



Bend Central Area Plan

FINAL ***TECHNICAL MEMORANDUM #6—*** ***FUTURE CONDITIONS***

Prepared for the City of Bend by:

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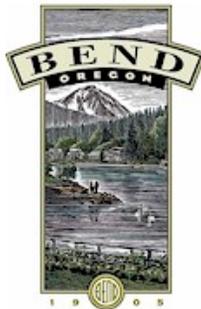


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Introduction

Background

The focus of Phase 2 of the Central Area Planning effort is on the area adjacent to Bend's existing downtown core, to the east, north and south. This area includes the 3rd Street corridor (formerly designated as US 97 and now designated as Business 97) that runs north-south through the center of Bend. Greenwood and Franklin Avenues connect the 3rd Street corridor with the downtown core. With the completion of the Bend Parkway several years ago, 3rd Street carries lower volumes than previously; however, the Bend Parkway acts as a significant barrier separating the downtown core from the study area. A map of the Central Area Plan study area is presented on the following page.

One of the key objectives of the Phase 2 planning process will be to identify improved transportation linkages between the study area and the downtown core, while accommodating significant changes in the character of land uses in the area. Development of the Central Area Plan must result in:

- A detailed list of transportation improvements needed to support planned land uses. In particular, the Central Area Plan must identify needed improvements to arterials, collectors and local streets.
- Changes to both land use and transportation plans within this study area.
- A general indication of issues and/or limitations related to other supporting infrastructure that might constrain land use development within the study area.

In Part 2, special attention will be paid to the issues of mobility, circulation and access within and between the districts comprising the study area, and the balance of the community.

Content of This Memorandum

This memorandum includes a discussion of future growth expectations within the Central Area Plan study area and the impact of this growth on existing transportation facilities and other urban infrastructure including sewer, water, storm drainage and other facilities and services. Two scenarios have been addressed including growth to the 2030 planning horizon year under the current General Plan, and growth assuming the potential development and redevelopment activities that have been highlighted for the Central Area in Technical Memoranda #1 (related to urban design concepts) and #4 (related to redevelopment potential).

Chapter 1 is this Introduction. Chapter 2 presents a synopsis of growth expectations in the Central Area based on either the current General Plan or on proposed Central Area Plan as defined in Technical Memorandum #4. Data in this chapter has been enhanced from the information contained in the Technical Memorandum to provide a comparison of current (2003) household and employment estimates in the study area with projections for 2030 under both the General Plan and CAP scenarios.

Chapter 3 discusses the future transportation system focusing on anticipated congestion challenges both the General Plan and CAP development scenarios.

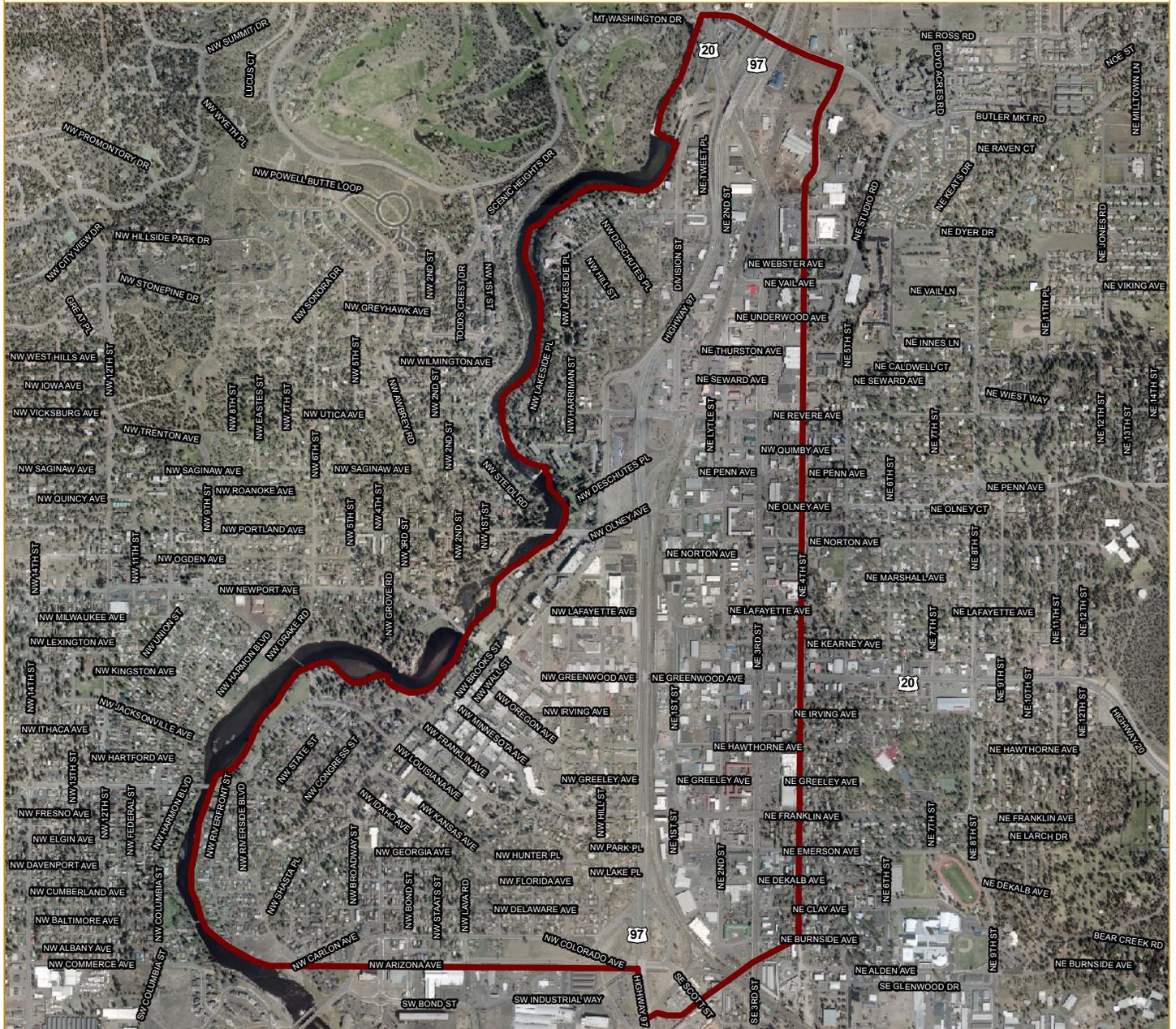
Chapter 4 presents a range of transportation system options to address both the anticipated congestion problems within the Central Area and the actions needed to accomplish the overall objectives of the Central Area Plan for enhanced multi-modal circulation opportunities. Included in this chapter is a discussion of policy and planning guidance provided by various state and local documents, review of the transportation system options including bicycle and pedestrian facility needs, a synopsis of the Central Area Plan strategy as related to transportation. Included as part of this strategy is a discussion of: key plan elements, compliance with state and local policies, proposed TSP amendments, transportation system implementing actions, and funding opportunities.

Chapter 5 summarizes expected impacts on non-transportation infrastructure serving the Central Area. This infrastructure includes public infrastructure such as the water distribution, storm drainage and sewer system facilities, and private infrastructure elements including power, broadband, telephone and natural gas services.



BEND CENTRAL AREA PLAN

Study Area Boundary



 City of Bend Central Area



0 500 1,000 1,500
Feet

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Data Source(s):
City of Bend, NAIP, Parametrix

Geographic Data Standards:

Projected Coordinate System:
State Plane - Oregon South
Units: US Foot

Parametrix

Future Community Development

Introduction

This chapter provides a brief summary of future land development and community growth expectations that affect transportation and other infrastructure needs within the Central Area Plan study area. This information has been excerpted from Technical Memorandum #4 and provides the foundation for development of future traffic volume projections for two scenarios: assuming continued development per the land use designations and zoning associated with the current General Plan, and for development expectations associated with the growth potential and land use allocations of the proposed Central Area Plan. Central Area Plan development expectations have also formed the basis of the qualitative assessment of future water, sewer, stormwater and other non-transportation infrastructure requirements.

Market Summary

Population and Employment Projections

Any forecast of future community development begins with a projection of growth in population and employment. Over the past decade, Bend has experienced some of the most rapid growth in the State of Oregon. While Bend’s population grew 26 percent between 2000 and 2005, the second-fastest growing large city, Hillsboro, grew by 14.1 percent, while the state as a whole grew just 6.1 percent. Bend’s population and employment as a whole are expected to continue to grow at rates that will far outpace the rates of other metropolitan areas around the state. Bend’s economy, driven by in-migration and increasing employment in high-tech, hospitality, specialty manufacturing and other targeted sectors, is also expected to maintain healthy growth.

Between 2002 and 2004, the City of Bend worked with the planning and legal staff of Deschutes County and the Cities of Redmond and Sisters to prepare a coordinated population forecast for all of Deschutes County. The county adopted a 2000 to 2025 coordinated population forecast in September of 2004. By 2025, this forecast estimates 240,811 people living in Deschutes County. Bend’s UGB population forecast for 2025 is 109,389 people. The City has chosen, for the purposes of the UGB expansion analysis, to forecast population five years beyond to 2030 to ensure that the City will have a 20-year buildable land supply (e.g. 2007 to 2027). Staff assumed an annual growth rate of 1.7 percent between 2025 and 2030, with Bend reaching a population of 119,009 by 2030.

Table 1 shows the average annual growth rate over five-year blocks of time between 2005 and 2030 for population and employment. It demonstrates how the rate of growth is projected to slow down over time.

Table 1. Bend Long-term Population and Employment Projection Summary						
Bend	2005	2010	2015	2020	2025	2030
Population	69,004	81,242	91,158	100,646	109,389	119,009
5-year avg. annual growth rate		3.3%	2.3%	2.0%	1.7%	1.7%
Employment	40,372	46,602	55,948	62,757	69,566	76,375
5-year avg. annual growth rate		2.9%	3.7%	2.3%	2.1%	1.9%

Source: Leland Consulting Group, 2007.

Central Area Plan Study Area

The Central Area Plan study area (see Figure 1) makes up a small percentage (just 4.3 percent) of Bend’s total population in 2006. Of the Central Area’s 2,977 current residents, the largest majority live in the

South Neighborhoods. In contrast, the Third Street Corridor is very lightly populated with just 122 residents spreads over 326 gross acres. Additionally, household incomes are significantly lower in the Central Area than in Bend in general – especially in Downtown and along the Third Street Corridor.

Table 2 shows an estimate of net new development by 2030 with the Central Area Plan (CAP). The table includes households, along with office, retail and light industrial square footage. Market conditions and the amount of growth projected for Bend are the driving factors influencing the overall amount of growth that will take place within the Central Area, but it is the Framework Concept that guides the specific land uses that are projected for different areas. Given this, it is important to note that the land use projections are based on the best current knowledge about existing conditions and future growth trends. These trends are best observed and are more accurate at the district level, but to assess the transportation and infrastructure requirements associated with this development plan, they have been interpolated down to the level of Transportation Analysis Zones (TAZs)¹. Individual property owner decisions and site-specific issues will inevitably alter the actual mix of uses achieved in any specific area. Locations of TAZs are illustrated in Figure 2.

Table 2. 2030 Central Area Plan Net New Development					
District/TAZ	Housing Units	Office (sq. ft.)	Retail (sq. ft.)	Light Ind. (sq. ft.)	Hotel Rooms
Third Street Corridor	1,369	1,230,089	201,918	(375,120)	969
252	0	16,007	-	(16,007)	-
253	24	8,297	(2,631)	-	-
254	23	4,196	(6,257)	(7,362)	-
255	32	52,705	27,329	(1,952)	-
256	19	36,530	8,495	(48,423)	-
257	(3)	(4,939)	9,428	2,245	-
258	0	-	-	-	-
309	100	78,379	8,164	(116,636)	-
310	1	29,393	(5,039)	(12,597)	14
311	4	21,166	5,292	(10,079)	-
312	655	575,977	113,314	(122,722)	618
313	66	58,080	36,960	-	87
314	17	(2,763)	(2,210)	-	-
315	37	5,177	(4,141)	-	-
316	21	6,659	666	(11,654)	-
387	22	7,654	8,164	(10,205)	-
401	351	337,571	4,384	(19,728)	250
North Neighborhood	184	12,862	13,844	(8,771)	21
259	4	16,445	12,059	(8,771)	(26)

¹ The Bend Metropolitan Planning Organization (BMPO), Oregon Department of Transportation (ODOT), and the City of Bend (City) began developing a new travel demand model for the greater BMPO area in 2003. The base year for the new model is 2003. The model was developed using household activity surveys, Census data, employment data, and information on travel patterns from other cities in Oregon. The 2003 model was calibrated to match existing traffic counts from the City and ODOT. The model boundary is defined by political, census, and topographical constraints. The model includes all of the lands within the City Urban Growth Boundary plus additional outlying areas. The model is divided into 463 Transportation Analysis Zones (TAZs). Each TAZ contains demographic data such as household income, household size, number of vehicles, etc. Each TAZ also includes the number and type of jobs. The model network is comprised of major roads including the state highways, arterials, collectors, and some local roads. The network links include the number of lanes, lane capacities, and intersection controls. The model attempts to answer several questions about how many people are traveling, where they are going, what type of transportation they are choosing, which routes they take, and the resulting quantity of traffic.

Table 2. 2030 Central Area Plan Net New Development					
District/TAZ	Housing Units	Office (sq. ft.)	Retail (sq. ft.)	Light Ind. (sq. ft.)	Hotel Rooms
260	128	(14,446)	(722)	-	-
261	52	10,863	2,507	-	47
South Neighborhood	761	61,389	24,992	(10,677)	50
295	(7)	-	-	-	-
296	160	-	-	-	-
402	93	209	-	-	-
403	98	33,245	16,623	-	50
410	78	22,838	8,194	(10,677)	-
411	91	-	-	-	-
412	14	2,523	554	-	-
413	16	2,574	565	-	-
414	77	-	-	-	-
415	59	-	-	-	-
416	82	-	(944)	-	-
TOTAL	2,314	1,304,340	240,754	(394,568)	1,040

Source: Leland Consulting Group, 2007.
 Note: Excludes Historic Downtown Core area.

The paragraphs below present a comparison of 2003 estimates of households, office, retail and light industrial employment with total projected development in the Central Area Plan study area for 2030 based on the current General Plan (and incorporated into the Bend Metropolitan Planning Organization’s regional travel demand model) and the projections that reflect potential development trends and opportunities presented in the proposed Central Area Plan. The 2030 estimates include both new development and those uses that will not change. Key findings are summarized in Table 3.

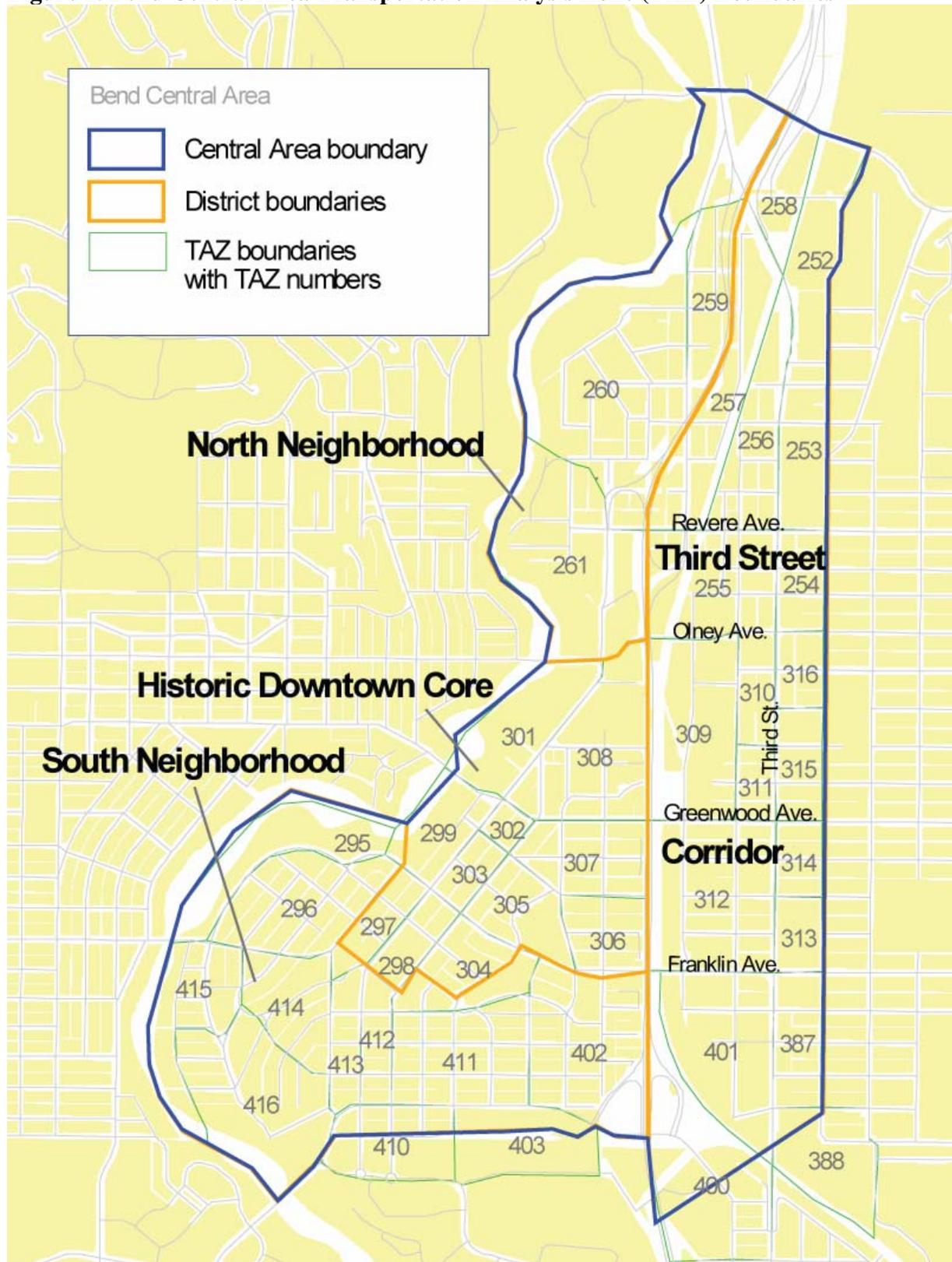
As indicated in the table, significant residential growth is anticipated along the Third Street Corridor and within the South Neighborhood. A moderate level of residential development is also anticipated within the Downtown core area. The Third Street Corridor and the Downtown Core areas would also see large increases in employment, particularly for office and retail employees. A drop in industrial employment is also anticipated in the overall Central Plan study area due to the conversion of current industrial properties to office and retail uses.

Households

As noted in Table 3, there would be a substantial increase in the number of households within the Central Area under the CAP development scenario. The existing General Plan anticipates little residential development in the Central area over today’s conditions (approximately 2 percent growth), while the CAP would see an increase of about 175 percent over today’s levels. Particularly in the Railroad District (zones 309-312), new housing is likely to take place in multistory buildings, many with ground floor retail or commercial uses.

It is important for the larger Bend Urbanized Area to prepare plans that are constrained to the Deschutes County control total and the County Coordinated Population Forecast. Thus, this localized increase in households and corresponding population must be accounted for within those control totals. While development of revisions to the currently forecasted levels of residential development throughout the Bend area is beyond the scope of this study, it is anticipated that some of this residential growth will likely come from redirecting growth elsewhere in the Bend UGB to the Central Area.

Figure 2. Bend Central Area Transportation Analysis Zone (TAZ) Boundaries



It should be noted, however, that many would contend the Coordinated Population Forecast underestimates both the recent growth experience and the potential for future growth. If this is the case, then it could be postulated that what the CAP captures will be new people coming to the area, attracted by the uniqueness of the CAP. That is, that the CAP creates an environment that fosters growth and economic development which would otherwise not occur. In either case, particularly with the policy interest in offering more affordable housing, the CAP could attract residents who would otherwise choose to live in Redmond or elsewhere in the County for affordability reasons, thus still fitting within the countywide population forecast. The Coordinated Population Forecast did not assume an enhanced CAP and, more importantly, a four-year university at Juniper Ridge that would completely change the economic paradigm of the region.

Beyond 2030, even more housing is likely as the Central Area continues to grow in prominence as the heart of Bend and the greater Central Oregon region.

Table 3. Comparison of Growth in Households with General Plan and CAP				
District/TAZ	2003 (1)	2030 General Plan	2030 CAP	Net Difference CAP over (under) General Plan
Households				
Third Street Corridor	60	24	1,393	1,369
North Neighborhood	327	284	468	184
South Neighborhood	910	917	1,678	761
Historic Downtown Core	226	328	668	340
Totals	1,523	1,553	4,207	2,654
Office Employment				
Third Street Corridor	1,857	1,665	4,198	2,533
North Neighborhood	82	476	231	(245)
South Neighborhood	213	241	315	74
Historic Downtown Core	3,124	3,610	4,769	1,159
Totals	5,276	5,992	9,513	3,521
Retail Employment				
Third Street Corridor	1,169	1,304	2,050	746
North Neighborhood	6	11	118	107
South Neighborhood	54	300	142	(158)
Historic Downtown Core	293	382	922	540
Totals	1,522	1,997	3,232	1,235
Lt. Industrial Employment				
Third Street Corridor	783	803	1,056	253
North Neighborhood	39	33	28	(5)
South Neighborhood	190	199	12	(187)
Historic Downtown Core	198	198	48	(150)
Totals	1,210	1,233	1,144	(89)
Total Employment				
Third Street Corridor	3,809	3,772	7,304	3,532
North Neighborhood	127	520	377	(143)
South Neighborhood	457	740	469	(271)
Historic Downtown Core	3,615	4,190	5,739	1,549
Central Area Total	8,008	9,222	13,889	4,667

(1) Most recent year for which MPO data is available.
Source: Leland Consulting Group, 2007.

Office Employment

Table 3 also shows a comparison of changes in office employment in the Central Area from 2003 estimates for 2030 forecasts for both the General Plan and Central Area Plan development scenarios. As with housing, a significant amount of new office space is projected along the Third Street Corridor. Indeed, Bend’s mixed employment zone is well suited for the technology and service businesses that will make up much of the region’s new employment. Interviews with local real estate brokers and developers indicate that the Railroad District in particular is well suited for office development and would likely see significant amounts of new development once the Central Area Plan is implemented.

In addition to office development, Third Street and the Railroad District will likely see an increase in the number of hotel rooms to serve Bend’s growing tourist base and also business travelers related to the office space. A hotel market study was not done for this report.

Retail Employment

Third Street will remain one of Bend’s most prominent retail districts, showing a modest net increase in retail space over the next 20 years. As Bend continues to grow outward with new single family residential neighborhoods and as retail continues to expand in the area near Cooley Road, the Central Area will capture a shrinking share of overall retail growth. Nevertheless, some growth will be needed to support new housing, offices, and nearby neighborhoods. Moreover, the physical design of the retail will likely change greater than the overall inventory of space. With urban design, pedestrian, and traffic improvements, particularly along Third Street, future retail will likely include more street-fronting buildings and retail space in the ground floor of mixed-use buildings. Table 3 presents a comparison of 2003 retail employment estimates with 2030 General Plan and Central Area Plan development scenarios.

Light Industrial Employment

One of the most notable changes from new development is the loss of light industrial buildings to other uses. This is largely due to the Framework Concept’s changing of emphasis of the Railroad District from a light industrial district to a mixed employment and housing neighborhood. Thus, those areas that show a loss of light industrial space concurrently show a significant increase in the number of housing units and amount of office space. Table 3 provides a comparison of light industrial employment in 2003 with the 2030 General Plan and Central Area Plan scenarios.

Central Area as a Percent of Overall Citywide Growth

Table 4 compares the rate of new development in the Central Area to the rate of growth projected citywide. As shown in this table, there will be negative growth in industrial employment, while the Central Area is targeted to capture 27 and 16 percent of office and retail employment growth, respectively. While the vast majority of new growth over the next 20 years will take place outside of the Central Area in new residential developments and employment centers such as Juniper Ridge, these “capture rates” reflect a significant increase in development for the Central Area in general, and the Third Street Corridor in particular.

Table 4. 2030 Central Area Growth as Percentage of Citywide Growth				
District/TAZ	Residents	Office Emp.	Retail Emp.	Ind. Emp
Third Street Corridor	4.77%	16.51%	7.75%	(16.99%)
North Neighborhood	0.61%	0.24%	0.66%	(0.40%)
South Neighborhood	0.66%	0.82%	1.04%	(0.47%)
Historic Downtown Core	1.77%	9.42%	6.09%	(0.96%)
TOTAL	7.81%	26.99%	15.54%	(18.82%)

Source: Leland Consulting Group, 2007.

Transportation System Needs

Introduction

This chapter identifies and discusses anticipated capacity and operational deficiencies for the 2030 future planning period. The roadway capacity analysis focuses on the peak travel hour during a typical weekday which generally occurs between 4:00 PM and 6:00 PM. Analysis reflects the existing unique lane channelization and traffic control features of each major intersection in the study area. Future volumes were developed from traffic forecasts provided by the Bend MPO from the regional travel demand model which were post-processed into intersection turning movement projections using the procedures in ODOT's "Analysis Procedures Manual".

Two 2030 future year scenarios were developed and evaluated. The first is based directly on output from the regional model (post-processed as discussed above) which represents likely conditions assuming that community growth is consistent with the existing adopted City General Plan. The second scenario is based on an assessment of changes in these future travel projections based on the new development and/or redevelopment opportunities identified for the Bend Central Area Plan.

2030 Future Traffic Volumes and Operations

Development of 30th Highest Hourly Volumes for 2030

The development of 2030 peak hourly traffic volumes for the Bend Central Area followed a multi-step process.

1. First, output from the MPO's travel demand model for 2003 and 2030 (RTP Alternative) was obtained and reviewed for reasonableness. Where appropriate, minor adjustments were made to the model output to reflect the character and patterns of existing observed traffic movement within the core area.
2. Using model output for 2003 and 2030, link volume projections for the baseline (General Plan) condition were post-processed to develop 2030 peak hourly turning movement projections at each study area intersection. This analysis was conducted according to the procedures outlined in ODOT's Analysis Procedures Manual and NCHRP Report 255. Post-processing is a method for developing future traffic turning movement volumes at intersections based on existing traffic counts and the relative differences between modeling scenarios. The basic steps in post-processing involve calculating the differences between current and future modeled volumes, and applying the relative differences to 2007 count data. The differences are assigned to turning movements at intersections in proportion to the existing distribution of turning movements on each intersection approach leg.
3. Using existing intersection geometry, future baseline volumes were evaluated to determine likely 2030 peak hourly traffic operating conditions. The timing of existing traffic signals was optimized to accommodate and anticipated changes in volumes.
4. Using the 2030 baseline turning movement projections at each intersection as a starting point, intersection traffic forecasts were developed to reflect the land use changes inherent in the Central Area Plan scenario. The redevelopment potential outlined in Technical Memorandum #4 and summarized in Chapter 2 of this report, was translated into a net increase (or decrease) in vehicle trips for each Transportation Analysis Zone (TAZ) using aggregated trip generation rates based on three demographic types – number of households, retail employment and other employment. These trip generation rates were derived from the Portland Metro regional travel demand model and reflect a more appropriate set of trip-making assumptions for the scale and type of development anticipated.

5. Each TAZ was reviewed to evaluate the potential for selecting alternative travel (non-auto) modes. Estimated trip reductions for walking, bicycling and transit were based on available facilities, service, and adjacent land uses. Trip reductions were also applied to TAZ’s where land uses internal to the zone complemented one another, such as residential and retail, and a reasonable level of trip interaction within the zone could occur. Internal trip-making was assumed to be largely walking trips. Total trip reductions related to the use of non-vehicular travel modes ranged from 3 percent to 14 percent of the estimated total trips within each TAZ, depending on location, presence of good non-motorized and/or transit connections, and land uses. These values are generally consistent with experience in other similar mixed use areas with enhanced bicycle, pedestrian and transit services.
6. After all the trip reductions were applied to each TAZ, the remaining trips were distributed to the surrounding roadway network within the study area. Because the destinations for household and employment trips are different, different distribution assumptions were applied to each. The destinations were also divided into three geographic areas: 1) internal to the Central Area Plan study area boundaries (see Figure 1), 2) within the City of Bend but outside of the Central Area, and 3) other regional destinations outside of the City of Bend. For household trips, it was estimated that the study area would capture 25 percent of new vehicle trips, the remainder of the City would capture 55 percent, and 20 percent would travel to/from destinations outside of the City. For the retail and other employment trips, it was estimated that the study area would capture 10 percent of new vehicle trips, the remainder of the City would capture 55 percent, and regional destinations would attract the remaining 35 percent.
7. For purpose of conducting traffic operations analysis of Central Area Plan trips intersection geometry was assumed to remain the same as existing, while the signal timing was optimized for this scenario.

Documentation of the 2030 traffic forecasting process and results are presented in Appendix A.

Intersection Operational Standards

Within the City of Bend, traffic operations are evaluated based on the relationship between traffic volumes and the roadway or intersection’s capacity or volume/capacity (V/C) ratio. For State Highways such as US 97 and US 20, the 1999 Oregon Highway Plan (OHP), identifies various V/C thresholds are applied to all state highways based on functional classification of these facilities.

Both US 97 and US 20 in Bend are classified as Statewide Highways. The peak hour, maximum V/C standards for these highways are related to posted roadway speeds and are summarized in Table 5.

Table 5. Maximum Volume to Capacity for Peak Hour Operating Conditions				
Highway Name	OHP Designation	Freight Route	Signalized Intersection Maximum V/C Ratio	Unsignalized Intersection Maximum V/C Ratio (Minor Movement)
US Highway 97	Statewide Expressway	Yes	0.80	0.90
US Highway 20	Statewide Highway	Yes	0.80	0.90

Source: Oregon Highway Plan, Policy 1F Mobility Standards, Table 6.

For city streets, performance criteria are laid out in the City’s Development Code, Chapter 4.7 which identifies traffic operational thresholds. The following standards define acceptable intersection operations, applied to the entire peak hour:

- **Two-Way Stop Control (TWSC)**
 - Delay for individual lane groups less than or equal to 50 seconds, and
 - Volume to capacity ratio for individual lane groups less than or equal to 1.0, and
 - 95th percentile queuing less than or equal to storage length available.
- **All-Way Stop Control (AWSC)**
 - Delay for the intersection as a whole less than or equal to 80 seconds.
- **Roundabout**
 - Volume to capacity ratio for individual approaches less than or equal to 1.0.
- **Signalized Intersection**
 - Volume to capacity ratio for the intersection as a whole less than or equal to 1.0, and
 - 95th percentile queuing less than or equal to storage length available
 - Further details of relevant standards from City Code are presented below in Table 6.

Table 6. Bend Signalized Intersection Operations Standards	
Intersection Status/Jurisdiction)	Operating Standards
Built to TSP/Master Plan; within Central Business/historic district	v/c less than 1.0 for hour preceding and following Peak Hour
Built to TSP/Master Plan; outside Central Business/historic district	v/c less than 1.0 for hour preceding and following Peak Hour
Not built to TSP/Master Plan; within Central Business/historic district	v/c less than 1.0 for hour preceding and following Peak Hour
Not built to TSP/Master Plan; outside Central Business/historic district	v/c less than 1.0 for Peak Hour

Source: Bend Development Code, Chapter 4.7, Transportation Analysis, Table 4.7.400a.

2030 Intersection Operations with General Plan (Baseline)

An understanding of general traffic patterns can be achieved by analyzing traffic volumes for selected intersections in an area. However, these patterns tell little of the roadway’s ability to handle additional traffic or about driver comfort level at these intersections. To describe a roadway’s ability to accommodate traffic, as well as the quality of traffic operations, analysis was conducted using the methodology in the 2000 Highway Capacity Manual (HCM) for signal-controlled or stop-controlled intersections. This methodology identifies both an average level of delay experienced by all vehicles passing through an intersection and a “volume-to-capacity” ratio indicating the degree of saturation experienced at the intersection.

Traffic conditions were analyzed for the future (2030) 30th highest hour period in the Central Area Plan study area using the Synchro software. Unlike other modeling software that analyzes intersections independently of each other, Synchro displays the effects of traffic congestion on a corridor-wide basis that allows for assessment of impacts related to traffic queuing. By using the Synchro model to conduct traffic analysis, multiple intersections along roadway corridors can be evaluated as a single interconnected network making it possible to assess the impacts of growth on corridor-wide traffic operations. Analysis was conducted using the existing intersection geometrics.

As noted in the discussion in the preceding section, for state facilities, the intersection v/c ratio must be used to characterize operational performance. The ratio calculated for each intersection is then compared with the v/c standards incorporated into the 1999 Oregon Highway Plan (last amendment August 2005).

V/C ratio is also used by the City of Bend (as established by Chapter 4.7 of the City of Bend Development Code).

Table 7 presents the results of the intersection level traffic operations analysis for the 19 signalized intersections that were evaluated in the study area. Detailed traffic operations calculations for 2030 baseline conditions are included in Appendix B.

The data in Table 7 indicate that seven signalized intersections are expected to exceed either the State v/c standard or the City’s operational standard for either v/c or average intersection delay by 2030. Five of these intersections are state facilities and two are city intersections. With the exception of the intersection of Portland Avenue with Wall Street, all of these intersections currently experience operational problems today which would become worse in the future. The intersection of Portland Avenue with Hill Street operated acceptably in 2007, but would fall below the city’s v/c threshold by 2030. For most of the intersections that do not meet applicable standards, signal retiming or additional lanes would bring the intersections into compliance with operational standard.



Table 7. 2030 30th Highest Hour Intersection Operations with Current General Plan					
#	Signalized Intersections	Overall V/C Ratio	Average Control Delay (sec./vehicle)	Exceeds City Standards	Exceeds State Standards
1	US 97/20 @ Butler Market Road	1.26	>80.0		Yes
2	Revere Avenue @ Parkway SB Ramps	0.83	20.6		No
3	Revere Avenue @ Parkway NB Ramps	0.92	27.8		Yes
4	Revere Avenue @ 3 rd Street	1.22	>80.0		Yes
5	Portland Avenue @ Wall Street	1.15	80.6	No (1)	
6	Olney Avenue @ 3 rd Street	1.15	>80.0		Yes
7	Greenwood Avenue @ Wall Street	0.84	33.5	No	
8	Greenwood Avenue @ Bond Street	0.69	17.4	No	
9	Greenwood Avenue @ 3rd Street	1.42	>80.0		Yes
10	Oregon Street @ Wall Street	0.70	14.1	No	
11	Oregon Street @ Bond Street	0.60	11.4	No	
12	Franklin Avenue @ Wall Street	0.80	20.6	No	
13	Franklin Avenue @ Bond Street	0.89	31.1	No	
14	Franklin Avenue @ 3rd Street	1.11	81.1	No (1)	
15	Colorado Avenue @ Wall Street	0.59	16.8	No	
16	Colorado Avenue @ Bond Street	0.72	21.0	No	
17	Colorado Avenue @ Parkway SB Ramp	0.74	26.0		No
18	Arizona Avenue @ Wall Street	0.71	13.2	No	
19	Arizona Avenue @ Bond Street	0.80	18.3	No	

(1) Hour before or after would have a v/c ratio of less than 1.0.

Intersections expected to exceed operational standards include:

- **US 97/US 20 at Butler Market Road** – expected to operate at a v/c ratio of 1.26. It should be noted that the intersection with Division Street and with Butler Market Road/Mt Washington Drive are very closely spaced together. According to ODOT, the spacing impacts signal progression along Butler Market Road today. The potential may exist for queue spillback impacts between these two intersections in the future.
- **Revere Avenue at Parkway Northbound Ramps** – expected to operate at v/c of 0.92 which exceeds the ODOT standard of 0.80 for this intersection.
- **Revere Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.22. According to ODOT, traffic queuing frequently occurs today along Revere between 3rd and 4th Streets with traffic queues backing up from the stop sign at 4th Street into the signalized intersection with 3rd Street. Safety and operations at the intersection are also affected by substandard access spacing at the intersection. It should be noted that the signal at this intersection is considered to be functionally obsolete and needs to be replaced. Problems include poorly aligned heads, no advance heads, and heads that are too small for current standards. ODOT is currently scoping the replacement of the signal at this intersection. Part of the replacement project will likely include replacement of the interconnect conduit between this intersection and the intersection at Revere Avenue and Division Street which has failed.
- **Portland Avenue at Wall Street** – this intersection would drop from a v/c of 0.92 in 2007 to an v/c of 1.15 by 2030. However, the second hour of the peak period (e.g., either before or after the peak hour) is expected to meet the City’s standard. Opportunities to enhance traffic operations at this location are very limited due to limited right-of-way.
- **Olney Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.15. Similar to the situation on Revere Avenue, traffic queuing frequently occurs along Olney between 3rd and 4th Streets with traffic queues backing up from the stop sign at 4th Street into the signalized intersection with 3rd Street.
- **Greenwood Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.42, this is one of the most heavily congested intersections along the US 20 corridor. As with the intersection of Revere Avenue with 3rd Street, the signal at this intersection is considered by ODOT to be functionally obsolete and needs to be replaced. Problems with this signal are similar to those described for the Revere/3rd intersection.
- **Franklin Avenue at 3rd Street** – this intersection is expected to operate with a v/c ratio of 1.11. However, the second hour of the peak period (e.g., either before or after the peak hour) is expected to meet the City’s standard.

Table 8 identifies 2030 volume-to-capacity ratios and delays for the 15 unsignalized intersections analyzed in the study area with the baseline condition. Detailed traffic operations calculations for 2030 General Plan conditions are included in Appendix B.

Table 8. 2030 30th Highest Hour Intersection Operations with General Plan							
#	Unsignalized Intersections	Type of Control	Worst Movement				
			Movement	Volume/ Capacity Ratio	Average Delay (sec/veh)	Overall V/C Ratio	Average Delay (sec/veh)
20	Parkway SB Ramp @ Butler Market Road	TWSC	SBL	>1.00	>80.0	0.94	>80.0
21	Parkway NB Ramp @ Butler Market Road	TWSC	NBL	0.48	58.5	0.81	2.0

Table 8. 2030 30th Highest Hour Intersection Operations with General Plan							
#	Unsignalized Intersections	Type of Control	Worst Movement				
			Movement	Volume/ Capacity Ratio	Average Delay (sec/veh)	Overall V/C Ratio	Average Delay (sec/veh)
22	4th Street @ Butler Market Road	AWSC	NBL	>1.00	>80.0	>1.00	>80.0
23	4th Street @ Studio Road	TWSC	WB	>1.00	>80.0	>1.00	>80.0
24	4th Street @ Revere Avenue	AWSC ¹	EBTR	>1.00	>80.0	>1.00	>80.0
25	4th Street @ Olney Avenue	AWSC	WBTR	>1.00	>80.0	0.92	>80.0
26	Parkway SB @ Lafayette Ave.	TWSC	EBR	>1.00	>80.0	0.99	4.2
27	Wall Street @ Bond Street	TWSC	SB	0.92	>80.0	0.59	15.5
28	Greenwood Avenue @ 4th Street	TWSC	SBR	0.56	30.0	0.61	3.0
29	Hawthorne Avenue @ 3rd Street	TWSC	EB	0.71	>80.0	0.63	2.7
30	Hawthorne Avenue @ 4th Street	TWSC	EB	0.18	11.7	0.28	4.1
31	SB Parkway @ Hawthorne Ave.	TWSC	EBR	>1.00	>80.0	0.99	36.6
32	Franklin Avenue @ 4th Street	TWSC	NB	0.87	>80.0	0.47	10.5
33	Riverside Drive @ Tumalo Avenue	AWSC	EBL	>1.00	>80.0	0.83	>80.0
34	Parkway NB Ramp @ Colorado Ave	TWSC	SBL	>1.00	>80.0	>1.00	>80.0

¹ HCM analysis allows a maximum of two lanes per approach to an AWSC intersection. The EB approach to this intersection has three lanes. As a result, the intersection would actually operate better than the analysis indicates.

As Table 8 indicates, most of the two-way stop-controlled (TWSC) intersections in the study are expected to exceed the City of Bend and ODOT operational standards. The three exceptions are the intersections of Butler Market Road with the NB Parkway Ramp, Greenwood Avenue with 4th Street, and Hawthorne Avenue with 4th Street. All four all-way stop-controlled (AWSC) intersections would exceed the City’s operational standard. The most likely measures that could be implemented to meet operational standards at these unsignalized intersections would involve adding lanes and/or either signal or roundabout control.

2030 Intersection Operations with Central Area Plan

Table 9 presents the results of the intersection level traffic operations analysis for the 19 signalized intersections that were evaluated in the study area. Detailed traffic operations calculations for 2030 conditions with the Central Area Plan are included in Appendix C.

The data in Table 9 indicate that seven signalized intersections are expected to exceed either the State v/c standard or the City’s operational standard for v/c (first hour only) by 2030. Five of these intersections are state facilities and two are city intersections. With the exception of the intersection of Portland Avenue with Wall Street, all of these intersections currently, and are expected to continue to operate with v/c ratios greater than applicable standards. The intersection of Portland Avenue with Wall Street operated within the standard in 2007, but would fall below the city’s v/c threshold for the first hour by 2030. For most of these intersections, signal retiming or additional lanes are options to bring the intersections below the operational standard.

Table 9. 2030 30th Highest Hour Intersection Operations with Central Area Plan					
#	Signalized Intersections	Overall V/C Ratio	Average Control Delay (sec./vehicle)	Exceeds City Standards	Exceeds State Standards
1	US 97/20 @ Butler Market Road	1.27	>80.0		Yes
2	Revere Avenue @ Parkway SB Ramps	0.90	25.0		No
3	Revere Avenue @ Parkway NB Ramps	1.06	30.6		Yes
4	Revere Avenue @ 3 rd Street	1.32	>80.0		Yes
5	Portland Avenue @ Wall Street	1.25	>80.0	Yes	
6	Olney Avenue @ 3 rd Street	1.30	>80.0		Yes
7	Greenwood Avenue @ Wall Street	0.88	37.0	No	
8	Greenwood Avenue @ Bond Street	0.76	18.7	No	
9	Greenwood Avenue @ 3rd Street	1.59	>80.0		Yes
10	Oregon Street @ Wall Street	0.75	13.9	No	
11	Oregon Street @ Bond Street	0.67	12.2	No	
12	Franklin Avenue @ Wall Street	0.92	24.5	No	
13	Franklin Avenue @ Bond Street	0.95	37.6	No	
14	Franklin Avenue @ 3rd Street	1.14	86.1	Yes	
15	Colorado Avenue @ Wall Street	0.61	16.4	No	
16	Colorado Avenue @ Bond Street	0.77	22.3	No	
17	Colorado Avenue @ Parkway SB Ramp	0.84	26.2		Yes
18	Arizona Avenue @ Wall Street	0.72	13.8		No
19	Arizona Avenue @ Bond Street	0.83	18.3	No	

Table 10 presents a summary of the analysis of traffic operations during the second highest hour of the peak period. Second highest hour traffic volumes were calculated by overlaying the traffic volume growth assumptions prepared for the peak hour with Central Area Plan land uses onto existing traffic volumes for the combined second hour of the two-hour peak period originally counted for and documented in Technical Memorandum #2. While this method may slightly overstate the impact of traffic growth with CAP development, it is the only reasonable approach to estimating these volumes in the context of this study.

As noted in Table 6, City standards for signalized intersections allow for the v/c ratio of 1.0 to be exceeded during the first hour provided they operate below v/c 1.0 for the hour on either side of the peak. Based on this assessment, the intersection of Portland Avenue with Wall Street would be in compliance with City standards reducing to six the number of locations where expected 2030 operations with the CAP would exceed applicable standards. Worksheets for the analysis documented in Table 10 are presented in Appendix D.

In summary, intersections expected to exceed operational standards include:

- US 97/US 20 at Butler Market Road** – expected to operate at a v/c ratio of 1.26 during the peak hour and 1.09 during the second highest hour of the peak period. It should be noted that the intersection with Division Street and with Butler Market Road/Mt Washington Drive are very closely spaced together. According to ODOT, the spacing already impacts signal progression along Butler Market Road. The potential may exist for queue spillback impacts between these two intersections in the future.

Table 10. 2030 2nd Highest Peak Hour Intersection Operations with Central Plan					
#	Signalized Intersections	Overall V/C Ratio	Average Control Delay (sec./vehicle)	Exceeds City Standards	Exceeds State Standards
1	US 97/20 @ Butler Market Road	1.09	81.3		Yes
2	Revere Avenue @ Parkway SB Ramps	0.80	18.7		No
3	Revere Avenue @ Parkway NB Ramps	0.93	21.6		Yes
4	Revere Avenue @ 3 rd Street	1.17	>80.0		Yes
5	Portland Avenue @ Wall Street	0.95	58.4	No	
6	Olney Avenue @ 3 rd Street	1.18	>80.0		Yes
7	Greenwood Avenue @ Wall Street	0.74	29.6	No	
8	Greenwood Avenue @ Bond Street	0.61	15.7	No	
9	Greenwood Avenue @ 3rd Street	1.53	>80.0		Yes
10	Oregon Street @ Wall Street	0.63	12.6	No	
11	Oregon Street @ Bond Street	0.53	11.6	No	
12	Franklin Avenue @ Wall Street	0.68	17.9	No	
13	Franklin Avenue @ Bond Street	0.75	26.2	No	
14	Franklin Avenue @ 3rd Street	1.06	66.2	Yes	
15	Colorado Avenue @ Wall Street	0.51	15.9	No	
16	Colorado Avenue @ Bond Street	0.62	19.2	No	
18	Arizona Avenue @ Wall Street	0.60	11.6	No	
19	Arizona Avenue @ Bond Street	0.66	14.9	No	

- **Revere Avenue at Parkway Northbound Ramps** - expected to operate at v/c of 1.06 during the peak hour and 0.93 during the second highest hour of the peak period. Both conditions would exceed the ODOT standard of 0.80 for this intersection.
- **Revere Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.32 during the peak hour and 1.17 during the second highest hour of the peak period. According to ODOT, traffic queuing frequently occurs today along Revere between 3rd and 4th Streets with traffic queues backing up from the stop sign at 4th Street into the signalized intersection with 3rd Street. Safety and operations at the intersection are also affected by substandard access spacing at the intersection. It should be noted that the signal at this intersection is considered to be functionally obsolete and needs to be replaced. Problems include poorly aligned heads, no advance heads, and heads that are too small for current standards. ODOT is currently scoping the replacement of the signal at this intersection. Part of the replacement project will likely include replacement of the interconnect conduit between this intersection and the intersection at Revere Avenue and Division Street which has failed.
- **Portland Avenue at Wall Street** – this intersection would drop from a v/c ratio of 0.92 in 2007 to a v/c of 1.25 during the 2030 peak hour. However, during the second hour of the peak period, this intersection is expected to operate with a v/c ratio of 0.95 which meets City standards.
- **Olney Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.30 during the peak hour and 1.18 during the second highest hour of the peak period. Similar to the situation on Revere Avenue, traffic queuing frequently occurs along Olney between 3rd and 4th Streets with traffic queues backing up from the stop sign at 4th Street into the signalized intersection with 3rd Street.

- **Greenwood Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.59 during the peak hour and 1.53 during the second highest hour of the peak period. This is one of the most heavily congested intersections along the US 20 corridor. As with the intersection of Revere Avenue with 3rd Street, the signal at this intersection is considered by ODOT to be functionally obsolete and needs to be replaced. Problems with this signal are similar to those described for the Revere/3rd intersection.
- **Franklin Avenue at 3rd Street** – expected to operate with a v/c ratio of 1.14 during the peak hour and 1.06 during the second highest hour of the peak period. This intersection would exceed the City’s v/c standard of 1.00 for a signalized intersection.
- **Colorado Avenue at Southbound Parkway Ramps** – expected to operate at v/c of 0.84 which is slightly above the ODOT threshold of 0.80.

Table 11 identifies 2030 volume-to-capacity ratios and delays for the 15 unsignalized intersections analyzed in the study area with the Central Area Plan. Detailed traffic operations calculations for 2030 CAP conditions are included in Appendix C.

As Table 11 indicates, most of the two-way stop-controlled (TWSC) intersections in the study are expected to exceed the City of Bend and ODOT operational standards. The two exceptions are the intersections of Greenwood Avenue with 4th Street, and Hawthorne Avenue with 4th Street. All four all-way stop-controlled (AWSC) intersections would exceed the City’s operational standard. The most likely measures that could be implemented to meet operational standards at these unsignalized intersections would involve adding lanes and/or either signal or roundabout control.

Table 11. 2030 30th Highest Hour Intersection Operations with Central Area Plan							
#	Unsignalized Intersections	Type of Control	Worst Movement				
			Movement	Volume/ Capacity Ratio	Average Delay (sec/veh)	Overall V/C Ratio	Average Delay (sec/veh)
20	Parkway SB Ramp @ Butler Market Road	TWSC	SBL	>1.00	>80.0	0.96	>80.0
21	Parkway NB Ramp @ Butler Market Road	TWSC	NBL	>1.00	>80.0	0.84	13.8
22	4th Street @ Butler Market Road	AWSC	NBL	>1.00	>80.0	>1.00	>80.0
23	4th Street @ Studio Road	TWSC	WB	>1.00	>80.0	>1.00	>80.0
24	4th Street @ Revere Avenue	AWSC ¹	EBTR	>1.00	>80.0	>1.00	69.3
25	4th Street @ Olney Avenue	AWSC	WBTR	>1.00	>80.0	0.99	67.9
26	Parkway SB @ Lafayette Ave.	TWSC	EBR	>1.00	>80.0	0.99	4.2
27	Wall Street @ Bond Street	TWSC	SB	>1.00	>80.0	0.63	42.1
28	Greenwood Avenue @ 4th Street	TWSC	SBR	0.64	37.2	0.66	4.9
29	Hawthorne Avenue @ 3rd Street	TWSC	EB	>1.00	>80.0	0.86	>80.0
30	Hawthorne Avenue @ 4th Street	TWSC	EB	0.24	13.2	0.34	5.0
31	SB Parkway @ Hawthorne Ave.	TWSC	EBR	>1.00	>80.0	0.99	36.6
32	Franklin Avenue @ 4th Street	TWSC	NB	>1.00	>80.0	0.50	27.1
33	Riverside Drive @ Tumalo Avenue	AWSC	EBL	>1.00	>80.0	0.85	64.2
34	Parkway NB Ramp @ Colorado Ave	TWSC	SBL	>1.00	>80.0	>1.00	>80.0

¹ HCM analysis allows a maximum of two lanes per approach to an AWSC intersection. The EB approach to this intersection has three lanes. As a result, the intersection would actually operate better than the analysis indicates.

Summary of Roadway Constraints

Congestion currently exists on all the routes leading to downtown, and is expected to worsen in the future with the anticipated community growth under either the baseline (General Plan) or Central Area Plan scenario. The number of travel lanes and levels of traffic delays at critical intersections along the east/west routes of Greenwood Avenue, Franklin Avenue and Portland/Olney Avenues, and the north/south routes of 3rd and 4th Streets affect access to downtown. Many of these routes accommodate significant amounts of through traffic, as well as traffic with downtown destinations. Revere Avenue is one of the few remaining at-grade railroad crossings in Bend and the close proximity of the Bend Parkway; Division Street and 3rd Street will make a future grade separation very difficult. Olney Avenue and BNSF Railroad crossing is also at-grade.

Several signalized intersections in the study area currently exceed and will continue to exceed either ODOT or City of Bend operational standards, and most of the unsignalized intersections of collector and arterial streets are experiencing significant delays for side street stop-controlled movements.

Table 12 compares the analysis results with the General Plan and Central Area Plan growth scenarios for signalized intersections. As indicated in the table, Central Area Plan land uses would not change the number of locations that are anticipated to exceed either State or City standards for intersection operations.

#	Signalized Intersections	General Plan		Central Area Plan	
		Overall V/C Ratio	Exceeds Standards	Overall V/C Ratio	Exceeds Standards
1	US 97/20 @ Butler Market Road	1.26	Yes	1.27	Yes
2	Revere Avenue @ Parkway SB Ramps	0.83	No	0.90	No
3	Revere Avenue @ Parkway NB Ramps	0.92	Yes	1.06	Yes
4	Revere Avenue @ 3 rd Street	1.22	Yes	1.32	Yes
5	Portland Avenue @ Wall Street	1.15	Yes	1.25	Yes
6	Olney Avenue @ 3 rd Street	1.15	Yes	1.30	Yes
7	Greenwood Avenue @ Wall Street	0.84	No	0.88	No
8	Greenwood Avenue @ Bond Street	0.69	No	0.76	No
9	Greenwood Avenue @ 3rd Street	1.42	Yes	1.59	Yes
10	Oregon Street @ Wall Street	0.70	No	0.75	No
11	Oregon Street @ Bond Street	0.60	No	0.67	No
12	Franklin Avenue @ Wall Street	0.80	No	0.92	No
13	Franklin Avenue @ Bond Street	0.89	No	0.95	No
14	Franklin Avenue @ 3rd Street	1.11	Yes	1.14	Yes
15	Colorado Avenue @ Wall Street	0.59	No	0.61	No
16	Colorado Avenue @ Bond Street	0.72	No	0.77	No
17	Colorado Avenue @ Parkway SB Ramp	0.74	No	0.84	Yes
18	Arizona Avenue @ Wall Street	0.71	No	0.72	No
19	Arizona Avenue @ Bond Street	0.80	No	0.83	No

Table 13 presents a summary comparison of traffic operations at unsignalized intersection with either General Plan or Central Area Plan land uses. As indicated in the table, most intersections would exceed the applicable State or City operational standard during the 2030 peak hour. For the scenario based on the existing General Plan, exceptions would be at the intersections of the Butler Market Road at the northbound Parkway ramps, Wall Street at Bond Street, Hawthorne Avenue at 3rd, and along 4th Street at the intersections with Greenwood Avenue, Hawthorne Avenue, and Franklin Avenue. For the scenario based on Central Area Plan land uses, exceptions would include the intersections of 4th Street at both Greenwood and Hawthorne Avenues. In comparison with the General Plan scenario, additional lane channelization and/or signal control would be required at the intersections of Butler Market Road at the northbound Parkway ramps, Wall Street at Bond Street, Hawthorne Avenue at 3rd Street, and Franklin Avenue at 4th Street.

Table 13. Comparison of 2030 30th Highest Hour Intersection Operations at Unsignalized Locations – General Plan and Central Area Plan					
#	Unsignalized Intersections	General Plan		Central Area Plan	
		Critical Movement V/C Ratio	Standard	Critical Movement V/C Ratio	Standard
20	Parkway SB Ramp @ Butler Market Road	>1.00	0.80	>1.00	0.80
21	Parkway NB Ramp @ Butler Market Road	0.48	0.80	>1.00	0.80
22	4th Street @ Butler Market Road	>1.00	1.00	>1.00	1.00
23	4th Street @ Studio Road	>1.00	1.00	>1.00	1.00
24	4th Street @ Revere Avenue	>1.00	1.00	>1.00	1.00
25	4th Street @ Olney Avenue	>1.00	1.00	>1.00	1.00
26	Parkway SB @ Lafayette Ave.	>1.00	0.80	>1.00	0.80
27	Wall Street @ Bond Street	0.92	1.00	>1.00	1.00
28	Greenwood Avenue @ 4th Street	0.56	1.00	0.64	1.00
29	Hawthorne Avenue @ 3rd Street	0.71	1.00	>1.00	1.00
30	Hawthorne Avenue @ 4th Street	0.18	1.00	0.24	1.00
31	SB Parkway @ Hawthorne Ave.	>1.00	0.80	>1.00	0.80
32	Franklin Avenue @ 4th Street	0.87	1.00	>1.00	1.00
33	Riverside Drive @ Tumalo Avenue	>1.00	1.00	>1.00	1.00
34	Parkway NB Ramp @ Colorado Ave	>1.00	0.80	>1.00	0.80

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Development and Evaluation of Roadway/Intersection Options

The City’s currently adopted Transportation System Plan (TSP) presents both projects and policies that govern the development and operation of the multi-modal transportation system. This plan is further supported by specific ordinances, standards and other guidance to address issues related to traffic operating performance, access management, and a functional hierarchy of streets along with right-of-way and street cross-sections for each roadway type. The TSP also establishes a general policy directive for the implementation of specific improvements along most major streets in the city.

Coupled with the land use, economic and urban design features of the Central Area Plan (CAP), the policies and specific objectives of the TSP and its implementing ordinances were considered in the development and evaluation of multi-modal system improvements designed to serve existing and future community transportation needs. Pertinent directives are described in the paragraphs below.

Policy/Planning Guidance

Traffic Operations Standards

Traffic operations standards for both ODOT and the City of Bend were presented and discussed in the preceding chapter. These standards formed the basis for determining:

- The magnitude of congestion and related safety challenges in the Central Area with 2030 land development under either the General Plan or Central Area Plan growth scenarios.
- The nature of potential transportation system enhancements to address traffic operational needs without consideration of other competing objectives within the Central Area such as bicycle and pedestrian circulation, right-of-way acquisition, costs and many other factors.

Development of projects to address traffic operational deficiencies constitutes one of the alternative approaches to modifying the existing roadway system in the CAP area as discussed later in this chapter.

Access Management Standards

Along state highways, access is commonly controlled by ODOT through the purchase of access rights. New access to/from a state highway is provided consistent with the standards adopted in the OHP for each highway classification, its location within an urban or rural area, and its posted speed. Access management guidelines for state highways are published in OAR 734-051. Access management standards along US Highways 20 and 97 within the Bend Metropolitan Area are shown in Table 14.

Table 14. Access Management Spacing Standards for Approaches	
US Highway 20	
Posted Speed (mph)	Public and Private Approach Spacing^a
≥ 55	1,320 feet
50	1,100 feet
40 & 45	990 feet
30 & 35	720 feet
≤ 25	520 feet
US Highway 97 (Bend Parkway)	
Posted Speed (mph)	At Grade Intersection Spacing^b
≥ or ≤ 55	2,640 feet

Source: OAR 734-051-00115 Table 1.

^a Measurement of the approach road spacing is from center to center on the same side of road.

^b See OHP for interchange spacing guidelines.

The City of Bend has established access management standards and policies. For arterial streets driveways should be spaced a minimum of 150 feet apart. Spacing should increase as speed increases with the maximum practical spacing and joint access with an adjoining property pursued wherever possible. Where medians are constructed on any arterial street, spacing between median openings should be at least 400 feet. The spacing may be reduced to 300 feet if a competent traffic study, satisfying officials shows that the lesser spacing will still safely and efficiently accommodate left turn movements to existing and projected future development in the immediate vicinity.

The installation of new traffic signals and/or the development of new intersections along arterial streets is also addressed in the city’s access management policies as articulated in the TSP. It is noted that traffic signals and coordinated timing plans can improve or optimize traffic flow by grouping vehicles into platoons that can be better served by the limited available green time. It is also noted that signals can improve gaps in traffic flow to facilitate safer access to arterial streets between signalized locations. Accordingly, it is important to follow consistent signal spacing standards to maximize the effectiveness and functionality of traffic signals along the length of an arterial street segment. Installation of new signals into this system should be carefully considered in order to maintain the overall pattern of coordinated operations.

Street Standards

The City of Bend Code (section 10-13.10 Table A) provides guidance for the development of dedicated public roadways within the city by functional classification. Included are requirements related to minimum rights-of-way, pavement widths, planter strip widths, and turn lanes/median widths; grade; appropriateness of direct access to adjacent parcels; and standards related to bicycle lanes and sidewalk location and widths. For major streets in the Central Area Plan study area, the City’s street standards are as follows.

Street Element	Principal Arterial (1)	Minor Arterial (2)	Major Collector (3)
Minimum right-of-way	100 feet	100 feet	80 feet
Minimum pavement width	76 feet	52 feet	52 feet
Minimum planter strip width	5 feet	8 feet	8 feet
Minimum turn lane/median width	16 feet / 10 feet	11 feet / 16 feet	11 feet / 16 feet
Maximum grade	6 percent	6 percent	8 percent
Direct site access	No	No	Yes
Bike lanes	Yes	Yes	Yes
Sidewalks	6 feet on both sides	5 feet on both sides	5 feet on both sides

- (1) 3rd Street through study area, Greenwood Avenue east of 3rd Street.
- (2) Butler Market Road, Division Street (Butler Market to Revere), 4th Street (Butler Market to Franklin), Revere (Hill to 8th), Olney (Wall to 8th), Greenwood (Wall to 3rd), Franklin/Riverside (Deschutes River to east of study area), Wall/Hill (Revere to Franklin), Bond (Wall to Franklin), Colorado/Arizona couplet.
- (3) Hawthorne (Wall to 4th), Wall (Franklin to Arizona), Bond (Franklin to Arizona)

In addition to existing street standards, certain other policies related to street cross-sections apply in the Central City. Of particular importance is the limitation in Minor Arterial street widening incorporated into the Bend Transportation System Plan (TSP), as described below.

Central City – Minor Arterial Widening Limitation

Based on the results of several recent transportation studies in the Central Area and on concern for the dual objectives of realizing benefits related to encouraging non-automobile alternatives and preserving the existing character of Central Area neighborhoods, the Bend TSP identified several corridors requiring unique consideration of the trade-offs between arterial widening and other enhancements. Within these

corridors, “*the combination of existing (and potential future) residential, commercial and institutional land uses, and the presence of a well-connected system of local streets and accessways, that provide a diverse range of travel options and mode choices, may make minor arterial roadway widening unnecessary and/or less desirable. Thus, the following minor arterial corridors are identified by the Plan as “not being authorized for lane expansion” (unless subsequent study has been supported by an amendment to the Plan to permit the roadway widening, an existing safety issue has been identified and approved by the City Council that will be resolved by a widening project, or the improvement is otherwise exempted by TSP Street Policy 21)*”):

West Central City

- Newport Avenue between 14th Street and Wall Street

Downtown Central City

- Greenwood Avenue between Wall Street and the Parkway
- Riverside Avenue between Tumalo and Franklin Avenues
- Franklin Avenue between Wall Street and the Parkway
- Wall Street between Greenwood and Franklin Avenues
- Bond Street between Greenwood and Franklin Avenues

Identified Improvements

The TSP provides specific guidance on the development and enhancement of the existing multi-modal transportation system throughout the city. The following paragraphs summarize some of the details pertinent to the arterial and collector street system in the Central Area.

Third Street North of Greenwood Avenue (Highway 20)

The TSP identifies an access management approach for US 20 (3rd Street north of Greenwood Avenue) in the Central Area, noting that implementation of this approach will be difficult due to existing land development and property access patterns. As indicated in the TSP, over the longer term redevelopment patterns “*will provide opportunities to close and combine driveways, or to provide access via adjacent side streets. A raised median should be considered for installation on a principal arterial when any of the following occur (per ODOT recommendations)*”:

1. *Daily traffic counts exceed 28,000 vehicles per day,*
2. *In conjunction with reconstruction or modification projects, or*
3. *When operational, safety, or pedestrian needs warrant it.”*

The TSP also notes, however, that construction of improvements that will limit left turn movements to/from between arterial streets and adjacent properties must be sensitive to existing development that relies on the convenience of roadway system access.

Third Street South of Greenwood Avenue

The section of 3rd Street south of Greenwood Avenue is designated as a Principal Arterial and is currently limited to two travel lanes in each direction with turn lane channelization at major intersections. After completion of the Parkway, traffic volumes initially dropped on 3rd Street. However, since 3rd Street remains a major business corridor within the urban area, traffic volumes have once again increased to significant levels and are expected to continue to grow.

Key issues identified in the TSP pertinent to this portion of 3rd Street include:

- The undercrossing of the BNSF railroad south of Burnside Street which is currently limited to one travel lane in each direction. The TSP anticipates that future traffic volumes and the need for

bicycle and pedestrian improvements to this section of 3rd Street will likely generate the need for undercrossing improvements.

- There are numerous gaps in the sidewalk and bicycle lane systems which the TSP recommends from completion. Additionally, the TSP anticipates that 3rd Street will be subject to beautification and Transportation System Management (TSM) enhancements to improve the appearance and performance of this roadway.

Greenwood Avenue from Newport Avenue to 3rd Street

Greenwood Avenue from Newport Avenue to 3rd Street is currently improved with two travel lanes in each direction with left turn channelization at key intersections. While there are sidewalks along this arterial, bicycle lanes are absent. A raised median prevents left turn movements at 2nd Street, to optimize traffic flow, and improve arterial safety and efficiency. The TSP documents prior discussions about the need for bicycle and pedestrian system improvements between Wall Street and the Parkway. Concern has been expressed about the possible loss of on-street parking in order to accommodate the bicycle lane. Phase 1 of the Central Area Plan recommended a cross-section of Greenwood Avenue west of the Parkway. Phase 2 will identify a recommended cross-section east of the Parkway along with enhancements to the existing narrow and dark pedestrian and bicycle undercrossing of the BNSF railroad and the Parkway.

The portion of Greenwood Avenue east of 3rd Street is designated as a Principal Arterial and an expressway and is part of the State's highway system (US 20).

Franklin Avenue

The TSP recommends that Franklin Avenue be improved to four and five lanes from the railroad underpass to 4th or 5th Streets, and that existing gaps in the sidewalk system be completed. It is suggested that the need to widen the Franklin Avenue undercrossing should be monitored as traffic growth occurs in the City, although the need is not anticipated during the 20-year planning horizon of the TSP. Bicycle and pedestrian system improvements to this undercrossing should also be considered. The TSP further suggests that alternatives to widening Franklin Avenue be evaluated. Hawthorne Avenue, between Hill and 3rd Streets, is included within the Plan as such an alternative and the TSP recommends that efforts be made to preserve this corridor for a future undercrossing as it may be a more cost-effective and achievable improvement than widening the Franklin Avenue undercrossing. A comprehensive study should be conducted to determine the viability and appropriateness of the Hawthorne undercrossing as a substitute for widening Franklin Avenue.

Revere Avenue

The TSP anticipates that Revere Avenue between Hill and 8th Streets will require widening to a full five lane cross-section in the future due to the fact that it is one of the few full access interchanges to the Parkway. Other improvement needs focus on the provision of sidewalk and bicycle lane facilities and on the existing at-grade crossing with the BNSF railroad. The close proximity of the railroad crossing to the Parkway, Division and 3rd Streets will make a future grade-separation very difficult.

Hill and Wall Streets

From Revere Avenue to Lafayette Avenue, Hill and Wall Streets have also been significantly affected by traffic between the Parkway interchange at Revere Avenue and the downtown core area. Hill and Wall Streets are a major northern entry into the downtown. Future improvements may be needed but potential impacts on Pioneer Park must be minimized.

Arizona/Colorado Avenue One-Way Couplet System

The conversion of Arizona and Colorado Avenues to a one-way pair "couplet" system between Broadway and the Parkway was implemented as a method of increasing arterial road capacity without the need to

widen existing Colorado Avenue. This couplet provides access between the Parkway and the southern portions of the Central Area and Old Mill District.

Wall and Bond Streets between Colorado and Industrial Way will also serve as major collectors connecting the Old Mill District with the downtown and other destinations. Per the TSP, the City will also study an additional connection, the use of Lava Road in combination the Bond and Wall Streets for this street connection.

Division Street

Prior to construction of the Parkway, Division Street extended from US 20/97 (just south of the Butler Market Road intersection with the highway) on the north to Broserhous Road on the south, and served as a major traffic reliever for 3rd Street. Since completion of the Parkway, Division Street has been fragmented. However, in the northern portion of the Central Area Plan study area, this street continues to serve as a minor arterial.

Hawthorne Street Extension

As part of the discussion of future railroad grade-separations in the City, an under crossing of the Parkway and railroad by Hawthorne Avenue is incorporated into the TSP. The Plan recommends that a detailed analysis of this connection be conducted when it is necessary to improve east/west capacity between the downtown and 3rd Street. The decision to construct this connection should be made as a part of a study of Franklin/RR/Parkway undercrossing (widening) alternatives (see discussion under Franklin Avenue).

Range of Roadway and Intersection Options

To address the intersection operational challenges anticipated by 2030 with either the General Plan or Central Area Plan development scenarios, a range of options for the transportation system were developed and considered. To provide grounding for the magnitude of capacity increases that would be needed to meet City and ODOT standards, one option was analyzed in detail focusing on roadway widening along with added turn lane channelization and signalized traffic control. Other options were formulated to address the general capacity requirements to service vehicular traffic but did so in a manner more inherently consistent with the overall vision of the Central Area Plan to provide opportunities for more intense, mixed use development served by a comprehensive multi-modal transportation system.

Findings and conclusions with respect to the No-Action Alternative and to various Build Alternatives are presented on the following pages. These options include:

- **No-Action Alternative:** Identifies the range of congestion challenges that would be experienced if no significant changes were made to the transportation system while allowing anticipated growth under either the General Plan or Central Area Plan development scenario.
- **Major Roadway Widening Alternative:** Identifies the magnitude of roadway system projects that would be required to meet City and ODOT standards while relying on the existing street classification system which articulates the role and purpose of each road in the study area (e.g., focus on using 3rd Street to accommodate north/south traffic movement with added east/west street capacity primarily along Butler Market Road, Revere Avenue and the Hawthorne Avenue Extension from Hill to 3rd Street).
- **3rd Street Corridor Enhancements:** this alternative includes at least three design options focusing to provide added roadway capacity along the 3rd Street corridor.
 - *Option 1* would involve developing a one-way couplet system using 2nd Street as the southbound half of the couplet and converting 3rd Street to the northbound half of the couplet. Both streets would be provided with widened sidewalks and bicycle lanes, narrowed

- pedestrian crossings of both 2nd and 3rd, management of access to adjacent properties, and potential on-street parking. Some changes could be made to Greenwood and Franklin Avenues through the couplet intersections to accommodate changes in allowable movements. Signals would be added at the intersections of 2nd Street at both Greenwood and Franklin Avenue. The extension of Hawthorne Avenue from Hill to 3rd Street would provide east/west reliever capacity for both Greenwood and Franklin Avenues. A variation on Option 1 would involve developing a one-way couplet system using 3rd and 4th Streets.
- *Option 2* would involve continued use of 3rd Street for two-way traffic operations with development of an expanded grid system throughout the area between Revere Avenue on the north and Burnside Avenue on the south. This expanded grid system could include potential widening on 2nd and 4th Streets with traffic signal control or roundabouts at major intersections. 2nd and 4th Streets would provide reliever capacity to 3rd Street by accommodating localized north/south travel demand. As with Option 1, the extension of Hawthorne Avenue from Hill to 3rd Street would provide east/wests reliever capacity for both Greenwood and Franklin Avenues.
 - *Option 3* would entail development of a one-way couplet system using 4th Street for northbound traffic and 2nd Street for southbound traffic. Two-way traffic would be maintained on 3rd Street between the two legs of the couplet but the existing cross-section could be narrowed to accommodate widened sidewalks, bicycle lanes and, potentially, on-street parking. Signals would be added at the intersections of 2nd and 4th Streets at both Greenwood and Franklin Avenue. The extension of Hawthorne Avenue from Hill to 3rd Street would provide east/west reliever capacity for both Greenwood and Franklin Avenues.
 - A *fourth option* has been suggested by City of Bend staff which could involve development of a boulevard along 3rd Street with emphasis on widening sidewalks, and adding enhanced streetscape and bicycle lanes. North/south traffic movement would continue to use this facility with some minor widening and right-of-way acquisition to accommodate the bicycle lanes and sidewalks. Existing lane widths would be reduced to minimize the needed right-of-way. This option would not attempt to address full accommodation of the anticipated traffic demand but would permit a higher level of congestion in the corridor, making it similar to a “downtown” type of environment.

Key findings with respect to each of these alternatives are discussed below. After this discussion, a short evaluation matrix summarized comparative differences using criteria identified and discussed at public and technical meetings.

Findings of the No-Action Alternative

Key findings related to the No-Action Alternative were more fully documented in the preceding chapter and are summarized below:

- Many existing traffic operational and safety problems exist, particularly along 3rd Street at major intersections.
- The bicycle and pedestrian system is not complete and lacks both connectivity and full ADA compliance. The bicycle and pedestrian environment along 3rd Street is unpleasant and not conducive to encouraging used of non-vehicular travel modes.
- By 2030, peak period congestion will significantly expand even with improved bicycle, pedestrian, and transit connections.

Findings of the Major Roadway Widening Alternative

As noted above, this alternative focuses on identifying changes to the transportation system that would be needed to achieve City and ODOT operational standards without significant alternations in the current patterns of street functionality and purpose to accommodate north/south traffic. Thus, the system would rely solely on 3rd Street to service this demand. Some expansion would be made to east/west system capacity for non-motorized travel via Greenwood and Franklin Avenues, and for all traffic along Butler Market Road, Revere Avenue, and with the Hawthorne Avenue Extension from Hill to 3rd Street.

For intersections that are currently signalized, the mitigation considers changes in intersection geometry and signal timing optimization. This would entail significant roadway widening along the length of 3rd Street to accommodate three through lanes in each direction with added turning lane capacity at many major intersections. Most of the unsignalized intersections would require signalization only with few changes in geometry in order to meet standards.

Key findings related to the analysis of this Alternative are discussed below and summarized in Table 16. It should be noted that this information is not intended to serve as a recommendation on corridor improvement projects. Rather, it should be viewed as an indication of the extent of street construction and right-of-way acquisition that would be needed if the ultimate recommendation were to focus solely on addressing traffic congestion. Intersection analysis worksheets for these improvement options are included in Appendix E.

Table 16. Traffic Operations Summary with CAP and Major Widening Alternative						
#	Intersections	Without Projects		With Projects		Standard
		Overall V/C Ratio	Average Delay (sec./veh.)	Overall V/C Ratio	Average Delay (sec./veh.)	
1	US 97/20 @ Butler Market Road <ul style="list-style-type: none"> Add NB and SB thru lanes Add WB separate right turn Covert SB right turn to thru/right 	1.26	>80.0	1.05	72.0	0.80
3	Revere Ave @ Pkwy NB Ramps <ul style="list-style-type: none"> Add 2nd NB right 	1.06	>80.0	0.93	21.8	0.80
4	Revere Avenue @ 3 rd Street <ul style="list-style-type: none"> Dual lefts for EB, WB and NB Separate EB right turn lane Add 3rd NB/SB thru lanes 	1.32	>80.0	0.92	47.1	0.80
6	Olney Avenue @ 3 rd Street <ul style="list-style-type: none"> Add separate EB & WB rights Add 3rd NB/SB thru lanes 	1.32	>80.0	1.00	62.6	0.80
9	Greenwood Avenue @ 3rd Street <ul style="list-style-type: none"> Provide dual left turn lanes for EB, WB & SB Add 3rd NB & SB thru lanes Add right turn lanes on all legs 	1.60	>80.0	1.03	57.6	0.80
14	Franklin Avenue @ 3rd Street <ul style="list-style-type: none"> Provide dual EB and WB left turn lanes 	1.18	>80.0	0.99	58.1	1.00
20	Parkway SB Ramp @ Butler Market Road <ul style="list-style-type: none"> Add 2nd EB & WB thru lanes Provide separate SB left and right turn lanes 	Unsignalized		Signalized		0.80
		>1.00	>80.0	0.78	15.4	

Table 16. Traffic Operations Summary with CAP and Major Widening Alternative						
#	Intersections	Without Projects		With Projects		Standard
		Overall V/C Ratio	Average Delay (sec./veh.)	Overall V/C Ratio	Average Delay (sec./veh.)	
21	Parkway NB Ramp @ Butler Market Road • No change to geometry	Unsignalized		Signalized		0.80
		>1.00	>80.0	0.81	8.3	
22	4th Street @ Butler Market Road • Add EB right turn lane	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.99	42.2	
23	4th Street @ Studio Road • Add NB right turn lane • Add SB left turn lane	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.92	23.0	
24	4th Street @ Revere Avenue • Add 2nd EB left turn lane • Provide NB & SB left turn lanes	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.99	30.3	
25	4th Street @ Olney Avenue • No change to geometry	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.96	25.7	
26	Parkway SB @ Lafayette Avenue • Consider closing EB to SB on ramp and adding SB deceleration lane	Unsignalized				
27	Wall Street @ Bond Street • Extend grid north of Greenwood with one-way on both Wall and Bond and median to allow free turns from Bond onto Wall	Unsignalized		Unsignalized		1.00
		>1.00	>80.0	0.79	19.3	
29	Hawthorne Avenue @ 3rd Street • Develop intersection with 3 NB/SB thru lanes, single WB/WB thru lanes, 1 WB left, dual WB left and 1 EB right	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.99	49.0	
31	SB Parkway @ Hawthorne Ave. • Consider closing EB to SB on ramp and adding SB deceleration lane	Unsignalized				
32	Franklin Avenue @ 4th Street • No change to geometry	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.61	12.3	
33	Riverside Drive @ Tumalo Ave • Add separate EB left turn lane • Overlap EBL and SBR signal phases	Unsignalized		Signalized		1.00
		>1.00	>80.0	0.84	22.7	
34	Parkway NB Ramp @ Colorado Ave • Add 2nd EB left turn lane • Separate WB thru & right lanes	Unsignalized		Signalized		0.80
		>1.00	>80.0	0.90	21.5	

Note: Unsignalized delay and V/C ratio represent operations of the worst movement.

Typically, by 2030 with either General Plan or Central Area Plan growth, peak period traffic volumes along 3rd Street are expected to increase significantly. This increase would require an additional northbound and southbound thru lane from approximately Franklin Avenue northward to Butler Market Road. In addition, many of the intersections in the 3rd Street corridor will require auxiliary turn lanes to

accommodate both right and/or left turning movements. The facility needs in this corridor will greatly impact the adjacent properties, as well as impact the travel of bicyclists and pedestrians.

The Parkway ramps at Lafayette and Hawthorne would experience considerable delay for vehicles entering the Parkway and heading south. The high volumes and speeds along the Parkway lead to safety concerns for the entering vehicles. Accordingly, it is recommended that ODOT consider closing the on-ramps and add deceleration lanes for the southbound off-ramps. The impact of a partial or total closure of these facilities on other study intersection was not evaluated.

Even with the wide variety of mitigation measures that were considered to address expected congestion problems in the Central Area, several intersections could potentially remain below either City or ODOT operating standards. For example, the intersection of Butler Market Road at US 97/20 would also remain in failure despite the addition of addition thru and turn lanes.

ODOT mobility standards were reviewed to determine if the state facilities would benefit from an STA designation. For US Highway 97, a statewide expressway, an STA designation is not an option. For US Highway 20, a statewide highway and freight route, the standard for signalized intersections would change from 0.80 V/C to 0.85 V/C, with a STA designation. This change does little to change the amount of mitigation required to bring the facilities into compliance with the estimated future volumes.

While the major roadway widening alternative addresses and attempts to resolve the anticipated traffic congestion issues associated with Central Area Plan growth along the 3rd Street corridor, it should be noted that this option does not meet the overall vision and objectives of the Central Area Plan in the following ways:

- It does not explicitly provide benefits for users of the non-motorized transportation system.
- It would require significant right-of-way acquisition and likely business relocation which could defeat the redevelopment focus of the CAP along 3rd Street.
- It would be very expensive and challenging to implement.
- It would still require concurrence by ODOT relative to acceptable levels of congestion that exceed current Oregon Highway Plan operational standards.
- Questionable support for efforts to redevelop and/or beautify the corridor.

Findings of the 3rd Street Corridor Enhancements

The 3rd Street corridor is the primary transportation link through the study area, connecting the Central Area with destinations both to the north and south. North of Greenwood Avenue, 3rd Street also serves as US 20, a statewide freight route operated and maintained by ODOT.

As indicated in the preceding section, significant capacity enhancements would be needed in the corridor to meet the applicable State and City operational standards based on the magnitude of vehicular traffic expected by 2030 with either the General Plan or Central Area Plan development scenarios. Assuming that three through lanes of north/south vehicle capacity would be needed (based on the analysis conducted above), the various design options considered in this section attempt to provide this capacity while minimizing the adverse impacts identified above.

Highlights of Corridor Options

Key findings with respect to each of these design options are as follows:

- Option 1 (one-way couplet using 2nd and 3rd Streets):
 - Could offer improved traffic operations and vehicular safety due to the reduction in conflicting movements at major intersections.

- Could accommodate widened sidewalks and bicycle lanes on both streets, thus offering a significantly improved and more attractive non-motorized circulation system in the Central Area.
- Could reduce street crossings for pedestrians at most major intersections along 3rd Street by allowing for a narrower street cross-section.
- As development occurs, parcel consolidation and street frontage improvements could offer opportunities to reduce access to adjacent properties, thus improving safety for all travel modes through the reduction of conflicting traffic movements.
- Includes an option for the extension of Hawthorne Avenue to relieve east/west traffic volumes on Greenwood and Franklin Avenues, while providing improved connectivity throughout the entire Central Area.
- Could have the disadvantage business impacts during the transition to one-way operations with the potentially long-term impacts associated with reduced traffic volumes in front of individual properties.
- Effective in providing improved accessibility for parcels along 2nd Street.
- Option 2 (Expanded Grid):
 - Could offer improved traffic operations by providing opportunities for traffic to disperse across added north/south and east/west street capacity in the area east of the Parkway. Would likely offer only limited ability to address existing congestion issues along 3rd Street.
 - Could accommodate widened sidewalks and bicycle lanes on several street (e.g., 2nd and 4th Streets), thus offering a significantly improved and more attractive non-motorized circulation system in the Central Area. Would be unlikely to improve pedestrian crossings of 3rd Street due to the need to retain similar street cross-section for capacity purposes.
 - As development occurs, parcel consolidation and street frontage improvements could offer opportunities to reduce access to adjacent properties, thus improving safety for all travel modes through the reduction of conflicting traffic movements.
 - Includes an option for the extension of Hawthorne Avenue to relieve east/west traffic volumes on Greenwood and Franklin Avenues, while providing improved connectivity throughout the entire Central Area.
 - May be one of the easiest to implement as the disruption to existing travel patterns in the study area would be minimized. Could also have lesser impacts on businesses dependent on the volume of traffic currently passing along 3rd Street. May have limited ability to encourage redevelopment opportunities along 3rd Street.
- Option 3 (On-way couplet on 2nd and 4th Streets, 2-way traffic retained on 3rd Street):
 - Could offer improved traffic operations and vehicular safety due to the reduction in conflicting movements at major intersections.
 - Could accommodate widened sidewalks and bicycle lanes on all three streets, thus offering a significantly improved and more attractive non-motorized circulation system in the Central Area.
 - Could reduce street crossings for pedestrians at most major intersections along 3rd Street by allowing for a narrower street cross-section.

- As development occurs, parcel consolidation and street frontage improvements could offer opportunities to reduce access to adjacent properties, thus improving safety for all travel modes through the reduction of conflicting traffic movements.
- Includes an option for the extension of Hawthorne Avenue to relieve east/west traffic volumes on Greenwood and Franklin Avenues, while providing improved connectivity throughout the entire Central Area.
- Could have the disadvantage of business impacts during the transition to one-way operations with the potentially long-term impacts associated with reduced traffic volumes in front of individual properties.
- Could help local businesses by providing on-street parking along 2nd, 3rd and 4th.
- Effective in facilitating redevelopment along 3rd Street while providing improved accessibility for parcels along 2nd Street.
- May be the easiest to stage for construction in comparison with Options 1 and 2.
- Could adversely impact residential areas along 4th and/or to the east due to increased traffic volumes. However, it should be noted that land uses along 4th Street are currently in transition away from residential toward office and retail uses.
- May be the most expensive of all the options considering the linear feet of roadway improvements that are included.
- Option 4 (Boulevard on 3rd Street with median and reduced lane widths):
 - Could accommodate widened sidewalks and bicycle lanes on 3rd Street, but would require right-of-way acquisition to accomplish. Would be unlikely to improve pedestrian crossings of 3rd Street at major intersections due to the need to retain similar street cross-section for capacity purposes. With installation of raised median, could provide some opportunities for reduced pedestrian crossing distances away from major intersections where left turn lanes would be needed.
 - As development occurs, parcel consolidation and street frontage improvements could offer opportunities to reduce access to adjacent properties, thus improving safety for all travel modes through the reduction of conflicting traffic movements.
 - Could include an option for the extension of Hawthorne Avenue to relieve east/west traffic volumes on Greenwood and Franklin Avenues, while providing improved connectivity throughout the entire Central Area.
 - Would likely experience significant levels of congestion at major intersections as indicated in the discussion of the Major Widening Alternative above.
 - May be one of the easiest to implement as the disruption to existing travel patterns in the study area would be minimized. Could also have lesser impacts on businesses dependent on the volume of traffic currently passing along 3rd Street. However, the need for right-of-way acquisition to add bicycle lanes and create a beautified and wider sidewalk environmental may have adverse business impacts.
 - May have limited ability to encourage redevelopment opportunities along 3rd Street.
 - May be one of the least expensive of all the options, dependent on extent of right-of-way acquisition needed. Narrowing of existing lane and median widths could help to minimize right-of-way acquisition needs, but will likely require concurrence by ODOT for the section of 3rd Street from Greenwood Avenue north.

3rd Street Roadway Option Conclusions

Based on discussions with the CAP Project Advisory Committee, city staff and a work session with City Council, it is recommended that the city further explore the feasibility and viability of the 3rd Street Option that includes development of a one-way couplet system along 2nd and 4th Streets while retaining two-way operations along 3rd Street with a narrowed cross-section and bicycle/pedestrian system enhancements including ADA-compliant pedestrian facilities. Street beautification should be emphasized to encourage revitalization.

Other Transportation Options

In addition to or in lieu of the foregoing design options that focus on 3rd Street, a variety of other transportation strategies might be considered to address the anticipated 2030 peak period congestion problems. These could include one or more of the following:

- Consider developing an expressway-to-expressway interchange at the existing signalized intersection of Butler Market Road with US 97/20. This improvement would need to be carefully coordinated with the existing adjacent Parkway interchange with Butler Market Road.
- Consider developing an improved Business 97 (3rd Street) bypass around the core city area to divert potential through traffic traveling from north of the Central Area to destinations east of the Central Area. A select link assessment was conducted of through trips on 3rd Street north of Greenwood Avenue which indicated that only about 5 percent of trips from north of Empire Avenue would likely be destined east of 27th Street. Other bypass options should be considered.
- Consider enhanced transportation system demand management strategies to reduce travel into and out of the Central Area. Such strategies could include further enhancements to the pedestrian and bicycle systems, expansion of transit service, parking pricing strategies in the core area, and other options.
- Consider a jurisdictional transfer of 3rd Street with the corresponding ability to reduce operating standards from those promulgated by ODOT to those currently in adopted City policy.

Bicycle and Pedestrian System Improvement Needs

Bicycle and pedestrian facilities in the Bend Central Area consist of dedicated bicycle lanes, bikeways (shared roadways), multi-use paths, and sidewalks. These systems are more fully described in Technical Memorandum #2 – Existing Conditions including identification of existing deficiencies.

There are many constraints to using the existing bicycle or pedestrian system within the study area. Both systems have many gaps where either no facilities or unattractive, unappealing facilities are provided. A key issue for the Central Area Plan is the lack of bicycle connections between the Third Street corridor and the core area. The existing Bend Parkway and BNSF tracks create a formidable barrier to connectivity by non-auto modes. Connections via either Greenwood Avenue or Franklin Avenue are narrow, dark and unappealing to the user. The existing connections must be shared between bicyclists and pedestrians and, in some instances, there is limited sight distance which could lead to potential conflicts between these two modes.

The width and traffic volumes along Greenwood Avenue have been identified as a barrier to pedestrian movement between the historic core and the neighborhoods/business areas to the north. Additionally, the level of traffic, frequent driveways and the presence of curb tight sidewalks (or lack of any sidewalks) make pedestrian activity along such streets as 3rd Street unappealing. In many



locations, sidewalk pavement quality is poor or the existing facilities are out of compliance with ADA standards.



These situations occur at several locations in the Bend Central Area. Significant gaps in the bicycle system include segments of Wall/Bond Streets, Portland Avenue, Greenwood Avenue, and Franklin Avenue. Pedestrians experience barriers at Greenwood Avenue and along Wall Street north of Greenwood Avenue. The railroad crossing is a barrier to providing connectivity for all modes.

Continuity of facilities and connections to desired destinations is essential to encourage both bicycle and pedestrian travel. Especially important is connecting people to other modes of transportation such as transit. Improving access to multi-modal travel is an important element in facilitating regional travel. The use of two or more modes of transportation in a single trip (i.e., bicycling and riding the bus) can extend the distance that someone is able to travel thus reducing another barrier to pedestrians and bicyclists, destinations that are out of reach.

Based on an assessment of existing deficiencies in the bicycle and pedestrian circulation system along the priority streets in the Central Area, the recommended system improvements are presented in Table 17.

Table 17. Pedestrian and Bicycle System Improvements with Central Area Plan			
Street	Segment	Improvement	
		Sidewalk	Bike Lane
3rd Street	Webster Avenue to Vail Avenue	1 side	
	Underwood Avenue to Thurston Avenue	1 side	
	Vail Avenue to Franklin Avenue (1)		2 lanes
4th Street	Vail Avenue to Thurston Avenue	1 side	
	Stewart Avenue to Revere Avenue	1 side	
	Quimby Avenue to Penn Avenue	1 side	
	Olney Avenue to Norton Avenue	1 side	
	Lafayette Avenue to Kearney Avenue	1 side	
	Irving Avenue to Franklin Avenue	1 side	
	Revere Avenue to Franklin Avenue		2 lanes
Studio Road	4th Street to Underwood Avenue	2 sides	
	South of Vail Avenue to Butler Market	1 side	
Division Street	Thurston Avenue to Riverview Park	1 side	
Revere Avenue	Hill Street to 4th Street		2 lanes
Greenwood Avenue	Hill Street to 2nd Street	Improve 2 sides	
	Bond Street to 3rd Street		Improve 2 sides
Hawthorne Avenue	2nd Street to 3rd Street	1 side	
	Parkway and BNSF RR undercrossing (2)	Pathway	Pathway

Table 17. Pedestrian and Bicycle System Improvements with Central Area Plan			
Street	Segment	Improvement	
		Sidewalk	Bike Lane
Hill Street	Lafayette Avenue to Kearney Avenue	1 side	
Franklin Avenue	Hill Street to 2nd Street Bond Street to 3rd Street	Improve 2 sides	Improve 2 sides
Wall Street	North of Lafayette to Norton Avenue Greenwood Avenue to Idaho Avenue Colorado Avenue to Arizona Avenue	1 side	Shared lane 1 lane
Bond Street	Greenwood Avenue to Idaho Avenue Colorado Avenue to Arizona Avenue		Shared lane 1 lane
Arizona Avenue	Lava Road to Hwy 97 ramps	2 sides	
Colorado Avenue	Chamberlain to Sizemore	1 side	

(1) Recommended in Bend Transportation System Plan, may be more practical to put on 4th Street due to significant traffic volumes expected along 3rd Street and need for widening.

(2) Recommended in Bend Transportation System Plan

Central Area Plan Strategy

This section draws preliminary conclusions from the discussion in the preceding section and lays out a strategy for proceeding with the transportation elements of a Central Area Plan strategy. This section includes a discussion of:

- Key plan elements
- Compliance with State laws and policies
- Compliance with Bend laws and policies
- Suggested TSP amendments
- Transportation system implementation actions
- Funding

Key Plan Elements

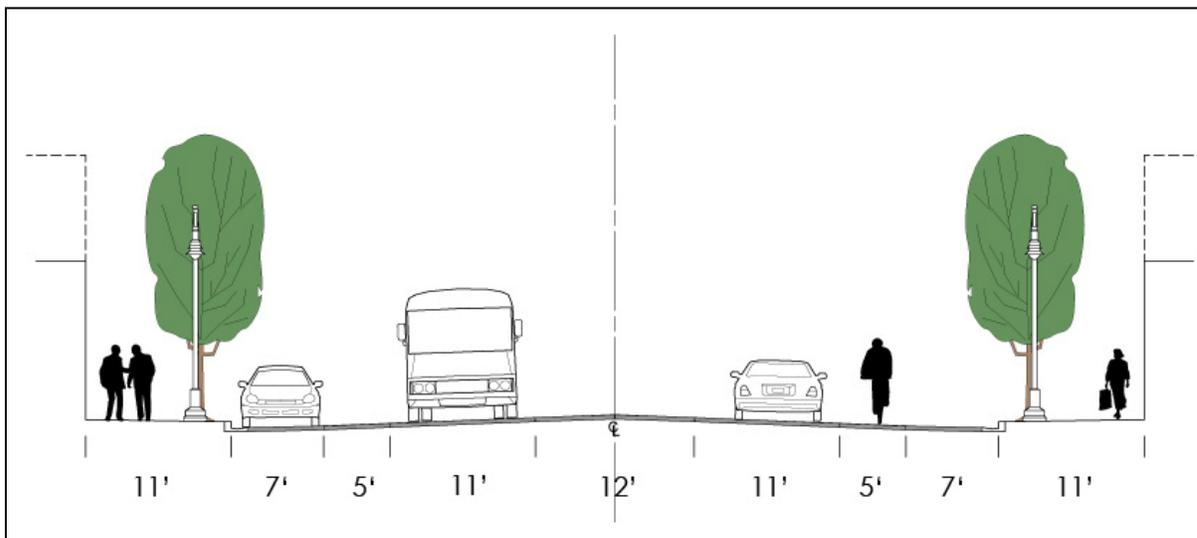
The key elements of the transportation portion of the Central Area Plan include a discussion of the primary objectives for the transportation system, along with specific direction on the component pieces of that system.

- **CAP Transportation Objectives**
 - Support a system of street hierarchies with accompanying cross-sections, access control and improvement concepts to implement the City's Transportation System Plan (TSP).
 - Improve connectivity for all travel modes (vehicles, pedestrians, bicyclists, transit)
 - Enhance the traveling environment and safety for pedestrians and bicyclists.
 - Address street system congestion problems.
 - Address implementation of city and/or ODOT access management policies (e.g., driveway consolidation, access off side streets, etc.).
 - Support revitalization of 3rd Street by enhancing street beautification.
 - Provide for and manage parking resources.
 - Consider using alleyways for access, pedestrians, stormwater management.

- **Circulation System Components**

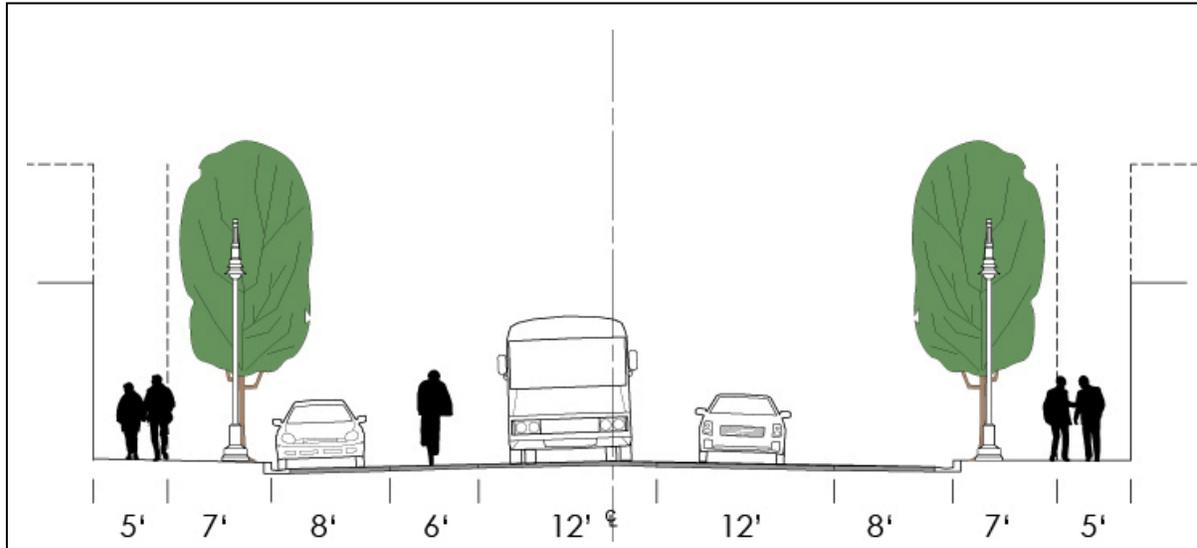
The components of the Central Area Plan circulation system include a variety of specific elements which are described below:

- Functional classification system – Building on the classification system established by the City’s Transportation System Plan, the Central Area Plan includes a hierarchical system of streets that reflect varying functions. Based on the preliminary choice of the 3rd Street Option that included a one-way couplet on 2nd and 4th Streets with two-way operations on 3rd Street, several classification system changes should be considered:
 - *3rd Street* is currently designated as a Principal Arterial whose primary function is to carry through traffic. This function influences the appropriate street cross-section (typically wider to accommodate large vehicles and heavy traffic), the nature of roadway system projects (usually focused on improving traffic flow and operations), and the control and/or reduction of access to adjacent properties and the spacing of side street intersections. If 3rd Street were to become a two-way street between a one-way couplet system, consideration should be given to changing its classification to Minor Arterial. Additionally, an overlay should be established that identifies it as a Great Street and defines what that means.
 - *2nd and 4th Streets* – 4th Street is currently designated as a Minor Arterial north of Franklin Street and a Major Collector south of Franklin Street. 2nd Street is currently designated as a local street. Both streets should be considered for Principal Arterial Designation consistent with their new through traffic-moving function under the CAP.
- Street cross-sections – Consistent with the CAP vision of a revitalized 3rd Street, changes in its existing street cross-section should be made consistent with a Minor Arterial/Boulevard type function. An example of such a cross-section is presented below.



3rd Street Boulevard Concept – Street Cross-Section in 80-foot Right-of-Way

Consistent with the proposed change in the functions of 2nd and 4th Streets, an appropriate cross-section might look like the following. The version shown here could be either 2nd Street looking north or 4th Street looking south.



2nd or 4th Street Concept – Street Cross-section in 70-foot Right-of-Way

- Street system connectivity – Several suggestions are made with respect to overall system connectivity. These include:
 - Extending Hawthorne Avenue from Hill Street to 3rd Street and providing enhanced transportation connections between the Historic Downtown and the Railroad District.
 - Incorporating platted but undeveloped streets into the grid to ensure long-term access and connectivity of the system.
 - Reviewing the role of Division Street in the City’s transportation system and offering suggestions for added connectivity as appropriate.
- Enhancements to the existing bicycle and pedestrian circulation system to include:
 - Completion of missing segments as identified in Table 17.
 - Improve pedestrian and bicycle connections between the Railroad District and the Historic Core via both Franklin and Greenwood Avenues
 - Provide multi-modal connections between Historic Downtown and the Railroad District via the Hawthorne Avenue Extension.
 - Enhance pedestrian crossings of 3rd Street by development of the narrowed street cross-section presented above, and through the use of curb bulb-outs at intersections.
 - Enhance the pedestrian and bicycling environment along 3rd Street by developing the Great Street Concept including widened sidewalks and installation of bicycle lanes.
 - Enhance the pedestrian and bicycling environment along 2nd and 4th Streets by including wider sidewalks and bicycle lanes as the one-way couplet concept is developed.
 - Continue to work towards a sidewalk and pedestrian pathway system that is fully compliant with the requirements of the Americans with Disabilities Act (ADA) using the City prioritization, funding and implementation mechanisms currently in place.
 - Consider adding or improving pathways and/or sidewalks in the Historic Southern Neighborhoods to provide better and safer connections between this area and the Historic Downtown.
 - Strong multi-modal connectivity should be maintained between the Old Mill District and the Historic Downtown for a focus on Wall and Bond Streets. The TSP also provides for consideration of Lava Road in this context.

- Explore the feasibility of providing a separate pedestrian and bicycle pathway across 3rd Street immediately south of the existing railroad crossing structure.
- Access management – based on existing ODOT and City policy, develop an access management plan in conjunction with a refined improvement concept for the 3rd Street Revitalization Concept. This access management plan should address:
 - Opportunities for driveway consolidation and/or shared driveway usage.
 - Opportunities for the installation of medians along 3rd Street with the proposed “Boulevard” concept (this could be an early action item to incorporate street trees along a portion of the corridor).
 - Opportunities for property access to be obtained from side streets wherever possible.
- Parking – consideration of parking within the Central Area should focus on the following key objectives:
 - To accomplish the vision of higher densities, a mix of land uses, and a viable multi-modal transportation system it will be important to consider both structured parking and establishing a paid parking system within the Central Area. The City is currently addressing this issue and the recommendations of this effort should be coordinated with the recommendations of this Plan.
 - Additionally, consideration should be given to identifying the location of future public parking facilities and land banking these as surface lots in advance of the need for parking structures.
- Transit – Suggestions related to the future transit system in the Central Area focused on two objectives:
 - Consider locating a permanent downtown transit center in the area generally bounded by the Parkway on the west, Franklin Avenue on the south, 2nd Street on the east and Greenwood Avenue on the north. A transit center located in this general area would provide greater proximity to the Historic Downtown than the current location and would be situated within the area with the highest potential for dense mixed use development within the Railroad District. Additionally, by located on the west side of 2nd Avenue, pedestrian crossings of the couplet would be eliminated for the largest target market – downtown workers and visitors.
 - Consideration should also be given to providing a Downtown shuttle bus as the Bend Area Transit system matures, densities in the core area increase, and parking becomes more constrained and/or expensive.
- Alleyways – Alleyways have been identified for a variety of functions in the Central Area Plan including added bicycle and pedestrian connectivity, back of building access for deliveries, and as a component element in a stormwater management strategy for the study area.
- Wayfinding – during Phase 1 of the Central Area Plan development process concern was raised by the community about how difficult it can be for visitors to find the downtown from either the Parkway or from 3rd Street (Business 97). During Phase 2, concerns were also expressed about wayfinding within the Central Area as development densities increase and transportation connectivity is enhanced. Accordingly, it is recommended that:
 - A wayfinding program be established to locate added and/or improved directional signage for



- motorists between the Parkway/3rd Street corridors and downtown.
- A wayfinding program focused on pedestrians and bicyclists be established in the Historic Downtown (and ultimately throughout the Railroad District) to direct people to major destinations. An example of a typical Wayfinding sign is presented in the adjacent photograph.

Compliance with ODOT Policies

Access Management

3rd Street north of Greenwood Avenue and Greenwood Avenue east of 3rd Street are under the jurisdiction of ODOT. The CAP does not call for any additional access points to either of these streets. However, the development of the CAP would alter the existing state highway by creating a one-way couplet system using 2nd and 4th Streets in lieu of the existing highway alignment along 3rd Street. Various modifications to existing north/south street cross-sections are proposed as a preliminary concept. It is recommended that a refinement plan be prepared to flesh out the details of the preliminary concept and finalize the details of a preferred concept. As this concept is further developed, ODOT Access Management Policies outlined in OAR 734-051 be addressed.

Transportation Planning Rule

Recent modifications to the Oregon Transportation Planning Rule require that *“where an amendment to a functional plan, an acknowledged comprehensive plan, or a land use regulation would significantly affect an existing or planned transportation facility, the local government shall put in place measures as provided in section (2) of this rule to assure that allowed land uses are consistent with the identified function, capacity, and performance standards (e.g., level of service, volume to capacity ratio, etc) of the facility.”* The modifications to the rule also explain that a land use plan or regulation significantly affects a facility if it would:

- *“Change the functional classification of an existing or planned transportation facility;*
- *Change standards implementing a functional classification;*
- *Allow land uses or levels of development that would result in types or levels of travel or access that are inconsistent with the functional classification of an existing or planned facility;*
- *Reduce the performance of an existing or planned facility below the minimum acceptable performance standard identified in the TSP or comprehensive plan; or*
- *Worsen the performance of an existing or planned transportation facility that is otherwise projected to perform below the minimum acceptable performance standard identified in the TSP or comprehensive plan.”*

As shown in Table 15, most signalized intersection in the CAP study area would meet the applicable standards with either the General Plan or Central Area Plan scenarios. As indicated in Table 16, most unsignalized intersections would exceed these standards, but many would require only signalization and/or minor turn land additions to come into compliance. However, in assessing the compliance of the Central Area Plan with the TPR, it should be noted that the CAP anticipates a future of significant change in the downtown and its surroundings which will alter the functional usage of several major streets to an increasingly urban “core area” type environment. Accordingly, along with the changes in land uses from the existing strip commercial and light industrial, to urban mixed use including retail, office and residential uses, the inherent nature of the CAP would result in a development pattern largely in keeping with the goals of the TPR. Thus, changes to the transportation system to address the anticipated growth in traffic volumes should be consistent with the vision of the CAP and not simply focused on “fixing” the traffic problem. Additionally, since the CAP in and of itself does not alter the existing General Plan, zoning or TSP, the need to determine identify a specific list of multi-modal projects should best be

determined when, and as these changes are made. Guidance in determining this list of projects is provided in the section entitled “Transportation Implementing Actions”.

Special Transportation Area and Urban Business Area

Consideration was given to designating 3rd Street and Greenwood Avenue as Special Transportation Areas or Urban Business Areas in order to meet OHP v/c standards. However, because these highways have been designated as statewide freight routes, an STA or UBA designation would only drop the standard from a v/c of 0.80 to 0.85 which would not make a difference. Accordingly, these designations were not considered further.

Compliance with City Policies

The Bend Development Code (Chapters 3 and 4) and various city street system policies provide specific guidance on the development and management of the city’s transportation system. Of particular relevance to the Central Area Plan are guidelines related to street design, traffic analysis to determine infrastructure requirements and access management provisions.

Design Requirements

Chapter 3 of the Development Code addresses street design standards including street geometrics and right-of-way, grades, sight distance, property access, traffic control, sidewalks, planter strips, bicycle lanes, curb cuts, parking and many other features. It is intended that implementation of transportation system projects pursuant to the CAP will be consistent with the requirements identified in Chapter 3.

Traffic Analysis

Chapter 4 of the Development Code and Street Policy #6 address transportation analysis requirements that determine needed street infrastructure to accommodate existing and potential future traffic volumes. These requirements are typically related to and carried out in conjunction with land development activity and stipulate: when study is required, how a study should be conducted, how the findings, conclusions and recommendations of a study are approved, and mitigation requirements/conditions of development approval. It is not intended that the transportation analysis prepared for the CAP substitute for any development-related transportation analysis required by Chapter 4 or Street Policy #6. This analysis should accompany specific development activity. However, there may be value in revisiting a streamlining of transportation analysis requirements as part of the 3rd Street Corridor Refinement Plan which is further discussed below.

Access Management

Within the Central Area all streets other than 3rd Street north of Greenwood Avenue, Greenwood Avenue east of 3rd Street and the Parkway are under the jurisdiction of the City of Bend. Accordingly, ODOT access management policies do not apply. The City of Bend had adopted several guidelines for managing access along major city streets (including City Street Policies #2 and #4, and Development Code Chapter 3.1) that identify guidelines for access spacing, sight distance, median openings, turn prohibitions, and coordination with other jurisdictions. As the CAP is implemented, the City of Bend should pursue opportunities for shared access arrangements with developers and property owners as new development occurs. This will ultimately minimize the number of access points to the City’s downtown street system; therefore preserving and enhancing the long term mobility and safety of the streets. In addition, this complements shared parking policies to minimize the amount of space devoted to parking supply.

TSP Amendments

Consideration should be given to amending the City’s current Transportation System Plan and Street Standards to accommodate the cross-sections and general streetscape features associated with new street classifications within the Central Area. These include:

- A Principal Arterial that has been designated as a Great Street (3rd Street)
- A Minor Arterial that has been designated as a Great Street (Greenwood, Olney and Franklin)
- Consider redesignation of 2nd Street as a Minor Arterial or Major Collector to distribute north/south traffic within revitalized corridor.

Transportation System Implementing Actions

This section focuses on identifying specific actions that could be taken to advance implementation of the Central Area Plan from the perspective of developing and altering the transportation system. Most particularly, this section focuses on the revitalization of 3rd Street and enhancements to the pedestrian and bicycle circulation systems, but also includes many other proposed actions. The discussion of implementing actions is organized as follows:

- Future refinement studies to address conceptual design issues that were beyond the scope of the Central Area Planning process;
- Public investment transportation catalyst projects to help “jump start” land use development consistent with the vision of the CAP; and
- Short, mid and long-range transportation projects that will help carry out the CAP.

Studies

- 3rd Street Corridor Refinement Plan – develop consensus on a preferred concept, layout linear details of the concept including identification of right-of-way and access needs, detailed cost estimates, and an implementation strategy. A key issue to be addressed in this study will include:
 - Address sidewalk, bicycle lane and travel lane widths, on-street parking configuration, property access, signal timing, and pedestrian crossings for not only the north/south streets in the corridor (2nd, 3rd and 4th Streets), but also the key east/west streets (Revere, Olney, Greenwood and Franklin). Consider long-term integration with a future Hawthorne Avenue extension between Hill and 3rd Streets.
 - Identify design standards and/or general guideline for streetscape and amenities along the 3rd Street corridor to provide each street with its own character
 - Resolve transitional areas at the northern and southern termini. This could include development of an additional railroad undercrossing at the southern terminus to improve connectivity between the 3rd Street corridor and the Old Mill District. It is suggested that the northern terminus be located north of Revere Street to provide sufficient capacity for north/south traffic through the intersections with this street which provide access to the Parkway.
 - Work out an implementation strategy that includes, at a minimum, refined cost estimates, funding sources, timing and priorities of projects, and an approach to phasing of construction and transitions between two-way and one-way traffic operations.
 - Initiate long-term discussion of a potential redesignation of Highway 20 away from its current alignment along 3rd Street north of Greenwood Avenue and along Greenwood Avenue to the east of 3rd Street.
 - Potentially consider creating a master transportation impact study to help streamline traffic impact analyses for development review in the Central Area. This could make development activity within the Central Area more attractive to and easier for various development interests.

Projects

- **Catalyst projects** – Actions that should be taken over the next 1 to 5 years to help “jump start” revitalization along the 3rd Street Corridor. These projects should include:
 - Pedestrian improvements under railroad and Parkway for Greenwood and Franklin Avenues to add lighting and security, improve line of sight.
 - Install raised and landscaped median along 3rd Street between Greenwood and Franklin Avenues with ADA compliant pedestrian projects at selected locations.
 - Build 2nd and 4th Streets to full 70-foot cross-section as identified with the couplet concept, but retain 2-way operations between Greenwood and Franklin Avenues until additional phases of couplet development to the north and south can be completed.
- **Short-term projects** – other actions that could be taken over the next 1 to 5 years that are not focused on 3rd Street revitalization.
 - Conversion of Wall Street between Greenwood and Bond, extend downtown grid to north (see illustration of this concept to the right).
 - Sidewalk along the west side of Wall Street north of Lafayette Street

Error! Objects cannot be created from editing field codes.

The catalyst and short-term transportation system projects are summarized in Table 18 along with a range of other suggested roadway, pedestrian and bicycle circulation projects to be developed in the study area in the medium (5 to 10 years) and longer-term (more than 10 years). Also presented in the table is an order-of-magnitude estimate of likely cost and a suggested assignment of funding and implementation responsibilities. It is anticipated that cost estimates and a more detailed funding and implementation strategy will be developed as project details are further refined through conceptual design in the proposed 3rd Street Corridor Refinement Study.

Table 18. Transportation Implementation Projects					
Description	Priorities/Timing			Cost	Funding and Responsibility
	Short	Medium	Long		
<i>Catalyst Projects</i>					
• Greenwood and Franklin Avenues at Parkway/Railroad – enhance pedestrian undercrossing	X			Moderate	City/Urban Renewal
• 3rd Street, Greenwood to Franklin – install raised, landscaped median and ADA improvements	X			Moderate	City/Urban Renewal
• 2nd and 4th Streets, Greenwood to Franklin – widen street and sidewalk, add bike lanes, install landscaping	X			Medium	City/Urban Renewal

Table 18. Transportation Implementation Projects					
Description	Priorities/Timing			Cost	Funding and Responsibility
	Short	Medium	Long		
Roadway Projects					
<ul style="list-style-type: none"> Wall Street, Bond to Greenwood – convert to one-way southbound, install angle parking, modify intersection of Wall @ Bond 	X			Low	City
<ul style="list-style-type: none"> 2nd and 4th Streets, Revere to Greenwood – widen street and sidewalk, add bike lanes, install landscaping and on-street parking 		X			City/Urban Renewal
<ul style="list-style-type: none"> Revere Avenue @ NB Parkway Ramps – NB right turn lane 		X		Medium	ODOT
<ul style="list-style-type: none"> Butler Market Rd @ US 97/20 – add lane capacity 		X		High	ODOT
<ul style="list-style-type: none"> Butler Market @ SB Parkway Ramp – provide right & left turn lanes from ramp 		X		Medium	ODOT
<ul style="list-style-type: none"> Butler Market @ 4th Street – EB right turn lane 		X		Low	City
<ul style="list-style-type: none"> 2nd and 4th Streets, Franklin to southern terminus – widen street and sidewalk, add bike lanes, install landscaping and on-street parking. Southern terminus could involve added railroad undercrossing to improve connectivity with Old Mill District 		X		High	City/Urban Renewal
<ul style="list-style-type: none"> 2nd and 4th Streets, north of Revere – construct new and modify existing streets to accommodate one-way couplet transition to 3rd Street 		X		High	City/Urban Renewal
<ul style="list-style-type: none"> 3rd Street, northern to southern terminus – narrow street, widen sidewalks, add bike lanes, landscaping and on-street parking, convert 2nd and 4th Streets to one-way operations 		X		High	City/Urban Renewal
<ul style="list-style-type: none"> Studio Road @ 4th Street – add turning lanes 		X		Medium	City
<ul style="list-style-type: none"> SB Parkway @ Lafayette Avenue – close on-ramp, decel lane for off-ramp 			X	Low	ODOT
<ul style="list-style-type: none"> SB Parkway @ Hawthorne Avenue under RR/Parkway to 2nd 			X	High	ODOT/City
<ul style="list-style-type: none"> Hawthorne Avenue undercrossing, Hill to 3rd – construct new grade-separated road with 2 vehicular lanes, bike lanes, sidewalks and landscaping. 			X	High	City/Urban Renewal
<ul style="list-style-type: none"> NB Parkway Ramp @ Colorado Avenue – signalize & added EB/WB turn lanes 			X	Medium	ODOT
Pedestrian Projects (excluding 2nd, 3rd, and 4th Street couplet corridor and catalyst projects)					
<ul style="list-style-type: none"> Wall Street: n/o Lafayette 	X			Medium	City
<ul style="list-style-type: none"> 3rd Street: Webster – Vail 		X		Low	ODOT
<ul style="list-style-type: none"> 3rd Street: Underwood – Thurston 		X		Low	ODOT

Table 18. Transportation Implementation Projects					
Description	Priorities/Timing			Cost	Funding and Responsibility
	Short	Medium	Long		
• 4th Street: Vail – Thurston		X		Low	City
• 4th Street: Steward – Revere		X		Low	City
• Hill Street: Lafayette – Kearney		X		Low	City
• Arizona Avenue: Lava – US 97		X		Medium	City
• Studio Road: 4th – Underwood			X	Low	City
• Studio Road: s/o Vail – Butler Mkt			X	Medium	City
• Division Street: Thurston - Riverview			X	Medium	City
• Colorado Avenue: Chamberlain to Sizemore			X	Low	City
<i>Bicycle Projects (excluding 2nd, 3rd, and 4th Street couplet corridor and catalyst projects)</i>					
• Revere Avenue: Hill – 4th		X			City/ODOT
• 3rd Street: Vail – couplet transition		X			ODOT

Note: Some of the suggested roadway projects are premised on meeting City operational standards, in particular focusing on the hours on either side of the peak.

Funding

A wide range of funding opportunities exist to support the development of transportation infrastructure in the Central Area consistent with the suggestions and recommendations of this Plan. These opportunities include the following.

- **State Gas Taxes** are collected by the State based on the amount of gasoline delivered, and distributed to local jurisdictions based on the amount sold locally. While the gas tax provides needed transportation system revenue, it is unlikely to keep pace with future maintenance needs. The legislature fuel efficiency and the appearance of hybrid or mixed-fuel vehicles offset the future purchasing power of the gas tax. This funding source can be used both by ODOT and the City to fund projects under their respective jurisdictions.
- **System Development Charges** or development impact fees are one-time fees assessed to new development and changes in use. These fees are paid by land developers to cover a portion of the increased system capacity needed to accommodate new development. Development charges are calculated to include the costs of impacts on adjacent areas or services, such as increased school enrollment, parks and recreation use, or traffic congestion. SDCs are one of the major sources of funding for the City of Bend’s current Capital Improvement Program which prioritizes the use of city revenues for transportation (and other infrastructure) purposes. New SDC assessments can be created in specific districts and can be dedicated to specific infrastructure investments.
- **Street Bonds** can be of two types: Revenue Bonds and General Obligation Bonds. Revenue bonds are typically secured by local gas tax receipts, street utility fees or other transportation-related stable revenue stream. General Obligation Bonds, which must be approved by majority of the voters and which are typically secured by a property tax, also can be used to finance transportation improvements.
- **Tax Increment Financing** – Tax increment financing is a mechanism where public projects are financed by debt borrowed against the future growth of property taxes in an urban renewal district. The assessed value of all properties within the district is set at the time the district is first established (the base). As public and private projects enhance property values within the district,

the increase in property taxes over the base (the increment) is set aside. Debt is issued, up to a set maximum amount, to carry out the urban renewal plan and is repaid through the incremental taxes generated within the district. Urban Renewal Districts usually are in effect for 15 to 20 years. When the district is retired, the base is removed and all property taxes in the district return to normal distribution. Bend currently has urban renewal districts in the Downtown Historic Core and at Juniper Ridge.

- **Enterprise Zone** – An Enterprise Zone is a State-designated area where businesses located within them that make capital investments, hire new employees, contribute to economic development plans, rehabilitate old buildings, and/or do research and development are provided a tax credit and potentially other development incentives. An Enterprise Zone designation would be an incentive to attract business investment in the Central Area.
- **Local improvement districts (LIDs)** levy special assessment charge on property owners within a defined area such as a neighborhood, street frontage or industrial/commercial district, with each property assessed a portion of total project cost. LIDs are commonly used for street paving, drainage, parking facilities and sewer lines. The justification for such levies is that many of these public works improvements provide a direct benefit or enhancement to the value of nearby land, thereby providing direct financial benefits to its owners. LIDs are used typically for local street projects that cannot be funded through other means. State law and city code govern the formation of LIDs, the assessment methodology, and other factors. LIDs are usually funded by the participants, but may also be combined with other funding sources to leverage all available resources. LIDs are typically petitioned by and must be supported by a majority or supermajority of the affected property owners.
- **Grant Revenue** is available through a number of state and federal programs for street, bicycle/pedestrian and transit improvements. Grant programs that the City has and/ or can pursue successfully include:
 - *Community Development Block Grants (CDBG)* from the federal Housing and Urban Development Agency (HUD);
 - *Transportation and Growth Management (TGM)* - ODOT provides grants to local governments in Oregon for a variety of purposes including updating land use and transportation plans, making walking and biking safer and more convenient, improving access to transit, improving the pedestrian-friendliness of downtowns and Main Streets, amending local codes to encourage "transportation efficient" development, and creating better connections between local destinations.
 - *ODOT local access street grants*; and
 - *ODOT Pedestrian and Bicycle Program* – ODOT provides grants for crosswalks, bike lane striping, and pedestrian crossing islands that fall within the rights-of-way of streets, roads and highways. Bike/ped grants usually fall between \$80,000 and \$500,000.
 - *Oregon Transportation Enhancements (TE) Program* – Using federal transportation funds, ODOT TE grants are awarded to local governments and other public agencies to support projects that improve communities and enhance the experience of traveling. New sidewalks, bike lanes, and pedestrian amenities such as benches and streetlights are eligible TE projects, as are the restoration of historic railroad stations, bus stations, and bridges. TE awards typically range from \$200,000 to \$1 million, and local governments must contribute ten percent of the project's cost.
 - *Safe Routes to School (SR2S)* – Administered in Oregon through ODOT, this federal program funds advocacy efforts such as traffic education, safety enforcement near schools, and public awareness campaigns aimed at making it safer for children to walk to school. SR2S funds

may also be used for the construction of sidewalks, pedestrian crossings, bike storage racks, and traffic calming facilities.

- **Parking District** – A Parking District is a special district created to fund parking improvements and programs. Typically, the District receives funding from parking meters, garages, and fines. Funds in a Parking District are part of a special enterprise fund, remaining separate from the City’s general fund. A Parking District can also include a fee in lieu of program for new development to fund shared parking structures.

Other revenue is available from a variety of smaller sources, most of which can be generated locally including:

- Pedestrian-scale Street Light Utility Fees
- Developer share of specific projects
- Signal Maintenance Charges to ODOT
- Jurisdictional Transfers from ODOT
- Fees from Street Cuts (e.g., for utility installation)

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Other Infrastructure

This section includes a brief summary of the improvement needs for water systems, sewer systems, storm water facilities, and other private utility systems. The study area consists of the area east of the Deschutes River, west of 4th Street, north of Arizona Avenue and south of Butler Market Road.

Water System

The Central Area is located primarily within the City of Bend’s Water Pressure Zone 5, which provides customers with gravity fed water from the Awbrey reservoir and the Pilot Butte reservoirs at elevations ranging from 3,650 to 3,750 feet. Pressure Zone 5 extends well beyond the Central Area and serves an existing population of approximately 20,890.² Future water demand assumptions and facility requirements have been identified within the Bend Water System Master Plan (October 2006 – Final Draft) with estimates of population for the service area at build-out. Key findings and assumptions contained within the Waster System Master Plan are cited in this Technical Memorandum for comparison and consistency purposes.

As indicated in Table 19, the current Bend Water Master Plan provides water demand forecasts for Pressure Zone 5, based upon vacant and redevelopment land assumptions. Zone 5 is expected to accommodate 29,840 people at build-out, after it adds approximately 9,007 residents. The average daily water demand (ADD) is expected to increase by 2.96 million gallons per day (mgd), and maximum daily water demand (MDD) is expected to increase by 6.8 mgd.

Table 19. Zone 5 Water Demand (Included Central Area)			
	2006 Estimate	Build-out	Change
Population	20,833	29,840	+ 9,007
Per Capita Water Demand *			
Avg. Daily Demand (gallons per day)	216	250	+ 34
Maximum Daily Demand (gallons per day)	518	590	+ 71
Peak Hour Factor (x MDD)	2.1	1.5	--
Water Demand in Central Area*			
Avg. Daily Demand (gallons per day)	4,500,000	7,460,000	+ 2,960,000
Maximum Daily Demand (gallons per day)	10,800,000	17,600,000	+ 6,800,000
Peak Hour Demand (gallons)	22,800,000	26,400,000	+ 3,600,000

* Derived from the Bend Water System Master Plan, October 2006 as compiled by Otak, Inc.

According to the market forecasts conducted as part of this planning effort (please refer to Table 2), the Bend Central Area is expected to add approximately 2,314 dwellings that house an additional 4,143 people by 2030. This amount of growth is likely to generate additional water demand, which is shown in Table 20. Future water demand within the Central Area is expected to increase by approximately 0.9 mgd, and maximum water demand is expected to increase by 2.2 mgd.

² Bend Water System Master Plan, October 2006 – Final Draft.

Table 20. Central Area Household Water Demand			
	2006 Estimate	2030 Projection	Change
Housing Units ⁺	2,056	4,370	+ 2,314
Population *	2,977	6,199	+ 4,143
Per Capita Water Demand **			
Avg. Daily Demand (gallons per day)	216	250	+ 34
Maximum Daily Demand (gallons per day)	518	590	+ 71
Peak Hour Factor (x MDD)	2.1	1.5	--
Calculated Water Demand in Central Area			
Avg. Daily Demand (gallons per day)	643,042	1,549,750	+ 906,708
Maximum Daily Demand (gallons per day)	1,500,000	3,700,000	+ 2,200,000
Peak Hour Demand (gallons)	3,200,000	5,550,000	+ 2,350,000

+ Excludes Historic Downtown core.

* Derived from Table 3 (assumes MPO forecast for Central Area equals 3,056 people for 2030).

** Derived from the Bend Water System Master Plan, Oct. 2006.

Compiled by Otak, Inc.

This preliminary analysis of water demand indicates that the Central Area is likely to account for approximately 22 percent of the Zone 5 water demand—which appears to be consistent with the Water Master Plan assumptions. Table 21 indicates that a portion of the total Central Area water demand will be generated by commercial users. Commercial demand will likely have a midday peak demand flow, while residential demand has an early and late-day peak flow. Lodging development can pose an exception to this rule. It appears that the commercial water demand that is expected to occur with full Central Area Plan residential and commercial build-out is consistent with the current Water Master Plan assumptions.

Table 21. Central Area Commercial Water Demand	
	2030 Net New Growth
Redevelopment ⁺	
Office (floor area square feet)	1,304,340
Retail (floor area square feet)	240,754
Industrial (floor area square feet)	(394,568)
Hotel (floor area square feet) *	728,000
Net New (floor area square feet)	1,878,526
Est. Redeveloped Land Area (acres) **	86.3
Avg. Daily Water Demand (gallons per acre) ***	
Avg. Daily Water Demand (gallons per acre)	4,500
Maximum Daily Water Demand (gallons per acre)	9,000
Peak Hour Factor (x MDD)	1.5
Calculated Water Demand in Central Area	
Avg. Daily Demand (gallons per day)	388,125
Maximum Daily Demand (gallons per day)	776,250
Peak Hour Demand (gallons)	1,164,376

+ Excludes Historic Downtown core.

* Based on 700 square feet per hotel room and 1,040 rooms added.

** Assumes 0.5 average floor area ratio.

*** Derived from the Bend Water System Master Plan, Oct. 2006.

Compiled by Otak, Inc.

Water Infrastructure Needs

To maintain consistency with the City of Bend Water System Master Plan Update and implementing policies, the following water system improvements are needed to adequately serve the Central Area:

- Various, scattered in-fill upgrades are planned in the area, especially in the areas just east and west of the Division Street corridor. The in-fills comprise distribution size (8-inch, 10-inch and 12-inch) additions to the existing system. Please refer to the Water Master Plan, Section 6.
- Pressure in the area is good (about 80 psi) and no pressure enhancing improvements are planned. However, mid-story building construction will need to provide its own internal pumping systems.
- Flow is good and will be sufficient to meet fire flow requirements. However, new building construction will need to provide its own fire suppression systems.
- Eventually, three new Pilot Butte reservoirs are needed to accommodate build-out water demand within Pressure Zones 5, 6 and 7. The exact timing for these will be a function of demand, city priorities, and funding.

Sewer System

The Central Area is located primarily within the City of Bend’s Sewer Area 6. According to the Bend wastewater Collection System Master Plan (2006), the city currently provides sewer service to approximately 4,413 residents within Area 6 (the total population of Area 6 is estimated at 5,455 people.) As indicated in Table 22 and based on the Sewer Master Plan, it is anticipated that the base wastewater flows generated in this area will increase from a current 0.436 mgd to 0.950 mgd by build-out.

Table 22. Zone 6 Sanitary Sewer Flows (Includes Central Area)			
	2006 Estimate	Build-out	Change
Population	5,455	11,866	+ 6,411
Per Capita Sewer Flow *			
Avg. Daily Flow (gallons per day)	79.9	80.06	+ 0.13
Calculated Sewer Flow in Central Area *			
Avg. Daily Flow (gallons per day)	436,000	950,000	+ 514,000

* Derived from the Bend Collection System Master Plan, Nov. 2006, as compiled by Otak, Inc.

According to the market forecasts conducted as part of this planning effort (please refer to Table 2), the Bend Central Area is expected to add approximately 2,314 dwellings that house an additional 4,143 people by 2030. This amount of growth is likely to generate additional wastewater flow, which is shown in Table 23. Future wastewater flow within the Central Area is expected to increase by approximately 0.258 mgd by 2030.

Table 23. Central Area Sanitary Sewer Flows			
	2006 Estimate	2030 Projection	Change
Housing Units +	2,056	4,370	+ 2,314
Population *	2,977	6,199	+ 4,143
Per Capita Sewer Flow **			
Avg. Daily Flow (gallons per day)	79.9	80.06	0.13
Calculated Sewer Flow in Central Area			
Avg. Daily Flow (gallons per day)	237,942	496,292	+ 258,350

+ Excludes Historic Downtown core.

* Derived from Table 3 (assumes MPO forecast for Central Area equals 3,056 people for year 2030).

** Derived from the Bend Collection System Master Plan, Nov. 2006.

Compiled by Otak, Inc.

This preliminary analysis of water demand indicates that the Central Area is likely to account for approximately 50 percent of the Zone 6 wastewater flow—which appears to be consistent with the Water Master Plan assumptions.

Wastewater Infrastructure Needs

To maintain consistency with the City of Bend Collection System Master Plan and implementing policies, the following wastewater system improvements are needed to adequately serve the Central Area:

- Small, localized capacity enhancing improvements throughout the study area consisting of small diameter, short re-routes of the current system (please refer to the wastewater Collection Master Plan).
- Many of the sewers in the existing core system are already at capacity. In order for the higher density suggested for the Central Area Plan to be served by sewer, the existing main interceptor sewer that runs through the study area will need to be relieved of significant flows to generate additional capacity. This will be a major issue that will limit the ability to implement increased density in the study area. The construction of at least a one, and eventually both, of two proposed new interceptor sewers will need to be done to relieve flows in the study area in order to generate additional new capacity,
- Construction of the proposed Westside Interceptor will divert some flows on the west side of Bend that currently flow through the existing main interceptor in the study area. Currently, sewer flows from the southeastern part of Bend are passing through the existing downtown interceptor. In order to alleviate that situation and provide additional capacity for a higher density downtown area, the proposed Southeast Interceptor will need to be constructed.
- Replacement of the Drake Pump Station.
- Replacement of the pump station near 4th and Addison.
- Replacing 2,700 feet of gravity sewer (including a bore under Highway 97) and installing a new pump station near the Linster Pump Station.

More detailed description of the system and its deficiencies can be found in the Master Plan document.

Storm Drainage

Generally, the existing storm drain system in the study area is inadequate. Compliance with DEQ standards is further aggravated by the area's close proximity to the river. The proximity to the Deschutes River provides both an opportunity and a constraint for storm drainage. As a regulated river, discharge of higher peak flows (i.e. from rerouting drywell or drill hole drainage through a piped system) should be permitted as the stormwater contribution from the downtown area would be so minor compared to total river flows. However, surface discharge to the river will need to have pre-treatment to meet DEQ water quality standards. This will make it very important to identify open spaces in the study area that are located in low-lying areas that would be available for stormwater treatment prior to discharging to the river.

Future redevelopment is unlikely to increase the total impervious area over existing conditions, as most properties are already paved and landscaping is limited to residential and park areas. Future developments will likely need to retrofit existing drywells, abandon drill holes, and/or install a piped conveyance system to avoid untreated subsurface discharge. More specific recommendations for individual and programmatic improvements can be found in the Bend Integrated Stormwater Management Plan, November 2006 (final draft).

Other Infrastructure

Currently no known power deficiencies or problem areas exist in the study area with regard to electric power, telecommunications, and natural gas. It should be noted that, by law, franchise utilities are required to meet the need and to serve any demand in the area.