CHAPTER 3

TRAVEL DEMAND FORECASTING

3.1 INTRODUCTION

The method and process used to predict growth in the Bozeman area up to the year 2030 is contained in this chapter of the Transportation Plan. By using population, employment and other socioeconomic trends as aids, the future transportation requirements for the Bozeman area were defined. A model of the transportation system for the Bozeman area was built with the additions and changes to the system that are projected to occur up to the year 2030 being applied to the model to forecast the future transportation conditions. From this model, various scenarios were developed to test a range of transportation improvements to determine what affects they would have on the transportation system.

3.2 SOCIO-ECONOMIC TRENDS

There is a direct correlation between motor vehicle travel growth and population and economic growth. The influx of traffic relating to the MSU campus being located in Bozeman is also of significant concern. The population in Gallatin County has seen significant increases since 1990 and has nearly doubled since 1980. There has been a 55 percent increase in population in Gallatin County between 1990 and 2005 alone. The employment numbers have also seen significant growth; between 1990 and 2005 the employment in Gallatin County has doubled. **Table 3-1** and **Figure 3-1** show the population and employment numbers for Gallatin County between 1970 and 2005.

Table 3-1
Gallatin County Population and Employment Trends (1970-2005)

Year	Population*	Employment**
1970	32,505	13,396
1980	42,865	21,797
1990	50,463	31,978
2000	67,831	51,586
2005	78,262	63,379

*Source: Us Bureau of the Census, Census of Population

**Source: US Department of Commerce, Bureau of Economic Analysis, REIS Data Series

Figure 3-1
Gallatin County Population & Employment Trends

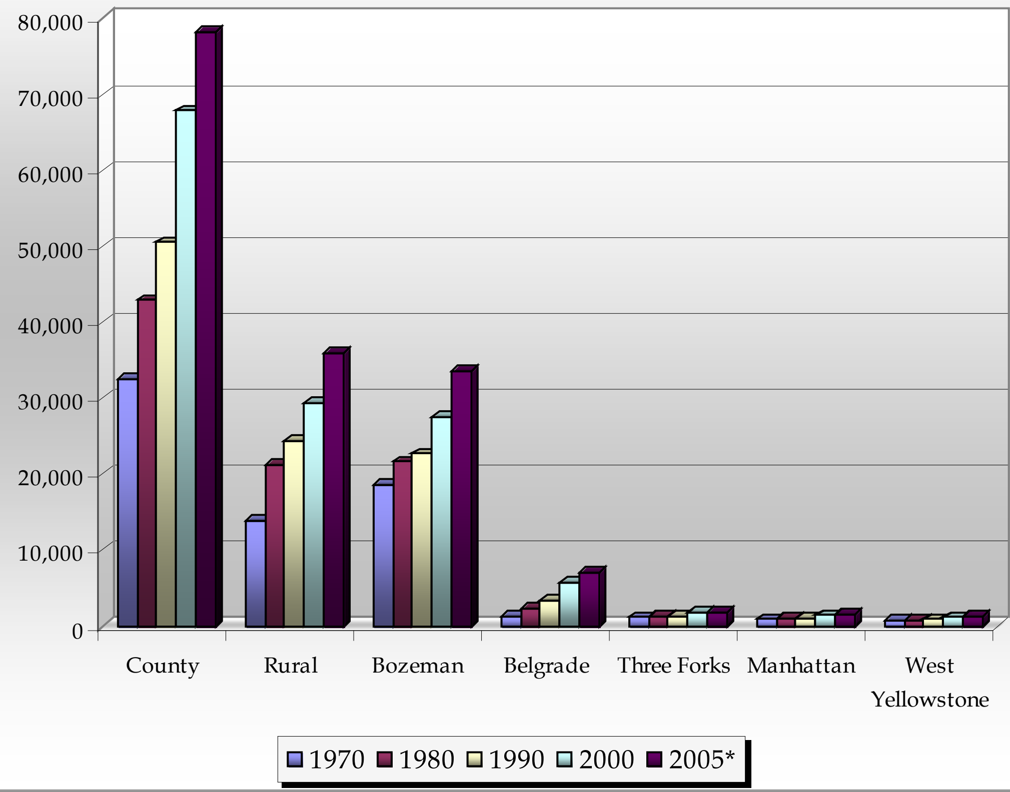
The population trends within Gallatin County in relation to the incorporated cities and the rural area are shown in **Table 3-2** and **Figure 3-2**. The incorporated cities in Gallatin County are Bozeman, Belgrade, Three Forks, Manhattan, and West Yellowstone. The population has increased significantly in each incorporated city as well as the rural areas since 1980. Bozeman has had a population increase of 44.6 percent between 1990 and 2005, while Belgrade has more than doubled in population in the same time period.

Table 3-2
Incorporated Cities in Gallatin County Historic Population Trends (1970-2005)

Year	County	Rural	Bozeman	Belgrade	Three Forks	Manhattan	West Yellowstone
1970	32,505	13,835	18,670	1,307	1,188	816	756
1980	42,865	21,220	21,645	2,336	1,247	988	735
1990	50,463	24,392	22,660	3,411	1,203	1,059	905
2000	67,831	29,371	27,509	5,728	1,728	1,396	1,177
2005*	78,262	35,943	33,535	7,033	1,845	1,465	1,223

Source: US Bureau of the Census, Census of Population
*Population data are estimates

Figure 3-2
Incorporated Cities in Gallatin County
Historic Population Trends (1970-2005)



In recent decades there were other notable changes in Gallatin County's population. In Gallatin County, and elsewhere in Montana and the nation, the population's age profile got older. Between 1970 and 2000, the number of county residents under the age of 18 increased by 5,232 persons, residents age 18 to 64 increased by 26,942 persons, and residents 65 and older increased by 3,152 persons. As "Baby Boomers" got older, they simply had fewer children than their parents. The change in age can be seen in **Table 3-3**. The percentage of each age group is shown graphically in **Figure 3-3**. From this figure, it is apparent that there has been an increase in the age group of 18-64 and a decrease in people less than 18 years of age. A more detailed age distribution for Gallatin County for the year 2000 is shown in **Figure 3-4**.

Table 3-3
Gallatin County Age Distribution (1970-2000)

Year	Age			Total
	<18	18-64	65+	
1970	9,667	20,220	2,618	32,505
1980	10,202	29,448	3,215	42,865
1990	12,263	33,709	4,491	50,463
2000	14,899	47,162	5,770	67,831
Change (1970-2000)	**5,232**	**26,942**	**3,152**	**35,326**

Source: US Bureau of the Census, Census of Population

Figure 3-3
Gallatin County Age Distribution (1970-2000)

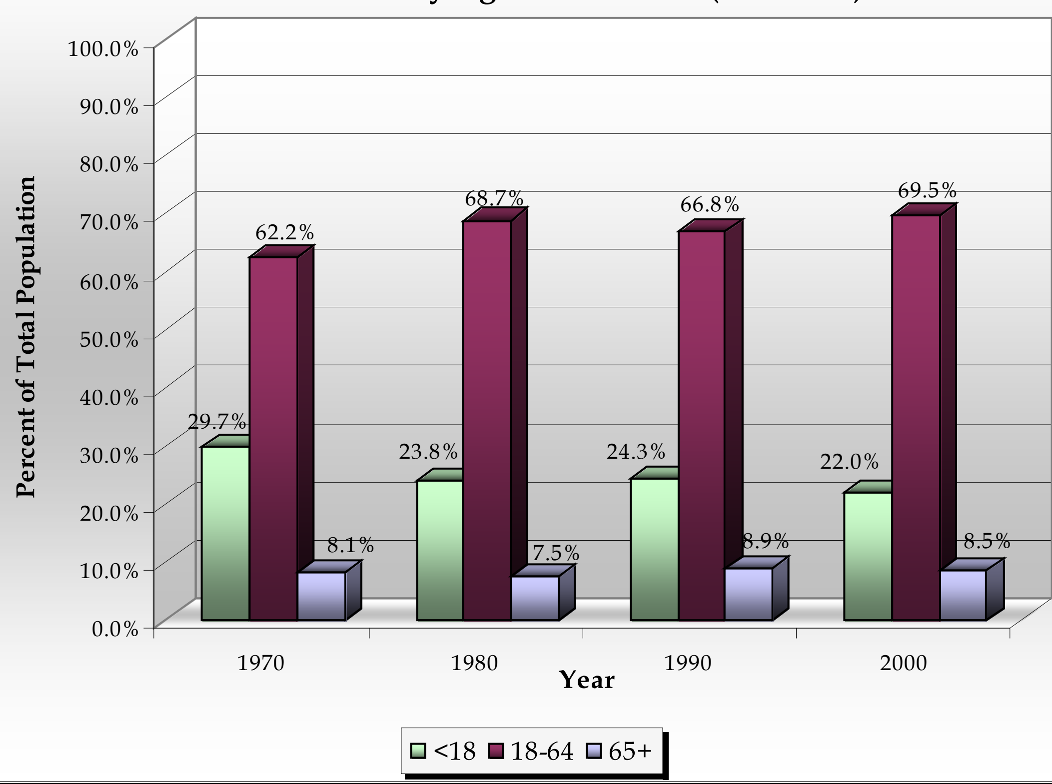
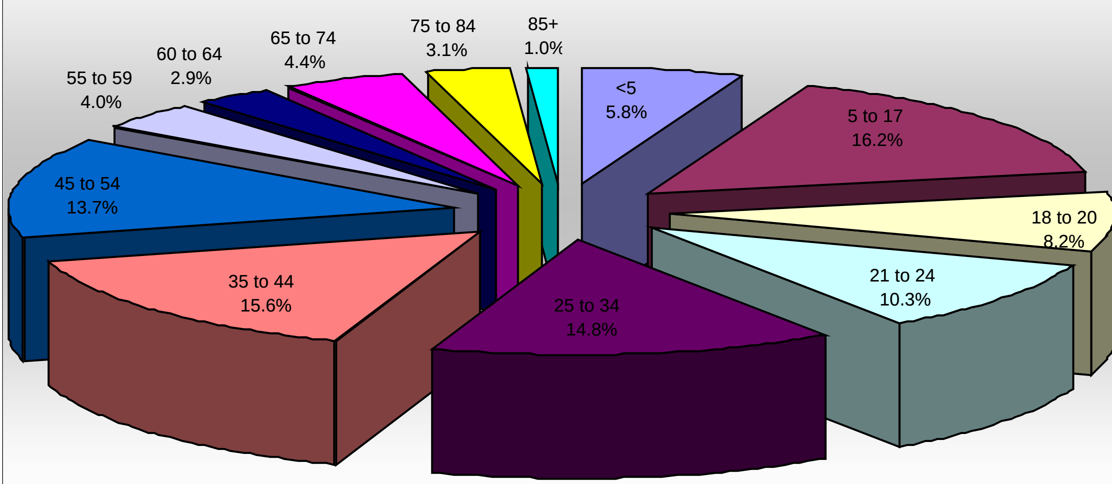


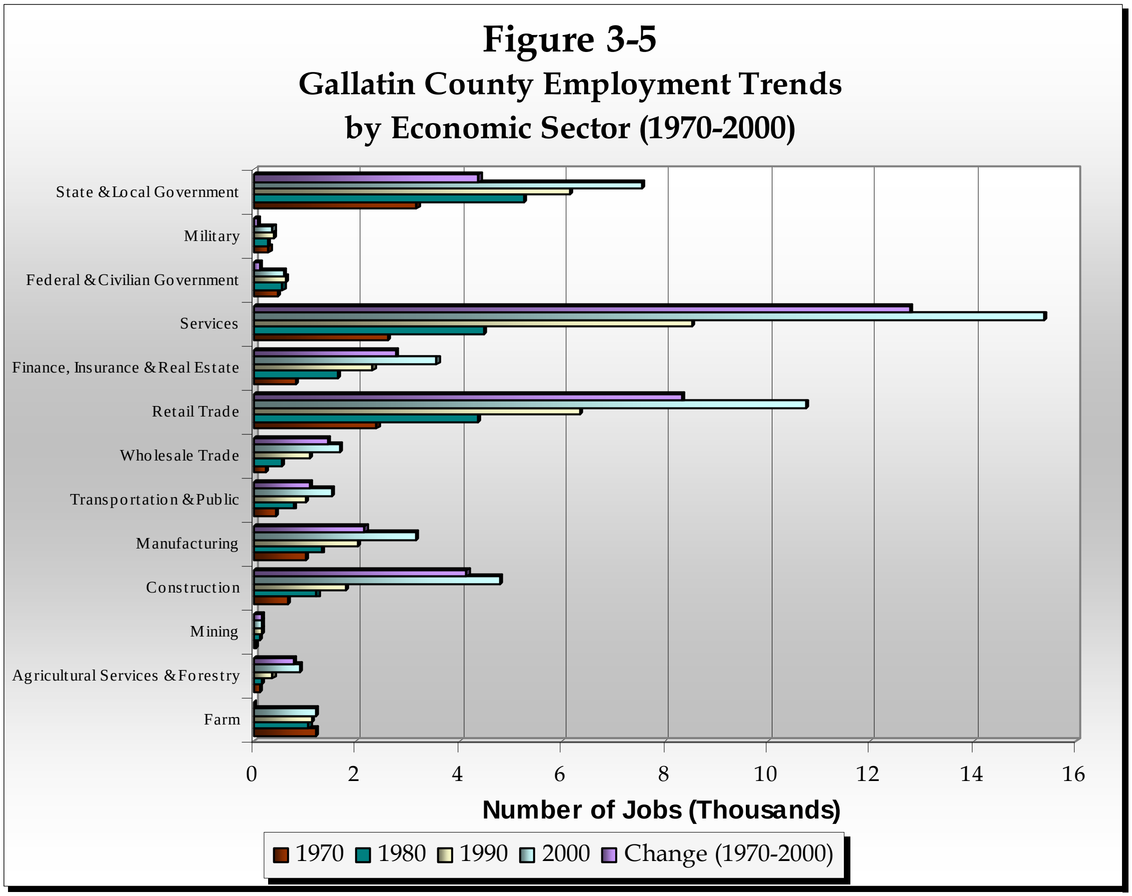
Figure 3-4
Gallatin County Age Distribution (2000)



In 2000, there were 51,586 jobs in Gallatin County. This number is almost four times the amount of 13,396 jobs that existed in 1970. Every sector has seen an increase in jobs since 1970 except for farming. **Table 3-4** displays countywide employment by economic sector from 1970 through 2000. This information is shown graphically in **Figure 3-5**.

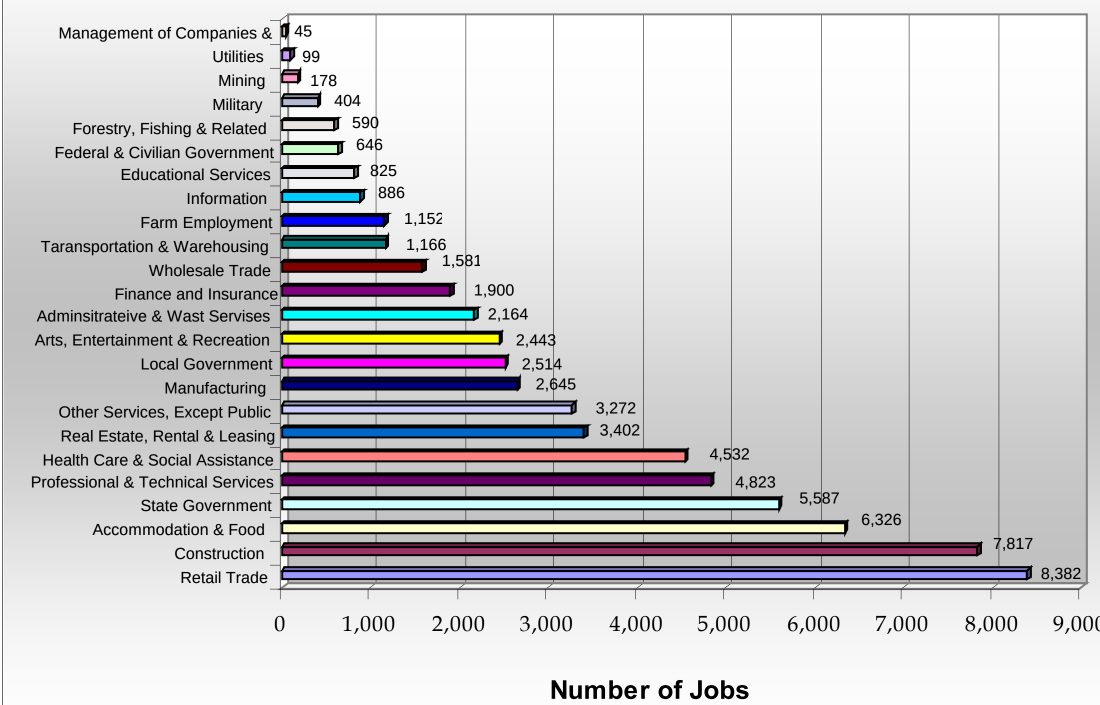
Table 3-4
Gallatin County Employment Trends by Economic Sector (1970-2000)

Economic Sector	1970	1980	1990	2000	Change (1970-2000)
Farm	1,212	1,075	1,128	1,193	-19
Agricultural Services & Forestry	106	172	370	882	776
Mining	30	105	174	173	143
Construction	656	1,227	1,805	4,801	4,145
Manufacturing	1,002	1,328	2,030	3,164	2,162
Transportation & Public Utilities	420	772	1,025	1,519	1,099
Wholesale Trade	247	555	1,101	1,692	1,445
Retail Trade	2,394	4,355	6,334	10,733	8,339
Finance, Insurance & Real Estate	812	1,622	2,315	3,562	2,750
Services	2,598	4,491	8,527	15,360	12,762
Federal & Civilian Government	454	567	610	580	126
Military	293	279	404	374	81
State & Local Government	3,172	5,249	6,155	7,553	4,381
Total Employment	**13,396**	**21,797**	**31,978**	**51,586**	**38,190**



An employment breakdown for Gallatin County in 2005 is shown in **Figure 3-6**. The employment in this graphic is broken out by economic sector based on classification by the *North American Industry Classification System (NAICS)*. This type of classification is the standard for all employment figures after 2000. NAICS classification is a more detailed approach to show employment figures than the economic sector approach. The highest employment sector for Gallatin County based on NAICS is retail. Construction is close behind retail for the second highest employment sector, followed by accommodation and food services.

Figure 3-6
Gallatin County Employment Trends by NAICS (2005)



The economic trend data presented in **Figure 3-5** and **Figure 3-6** is not surprising, given the amount of growth in Gallatin County. There has been a large increase in the amount of part-time jobs, many of which are in the retail and food service industry. The increase in population to Gallatin County has also sparked a large increase in construction and real estate related jobs. The increase in the number of jobs in technical and high end jobs can be partially attributed to an increase in the number of people with college educations. With MSU being located in Bozeman, there are a large number of college graduates that elect to stay in the Bozeman area after they graduate. The fundamental importance of understanding economic trends is that eventually, the numbers and types of jobs correlate to vehicle travel on our transportation system.

3.3 POPULATION AND EMPLOYMENT PROJECTIONS

Population and economic projections are used to predict future travel patterns, and to analyze the potential performance capabilities of the Bozeman area transportation system. Projections of the study area's future population and employment are developed from Gallatin County trends (regression line projections), ongoing Growth Policy discussions, and estimates presented by *Woods and Poole Economics, Inc.* Three projection scenarios are provided through the year 2030 (the planning horizon) and are discussed below.

The first scenario that is presented is referred to as the "Moderate Growth" scenario. This is the scenario that is most likely to occur, based on past trends and what has happened in other Montana community's over the past thirty years. This scenario was selected as the basis for the transportation modeling. It represents a continuation of the current population and growth trends already observed as presented in **Section 3.1**, such that adequate services and infrastructure will be planned for if the current levels of development continue. It assumes that the Gallatin County population and economy will grow to the numbers specified by *Woods and Poole Economics, Inc.* If this growth rate pattern does not develop further, or is not sustained, then demand will not occur as planned for in this Transportation Plan, and projects may be delayed or avoided.

A second scenario was also developed, and is referred to as the "Low Growth" scenario. It builds from much of the population and employment trends that were realized in the 1980's, where growth was fairly flat due to many different circumstances.

Lastly, a third growth scenario, referred to as a "High Growth" situation, was developed to reflect a more aggressive growth pattern in both population and employment. This growth trend is patterned after population and employment trends that were realized between 1990 and 2005, where growth was higher than in past years. A breakdown of the population and employment projections produced in each scenario are presented in **Table 3-5** and shown graphically in **Figure 3-7** and **Figure 3-8**.

Table 3-5
Gallatin County Population and Employment Projections (2005-2030)

Year	Low Growth		Moderate Growth		High Growth	
	Population	Employment	Population	Employment	Population	Employment
2005	78,262	63,379	78,262	63,379	78,262	63,379
2010	84,935	68,277	87,406	69,680	90,727	73,474
2015	92,177	73,554	97,618	76,607	105,187	85,176
2020	100,037	79,238	109,023	84,223	121,930	98,742
2025	108,567	85,362	121,760	92,596	141,350	114,470
2030	117,824	91,959	135,986	101,802	163,863	132,702

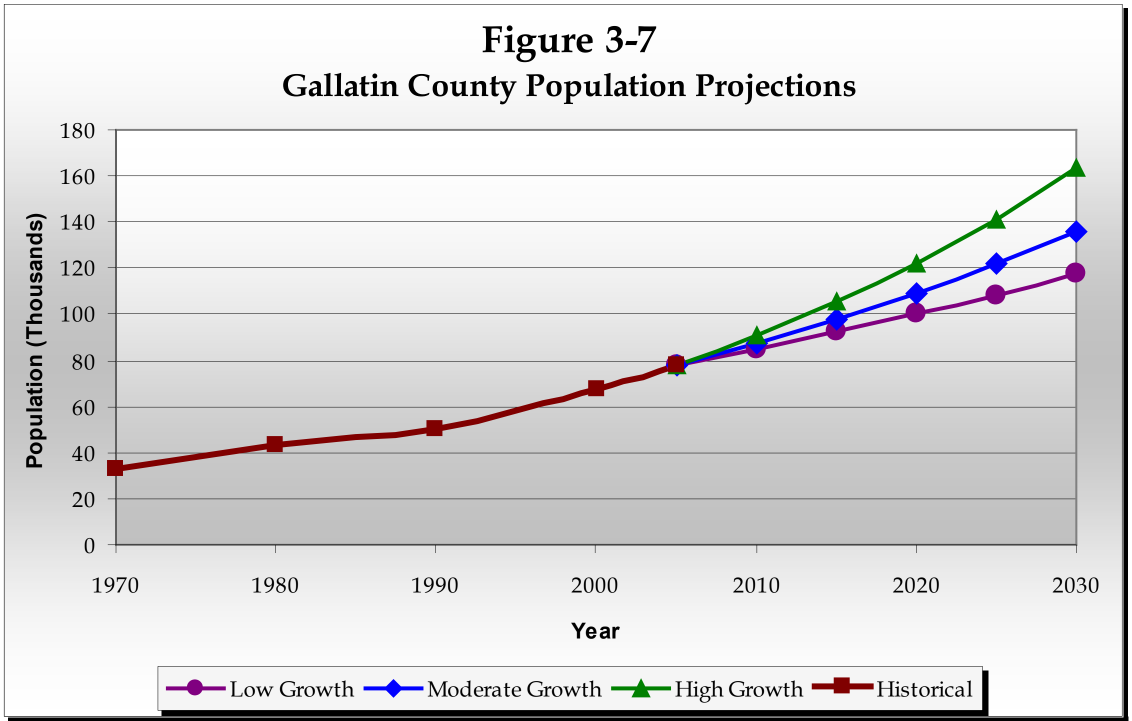


Figure 3-7
Gallatin County Population Projections
Population (Thousands)
180
160
140
120
100
80
60
40
20
0
1970
1980
1990
2000
2010
2020
2030
Year
Low Growth
Moderate Growth
High Growth
Historical

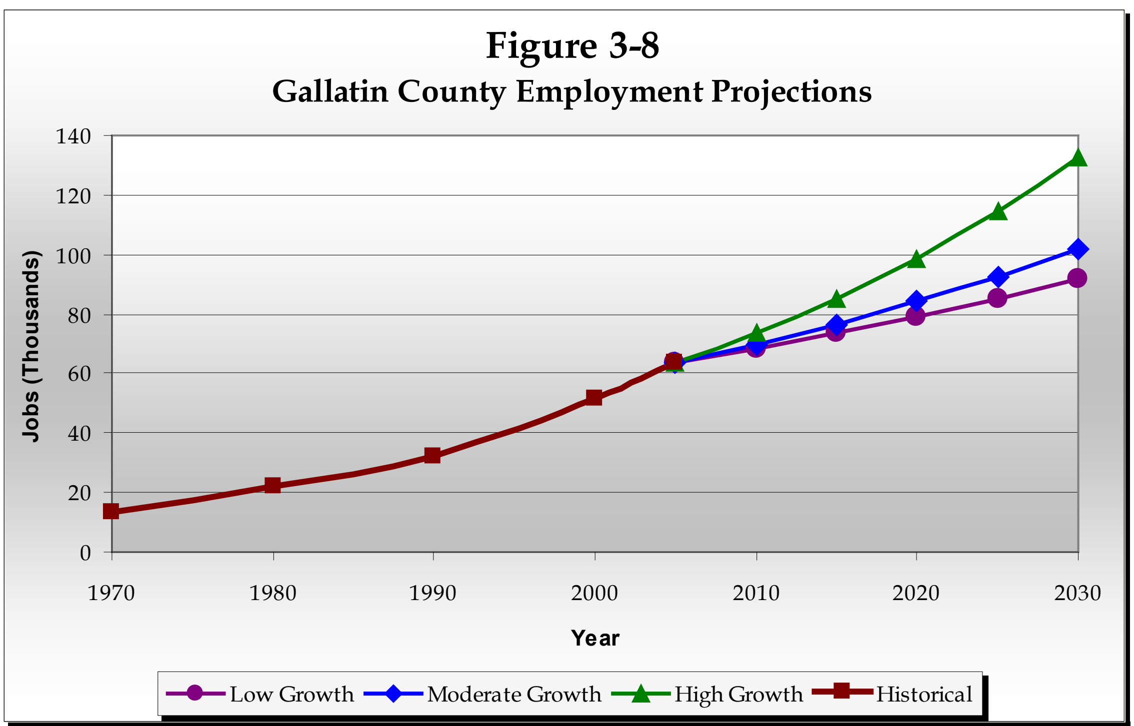


Figure 3-8
Gallatin County Employment Projections
Jobs (Thousands)
140
120
100
80
60
40
20
0
1970
1980
1990
2000
2010
2020
2030
Year
Low Growth
Moderate Growth
High Growth
Historical

3.4 FUTURE DWELLING UNITS

The number of dwelling units is a key component in the traffic model. Dwelling units distribute people throughout the network to given locations. They represent the population and act as a hub for traffic within the network. Having an accurate value for the number of people per dwelling unit helps distribute the traffic more accurately. However, it is often quite difficult to accurately represent the population through dwelling units. This is in part because the number of people per dwelling units varies based on location and can change at any time. The best that can be done is to take an average for the entire network and apply that value to the model.

In the year 2005, the population in Gallatin County was 78,262 people according to the 2005 census. The traffic model developed for the greater Bozeman area uses 32,495 dwelling units for Gallatin County. This works out to be approximately 2.41 people per dwelling unit. A recent road impact fee study for Gallatin County showed that there was expected to be 2.41 people per dwelling unit in the year 2030. The City of Bozeman Water Facility Plan shows that, "in 1990 the average number of people per dwelling unit was 2.5, while in 2000 the average number declined to 2.3 people per dwelling unit." Based on this information, an average of 2.41 people per dwelling unit was used in this plan.

It is expected that the average number of people per dwelling unit for the entire Gallatin County will be slightly higher than that of the city of Bozeman alone. It is also expected that the average number of people per dwelling unit for the study area would more accurately reflect the county wide ratio. Based on a value of 2.41 people per dwelling unit, there will be approximately 56,462 total dwelling units in the year 2030. This works out to be 23,967 additional units compared to 2005 numbers. The results up to the year 2030 can be found in **Table 3-6**. This table represents the estimated projected dwelling units based on 2.41 people per dwelling unit using the previously estimated population from **Table 3-5**.

Table 3-6
Gallatin County Projected Dwelling Units

Year	Population	Dwelling Units*	
		Total	Additional
2005	78,262	32,495	0
2010	87,406	36,291	3,797
2015	97,618	40,531	8,037
2020	109,023	45,267	12,772
2025	121,760	50,555	18,061
2030	135,986	56,462	23,967

*Dwelling unit projection based on 2.41 people per dwelling unit

3.5 Future Employment

Employment numbers are used in the traffic model to help distribute vehicle traffic as accurately as possible. Places with high levels of employment will tend to generate high levels of vehicle traffic. The traffic generated is based in part on the employment type: either retail or non-retail jobs. Non-retail jobs consist of all types of jobs broken out by the NAICS classifications shown in **Figure 3-5** excluding "retail trade."

The "Moderate Growth" scenario presented in **Table 3-5** shows an estimated 101,802 total jobs available in the year 2030. This works out to be 38,423 new jobs between 2005 and 2030. Of the 38,423 new jobs in the year 2030, 12,203 (or 32%) are expected to be retail and 26,220 (or 68%) are expected to be non-retail. A summary of the number of projected additional employment can be found in **Table 3-7** below.

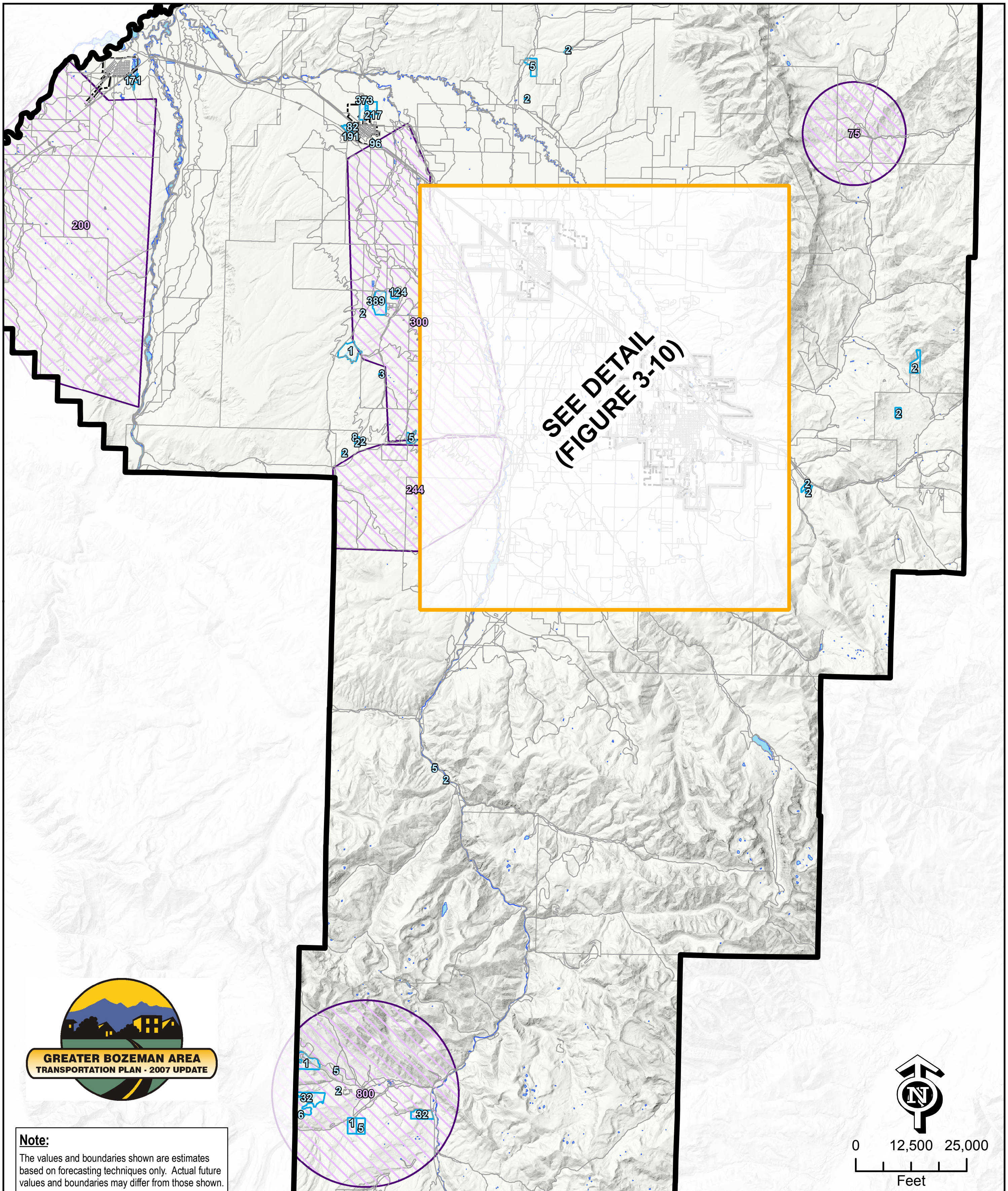
Table 3-7
Gallatin County Projected Additional Employment

Year	Jobs		
	Retail	Non-Retail	Total
2005	0	0	0
2010	2,001	4,300	6,301
2015	4,201	9,027	13,228
2020	6,620	14,224	20,844
2025	9,279	19,938	29,217
2030	12,203	26,220	38,423

3.6 Allocation of Growth

Montana Department of Transportation's modeling of future traveling patterns out to the year 2030 planning horizon required identification of future socioeconomic characteristics within each census tract and census block. County population and employment projections were translated to predictions of increases in housing and employment within Gallatin County. To accomplish this task, a "Land Use Advisory Committee" (LUAC) was formed to discuss and reach consensus on the distribution of future housing and employment growth in the planning area. The committee's membership was comprised of staff from public agencies and utilities familiar with ongoing development trends in Gallatin County. A LUAC meeting was held on August 20th, 2007 to discuss the future development in the planning area.

The committee's work considered recent land use trends, land availability and development capabilities, land use regulations, planned public improvements, and known development proposals. It also included a review of the previous land use assumptions associated with the Belgrade Interchange. **Figures 3-9** and **3-10** show where potential dwelling units are expected to be developed up to the year 2030 in Gallatin County. **Figures 3-11** thru **3-13** show the projected employment values throughout Gallatin County for the year 2030.



Note:
The values and boundaries shown are estimates based on forecasting techniques only. Actual future values and boundaries may differ from those shown.

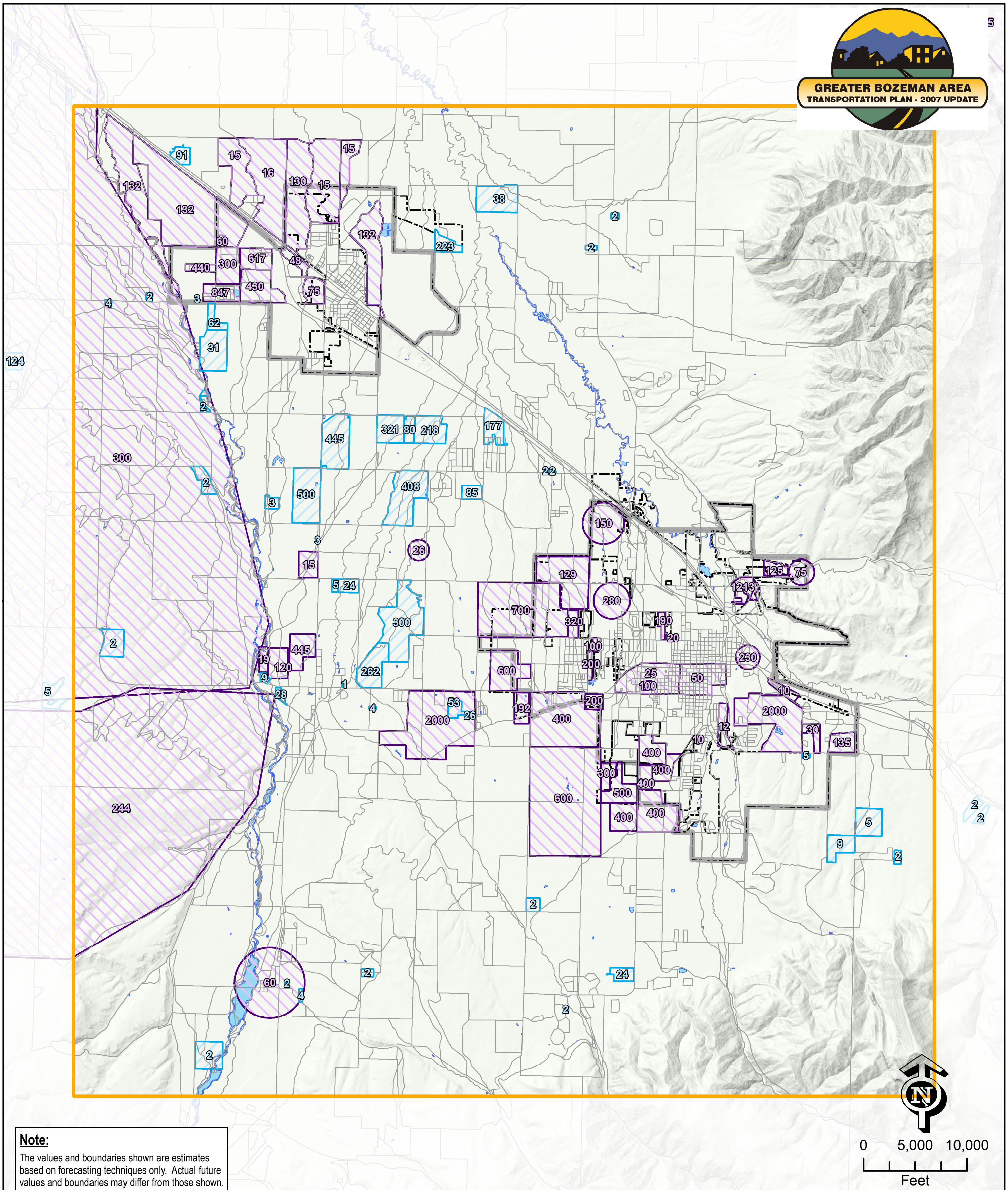
Legend

86	Currently Proposed Additional Dwelling Units (as of 10/07)
100	Additional Forecasted Residential Dwelling Units
	Census Block
	County Boundary
	Detail Area
	City Boundary
	Urban Boundary

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Gallatin County Additional Future (2030) Dwelling Units
Figure 3-9



Note:
The values and boundaries shown are estimates based on forecasting techniques only. Actual future values and boundaries may differ from those shown.

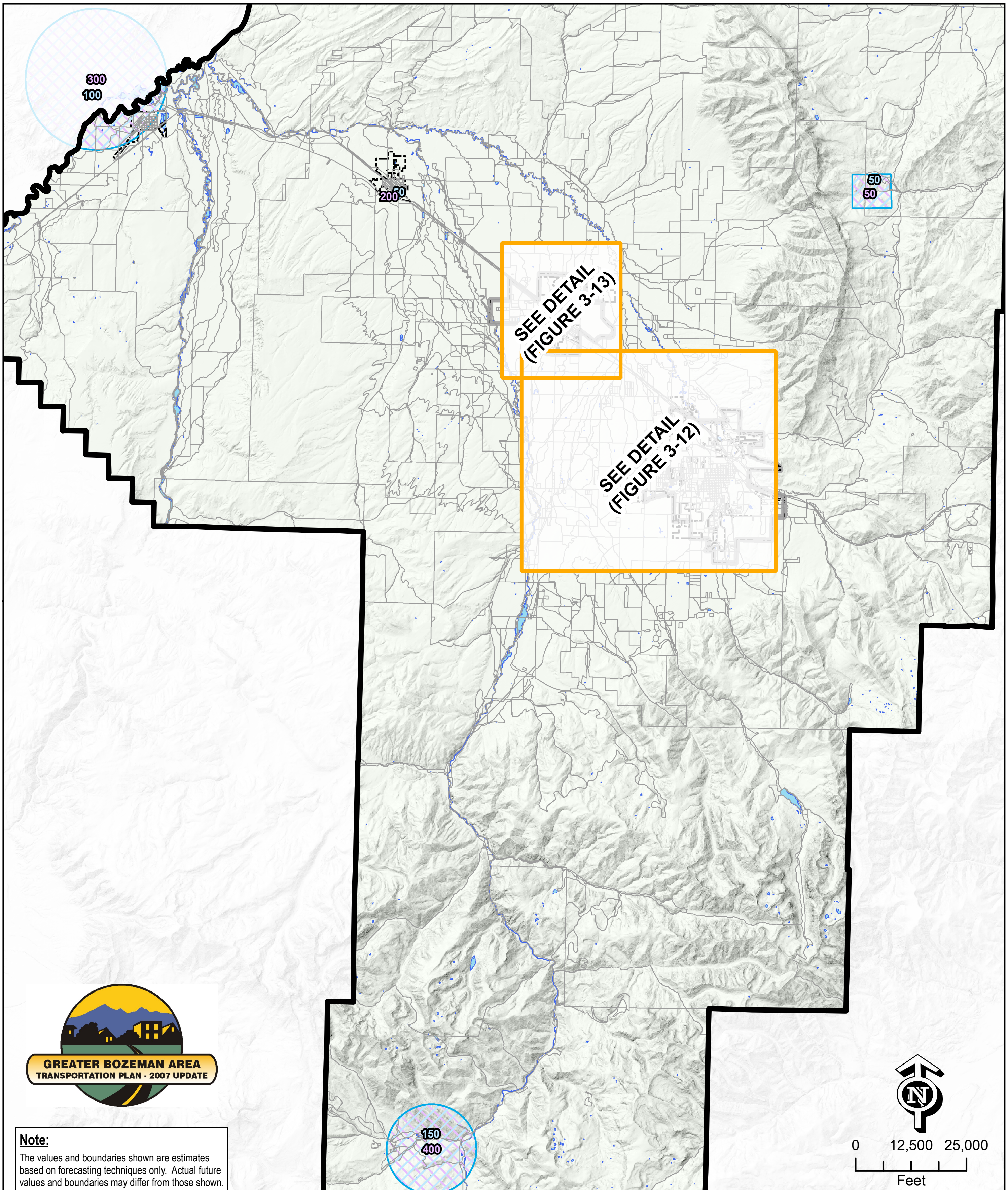
Legend

- 86 — Currently Proposed Additional Dwelling Units (as of 10/07)
- 100 — Additional Forecasted Residential Dwelling Units
- Census Block
- County Boundary
- Detail Area
- City Boundary
- Urban Boundary

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Gallatin County Additional Future (2030) Dwelling Units
Figure 3-10



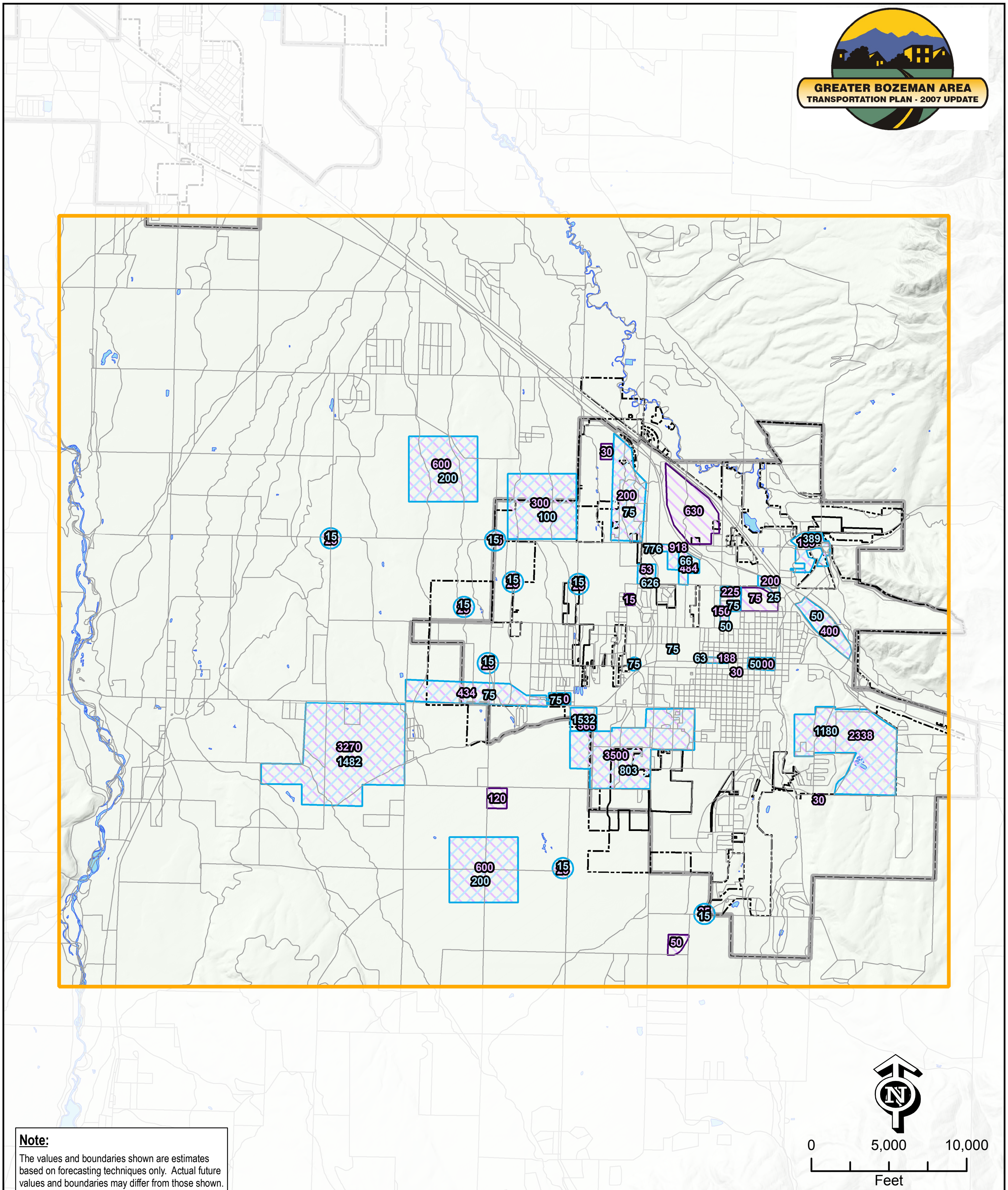
Note:
The values and boundaries shown are estimates based on forecasting techniques only. Actual future values and boundaries may differ from those shown.

Legend

86 Additional Forecasted Retail Jobs	County Boundary
	Detail Area
100 Additional Forecasted Non-Retail Jobs	City Boundary
Census Block	Urban Boundary

Greater Bozeman Area Transportation Plan (2007 Update)

Gallatin County Additional Future (2030) Employment
Figure 3-11



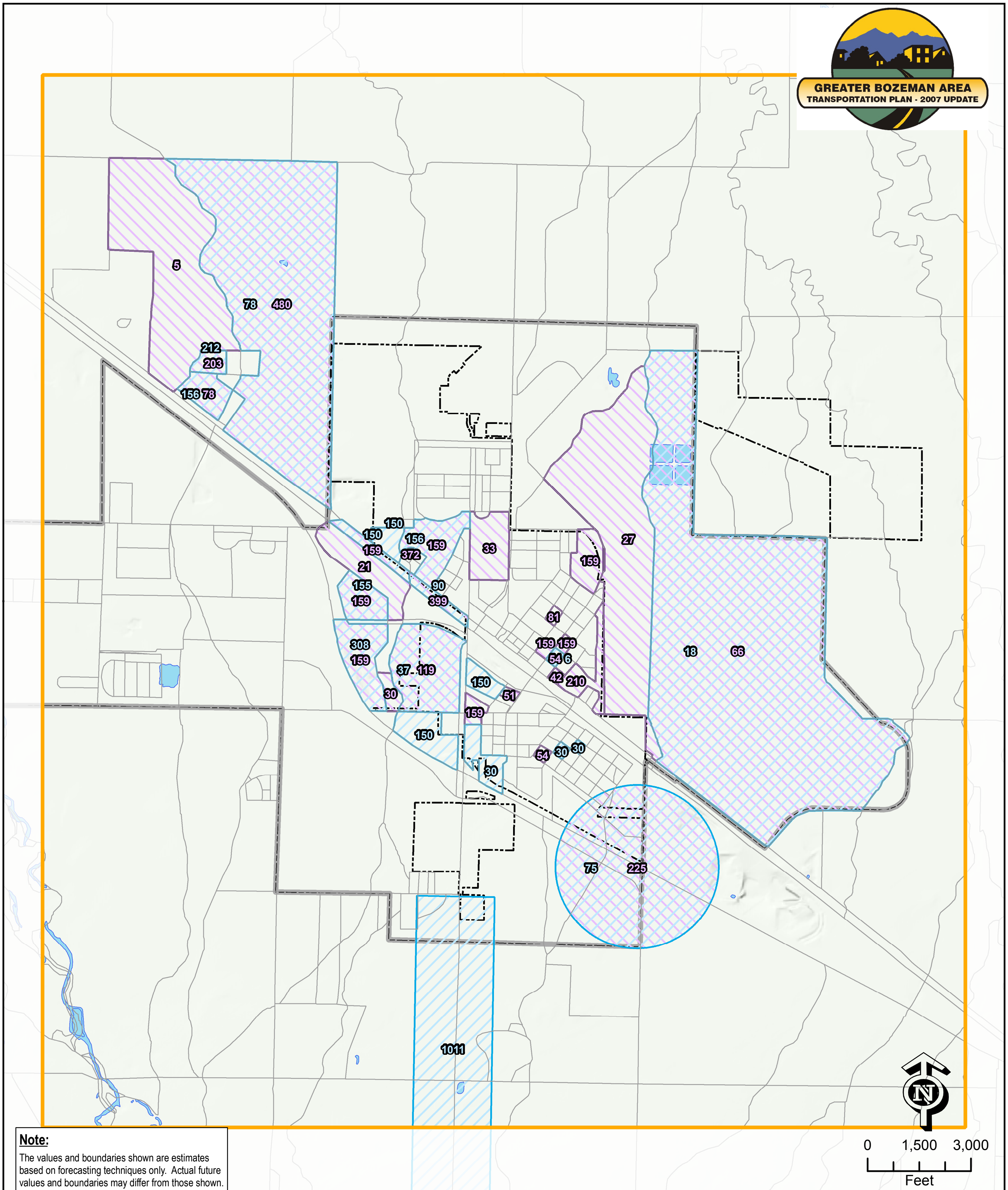
Legend

86	Additional Forecasted Retail Jobs		County Boundary
			Detail Area
100	Additional Forecasted Non-Retail Jobs		City Boundary
	Census Block		Urban Boundary

Greater Bozeman Area Transportation Plan (2007 Update)

Gallatin County Additional Future (2030) Employment

Figure 3-12



Note:
The values and boundaries shown are estimates based on forecasting techniques only. Actual future values and boundaries may differ from those shown.

Legend

86 Additional Forecasted Retail Jobs	County Boundary
100 Additional Forecasted Non-Retail Jobs	Detail Area
Census Block	City Boundary
	Urban Boundary

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Gallatin County Additional Future (2030) Employment
Figure 3-13

3.7 TRAFFIC MODEL DEVELOPMENT

All of the characteristics of the various areas of the greater Bozeman area combine to create the traffic patterns present in the community today. To build a model to represent this condition, the population information was collected from the 2000 census, and employment information was gathered from the Montana Department of Labor and Industry, second quarter of 2006, and was carefully scrutinized by local agency planners and MDT modeling staff.

The roadway network / centerline information was provided by the Gallatin County GIS office. This information was supplemented by input from staff at the City of Bozeman, Gallatin County, and the Montana Department of Transportation who have substantial local knowledge and were able to increase the accuracy of the base model.

The GIS files, population census information, and employment information are readily available. The *TransCAD* software is designed to use this information as input data. *TransCAD* has been developed by the Caliper Corporation of Newton, Massachusetts, and version 4.0 was used as the transportation modeling software for this project. *TransCAD* performs a normal modeling process of generating, distributing and assigning traffic in order to generate traffic volumes. These traffic volumes are then compared to actual ground counts and adjustments are made to "calibrate", or ensure the accuracy of, the model. This is further explained below:

> **Trip Generation** - Trip Generation consists of applying nationally developed trip rates to land use quantities by the type of land use in the area. The trip generation step actually consists of two individual steps: trip production and trip attraction. Trip production and trip attraction helps to "explain" why the trip is made. Trip production is based on relating trips to various household characteristics. Trip attraction considers activities that might attract trip makers, such as offices, shopping centers, schools, hospitals and other households. The number of productions and attractions in the area is determined and is then used in the distribution phase.
>
> **Trip Distribution** - Trip distribution is the process in which a trip from one area is connected with a trip from another area. These trips are referred to as trip exchanges.
>
> **Mode Split** - Mode choice is the process by which the amount of travel will be made by each available mode of transportation. There are two major types: automobile and transit. The automobile mode is generally split into drive alone and shared ride modes. For the Bozeman travel demand model, there were no "mode split" assignments (i.e. all trips are assumed to be automobile mode).
>
> **Trip Assignment** - Once the trip distribution element is completed, the trip assignment tags those trips to the Major Street Network (MSN). The variable that influence this are travel time, length, and capacity.

Due to the inherent characteristics of a traffic model, it is easy to add a road segment, or "link", where none exists now or widen an existing road and see what affect these changes will have on the transportation system. Additional housing and employment centers can be added to the system to model future conditions, and moved to different parts of the model area to see what affect different growth scenarios have on the transportation system. Thus the land use changes anticipated between now and 2030 can be added to the transportation system, and the needed additions to the transportation system can then be identified. Additionally, different scenarios for how the Greater Bozeman area may grow between now and 2030 can be examined to determine the need for additional infrastructure depending upon which one most accurately represents actual growth.

Also necessary in the development of a transportation model is the establishment of the modeling area. The modeling area is, by necessity, much larger than the Study Area. Traffic generated from outlying communities or areas contributes to the traffic load within the Study Area, and is therefore important to the accuracy of the model. Additionally, it is desirable to have a large model area for use in future projects.

The future year model was developed specifically for the year 2030 planning horizon. The 2030 model is used in this document to evaluate future traffic volumes, since 2030 is the horizon year for this document. The information contained earlier in this Chapter was used to determine the additions and changes to the traffic volumes in 2030.

The modeling area was subdivided by using census tracts and census blocks, as previously described in this chapter. Census blocks are typically small in the downtown and existing neighborhood areas, and grow geographically larger in the less densely developed areas. The census blocks & census tracts were used to divide the population and employment growth that is anticipated to occur between now and 2030.

Built into the traffic model are assumptions about traffic characteristics. The model assumes that traffic characteristics in the future will be similar to those seen today. Changing factors such as fuel costs, technological advances, and other unknown issues may affect the amount and type of traffic on the road network in the future. The model also assumes that the socio-economic information contained earlier in this chapter will be realized in the year 2030. While this may be a conservative assumption, it does give an indication of potential problem areas within the transportation system that may need to be addressed in the future. The future 2030 model is a useful planning tool to help predict how traffic might behave in the future.

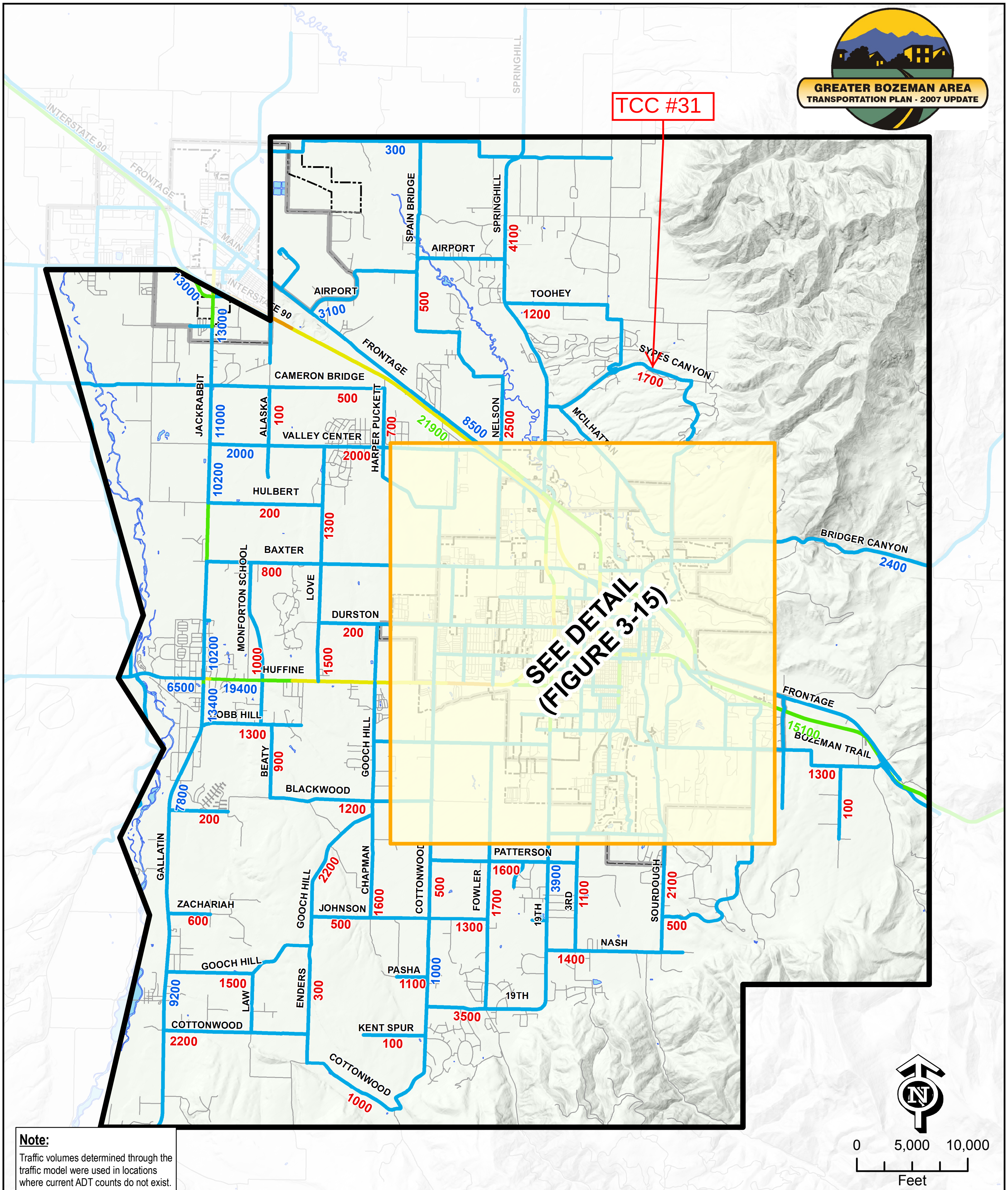
3.8 TRAFFIC VOLUME PROJECTIONS

The traffic model was used to produce traffic forecasts for the planning horizon year of 2030. For comparison purpose, traffic model results for the calibration year of 2005 are presented herein on **Figure 3-14** and **Figure 3-15**. Year 2030 traffic volume projections are presented in **Figure 3-16** and **Figure 3-17.** These projections indicate that the traffic volumes on some of the major corridors will increase significantly over the next 25 years.

In addition to traffic volumes, the model was used to determine volume to capacity (v/c) ratios. **Figure 3-18** and **Figure 3-19** show the v/c ratios for the calibration year of 2005; future 2030 v/c ratios are shown on **Figure 3-20** and **Figure 3-21**. A discussion of v/c ratios can be found in **Chapter 4**.

It is important to recognize that the volumes shown on **Figure 3-16** and **Figure 3-17** and v/c ratios shown on **Figure 3-20** and **Figure 3-21** are based on the "Existing plus Committed" roadway network. In other words, these are the volumes and v/c ratios if no changes to the transportation system are made other than those currently committed to. Similar graphics are presented in **Chapter 9** that show future values based on a "recommended" transportation system network.

The future E+C modeling scenario was modified to include the roadways contained in the TCC #33 change. This change is reflected in Figures 3-16,17,20 and 21.



Note:
Traffic volumes determined through the traffic model were used in locations where current ADT counts do not exist.

Legend

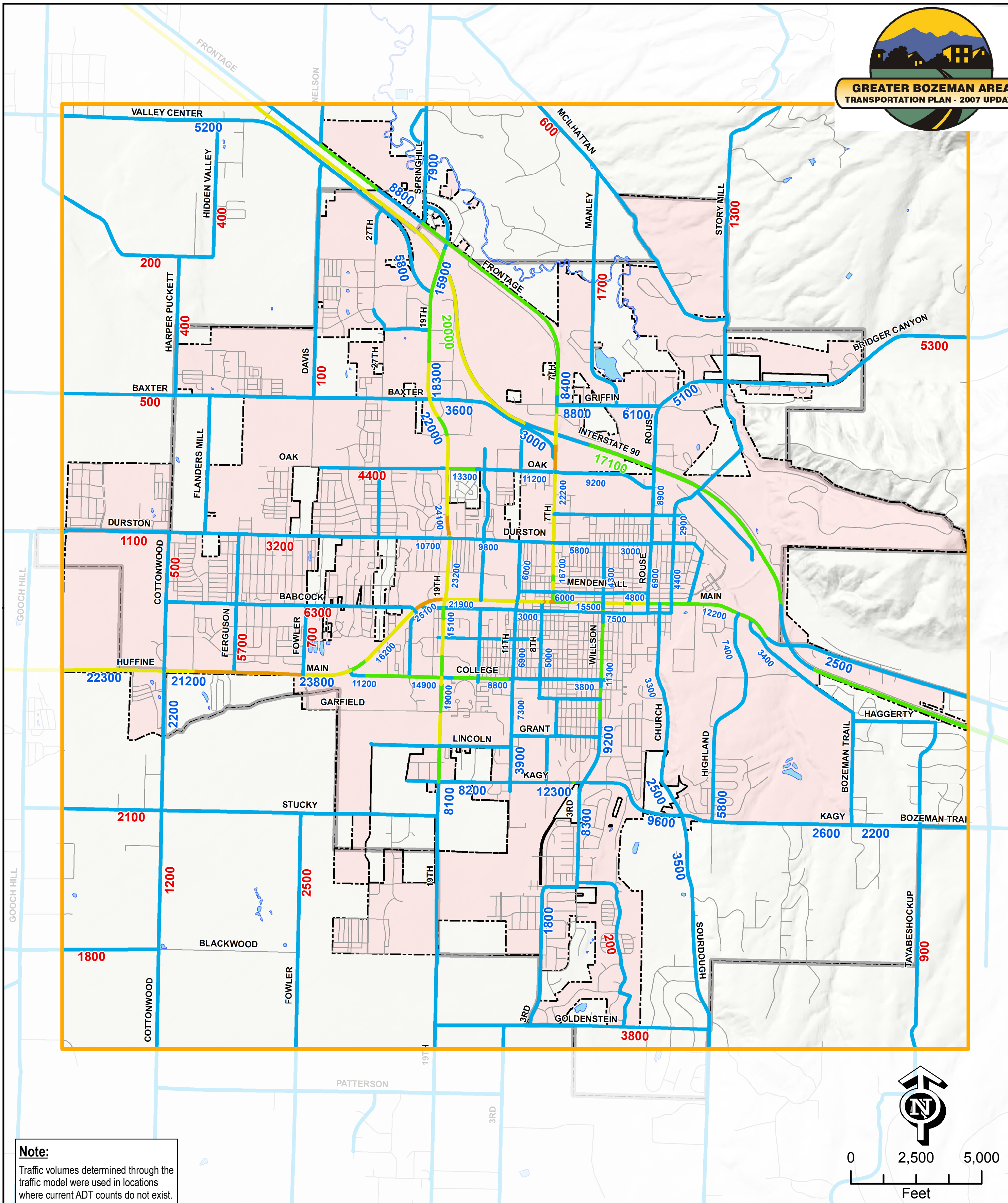
- > 12,000
- 12,000 - 18,000
- 18,000 - 24,000
- 24,000 - 35,000
- > 35,000
- 1200 2005 Average Daily Traffic (ADT)
- 1200 2004 Average Daily Traffic (ADT)
- 1200 2005 Traffic Model Volume*
- Study Area Boundary
- Detail Area
- City Boundary
- Urban Boundary

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Existing (2005) ADT Traffic Volumes

Figure 3-14



Note:
Traffic volumes determined through the traffic model were used in locations where current ADT counts do not exist.

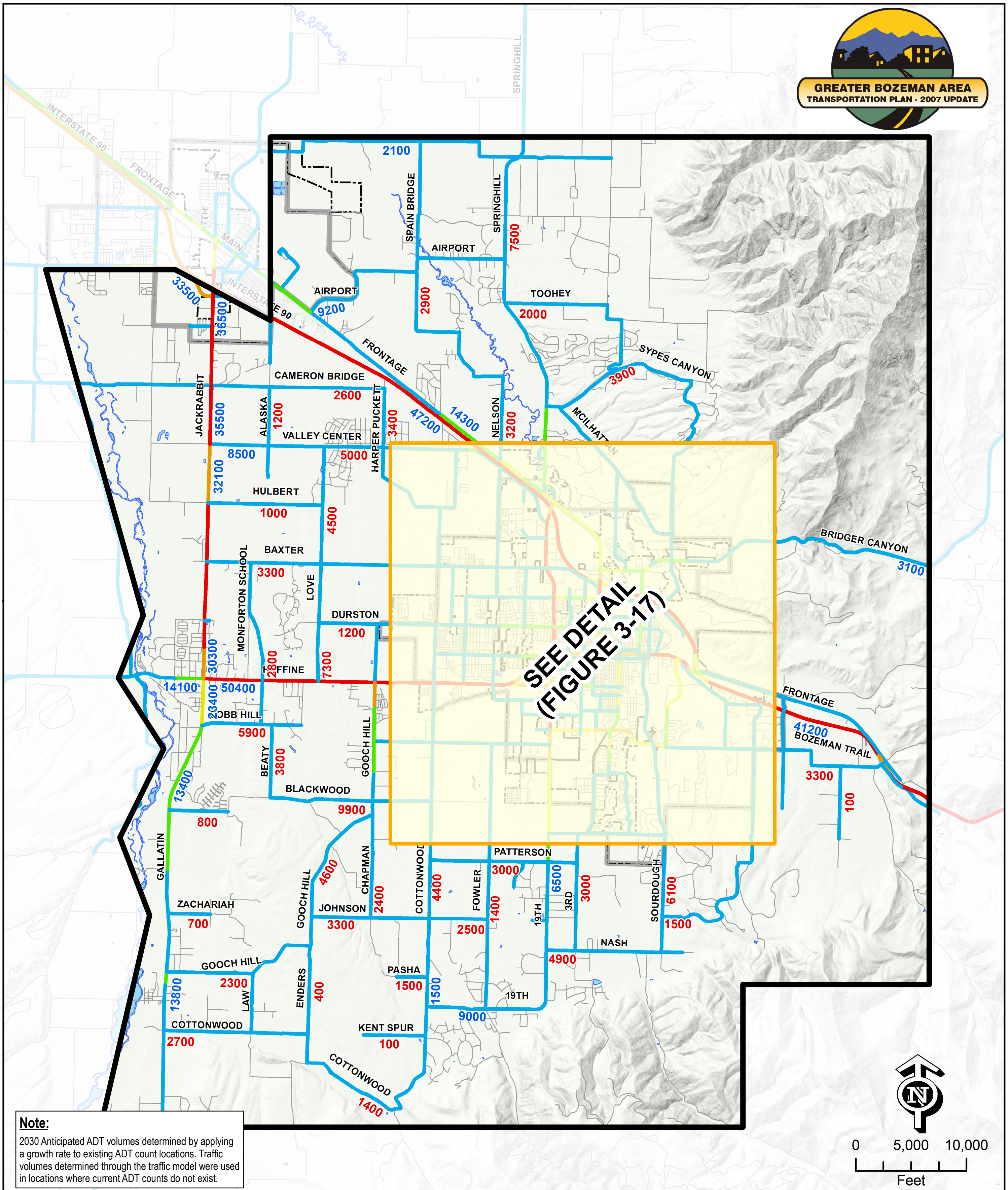
Legend

- < 12,000
- 12,000 - 18,000
- 18,000 - 24,000
- 24,000 - 35,000
- > 35,000
- Detail Area
- City Boundary
- Urban Boundary
- 1200 2005 Average Daily Traffic (ADT)
- 1200 2004 Average Daily Traffic (ADT)
- 1200 2005 Traffic Model Volume*

Greater Bozeman Area Transportation Plan (2007 Update)

Existing (2005) ADT Traffic Volumes
Figure 3-15

RPA



Note:
2030 Anticipated ADT volumes determined by applying a growth rate to existing ADT count locations. Traffic volumes determined through the traffic model were used in locations where current ADT counts do not exist.

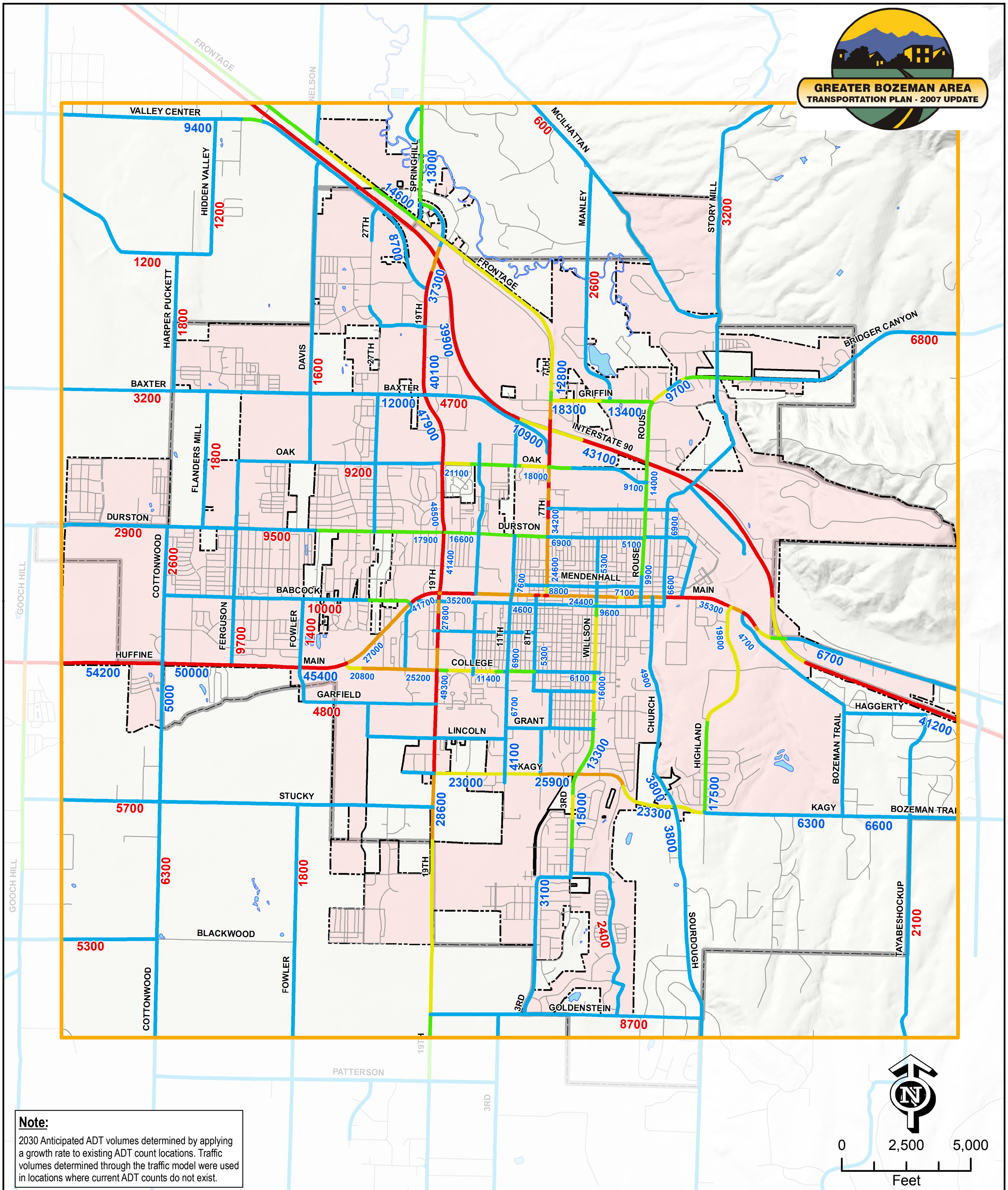
Legend

- < 12,000
- 12,000 - 18,000
- 18,000 - 24,000
- 24,000 - 35,000
- > 35,000
- 1200 2030 Anticipated Average Daily Traffic (ADT)*
- 1200 2030 Model Traffic Volume*
- Study Area Boundary
- Detail Area
- City Boundary
- Urban Boundary

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Future (2030) ADT Traffic Volumes
Figure 3-16



Note:
2030 Anticipated ADT volumes determined by applying a growth rate to existing ADT count locations. Traffic volumes determined through the traffic model were used in locations where current ADT counts do not exist.

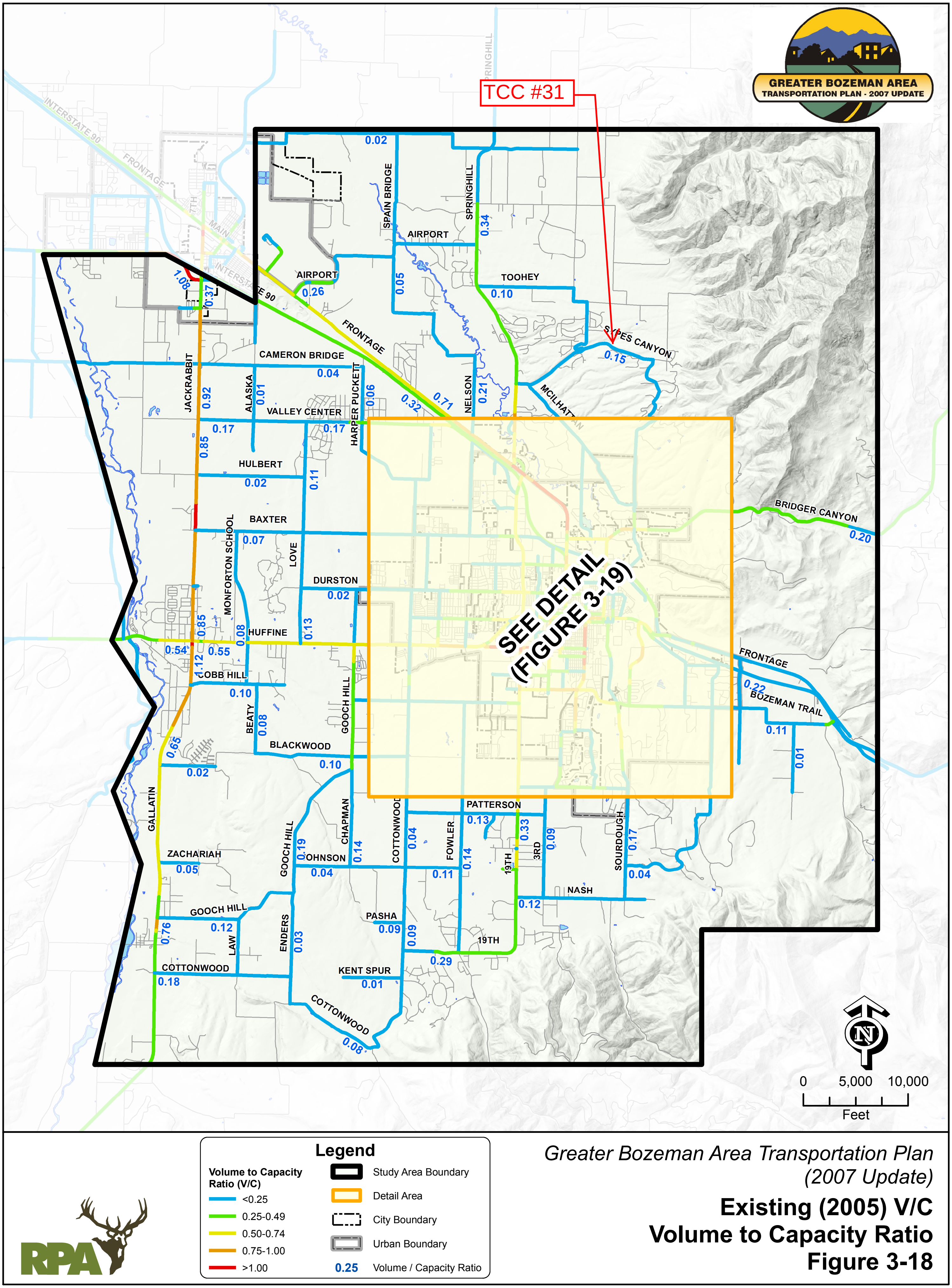
Legend

< 12,000	Detail Area
12,000 - 18,000	City Boundary
18,000 - 24,000	Urban Boundary
24,000 - 35,000	1200 2030 Anticipated Average Daily Traffic (ADT)*
> 35,000	1200 2030 Traffic Model Volume*

RPA

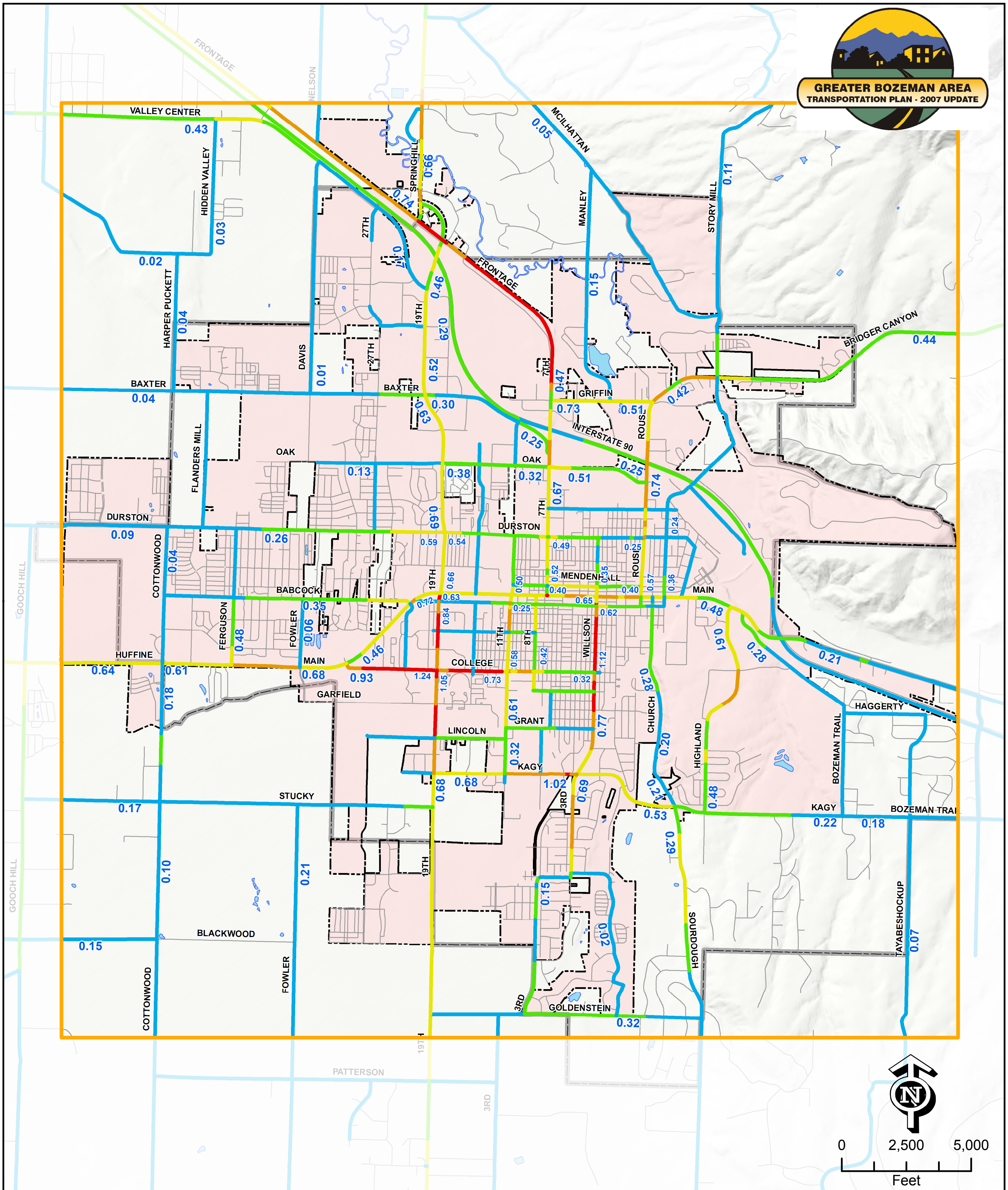
Greater Bozeman Area Transportation Plan (2007 Update)

Future (2030) ADT Traffic Volumes
Figure 3-17



Greater Bozeman Area Transportation Plan (2007 Update)

Existing (2005) V/C
Volume to Capacity Ratio
Figure 3-18



Legend

Volume to Capacity Ratio (V/C)

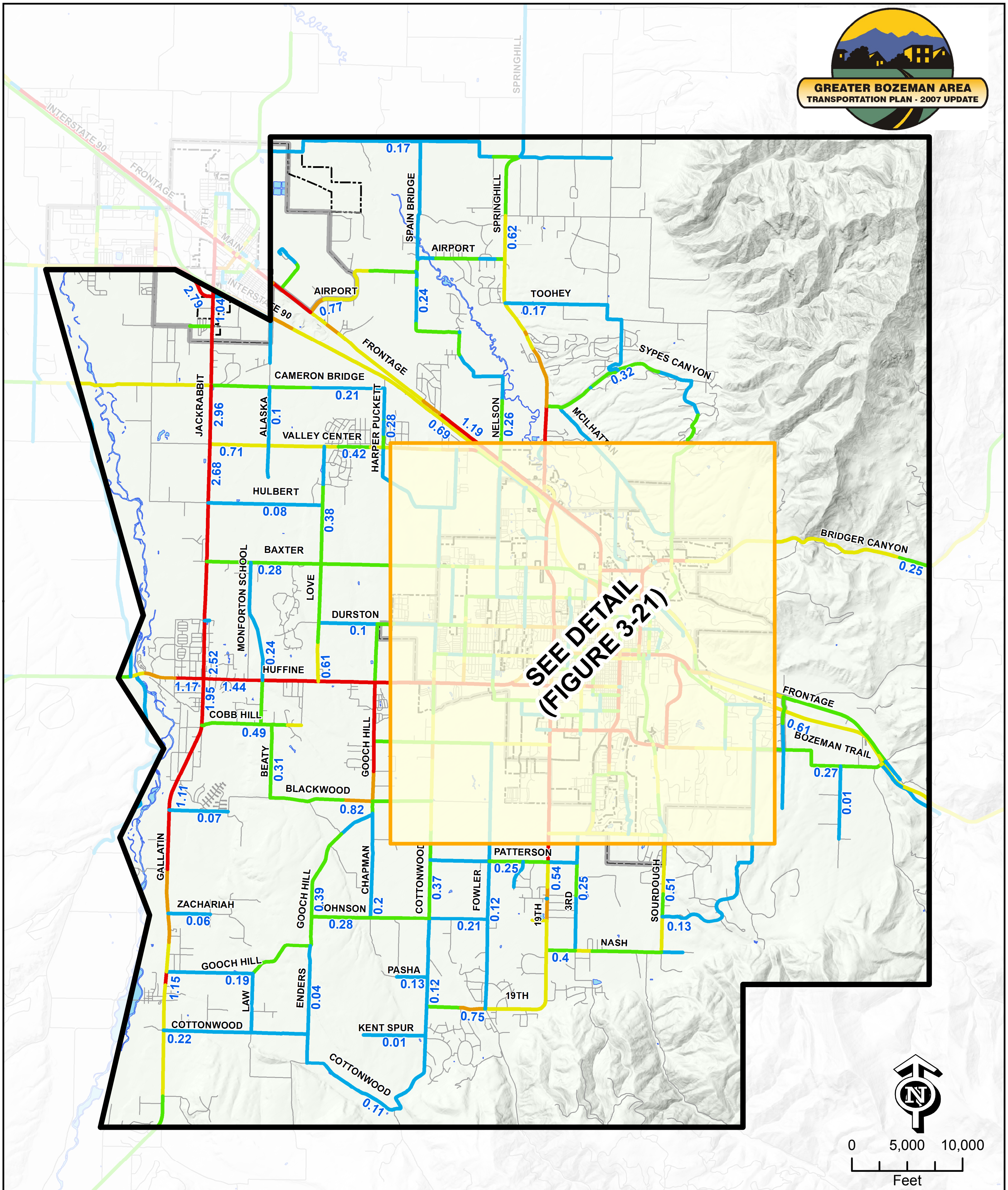
- <0.25
- 0.25-0.49
- 0.50-0.74
- 0.75-1.00
- >1.00

- Detail Area
- City Boundary
- Urban Boundary
- 0.25 Volume / Capacity Ratio

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Existing (2005) V/C
Volume to Capacity Ratio
Figure 3-19



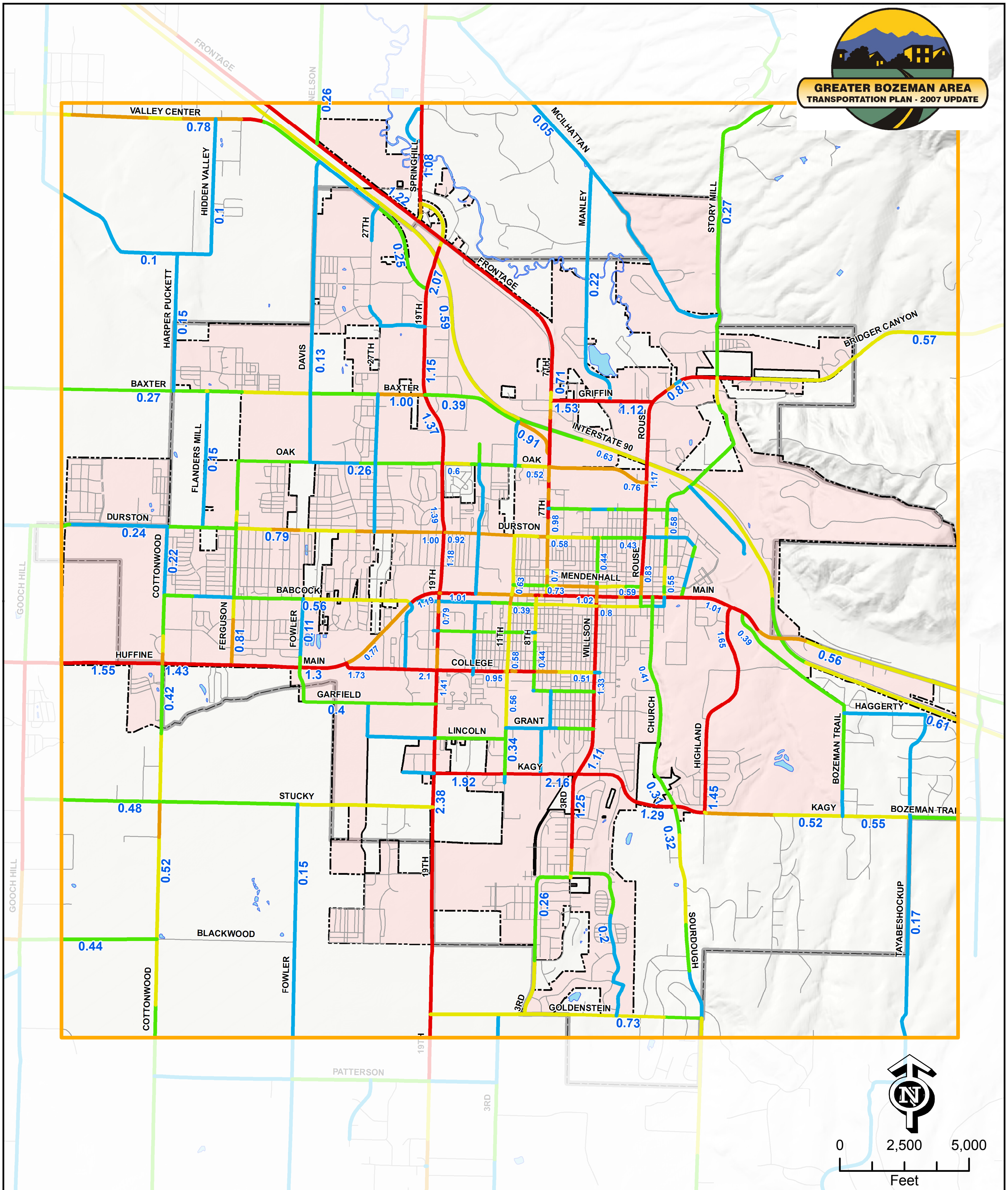
Legend

Volume to Capacity Ratio (V/C)		
<0.25		Study Area Boundary
0.25-0.49		Detail Area
0.50-0.74		City Boundary
0.75-1.00		Urban Boundary
>1.00	0.25	Volume / Capacity Ratio

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Future (2030) V/C
Volume to Capacity Ratio
Figure 3-20



Legend

Volume to Capacity Ratio (V/C)

- <0.25
- 0.25-0.49
- 0.50-0.74
- 0.75-1.00
- >1.00

- Detail Area
- City Boundary
- Urban Boundary
- 0.25 Volume / Capacity Ratio

Greater Bozeman Area Transportation Plan (2007 Update)

Future (2030) V/C
Volume to Capacity Ratio
Figure 3-21

3.9 NETWORK ALTERNATIVES TEST RUN ANALYSIS

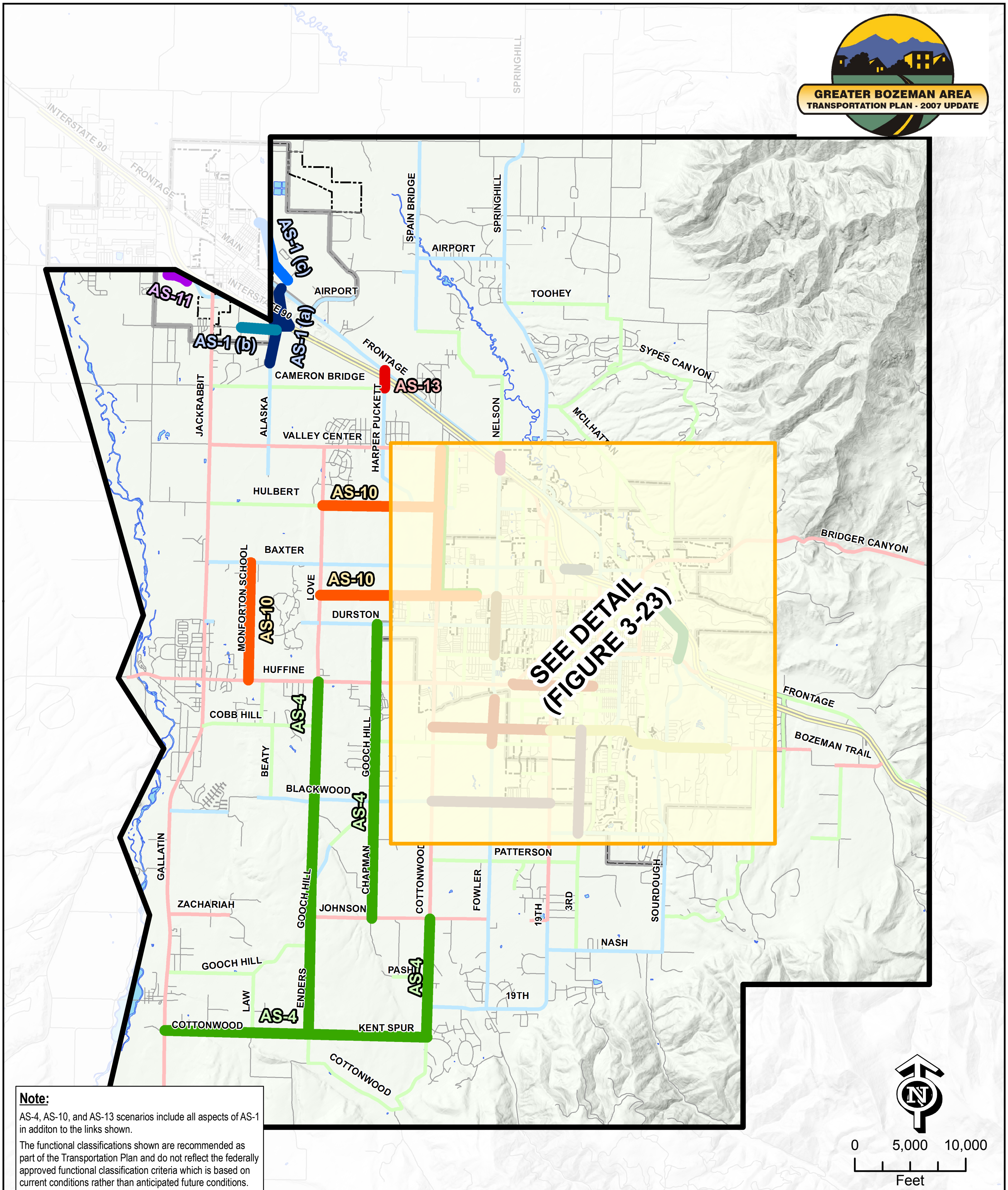
Thirteen (13) scenarios were developed for model alternative test run analysis. Each of the 13 scenarios that were developed involve roadway capacity additions in areas where transportation needs presently exist, or in areas where future investment may be needed as a result of expected population/employment growth. Most scenarios are localized, creating new links or expanding existing facilities in a particular study subarea, with investment effects impacting only a small portion of the study area network, i.e., larger system-wide impacts would not be expected. Because all scenarios involve roadway capacity additions, with the exception of *Alternative Scenario (AS-3) – Access Management*, scenario analysis is focused on how traffic volume and travel times are shifted on key facilities throughout the area of investment (i.e., no multimodal, land use, or other demand management investment options to reduce the number of trips or traffic volume were directly modeled).

The alternatives presented in this section are for modeling purposes only and do not represent actual project recommendations at this time. The analysis of these alternatives was made to give a theoretical idea of how certain network modifications made to the transportation system affect the overall network and surrounding area. Should projects arise in the future along these corridors, design alternatives to those discussed in this section will need to be analyzed to determine the appropriate configuration of the roadways.

To complete the scenario analysis, the 2030 Existing plus Committed (E+C) network was compared to 2030 scenario results for each alternative. The 2030 E+C model run consisted of the 2005 base travel model network with the addition of one committed project, a widening on South 19th street, and 2030 socio-economic projections. For each of the 13 alternatives, link-level model output (in GIS format) generated by MDT for the entire model domain was clipped to the Bozeman study area only. Individual links on key roadways were then selected and extracted into a new GIS layer to focus analysis; this was done for each of the 13 scenarios individually. Corresponding link-level data was grouped by roadway facility, and converted to *Excel* platform for calculation of performance measures which included:

- Link-level percent-difference in AADT between 2030 E+C and 2030 Scenario,
- Link-level percent-difference travel time between 2030 E+C and 2030 Scenario,
- Average AADT by roadway facility,
- Average travel time by roadway facility,
- Volume-weighted percent-difference AADT by roadway facility, and
- Volume-weighted percent-difference travel time by roadway facility.

Percent AADT and travel time differences were first calculated for each roadway link, weighted by link traffic volume, and averaged over the length of the roadway. For models as large as the Bozeman travel model being used for the plan update, fluctuations in traffic conditions are often seen at a very refined (link) level with oscillations between positive and negative increases occurring over a small area. In order to normalize this effect and get a sense for overall performance at the facility level, percentage differences were weighted by traffic volume (to provide greater weight to links with the greatest volume and least weight to links with the least volume) and averaged over the facility.



Note:

AS-4, AS-10, and AS-13 scenarios include all aspects of AS-1 in additon to the links shown.

The functional classifications shown are recommended as part of the Transportation Plan and do not reflect the federally approved functional classification criteria which is based on current conditions rather than anticipated future conditions.

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Alternative Scenario*
- Study Area Boundary
- Detail Area
- City Boundary
- Urban Boundary

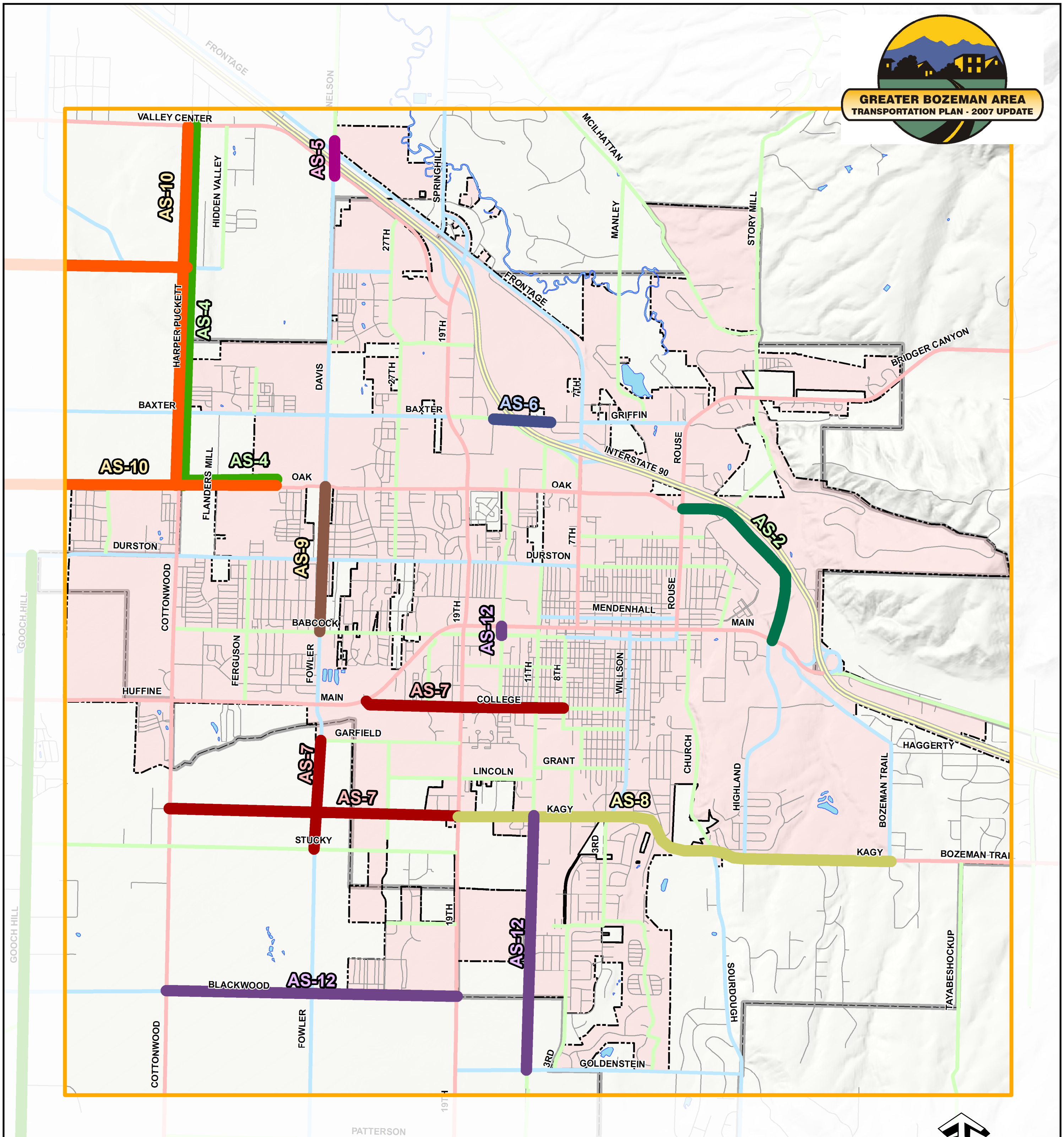
*The colors shown are for designation of modeling alternatives and do not represent any sort of classification.

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Travel Demand Model Alternative Scenarios

Figure 3-22



Note:

AS-4, AS-10, and AS-13 scenarios include all aspects of AS-1 in additon to the links shown.

The functional classifications shown are recommended as part of the Transportation Plan and do not reflect the federally approved functional classification criteria which is based on current conditions rather than anticipated future conditions.

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Detail Area
- City Boundary
- Urban Boundary
- Alternative Scenario*

*The colors shown are for designation of modeling alternatives and do not represent any sort of classification.

RPA

Greater Bozeman Area Transportation Plan (2007 Update)

Travel Demand Model Alternative Scenarios

Figure 3-23

Alternative Scenario 1 – East Belgrade Interchange

The northwest portion of the Bozeman study area shows the highest expected growth in population by 2030, in particular towards Belgrade. Between 2005 and 2030, the north-south principal arterials Jackrabbit and Love both show greater than 200% increase in traffic volume, with east-west facilities between Cameron Bridge and Huffine also showing greater than 200% increase. I-90 west shows a greater than 50% increase in volume closer to the city, with increasing growth in volume towards Belgrade (greater than 200% increase outside of the study area towards Belgrade). New interstate access points must serve a regional purpose in accordance with Federal Highway Administration requirements. The purpose of the proposed East Belgrade Interchange is to facilitate greater intermodal connectivity with the Gallatin Field Airport, not to accommodate local traffic. In addition to serving a regional need, the East Belgrade Interchange project is intended to accommodate the projected volume increase in the north-west portion of the study area. Travel demand modeling completed for this analysis includes the following:

- Interchange footprint with a connection to Alaska Road (to the south) and the Gallatin Airport entrance (to the north),
- Connection to Northern Pacific Avenue and also a connection to Frank Road,
- North Dry Creek Road Bypass which connects to the airport road entrance, and
- Extension of Love Lane from its terminus at the south to connect to Cameron Bridge Road.

Scenario analysis results indicate:

- Alaska Road, Cameron Bridge, and Love Lane all experience an increase in traffic volume between the 2030 E+C and 2030 AS-1, as indicated in **Table 3-8**, as trips shift from parallel routes to access I-90 at the new interchange. While Alaska Road experiences a slight increase in travel time of 1.24% due to the volume increase, Cameron Bridge experiences a much greater increase in average weighted travel time of 1081%, from an average travel time of 15 minutes to 51 minutes. It is recommended that an additional capacity connection between the new northern terminus of Love Lane and the new interchange be tested, with the intent of the new capacity connection to draw some of the additional traffic off of Cameron Bridge. Note that Valley Center, which runs parallel to Cameron Bridge, shows a drop in traffic volume of 28% with a corresponding decrease in travel time of 46%. A possible upgrade of Valley Center from a 2-lane collector to a minor arterial could also be tested to divert a portion of trips off of Cameron Bridge, while still providing a direct connection to Alaska and the new interchange.
- Overall, the average weighted travel time on Love Lane between Huffine and Cameron Bridge drops by almost 100%, despite the 22% increase in traffic volume, as a result of the additional capacity being added at its northern terminus (i.e., additional volume that is shifted to the upgraded facility is not enough to cause total volume to exceed available new capacity, therefore volume/capacity ratios decrease between the 2030 E+C and 2030 AS-1, and travel times decrease).

- Key parallel facility, Jackrabbit, benefits from a 14% decrease in volume and 7% decrease in travel time, and Harper Puckett benefits from a 26% decrease in volume and 50% decrease in travel time.
- Both Frontage Road and I-90 show a decrease in traffic volume and travel time with Frontage decreasing in volume and travel time by 21% and 25%, respectively, and I-90 decreasing in volume and travel time by 8% and 3% respectively. This is likely a result of the new interchange facilitating additional trip routing between I-90 and the City of Bozeman onto upgraded, non-interstate (principal arterial) facilities, namely Alaska to Cameron Bridge to Love.

Table 3-8
Alternative Scenario 1 - East Belgrade Interchange

Roadway	Termini	AADT % Change	Travel Time % Change
Alaska	Alaska southern termini /I-90	198.45	1.24
Baxter	Jackrabbit/Harper Puckett	4.17	14.96
Cameron Bridge	Thorpe/Harper Puckett	41.99	1081.39
Frontage	Belgrade Interchange/Springhill	-21.37	-25.4
Harper Puckett	Baxter/Cameron Bridge	-26.01	-50.48
Hulbert	Jackrabbit/Love	-5.67	-0.34
I-90	Gallatin Field/Springhill	-7.8	-2.94
Jackrabbit	Huffine/Amsterdam	-14.09	-6.85
Love	Huffine/Cameron Bridge	22.47	-97.86
Valley Center	Jackrabbit/Harper Puckett	-28.44	-46.09

Alternative Scenario 2 – Northeast Arterial Link

The purpose of this model scenario is to assess the traffic related impacts of creating an arterial link in the northeast portion of the City of Bozeman. This scenario includes the following:

- Extend Highland Boulevard from its current terminus at Main Street north to connect with Cedar Street. This extension is envisioned as a minor arterial link.
- Extend Oak Street east of Rouse Avenue to connect with Cedar Street. This extension is also envisioned as a minor arterial link.
- For purposes of continuity in the traffic model, upgrade Cedar Street to a minor arterial link.

These three modifications are intended to provide a new important connection to reduce traffic along Main Street, Rouse Avenue and within the Northeast Neighborhood.

Scenario analysis results indicate:

- Main Street, between 19th and Haggerty, benefits from a 3% decrease in AADT, and a 7% decrease in travel time. Rouse also benefits from a 5% decrease in AADT and a 5% decrease in travel time.
- Almost all roadways evaluated in the northeast neighborhood see a benefit as indicated in **Table 3-9** below. Note Highland experiences a slight increase in AADT of 2% and travel time of 0.5% due to the new capacity connection causing a shift in trips from parallel collectors, Church and Bozeman Trail, to the upgraded, minor arterial Highland.
- This scenario provides a good example of dispersion of traffic due to well-made capacity connections in an area of expected growth; in this case with the growth occurring in the portion of the City of Bozeman bounded by Kagy, Highland, I-90 and Bozeman Trail, where redevelopment is already occurring to support increased residential development. Traffic is able to be dispersed due to the creation of a gridded system, with several key north-south facilities able to provide comparable level of service and access to I-90; therefore, no disproportionate shift of traffic to one facility over another.

Table 3-9

Alternative Scenario 2 - Northeast Arterial Links

Roadway	Termini	AADT % Change	Travel Time % Change
7th	I-90/Main	0.11	-1.77
Babcock	19th/Wallace	-7.96	-2.23
Bozeman Trail	Kagy/Haggerty	-8.68	-15.1
Broadway	Main/Avocado	-23.57	-11.29
Church	Sourdough/Babcock	-8.98	-40.18
Durston	19th/Avocado	-2.14	-3.33
Highland	Kagy/Cedar	1.55	0.46
Main	19th/Haggerty	-3.3	-6.61
Oak	19th/Rouse	18.8	0
Peach	7th/Rouse	-19.09	-0.7
Rouse	Griffin/Peach	-4.6	-4.97
Sourdough	Kagy/Church	-2.86	-12.08
Tamarack	19th/Wallace	-12.16	-16.57
Wallace	L/Babcock	-23.67	-61.33

Alternative Scenario 3 – Access Management Scenario

This scenario involves modeling existing access management plans for Jackrabbit and Huffine. The purpose of this scenario is to define what access management principles can accomplish in providing excess capacity and congestion relief along existing corridors, potentially delaying major capacity upgrades.

A 5% increase in capacity was modeled for both Jackrabbit and Huffine with turn prohibitions implemented to local roads without signalized intersections (reference May 27, 2008, Access Management memo). This provides a "surrogate" modeling approach to show the benefit of reducing conflict points between vehicles entering/exiting a roadway and channeling vehicle traffic in a manner that supports smoother traffic flow and increased travel speeds.

Scenario analysis results indicate:

- Huffine benefits from an 11% decrease in traffic volume and a 35% decrease in travel time, while Jackrabbit sees a 6% increase in volume and a corresponding 6% increase in travel time. While it is not unusual to expect a volume increase under this scenario as a result of added capacity improving the function of a facility (thereby pulling more trips to it), an overall decrease in travel time should be expected due to the addition of turn prohibitions that mimic reduced conflict points.
- As noted in the Access Management modeling memo, when reviewing the network along the two subject corridors for network detail, it was found that the centroid for traffic analysis zone (TAZ) 9595 is located inside the loop ramp in the southwest quadrant of the interchange at Interstate 90 and Jackrabbit Lane. Since no land use activity is located inside this loop ramp, it was recommended that the centroid be moved to more accurately represent the center of activity and loading of trips onto the network.
- Because there may be an issue with loading of trips in this area, it is recommended that the centroid connector issue be addressed, and that the scenario be re-modeled in the future. It may be beneficial to also model this scenario with the inclusion of the East Belgrade Interchange so that the additional trips drawn to the area as a result of the improved facility can directly access I-90 in another location of close proximity.

Table 3-10
Alternative Scenario 3 - Access Management Scenario

Roadway	Termini	AADT % Change	Travel Time % Change
Alaska	Alaska southern termini/I-90	-5.28	-0.13
Baxter	Jackrabbit/Harper Puckett	-1.23	-3.26
Cameron Bridge	Thorpe/Harper Puckett	33.53	953.48
Durston	Love/Cottonwood	0.46	24.81
Huffine	Zoot/Fowler	-10.87	-34.94
Hulbert	Jackrabbit/Love	-14.46	-1.74
Jackrabbit	Huffine/I-90	5.85	6.23
Love	Huffine/Valley Center	-3.75	-11.12
Valley Center	Jackrabbit/Hidden Valley	2.64	18.99

Alternative Scenario 4 – Arterial Connections / Cross Regional Grid System

This scenario involves modifying and/or widening existing roads, and constructing key new roadway segments for facilities that support critical cross-region movement. Upgrades would be to principal arterials only (four-lane and/or five-lane cross sections). This will serve to create a strong grid arterial system. The focus for this would be on the western and southern portions of the study area where there are greatest increases in traffic volumes as a result of expected long-term population and employment growth.

Recommended modeling assignments build off of existing key principal arterial corridors (e.g., Jackrabbit/Gallatin between I-90 and Cottonwood, 19th between Nash and I-90, Cottonwood between Johnson and Oak). Modeling included the following upgrades:

- **Upgrade 1 – North/South Connection**
    - Extend existing principal arterial, Love Lane, south to connect to Gooch Hill/Johnson
    - Upgrade Gooch Hill/Enders south to Cottonwood from Minor Arterial to Principal Arterial
    - Include all aspects of Alternative Scenario 1 – East Belgrade Interchange

- **Upgrade 2 – East/West Connection**
    - Upgrade existing minor arterial, Cottonwood, between Gallatin and Enders to Principal Arterial
    - New principal arterial capacity connecting Cottonwood/Enders to Kent Spur
    - Upgrade Kent Spur from minor to principal arterial

- **Upgrade 3 – North South/Connection**
    - Upgrade Cottonwood/Kent Spur north to Johnson from minor arterial to principal arterial.
    - Connect Cottonwood between Oak and Harper Puckett – principal arterial
    - Extension of Cottonwood Road from its current terminus to Valley Center Road (as a principal arterial).

- **Upgrade 4 – North South Connection**
    - Upgrade Gooch Hill and Chapman between Johnson and Durston from minor to principal arterial

Scenario analysis results indicate:

- All key north-south, newly upgraded principal arterial facilities – Jackrabbit / Gallatin, Love / Gooch Hill, Cottonwood / Harper Puckett, and north 19th experience significant travel time benefits, as indicated in **Table 3-11**. Similar to AS2, but on a larger scale, traffic is able to be evenly dispersed due to the creation of a connected system, with several key north-south facilities able to provide comparable level of service and access to I-90; therefore, no disproportionate shift of traffic to one facility over another.

- I-90 and Frontage between the new East Belgrade Interchange and 19th also show traffic improvements with 19th showing a 4% decrease in traffic volume and a 3% decrease in travel time, and Frontage Road showing a 19% decrease in volume and 17% decrease in travel time.
- Similar to the other alternatives where the East Belgrade Interchange in modeled, Alaska sees a significant increase in volume of 219% as trips are shifted to the facility to access I-90 at the new location, and a corresponding increase in travel time of 4%. Cameron Bridge experiences deterioration in level of service of 85% increase in volume and greater than 2500% increase in travel time (from an average travel time of 2 minutes to 23 minutes) as trips are shifted to the area. It is recommended that additional improvements be tested in the area to relieve the induced traffic created on Cameron Bridge, e.g., an additional capacity connection between the new northern terminus of Love Lane and the new interchange, or an upgrade of Valley Center from a 2-lane collector to a minor arterial facility. Valley Center shows a 22% drop in volume and 39% drop in travel time and can likely accommodate shift in additional volume to the facility if it is upgraded. There is an active Environmental Assessment (EA) for Valley Center that calls for the roadway to be widened and turn lanes to be added.
- Harper Puckett shows an increase in traffic volume of 58% and greater than 2500% increase in travel time (from an average travel time of 2 minutes to 52 minutes), also due to the significant shift in trips to the area. The improvements suggested above, may also serve to alleviate the increase in volume and travel time on Harper Puckett if they reduce the volume increase (bottleneck which is likely occurring) on Cameron Bridge.
- Key east-west facilities extending between the upgraded north-south principal arterials show both traffic improvements and deterioration, with the majority showing improvement. Durston shows a 17% increase in volume and 9% increase in travel time, while Huffine shows a 6% decrease in volume and 20% decrease in travel time, Main with a 6% decrease in volume and 14% decrease in travel time, and Johnson a 26% and 79% decrease in volume and travel time, respectively. Oak shows a 93% increase in volume, but 90% decrease in travel time as the addition of new capacity causes trips and volume to shift to the upgraded facility; however this volume increase is not enough to exceed available (new) capacity allowing the volume/capacity ratio to drop and average travel times to decrease.
- In general, significant volume and travel time reductions are seen on the entire western side of the study area as a result of the interconnected principal arterial system created in an area of expected population and employment growth.

Table 3-11
Alternative Scenario 4 - Arterial Connections / Cross Regional Grid System

Roadway	Termini	AADT % Change	Travel Time % Change
19th	Valley Center/Main	-4.2	-2.58
I-90	East Belgrade Interchange/19th	-10.17	-5.34
Alaska	Alaska southern termini/I-90	218.68	4.08
Cameron Bridge	Jackrabbit/Harper Puckett	84.79	2784.17
Cottonwood	Kent Spur/Harper Puckett	39.98	-66.39
Durston	Love/19th	17.47	8.59
Frontage	East Belgrade Interchange/19th	-19.38	-16.64
Gallatin	Cottonwood/Jackrabbit	-2.3	-14.07
Gooch Hill/Enders	Cottonwood-Kent Spur/Love	-10.76	-48.22
Harper Puckett	Valley Center/Baxter	57.89	2843.66
Huffine	Jackrabbit/Main	-5.78	-20.35
Jackrabbit	Huffine/I-90	-16.07	-6.98
Love	Gooch Hill/Cameron Bridge	42.67	-97.78
Main	Fowler/19th	-6.34	-14.33
Oak	Cottonwood/19th	92.87	-89.67
Valley Center	Jackrabbit/19th	-22.08	-39.37

Alternative Scenario 5 – Interstate 90 Overpass at Davis / Nelson Alignment

The scenario is created to assess the benefits of providing a grade separated overpass of I-90 and the existing railroad tracks along the north-south alignment of Fowler/Davis and Nelson roads. This is not envisioned as an interchange; however it may serve to reduce traffic along the Frontage Road entering Bozeman, North 19th Avenue, and Valley Center Road.

Scenario analysis results indicate:

- Frontage Road entering Bozeman experiences a 7% decrease in AADT and 10% decrease in travel time. North 7th experiences a 3% decrease in AADT and 12% decrease in travel time.
- North 19th and Valley Center both experience an increase in traffic volume and travel time, with North 19th seeing a 15% increase in AADT and 12% increase in travel time, and Valley Center experiencing an 18% increase in AADT and greater than 300% increase in travel time (from an average travel time of 3.3 minutes to 10.2 minutes).
- Davis is impacted by a 76% increase in traffic volume, but a 67% decrease in travel time, indicating that the increased capacity is enough to accommodate the shift in traffic volume (volume/capacity ratio drops allowing travel times to decrease).
- The intended goal to reduce traffic along the Frontage Road was addressed as a portion of trips are shifted from accessing Frontage Road at Springhill, to enter Bozeman. Instead, trips are shifted to the new capacity connection at Davis/Nelson

to enter northeast Bozeman from Davis and North 19th. This shift in trips, however, causes the increase in traffic volume on these two facilities. Baxter also sees an increase in AADT of 15% and travel time of 56% as a result of a large number of trips shifting to the area.

- Recommend testing additional improvements to Valley Center and/or North 19th if 1-90 Overpass is constructed at Davis/Nelson.

Table 3-12

Alternative Scenario 5 - Interstate 90 Overpass at Davis / Nelson Alignment

Roadway	Termini	AADT % Change	Travel Time % Change
North 19th	Valley Center/Oak	15.09	11.84
7th	Frontage/Oak	-3.01	-12.03
Baxter	Harper Puckett/7th	14.72	55.66
Davis	Baxter/Nelson	76.47	-66.51
Frontage	Sacajawea Peak/7th	-7.39	-9.61
Hidden Valley	Valley Center/Harper Puckett	-10.8	-6.13
Oak	New Holland/7th	-1.18	-9.9
Valley Center	Harper Puckett/19th	18.78	304.42

Alternative Scenario 6 – Interstate 90 Overpass at Baxter / Mandeville Alignment

The scenario is created to assess the benefits of providing a grade separated overpass of Interstate 90 along the west-east alignment of Baxter/Mandeville Lane. This is not envisioned as an interchange; however it may serve to reduce traffic along the Frontage Road entering Bozeman, North 7th Avenue, and Griffin Drive.

Scenario analysis results indicate:

- North 7th experiences a 5% decrease in AADT, and a 19% decrease in travel time.
- Frontage Road entering Bozeman benefits from a 5% decrease in AADT and 14% decrease in travel time.
- Griffin experiences a 4% increase in AADT and 9% increase in travel time resulting from its proximity to the new capacity connection at Baxter/Mandeville, which causes additional trips to load onto Griffin heading to/from Baxter. For the same reason (proximity to new capacity connection), Mandeville sees a 233% increase in traffic volume, but a 56% decrease in travel time.

Table 3-13
Alternative Scenario 6 - Interstate 90 Overpass at Baxter / Mandeville Alignment

Roadway	Termini	AADT % Change	Travel Time % Change
7th	Oak/Frontage	-5.43	-19.21
Baxter	Davis/Mandeville	9.08	-2.14
Davis	Baxter/Valley Center	0.51	2.27
Frontage	Nelson/7th	-5.13	-13.83
Griffin	Mandeville/Rouse	4.27	8.51
Mandeville	Baxter/Griffin	232.57	-55.7
Oak	New Holland/Rouse	0.92	0.01
Rouse	Oak/Griffin	-3.84	-20.02

Alternative Scenario 7 – Southwest Grid Modifications

The scenario will expand and strengthen the southwest grid in an existing and forecasted growth area. It includes the following:

- College Street upgrade to a five-lane principal arterial between Main Street and S. 19th Ave.
- College Street upgrade to a three-lane minor arterial between S. 8th Ave. and S. 19th Ave.
- Extending Kagy Boulevard from S. 19th Avenue to Cottonwood near the Stucky Road intersection (as a three-lane principal arterial)
- Completing the Fowler Lane connection from Garfield Street south to Stucky (as a minor arterial).

Scenario analysis results indicate:

- Parallel facilities to the new Kagy Boulevard capacity extension, Babcock and Stucky, show significant travel time benefits as trips shift to the new capacity; Babcock sees a 4% decrease in AADT and 10% decrease in travel time, Stucky sees a 62% decrease in AADT and almost 100% decrease in travel time.
- Overall, Kagy experiences a 48% increase in AADT as a result of trips shifting to the upgraded and expanded facility, but only a slight 3% increase in travel time.
- College Avenue between Cottonwood and 11th benefits from a 5% decrease in AADT and a 27% decrease in travel time.
- Extension of Fowler lane from Stucky to Garfield Street is causing an increase in traffic volume on Fowler of 41% and a significant increase in travel time of 359%. While you would expect an increase in volume on the facility as trips are shifted to the new capacity, the increase in travel time may not warrant the new capacity addition, in particular as the parallel facilities Cottonwood and 19th are not showing significant traffic improvements as trips are shifted from these facilities to the new capacity; Cottonwood shows a 4% increase in travel time and 19th shows a 5% increase in travel time.

Table 3-14
Alternative Scenario 7 - Southwest Grid Modifications

Roadway	Termini	AADT % Change	Travel Time % Change
19th	Babcock/Patterson	-0.97	4.64
Babcock	Cottonwood/11th	-3.66	-10.1
College	Cottonwood/11th	-5.15	-27.42
Cottonwood	Patterson/Babcock	0.17	3.73
Fowler	Patterson/Babcock	40.98	359.43
Huffine	Cottonwood/11th	-2.24	-11.13
Kagy	Cottonwood/7th	48.34	3.03
Stucky	Cottonwood/19th	-62.53	-98.5

Alternative Scenario 8 – Kagy Boulevard Expansion

This scenario involves expanding the existing Kagy Boulevard from its current two-lane configuration (with left-turn bays) to a widened five-lane principal arterial. This would create a high capacity principal arterial corridor.

Scenario analysis results indicate:

- Kagy Boulevard benefits from a decrease in travel time of 4%, despite a slight increase in AADT of 1%, with the AADT increase expected due to the improvement of the facility. Adjacent Bozeman Trail also benefits from a 5% decrease in AADT and 2% decrease in travel time.
- Other impacts in the area of improvement are minimal/negligible (see **Table 3-15** below), with the most significant change occurring on Sourdough which shows a 16% decrease in AADT and 36% decrease in travel time.

Table 3-15
Alternative Scenario 8 - Kagy Boulevard Expansion

Roadway	Termini	AADT % Change	Travel Time % Change
19th	Goldenstein/Main	4.38	8.46
3rd	Goldenstein/Westridge	0.09	-2.14
Babcock	19th/Church	-0.63	1.43
Bozeman Trail	Haggerty/Tayabeshockup	-4.53	-1.56
Church	Main/Sourdough	-0.58	-1.15
Highland	Bozeman Trail/Main	-0.01	0
Kagy	19th/Tayabeshockup	1.07	-4.07
Main	19th/Haggerty	0.8	3.43
Sourdough	Goldenstein/Church	-16.06	-35.97
Willson	Bozeman Trail/Main	-1.13	-0.92

Alternative Scenario 9 – Fowler Lane Extension

This scenario involves completing the Fowler Lane corridor north of Main Street, specifically between Babcock and Oak Street, in hopes of providing additional north-south travel mobility. This is envisioned as a minor arterial facility.

Scenario analysis results indicate:

- Fowler experiences a significant increase of 285% AADT due to the shift in trips to the newly upgraded north-south arterial facility, but a 72% decrease in travel time; indicating that the increase in additional capacity between Babcock and Oak is able to accommodate the shift in travel to the upgraded corridor (i.e., volume/capacity ratio is reduced allowing travel times to decrease).
- Adjacent Davis Street, at the north end of Fowler, benefits from a 12% decrease in AADT and a 35% decrease in travel time.
- Parallel facility, Cottonwood, benefits from a 5% decrease in volume and 14% decrease in travel time, as trips are shifted to Fowler; however parallel 19th shows in a increase in volume and travel time of 6% and 8%, respectively.
- Surrounding key facilities show largely improved travel conditions as indicated in **Table 3-16** below.

Table 3-16
Alternative Scenario 9 - Fowler Lane Extension

Roadway	Termini	AADT % Change	Travel Time % Change
19th	Babcock/Valley Center	5.98	7.84
Babcock	19th/Cottonwood	-0.98	-42.69
Cottonwood	Huffine/Durston	-4.57	-13.93
Davis	Valley Center/Baxter	-11.89	-34.71
Durston	Cottonwood/19th	15.4	7.93
Fowler	Huffine/Davis	284.7	-72.01
Huffine	Cottonwood/Main	-4.78	-18.73
Main	Huffine/19th	-8.4	-17.76
Oak	Fowler/19th	-12.54	-50.1
Valley Center	Hidden Valley/19th	-7.52	-14.78

Alternative Scenario 10 – Northwest Grid Modifications

As with AS 1 – East Belgrade Interchange, the northwest grid system modification have been developed to address the growth occurring in the north-west portion of the study area. This scenario has been modeled to complete the principal arterial system in the "triangle" area.

This model scenario includes the following:

- All aspects of AS 1 - East Belgrade Interchange.
- Extension of Oak Street from its current western terminus all the way to the west to intersect Love Lane (as a principal arterial).
- Extension of Love Lane to the north to connect with Cameron Bridge Road, as a principal arterial.
- Extension of Cottonwood Road from its current terminus to Valley Center Road (as a principal arterial).
- Re-classification of Monforton School Road to a collector with attributes adjusted accordingly.
- Extension of Hulbert Road from its eastern terminus to the east to connect with an extended Harper Puckett Road (as a collector).

Scenario analysis results indicate:

- Similar to AS 1, traffic is being pulled onto Alaska, Cameron Bridge, and Love Lane to access the new interchange. Each of these roadways experiences an increase in traffic volume with Alaska seeing a 217% increase, Cameron Bridge a 45% increase, and Love Lane a 25% increase in AADT. Note that despite the volume increase on Love, average travel time drops by almost 100% from 28 minutes to less than 1 minute.
- Huffine experiences a 6% decrease in AADT and 21% decrease in travel time, and Valley Center shows a 30% decrease in AADT and 60% decrease in travel time.
- Jackrabbit, between Huffine and Amsterdam, also shows travel benefits, with a 14% decrease in AADT and 6% decrease in travel time.
- There is a significant shift in traffic from Hidden Valley Road (66% decrease in AADT and 13% decrease in travel time), a collector street, to Harper Puckett/Cottonwood, due to the Cottonwood extension as a higher functional class principal arterial.
- Oak shows a 31% increase in volume, but a 120% decrease in travel time. This is a result of new capacity connections causing a shift in traffic volume to the upgraded facility. The volume increase is not enough, however, to exceed available (new) capacity allowing average travel times to decrease. Similarly, Harper Puckett shows an 11% increase in AADT, but a 41% decrease in travel time.
- In general, grid modifications in connection with the new interchange appear to support reductions in traffic volume and travel times on key facilities in the north-west portion of the study area as traffic is dispersed on to a completed grid system to the south and west of the new interchange. Some locations (e.g., Cameron Bridge and the southern portion of Cottonwood at Huffine) are showing more localized, but fairly significant increases in travel time, however, and may require additional analysis.

Table 3-17
Alternative Scenario 10 - Northwest Grid Modifications

Roadway	Termini	AADT % Change	Travel Time % Change
Alaska	Alaska southern termini/I-90	217.45	3.61
Baxter	Jackrabbit/19th	-23.88	54.62
Cameron Bridge	Thorpe/Harper Puckett	44.9	1177.57
Cottonwood	Huffine/Valley Center	47.34	583.19
Durston	Love/19th	8.73	4.41
Harper Puckett	Cameron Bridge/Hulbert	11	-41.47
Hidden Valley	Valley Center/Hulbert	-65.85	-12.63
Huffine	Jackrabbit/Main	-5.77	-21.13
Jackrabbit	Huffine/Frank	-13.99	-5.74
Love	Huffine/Cameron Bridge	25.31	-97.94
Oak	Love/19th	31.01	-119.59
Valley Center	Jackrabbit/Harper Puckett	-30.47	-60.35

Alternative Scenario 11 – Amsterdam On-Ramp

This scenario added an interchange on-ramp from Amsterdam Road onto Interstate 90 to reduce congestion at Amsterdam Road and Jackrabbit Lane (just south of Belgrade).

Scenario analysis results indicate:

- A reduction in 25% AADT and 89% travel time on Amsterdam, and a reduction of 1.32% AADT and 1.89% travel time on Jackrabbit.
- Impacts in the surrounding area are minimal. Reference **Table 3-18** below.

Table 3-18
Alternative Scenario 11 - Amsterdam On-Ramp

Roadway	Termini	AADT % Change	Travel Time % Change
Alaska	Cameron Bridge/I-90	-1.3	0
Amsterdam	Jackrabbit/	-25.01	-88.93
Cameron Bridge	Thorpe/Alaska	0.58	6.43
Jackrabbit	Hulbert/Amsterdam	-1.32	-1.89
Frank	Thorpe/Jackrabbit	-1.26	-7.23
Thorpe	Cameron Bridge/	-3.99	-3.05

Alternative Scenario 12 – Southern Grid Modifications

The southern grid modifications include the following:

- Extend 11th Ave. from Kagy Boulevard to Goldenstein (as a collector).
- Extend 15th Ave. from Main Street to Babcock (as a collector).
- Extend Blackwood Road from S. 19th Ave. west to Cottonwood Road (as a minor arterial).

Scenario analysis results indicate:

- 11th Street AADT increases 16% with a slight 1.24% increase in travel time. 15th Street AADT increases by 111% with a 17% increase in travel time. These increases are a result of the new capacity connections causing a shift in trips and traffic volume to the expanded facilities, with most significant volume increases occurring on links immediately adjacent to new capacity. The fairly large travel time increase on 15th is likely because the capacity addition is very short in length; trips are shifted to the newly connected facility causing volume to increase, but the slight capacity addition is not enough to accommodate this increase, therefore volume/capacity ratio increases and travel time increases.
- 19th and Wilson/3rd, both of which run parallel to the upgraded 11th and 15th street facilities, experience a reduction in AADT and travel time due to the shift in trips to 11th and 15th.
- Cottonwood benefits from a significant decrease in AADT of 27% and travel time decrease of 54%, as new capacity connections on Blackwood and 11th create more direct access to downtown Bozeman.
- Kagy Boulevard shows a 4% decrease in AADT and less than 1% decrease in travel time.
- Patterson and Stucky, which run parallel to the Blackwood extension, see significant benefit due to the grid modifications in the area which allow traffic to more evenly disperse onto other facilities. Patterson shows a 14% decrease in AADT and 43% decrease in travel time and Stucky shows a 9% decrease in AADT and 48% decrease in travel time.
- Sourdough benefits from a 25% decrease in AADT and 52% decrease in travel time.
- In general, grid modifications appear to support reductions in traffic volume and travel times on key facilities in the southern portion of the study area as traffic is dispersed on to a completed grid system.

Table 3-19
Alternative Scenario 12 - Southern Grid Modifications

Roadway	Termini	AADT % Change	Travel Time % Change
11th	Goldenstein/Durston	15.93	1.24
15th	College/Durston	111.53	16.95
19th	Cottonwood/Durston	-0.57	-1.82
3rd	Goldenstein/Kagy	-21.56	-4.96
College	19th/Willson	-0.19	1.89
Cottonwood	19th/Stucky	-26.95	-53.54
Durston	19th/Rouse	-26.95	0.13
Goldenstein	19th/Sourdough	-13.74	-18.02
Kagy	19th/Sourdough	-4.07	-0.63
Patterson	Cottonwood/19th	-14.37	-42.88
Sourdough	Goldenstein/Kagy	-24.5	-51.94
Stucky	Cottonwood/19th	-8.7	-48.3
Willson	Kagy/Peach	-3.74	-2.2

Alternative Scenario 13 – Interstate 90 Interchange (Harper Puckett Road)

The purpose of AS-13 is to model the effects of a future interchange approximately half way between the proposed East Belgrade interchange and the 19th Avenue interchange. This scenario includes all aspects of AS-1 as well.

It should be noted that the Federal Highway Administration requires that new interstate access points must serve a regional purpose. At this time this scenario would not serve a regional need and as such would not meet Federal Highway Administration requirements.

Scenario analysis results indicate:

- Similar to AS 1 and AS 10, traffic is being pulled onto Alaska, Cameron Bridge, and Love Lane, to access the new East Belgrade interchange. Each of these roadways experiences an increase in traffic volume with Alaska seeing a 170% increase, Cameron Bridge a 103% increase, and Love Lane a 24% increase in AADT. Note that Cameron Bridge is seeing a much greater increase in AADT compared to Alternatives 1 and 10 because of the additional interchange directly to the north of the roadway, causing even more trips and traffic volume to shift to this facility. The very significant increase in travel time on Cameron Bridge resulting from this shift in traffic volume (average-weighted travel time increase greater than 4500%; or in absolute terms, an increase in average travel time from 9-87 minutes), may preclude this as an alternative to consider, unless additional improvements are made in the area.
- Most roadways in the area are experiencing a general increase in AADT and travel time as a significant number of trips shift to access I-90 at one of the two proposed

interchanges. I-90 does show improvement, with a 13% decrease in AADT and 32% decrease in travel time, as a result of some traffic shifting off of the interstate onto the arterial system to access the City of Bozeman. Jackrabbit also sees a decrease in 15% AADT and 6% travel time, similar to AS 1 and AS 10.

- There is no apparent benefit to this scenario over Alternative 1 which includes only the East Belgrade Interchange (with the exception of greater travel benefits on I-90 in the area of improvement). This is possibly because the proposed interchanges are located too closely together, drawing too much traffic into the north west portion of the study area to access I-90 in the same general location.

Table 3-20
Alternative Scenario 13 - Interstate 90 Interchange (Harper Puckett Road)

Roadway	Termini	AADT % Change	Travel Time % Change
19th	Goldenstein/Main	4.38	8.46
3rd	Goldenstein/Westridge	0.09	-2.14
Babcock	19th/Church	-0.63	1.43
Bozeman Trail	Haggerty/Tayabeshockup	-4.53	-1.56
Church	Main/Sourdough	-0.58	-1.15
Highland	Bozeman Trail/Main	-0.01	0
Kagy	19th/Tayabeshockup	1.07	-4.07
Main	19th/Haggerty	0.8	3.43
Sourdough	Goldenstein/Church	-16.06	-35.97
Willson	Bozeman Trail/Main	-1.13	-0.92

3.10 Traffic Model Development Conclusions

The alternative scenarios modeled, and described above, are reflective of major street network (MSN) projects that may or may not have considerable value to the transportation conditions in the community. Some of the alternative scenarios modeled will be carried forward later in the Plan in the form of specific recommendations. These are primarily found in **Chapter 5**. A few of the scenarios do not appear to have substantial value, so will not be considered further. Ultimately, the recommended projects defined in **Chapter 5** will transform into what is known as the community's "Recommended Major Street Network". This network is shown graphically in **Chapter 9**, along with travel demand model volume outputs. The "Recommended Major Street Network" is the future transportation system network that the community should be planning towards as land use changes occur over the planning horizon (year 2030).