VI. CORRIDOR PRACTICAL CAPACITY ANALYSES

This section summarizes the practical highway capacity performed for State Highway 97 Corridor Study. The analysis was performed to determine the planning level vehicle capacity availability (from here on referred to as practical capacity or capacity only) of SH 97 based on existing geometric (i.e. highway design) and operational (i.e. traffic flow) conditions. The analysis also helps the East Side Highway District, the Idaho Transportation Department, and Kootenai County understand the impact of land use (residential development) decisions on the highway.

TRAFFIC VOLUMES

Average daily traffic (ADT) counts and peak/design hour factor data was obtained from the ITD 2006 traffic volume reports. ITD collects and maintains volume data for twelve segments on SH 97. These segments are:

- 60.63 to 61.19 – State Highway 3 Junction to O'Gara Road
- 61.19 to 67.23 – O'Gara Road to Locust Drive (approximately Woodlawn Drive)
- 67.23 to 68.03 – Locust Drive to Harrison Street
- 68.03 to 68.14 – Harrison Street to Pine Street
- 68.14 to 70.06 – Pine Street to Harlow Point Road
- 70.06 to 70.75 – Harlow Point Road to Stott Road
- 70.75 to 79.47 – Stott Road to Carlin Bay Road
- 79.47 to 83.20 – Carlin Bay Road to Driftwood Drive
- 83.20 to 90.34 – Driftwood Drive to Burma Road
- 90.34 to 95.42 – Burma Road to Mineral Ridge Boat Launch at Wolf Lodge Bay
- 95.42 to 96.33 – Mineral Ridge Boat Launch at Wolf Lodge Bay to Interstate 90 Eastbound Ramp
- 96.33 to 96.43 – Interstate 90 EB Ramp to Interstate 90 Westbound Ramp

In addition, ITD volume reports define the peak hour volume (PHV) as a percentage of average daily trips (ADT) within each segment. The PHV is the highest traffic volume within a timeframe of one hour. Design hour volume (DHV) is usually the 30th highest hour traffic volume, which may not necessarily be equivalent to the peak hour traffic volume. DHV may be different (than the 30th highest hour) on a Scenic Byway with inordinately heavier seasonal traffic. A summary of ADT volumes and the calculated DHV is provided in Table X. This data is used to support the existing capacity analyses in this report. Independent counts performed at select locations have supported the accuracy of ITD's counts.

Forecast traffic volumes were developed for the purpose of reviewing future capacity conditions. Forecasts were developed using growth rates identified from the *2007-2030 Kootenai County Metropolitan Transportation Plan* (KMPO, 2007). Existing 2006 and future year 2030 traffic volumes were compared. The comparison indicates that traffic is expected to increase by

between 0.5 to 3.6 percent annually, depending on the location. A summary of growth rates expected for various locations on the highway is shown on Table 13. This growth primarily reflects the growth of traffic associated with new residential development in the study area.

Growth rates were used to generate forecast ADT and design hour volumes (DHV). The DHV represents forecast PHV, which is used for the purpose of future operational/capacity analyses and roadway design. A summary of SH 97 growth rates (which correspond to ITD's milepost segments) and the resulting ADT and DHV forecasts are also provided on Table 13.

Table 13. Year 2006 and Forecast Year 2030 SH 97 ADT and PHV/ DHV

Milepost Range		Year 2006[1] ADT	Year 2006 PHV[2]		Growth Rate/Year[3]	Year 2030 Volumes	
Start	End		%	Calc.		ADT	DHV[4]
60.63	61.19	1,000	14.15	140	0.5%	1,100	160
61.19	67.23	670	15.75	105	0.5%	800	120
67.23	68.03	610	16.22	100	0.5%	700	115
68.03	68.14	650	15.90	105	0.5%	700	120
68.14	70.06	470	17.81	85	0.5%	500	95
70.06	70.75	450	18.11	80	0.5%	500	90
70.75	79.47	530	17.03	90	0.5%	600	100
79.47	83.20	700	15.54	110	2.1%	1,200	180
83.20	90.34	1,300	13.41	175	2.1%	2,100	290
90.34	95.42	1,600	12.94	205	3.6%	3,700	480
95.42	96.33	2,200	12.39	275	3.6%	5,100	645
96.33	96.43	1,400	12.23	185	3.6%	3,300	430

1. Count Source: Idaho Transportation Department 2006 Volume Report.
2. PHV = Peak Hour Volume.
3. Growth Rate Source: *2007-2030 Kootenai County Metropolitan Transportation Plan* (KMPO, 2007).
4. DHV = Design Hour Volume (Future PHV).

Limited alternate routes for SH 97 are available between Interstate 90 and the SH 97 and SH 3 junction. Other than two connections to SH 97, one at Interstate 90 and the other at the SH 97/SH 3 junction, no other year round routes provide a full routing alternate to SH 97. Local roads off SH 97 do offer some alternate routing; however, these routes all begin or end back on SH 97.

CAPACITY ANALYSES

The *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000) defines vehicle capacity as *"the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic, and control conditions"*. The HCM continues to describe that vehicle capacity can be reviewed for two lane highways in segments, given the characteristics of these segments are similar in cross sectional (i.e. lane and shoulder widths, etc.) and volume conditions.

Thus, this *highway capacity analyses* reviews the sections of SH 97 with similar design and volume characteristics so the planning level capacity of the highway can be estimated. This capacity threshold will help staff from the KMPO, Idaho Transportation Department (ITD), East Side Highway District, and Kootenai County make traffic and land use planning and design decisions prior to the future development of properties, which would rely on SH 97.

Level of Service Concept

This study reviewed capacity based on the level of service (LOS) methodologies outlined within the HCM. The HCM provides nationally recognized and locally accepted analysis procedures for evaluating and quantifying the function, capacity, and operation of highways, arterials, and intersections. According to the KMPO *2007-2030 Metropolitan Transportation Plan*, LOS is defined as:

> *"A measure of the performance of an element of a transportation infrastructure. An intersection, a rural roadway, a freeway ramp, an arterial, or a freeway segment can all be graded on the adequacy of their performance under given traffic conditions.*
>
> *Level of Service is a description of different operation conditions that occur on a roadway or at an intersection when accommodating various traffic volumes. It is a qualitative measure of the effect of traffic flow factors such as speed and travel time, interruptions and delays, freedom to maneuver, and driver comfort and convenience."*

Levels of service range from LOS A to LOS F. According to the KMPO, LOS grades are described as follows:

- LOS A – Free flow, low volumes, and densities with this speed. Drivers can maintain their desired speeds with little or no delays.
- LOS B – Stable flow, operating speeds are beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed. Suitable for rural design standards.
- LOS C – Stable flow, but speeds and higher volumes more closely control maneuverability. Suitable for urban design standards.
- LOS D – Approaches unstable flow, tolerable operating speeds that are, however, considerably affected by operating conditions. Drivers have little freedom to maneuver.
- LOS E – Unstable flow, with yet lower operating speeds and, perhaps, stoppages of momentary duration. Volumes at or near capacity.
- LOS F – Forecast flow, both speed and volumes can drop to zero. Stoppages may occur for short or long periods. These conditions usually result from queues of vehicles backing up from a restriction downstream.

The KMPO *2007-2030 Metropolitan Transportation Plan* generally recognizes a LOS D as the guideline for acceptable service for rural highways such as SH 97. This planning level standard is appropriate for use in estimating future available capacity, and the number of (traffic generating) residential homes or equivalents that can be developed on the highway prior to unacceptable LOS E conditions.

Note that DHV evaluations were performed for this study as they result in more conservative LOS ratings versus the evaluation of future ADT volumes and LOS.

Class II Highway Application

The Highway Capacity Manual categorizes two-lane highways into two classes. SH 97 would fall under the Class II classification of highways. HCM states that:

> *Class II – These are two lane highways on which motorists do not necessarily expect to travel at high speeds. Two lane highways that function as access routes to Class I facilities, serve as scenic or recreation routes that are not primary arterials, or pass through rugged terrain are generally assigned to Class II. Class II facilities most often serve relatively short trips, the beginning and ending portions of longer trips, or trips for which sightseeing plays a significant role. On Class II highways, LOS is defined only in terms of percent-time-following, and does not consider average travel speed. Drivers can usually be expected to tolerate higher levels of percent-time-following on Class II highways because they serve different trip purposes (HCM, 2000, Section 12-12, Page 12-16).*
>
> *On Class I highways, efficient mobility is paramount, and LOS is defined in terms of both percent-time-following and average travel speed. On a Class II highway, mobility is less critical, and LOS is defined only in terms of percent-time-following, without consideration of average travel speed. Drivers will tolerate higher levels of percent-time-following on a Class II facility than on a Class I facility, because Class II facilities usually serve shorter trips and different trip purposes (HCM 2000, Section 20-1, Page 20-3).*
>
> *For example, a Class I two lane highway with percent-time-following equal to 45 percent and an average travel speed of 40 mi/h would be classified as LOS D based on criteria/thresholds for a Class I highway. However, a Class II highway with the same conditions would be classified as LOS B based on criteria/thresholds for a Class II highway (HCM, 2000, Section 20-1, Page 20-3).*

Essentially, these statements indicate that LOS is a function of percent-time-following (Table 14) other vehicles in traffic, and that speed is neglected on a Class II highway because drivers expect to travel at reduced speeds. As opposed to Class I highways, this provides much higher LOS results on the hourly basis, as speeds are not the primary issue.

Table 14. HCS LOS Thresholds for Class II Highways

LOS	Percent-Time-Following
A	≤ 40
B	40 to 55
C	55 to 70
D	70 to 85
E	85 to 100
F	≥ 100

Source: *Highway Capacity Manual (TRB, 2000)*

LOS thresholds for a two lane Class II, scenic highway are provided in Table 15 for the year 2006 Peak Hour Volume (PHV) and year 2030 Design Hour Volume (DHV). As indicated, LOS thresholds are based on percent-time-following data, which is a function of volume, heavy vehicles in traffic (trucks, RVs, buses, construction trucks, etc.), grade of roadway (level, rolling, or mountainous), the existence of passing lanes, and the peak 15 minute traffic flows of the PHV (quantified by the peak hour factor). Given this is a planning level study, the average/common elements of highway sections were reviewed for SH 97. There are minor instances where actual attributes (such as grade) might exceed these averages, but overall the common character of the highway segment is consistent. The base assumptions are as follows:

- Based on independent traffic counts for SH 97 and correlated with ITD data, about four percent of traffic is made up of heavy freight vehicles, two percent buses, and eleven percent is typically faster moving large vehicles, such as recreational vehicles, and construction related trucks. Passenger vehicles make up 83 percent of the traffic.
- The HCM indicates that "mountainous" conditions exist when grades in excess of three percent occur for extended segments of 0.6 miles or longer. Field surveys performed of the roadway with a global positioning device indicate that, while grades in excess of three percent do exist, they do not occur with enough consistency to perform mountainous HCM analyses. As such, "rolling" terrain was assumed in the analysis.
- Field counts indicate a variable peak hour factor. However, an average of PHV factor of 0.82 was identified through a review of counts. To produce conservative results, a PHV factor of 0.80 was used for this study in reviewing both PHV and DHV service levels.
- A passing lane does exist on SH 97 along with other limited passing zones. However, passing opportunities occur infrequently, and do not provide a measurable increase in LOS for SH 97. As such, 100 percent no-passing lanes were assumed in this analysis.
- A 70/30 directional distribution of traffic was assumed for the analysis, as based on traffic count data.

Contained in the appendices of this report are the spreadsheets used to calculate LOS in the design hour for SH 97. Existing and forecast DHVs were then reviewed in accordance with the methods outlined within the HCM. The resulting LOS are provided on Table 15 for the year 2006 PHV and year 2030 DHV.

Table 15. LOS Results for SH 97

Milepost Range		Year 2006		Year 2030	
Start	End	PHV	LOS	DHV	LOS
60.63	61.19	140	B	160	B
61.19	67.02	105	A	120	B
67.02	67.23	105	A	120	B
67.23	68.03	100	A	115	B
68.03	68.13	105	A	120	B
68.13	68.77	85	A	95	A
68.77	70.06	85	A	95	A
70.06	70.75	80	A	90	A
70.75	79.47	90	A	100	A
79.47	83.20	110	B	180	B
83.20	90.34	175	B	290	C
90.34	95.42	205	B	480	D
95.42	96.33	275	C	645	C
96.33	96.43	185	B	430	C

As shown, year 2006 LOS ranges up to LOS C in a high volume area located on the north end of SH 97 by the Mineral Ridge boat launch at Wolf Lodge Bay area. By year 2030, the analysis segment in the Beauty Bay Hill area degrades to LOS D during the DHV. However, overall the analysis indicates the highway operates within the KMPO recommended planning level guidelines for rural highways.

Thus, the highway capacity analysis does conclude that there is capacity available for limited growth in the area served by SH 97. As discussed in other sections of this report, this capacity is constrained by design issues identified for the highway, which is supported by the accident analyses. The Beauty Bay Hill area is the most restrictive segment of the highway given topography and geographic water constraints.

HOUSING EQUIVALENTS

As of January 1, 2008, there were 1,744 dwelling units in areas of the County served by SH 97. The 2030 volume and LOS forecasts provided above in Table 15 are based on KMPO's regional travel demand model. When the regional model was developed in 2003, KMPO assumed that approximately 2,740 dwelling units would exist in the area served by SH 97 by 2030 (approximately 1,000 more homes than SH 97 serves today). KMPO's growth assumptions were updated based on a demographic analysis performed for the model (*Spokane and Kootenai County Regional Travel Survey, Final Report, July 2005,* NuStats) to identify current land uses and anticipated growth areas across Kootenai County. However, recent heightened interest in the area has brought development pressures to the east side of Coeur d'Alene Lake that were not

anticipated during development of the model six years ago. At the present time, KMPO is updating existing land uses in the regional model, and will be revising forecasted land uses based on Kootenai County's Comprehensive Plan update.

The primary question to be addressed with this practical capacity analysis is how many additional single-family homes (or equivalents) can be constructed in the area served by SH 97 before acceptable LOS standards are exceeded in the peak hour.

For this analysis, the KMPO standard of LOS D was used as an acceptable threshold for SH 97, as it is an appropriate gauge/measure of acceptable conditions for this rural scenic byway. Segment MP 60.63 to 61.19 (near the junction with SH 3) is the limiting segment for the south end of the highway while MP 90.34 to 95.42 (Beauty Bay Hill area) is the limiting segment for the north end of the highway. Volume and housing capacity determinations were made for both ends of the highway as travel patterns change at approximately the lower third of the SH 97 Corridor. From approximately the Powderhorn Bay area (MP 74), travel times to Interstate 90 and destinations such as Coeur d'Alene actually are shorter when traveling to/from the south on SH 97 and then using SH 3 to travel to/from the north. Thus, the travel conditions and therefore the available capacity are different for the northern two-thirds of the highway versus the southern third of the highway.

Data collected for the *Spokane and Kootenai County Regional Travel Survey, Final Report* (SRTC and KMPO, 2005) and further discussions with the KMPO staff indicates that 6.5 trips are generated per single family home in the area served by SH 97. Using comparative rates provided within the Institute of Transportation Engineers, *Trip Generation Manual* (7th Edition, 2003), this would equate to a DHV trip rate of about 0.68 trips per single family home.

AVAILABLE CAPACITY

MP 60.63 - 61.19

As indicated on Table 15, this section of the highway experiences a LOS B with a 160 DHV in the year 2030. A review of corridor LOS via HCM methods indicates this volume could elevate to a DHV of 1,020 vehicles prior to triggering a LOS E grade for this section of highway. This represents an allowable gain of 880 DHV between the year 2006 and forecast year 2030 volumes.

Thus, a comparison of this rate with the trips per home rate (880 trips ÷ 0.68 trips/home) indicates that **approximately 1,294 additional homes or equivalents could be constructed in areas served by the southern one-third of SH 97, before an unacceptable level of service (LOS E) occurs.**

MP 90.34 - 95.42

As indicated on Table 15, this section of highway experiences a LOS D grade with a 480 Year 2030 DHV. A review of corridor LOS via HCM methods indicates that this volume could elevate to a DHV of 855 trips prior to triggering a LOS E grade for this section of highway. This represents an allowable gain of 650 DHV between the existing year 2006 and forecast year 2030 volumes.

Thus, a comparison of this rate with the trips per home rate (650 trips ÷ 0.68 trips/home) indicates that **approximately 956 new homes or equivalents could be constructed in areas served by the northern two-thirds of SH 97, before an unacceptable level of service (LOS E) occurs.**

RECOMMENDATIONS

This section provides a summary of recommendations for SH 97; including some planning/policy decision recommendations.

Practical Capacity

From an operational perspective, the highway currently functions at acceptable LOS ranges during the typical weekday and design hour, with sufficient capacity and tolerable levels of percent-time-following. MP 95.42 through 96.33 currently experiences the most restrictive LOS of the highway (existing LOS C in the peak hour), as traffic volumes are highest versus any other section of the highway. Despite this, LOS is still acceptable under current standards.

If growth follows the historic rates assumed by KMPO, then by year 2030, the DHV review indicates that a LOS C/D range will be experienced between MP 83.20 through 96.43, with the remainder of the highway still functioning at LOS B or better. If growth occurs at a more rapid rate than in the past, it is possible that the highway's remaining carrying capacity could be exceeded before the end of the 20 year planning period.

The push for development and the current state of the roadway leads to the conclusion that improvements should be considered along sections of highway, to help improve safe traffic operations, enhance practical capacity, and reduce percent-time-following.

The *Highway Capacity Manual* indicates the provision of appropriately located passing zones could reduce percent-time-following by up to 35 percent; thus, improving operations back into the LOS B range for MP 83.30 through 96.43 for year 2030. However, this is "ideal" and not practical as the *Highway Capacity Manual* and ITD *Design Manual* also indicate that these passing zones should extend at least one mile to provide the optimal distance needed to improve capacity. Horizontal roadway alignment issues, topography, and fiscal constraints preclude the ability to provide "standard" additional passing lanes. An appropriate compromise might be to provide additional passing zones where it is safe to do so and also provide pullout areas for slow moving vehicles where passing zones cannot be provided safely.

A Policy on the Geometric Design of Highways and Streets (AASHTO, 2004, the "Greenbook") provides alternative passing zone suggestions for reduced speed highways. The "Greenbook" suggests that a minimum passing lane length of 1,835 feet can be used on two lane highways with an operating speed of between 45 and 50 mph. A shorter length of 1,470 feet can be used in areas with reduced 30 to 40 mph travel speeds. However, this distance is not recommended unless reduced speeds are posted and assured, as drivers on SH 97 tend to travel at higher speeds (45 mph or greater) where straight segments of the roadway occur. A passing zone of nearly 2,135 feet should be used in southern areas of the highway where speeds are posted at 55 mph (assumes design speed of up to 60 mph).

Passing lanes/zones could be considered, two way passing lanes at MP 65.1 – 65.88 (south of Harrison near South Manifold Road), an eastbound lane at MP 89.1 – 89.7 (by the Eddyville Road), and an eastbound lane at MP 91.3 – 91.7, where such zones can be provided reasonably, to improve the capacity of the highway. Even the provision of 20 percent available passing zones (roughly equivalent to one passing zone every two miles) would improve operations back into the LOS C range in highway MP 83.20 through 96.43 through year 2030. It must be noted; however, that as volumes increase on SH 97, passing zones will become inherently less safe as drivers risk passing with fewer and shorter gaps in oncoming traffic. The decision to provide additional passing lanes/zones must be based on safety considerations as well as capacity concerns.

Where passing lanes cannot be provided, a "pullout" lane can be provided to help with capacity improvements, albeit to a lesser extent. The "Greenbook" recommends a 300 feet pullout lane where speeds are up to 30 mph, a 450 feet pullout lane where speeds are up to 50 mph, and a 600 feet pullout lane where speeds are up to 60 mph. The frequency would still occur approximately every two miles.

Planning / Policy

In preparing its Comprehensive Plan update, Kootenai County should carefully consider the remaining capacity available on SH 97. The highway should be able to acceptably serve approximately 956 new homes or equivalents constructed in areas of the northern two-thirds of the highway (approximately north of Powderhorn Bay Road), and 1,294 new homes constructed in the southern one-third of the highway (approximately in the area of Powderhorn Bay Road to the south). Unless additional capacity measures are identified and implemented, development that results in higher numbers of homes or equivalents will lead to excessive traffic delays on the highway.

It should also be reiterated that this study provides planning capacity thresholds used in the guidance of land use decisions on SH 97. ITD has indicated that a traffic impact study will be requested of any future developments seeking to directly or indirectly access the highway (via East Side Highway District roads). These studies would be used to help further determine the need of traffic mitigation improvements, which would include participation in needed safety improvements located along the highway.

It is recommended that the agencies of jurisdiction: Kootenai County, Idaho Transportation Department, East Side Highway District, and the City of Harrison should adopt the SH 97 Corridor Plan or amend the Plan to their current planning documents to allow for ease of implementation.