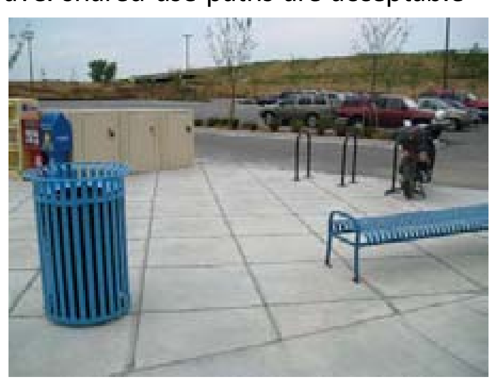
Condition considers the type of bicycle facilities available. The southern portion of Westminster south of 72nd Avenue contains shared roadways with some shared use paths. The central portion of Westminster is comprised of shared roadways and shared use paths. The northernmost portion is primarily shared use paths. The use of bike lanes is minimal throughout the city.

Visual Interest

Visual Interest considers the esthetics along the trail. Items such as the newness of the trail, the way the trail complements its surrounding, and the path which the trail takes are analyzed. Many of the shared use paths on the west side of Westminster are visually appeasing, with lakeside paths and mountain vistas. Big Dry Creek is one of the major attractions located along Standley Lake. Some of these paths are natural trails complementing the surrounding area. For example most of the natural trails located on the west side of Westminster are located in Standley Lake Regional Park or in designated open space. These trails are acceptable in a public/city park setting. Within the city shared use paths continue along creeks, parks and roadways. Some of the shared use paths in the city are paved sidewalk. Other shared us paths are made of gravel. Paved or gravel shared use paths are acceptable within the city limits.

Additional Amenities

Additional Amenities considers all the facilities and programs of a biking system that do not fall under other categories and may include as bike racks, bike lockers, racks on buses and programs designed to promote biking. As seen in the photo to the right, the bike racks, lockers and bus bike racks are already in use at the Park-n-Ride centers in Westminster. Brochures pertaining to trails and bike routes are also available



Westminster Center Bike Racks and Lockers from the City of Westminster and RTD. The Colorado Department of Transportation holds "Colorado Bike Month" every June to help encourage bicycling. Also the Denver Regional Council of Governments holds "Colorado's Bike to Work Day" on the fourth Wednesday in June each year to help promote biking. These are all great ways to involve the community in biking.

System Summary

Westminster has focused on the public support for open space in the city and thus has built and extensive trail system. While on street bicycle paths can serve the bicycle commuter, the bicycle trail or shared use path can serve the widest demographic of bicycle rider. As such the City has invested in the shared path that provides for a path that can provide for a high degree of rider safety separated from automobile traffic. To provide for connectivity using on street bicycle paths, substantial investment in reconfiguration of the existing street system would be required.

As such, focus of the trail system should consider current and future multimodal facilities and the connection of the trail system to the facilities. The future South Westminster Transit Station south of 72nd Avenue and between Lowell Boulevard and Federal Boulevard should consider connectivity through expansion of the bicycle system.

Planned improvements are scheduled in 2008 for construction of Lowell Boulevard. Reconstructing of Lowell Boulevard between 75th Avenue and 78th Avenue will narrow the street slightly to provide wider sidewalks that are separated from the street by a buffer with trees and decorative street lighting.

A deficiency for consideration is that many of the shared use paths are a mix between pavement and gravel. Filling in the gaps with paved surfaces would allow utilization by a wider variety of the community. Paving the stretch of Farmers' High Line Canal Trail between 91st Avenue and Trendwood Park and Betty Adams Elementary School would allow for better utilization.

Another improvement for consideration is the lack of shared use paths between the 92nd Avenue and 76th Avenue. While it is not necessary, the addition of paths connecting the Farmers' High Line Canal Trail and Little Dry Creek Trail will add uniformity to the southwest portion of Westminster and Arvada and allow better access to the trail system to those living in that area.

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