10PD031

TRAFFIC IMPACT STUDY

FOR THE

PROPOSED BLACK HILLS CENTER

RAPID CITY, SOUTH DAKOTA

Prepared For:

THF Realty

In Cooperation With:

City of Rapid City & South Dakota DOT

March **2010**

Prepared By:

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

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Prepared For:

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CBB Job Number 5-10

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Executive Summary

THF Realty is proposing a commercial development, known as Black Hills Center, in the northwest quadrant of Catron Boulevard and 5th Street in Rapid City, South Dakota. Based on the latest plan, the proposed 58 acre site would consist of a 154,750 square feet Wal-Mart supercenter, approximately 46,900 square feet of retail space and 14 outlots. Access to the Wal-Mart Supercenter would be provided via three full-access driveways on Stumer Road which runs parallel to Catron Boulevard and intersects 5th Street just north of Catron Boulevard. Access is also provided off Catron Boulevard via Black Hills Boulevard which ties into Stumer Road.

A traffic impact study for essentially the same development area was previously prepared in July 2005 by Felsburg Holt & Ullevig (FHU). However, the FHU study considered a development area of approximately 87 acres. Since the 2005 FHU study, minimal development has occurred on the site. Stumer Road has been constructed and is a hybrid between the two options considered in the study. Based on the current proposed development plan, Parkview Drive would not connect to the main development area or extend to Stumer Road as previously assumed in the FHU study.

At the request of the City of Rapid City and the South Dakota Department of Transportation (SDDOT), a new Traffic Impact Study was completed for the current development plan under consideration, as well as the approximate 30 acres adjacent to the site in order to account for the entire 87 acres available for development. This study was prepared in accordance with parameters discussed with both the City and the SDDOT.

2010 No Build Conditions

In order to identify the traffic impacts associated with the proposed development, it was first necessary to quantify the 2010 No Build (base) roadway, traffic, and operating conditions. To that end, an operational analysis of the 2010 No Build traffic volumes on the surrounding road system was performed.

In order to establish the baseline traffic conditions, manual peak period traffic counts were conducted in February 2010 at the critical intersections within the study area during the weekday p.m. and Saturday midday peak periods. In general, traffic volumes were fairly light throughout the study corridor with plenty of excess capacity at the study intersections. Also considered in the 2010 Build conditions was the planned widening of Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a center left-turn lane.

Based on the evaluation of the 2010 No Build conditions, all of the study intersections had overall favorable operating conditions during the weekday p.m. and Saturday midday peak hours with each intersection approach operating at LOS C or better with the majority operating at LOS A or B during the peak hours.

It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for these programmed roadway projects was based, in part, on additional commercial development along the corridors.

2010 Build Conditions

Forecasts were prepared for the proposed Black Hills Center development area by calculating the trip generation and directional distribution for the proposed uses. Based on the current plan, the proposed development would be expected to generate a total of 2,630 *new* trips during the weekday p.m. peak hour and 2,870 *new* trips during the Saturday midday peak hour.

It is important to note, that the trip generation rate utilized for the Wal-Mart Supercenter was approximately 40% higher than the rate typically used throughout the country. However, based on the existing trip generation for the Rapid City Wal-Mart, staff felt the inflated rate was appropriate at this location.

In order to accommodate the proposed development traffic, the following roadway and traffic control improvements are recommended:

- Signalize the intersection of Catron Boulevard and Black Hills Boulevard.
- Signalize the intersection of 5th Street and Stumer Road.
- Coordinate the two proposed traffic signals with the existing traffic signal at Catron Boulevard and 5th Street.
- Convert the existing all-way STOP at Stumer Road and Black Hills Boulevard to a side-street STOP condition with Black Hills Boulevard operated under stop control and Stumer Road maintaining the right-of-way. Alternatively, a single-lane roundabout would also provide favorable operations.
- Construct a separate westbound right-turn lane on Stumer Road at the main Wal-Mart drive. This right-turn movement should be channelized.
- Construct a separate westbound right-turn lane at the east driveway serving the retail shops.
- Consider providing a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10.
- Restripe the eastbound Stumer Road approach at 5th Street to provide 290 feet of left-turn storage.
- Maintain free operation for the three perimeter traffic signals at Highway 16 and Catron Boulevard, Highway 79 and Catron Boulevard, and 5th Street and Minnesota Street.

The 2010 Build traffic volumes were reanalyzed in an effort to identify the impacts of the proposed development and to evaluate the adequacy of the proposed roadway and traffic control improvements to mitigate those impacts. The evaluation reflected the implementation of the proposed improvements noted above.

Even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the widening project on Catron Boulevard. Both of these

roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

The access along Stumer Road, as proposed in the current plan, exceeds the desired spacing of 200 feet identified in the City's Street Design Criteria Manual. Ideally, the access for adjoining outlots could share one access drive onto Stumer Road. However, as specific users are identified, there may be a need to modify the access along Stumer Road from that shown in the current site plan. In general, any modifications to the access should, at a minimum, provide 105 feet of separation, and ideally provide the desired 200 feet.

2030 Build Conditions

"Design Year" 2030 traffic conditions were evaluated in an effort to determine the ability of the area road system to accommodate long-term traffic demands. By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and with Black Hills Boulevard introduces additional signal phases not required in the 2010 Build conditions. As a result of the fourth leg and the increased background traffic, the two intersections would decline to LOS D overall with several movements operating near capacity.

Consequently, the following roadway improvements may be necessary to accommodate the 2030 traffic conditions:

- Consider providing eastbound dual-left turn lanes on Catron Boulevard at Black Hills Boulevard. In order to accommodate the eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road.
- Consider providing southbound dual-left turn lanes on 5th Street at Catron Boulevard.

With the implementation of the above roadway improvements, all of the signalized intersections would operate at LOS C during the weekday p.m. peak hour.

Introduction

Crawford, Bunte, Brammeier prepared the following study to address the traffic impacts associated with the proposed Black Hills Center commercial development in Rapid City, South Dakota. This study was prepared in accordance with parameters discussed with both the City of Rapid City and the South Dakota Department of Transportation (SDDOT). The site is located in the northwest quadrant of Catron Boulevard and 5th Street. The site is approximately 58 acres and is zoned commercial. Currently, the site is vacant with the exception of a small apartment complex in the northwest quadrant of Catron Boulevard and Black Hills Boulevard. The study area is depicted in **Figure 1**.

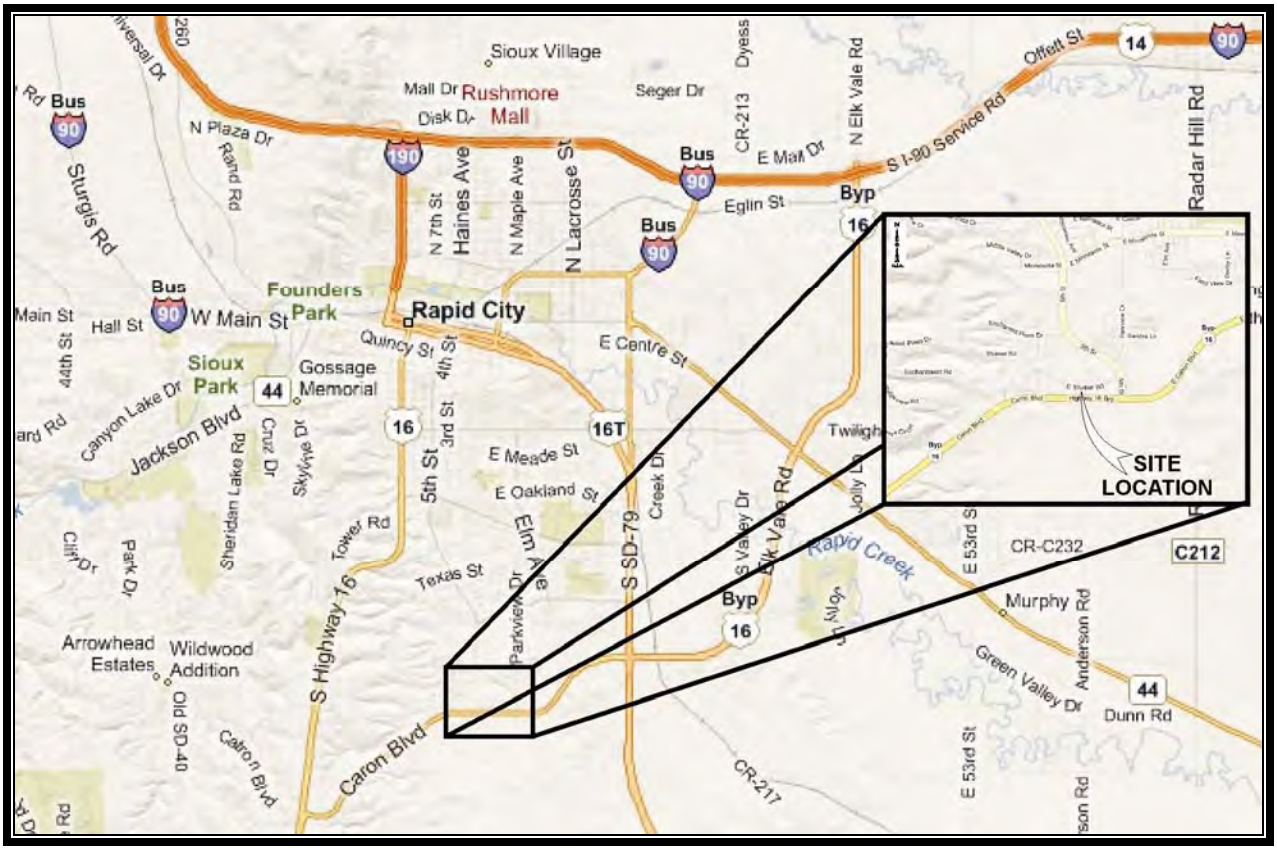

Figure 1: Site Location Map

A traffic impact study for essentially the same development area was previously prepared in July 2005 by Felsburg Holt & Ullevig (FHU). However, the FHU study considered a development area of approximately 87 acres. Several recommendations were offered by FHU including signalizing the intersections of Catron Boulevard with Black Hills Boulevard and 5th Street with Stumer Road. Additionally, two options for the alignment of Stumer Road through the development area were considered. Option 1 aligned Stumer Road through the southern portion of the site and required the signalization of 5th Street with Parkview Drive, while Option 2 aligned Stumer Road through the northern portion of the site and recommended to monitor the intersection of 5th Street with Parkview Drive for future signal warrants.

Since the 2005 FHU study, minimal development (approximately 96 apartment units) has occurred on the site. Stumer Road has been constructed and is a hybrid between the two options, though the constructed alignment follows more of a southern tract through the development area. Based on the current proposed development plan, Parkview Drive would not connect to the main development area or extend to Stumer Road. Thus, it may not be necessary to signalize 5th Street and Parkview Drive as previously recommended in the FHU study. Additionally, with the redistribution of site-generated traffic from Parkview Drive to Stumer Road, the roadway geometrics at 5th Street and Stumer Road need to be reevaluated to determine if any improvements are necessary to accommodate the current proposed development plan.

To that end, a new Traffic Impact Study was completed for the current development plan under consideration, as well as the approximate 30 acres adjacent to the site in order to account for the entire 87 acres available for development. Based on the latest plan submitted by THF Realty (and prepared by Wolverton & Associates, Inc.), the proposed 58 acre site would consist of a 154,750 square feet Wal-Mart supercenter, approximately 46,900 square feet of retail space and 14 outlots. Access to the Wal-Mart Supercenter would be provided via three full-access driveways on Stumer Road. Stumer Road runs parallel to Catron Boulevard and intersects 5th Street just north of Catron Boulevard. Access is also provided off Catron Boulevard via Black Hills Boulevard which ties into Stumer Road. The proposed site plan is depicted in **Exhibit 1**.

The purpose of this study was to determine the amount of traffic that would be generated by the proposed Black Hills Center development, evaluate its impact upon the adjoining road system and identify the need for roadway and/or traffic control improvements to mitigate those impacts. The focus of the analysis was the p.m. peak hour of a typical weekday and the midday peak period of a Saturday since these represent the most critical time periods with regards to traffic operations for the proposed commercial development.

The following report summarizes our findings regarding existing conditions (2010 No Build) and forecasted conditions (2010 Build and 2030 Build). The methodology employed to complete this study, along with the findings and recommendations, are discussed in greater detail in the subsequent sections.

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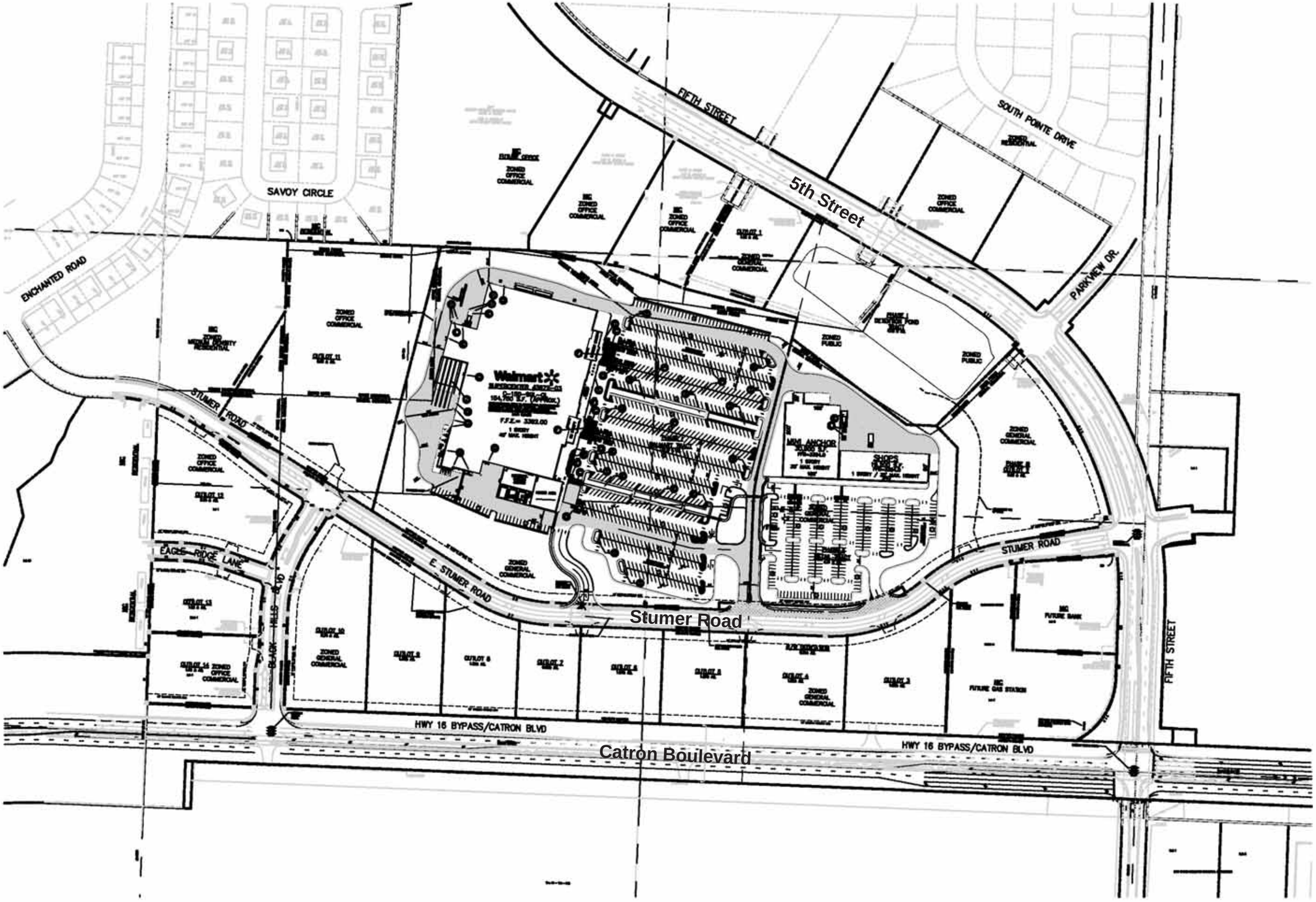

Exhibit 1: Site Plan

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Existing Roadway & 2010 No Build Traffic Conditions

Before analyzing the impacts of the proposed Black Hills Center development area, it was first necessary to establish the baseline traffic conditions on the adjacent roadways *without* the additional traffic that would be generated by the proposed development.

Existing and Proposed Roadway Network

Catron Boulevard is a primary east-west expressway through the southern portion of the City of Rapid City. Catron Boulevard currently extends from Sheridan Lake Road on the east side to Highway 44 on the western end. Catron Boulevard adjacent to the subject site is currently three lanes (two westbound lanes and one eastbound lane), east of 5th Street Catron Boulevard narrows to two lanes. Catron Boulevard has a posted speed of 60 miles per hour (mph) and serves as a truck bypass route for Highway 16.

Construction is expected to begin this spring to widen Catron Boulevard from Highway 16 to just west of Highway 79 to a four-lane roadway with a center left-turn lane. Additionally, auxiliary turn lanes at the intersections of Black Hills Boulevard and at 5th Street are planned as part of the construction project. In addition, Dan Christy Lane which is just west of Black Hills Boulevard will be converted from a full access intersection to a right-in/right-out only intersection.

Fifth Street is a primary north-south roadway through the central portion of the City. Fifth Street through the study area is a five-lane roadway with two lanes in each direction and a center left-turn lane. A raised median exists between Catron Boulevard and Parkview Drive and on either side of Enchanted Pines Drive. The posted speed along 5th Street is 45 mph.

Black Hills Boulevard is a collector road serving as a main access off Catron Boulevard for the Black Hills center development area. Black Hills Boulevard is a three lane roadway with one lane in each direction with left-turn lanes provided at Stumer Road and Bald Eagle Lane. **Figure 2** provides an aerial view of Black Hills Boulevard between Catron Boulevard and Stumer Road.

Figure 2: Black Hills Boulevard – Catron Boulevard to Stumer Road

Stumer Road is a collector roadway that parallels Catron Boulevard to its north. The City recently constructed Stumer Road through the development area. Stumer Road between Black Hills Boulevard and 5th Street is a three-lane roadway with one lane in each direction and a center left-turn lane. The posted speed limit on Stumer Road is 25 mph. **Figure 3** provides an aerial view of the 5th Street and Stumer Road intersection.

Figure 3: 5th Street and Stumer Road Intersection

Parkview Drive, Enchanted Pines Drive and Enchantment Road are all local collector roadways in the vicinity of the site.

The intersection of Catron Boulevard and 5th Street is signalized. The traffic signal operates free. The left-turn movements on Catron Boulevard operate under protected only left-turn phasing (left-turn only on left arrow).

The intersection of Catron Boulevard and Black Hills Boulevard is operated as side-street STOP control with Black Hills Boulevard required to stop.

Likewise, the intersections of 5th Street with Stumer Road, Parkview Drive and Enchanted Pines Drive are all operated as side-street STOP control with the side streets required to stop and 5th Street maintaining the right-of-way.

The intersection of Black Hills Boulevard and Stumer Road is operated as an all-way STOP control intersection.

The 2010 No Build lane configurations and traffic control at each study intersection are graphically illustrated in **Exhibit 2**. Note that the planned roadway improvement project along Catron Boulevard is depicted in the 2010 No Build roadway network.

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Legend

= Existing Traffic Signal
= Existing Side Street Stop Control
= All-Way Stop
= Existing Laneage
XXX' = Turning Bay Length

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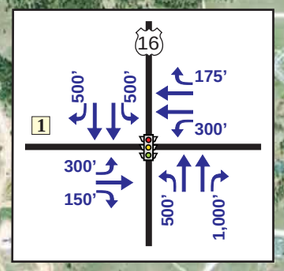
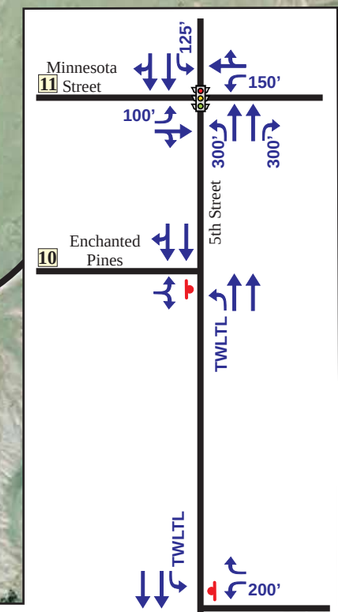
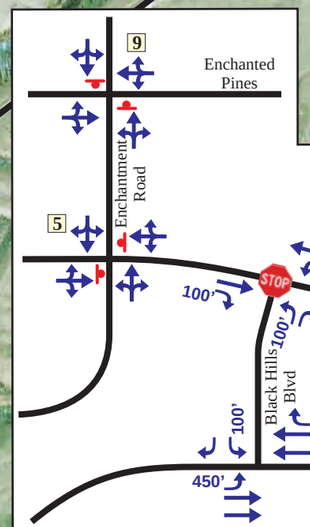
16
5th Street
Minnesota Street
11
Parkview Drive
79
4
Elk Vale Road
Enchanted
Pines
9
10
5
Enchantment
Road
6
Stumer Road
8
7
2
3
1







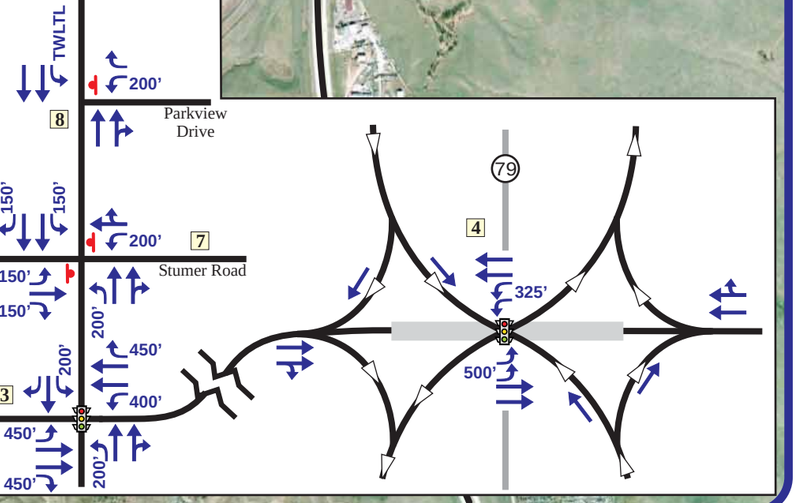


Exhibit 2: 2010 No Build Lane Assignments and Traffic Control

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Existing Land Uses

The proposed development area is located in the northwest quadrant of Catron Boulevard and 5th Street. The study site is bordered by Catron Boulevard to the south, 5th Street to the east and north, and Enchantment Road to the west. The land surrounding the proposed development area is largely undeveloped, though the City's Zoning Map shows that much of the land bordering 5th Street and Catron Boulevard is zoned General Commercial, Office Commercial or Highway Service. The zoning outside of these areas is mostly Lower and Medium Density Residential. An excerpt from the City's Land Use Zoning Map is shown in **Figure 4**.

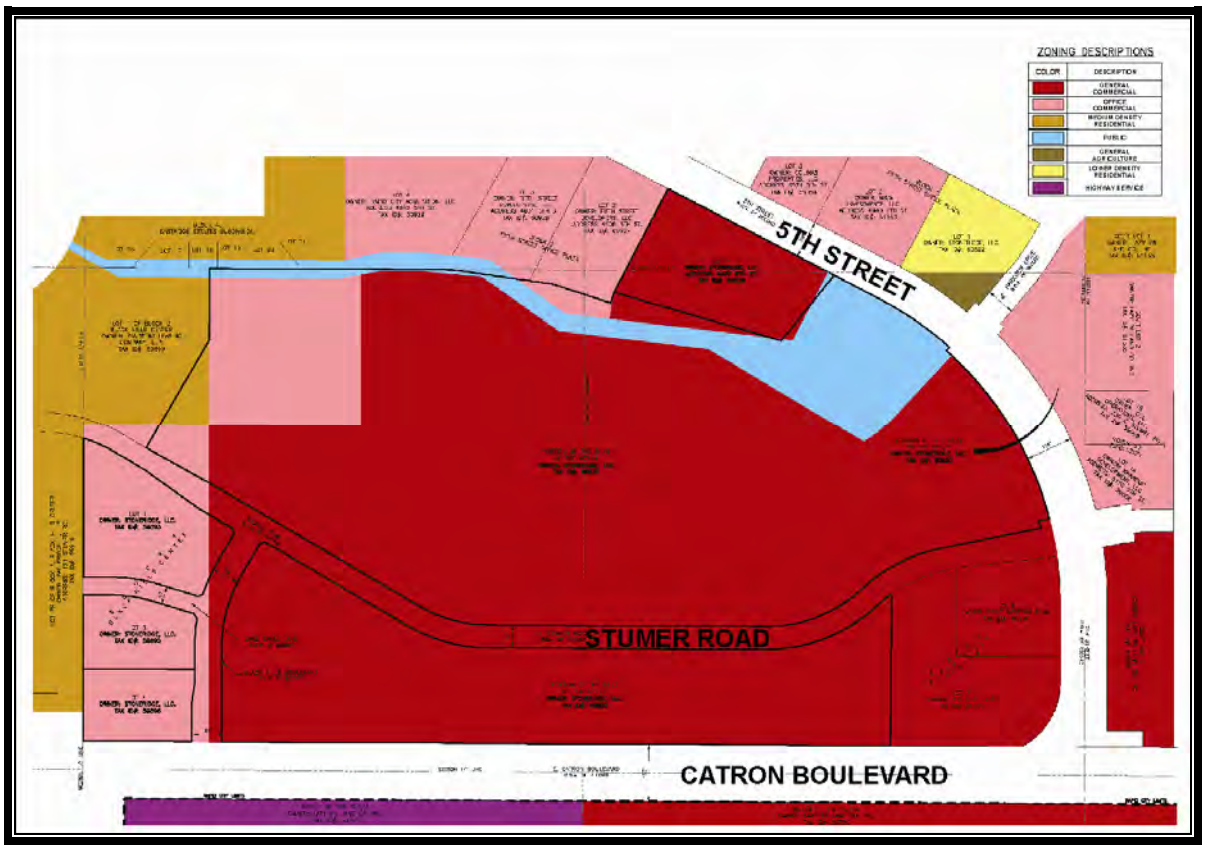


Figure 4: Land Use Zoning Map

Existing Traffic Volumes

The immediate study area for the analyses includes the following intersections:

- Catron Boulevard and 5th Street (signalized);
- Catron Boulevard and Black Hills Boulevard (unsignalized);
- 5th Street and Stumer Road (unsignalized);
- 5th Street and Parkview Drive (unsignalized);
- 5th Street and Enchanted Pines Drive (unsignalized); and
- Stumer Road and Black Hills Boulevard (unsignalized).

At the request of Rapid City and SDDOT, the following additional intersections were evaluated for the weekday p.m. peak hour scenario:

- Catron Boulevard and Highway 16 (signalized);
- Catron Boulevard and Highway 79 (signalized); and
- 5th Street and Minnesota Street (signalized).

In order to quantify the existing traffic conditions near the site, turning movement counts were performed at the aforementioned study intersections during the weekday afternoon (4:00-6:00 p.m.) peak period and the Saturday midday peak period (11:00 a.m. - 1:00 p.m.) in February 2010. The City and SDDOT provided the weekday p.m. peak hour traffic counts for the additional intersections noted above.

Based on these counts, a weekday afternoon peak hour (4:30 to 5:30 p.m.) and a Saturday midday peak hour (11:15 a.m. to 12:15 p.m.) were chosen for analysis. These peak periods of the adjacent roadway would coincide with the peak trip generation times for the proposed Black Hills Center development. Therefore, if traffic from the proposed Black Hills Center development can be accommodated at these times, it can be reasoned that adequate capacity would be available throughout the remainder of the day.

Additionally, daily traffic volumes were provided by the City and SDDOT for 5th Street and Catron Boulevard in the vicinity of the development. A review of this count data found that traffic volumes along Catron Boulevard are approximately 800 vehicles per hour (vph) for the weekday a.m. and p.m. peak hours, while the traffic volumes are fairly consistent from approximately 8:00 a.m. to 4:00 p.m. with two-way traffic volumes of approximately 500 vph. During the weekday p.m. peak hour, the traffic volumes along Catron Boulevard are heavier in the westbound direction. For the Saturday midday peak hour, the traffic volumes along Catron Boulevard are much lower with approximately 500 vph. The traffic flow on Saturday is balanced between the eastbound and westbound directions.

Traffic volumes along 5th Street are approximately 450 vph for the weekday a.m. and p.m. peak hours, while the traffic volumes are fairly consistent through the midday with two-way traffic volumes of approximately 240 vph. During the weekday p.m. peak hour, the traffic volumes along 5th Street are heavier in the southbound direction. For the Saturday midday peak hour, the traffic volumes along 5th Street are much lower with approximately 200 vph. The traffic flow on Saturday is fairly balanced between the northbound and southbound directions.

According to the daily traffic volumes provided by the City and SDDOT, Catron Boulevard carries nearly 13,400 vehicles per day (vpd) during a typical weekday, while 5th Street carries nearly 6,100 vpd during a typical weekday.

As discussed with the City and SDDOT, due to the seasonal fluctuations in the traffic volumes in the area as a result of the tourism industry, the existing traffic volumes were adjusted. Based on data provided by the City, the adjustment factor for the month of February is 1.04. Thus, the existing traffic counts were increased by a factor of 1.04 and rounded to the nearest 5. The base, 2010 No Build, traffic volumes are summarized in **Exhibit 3**.

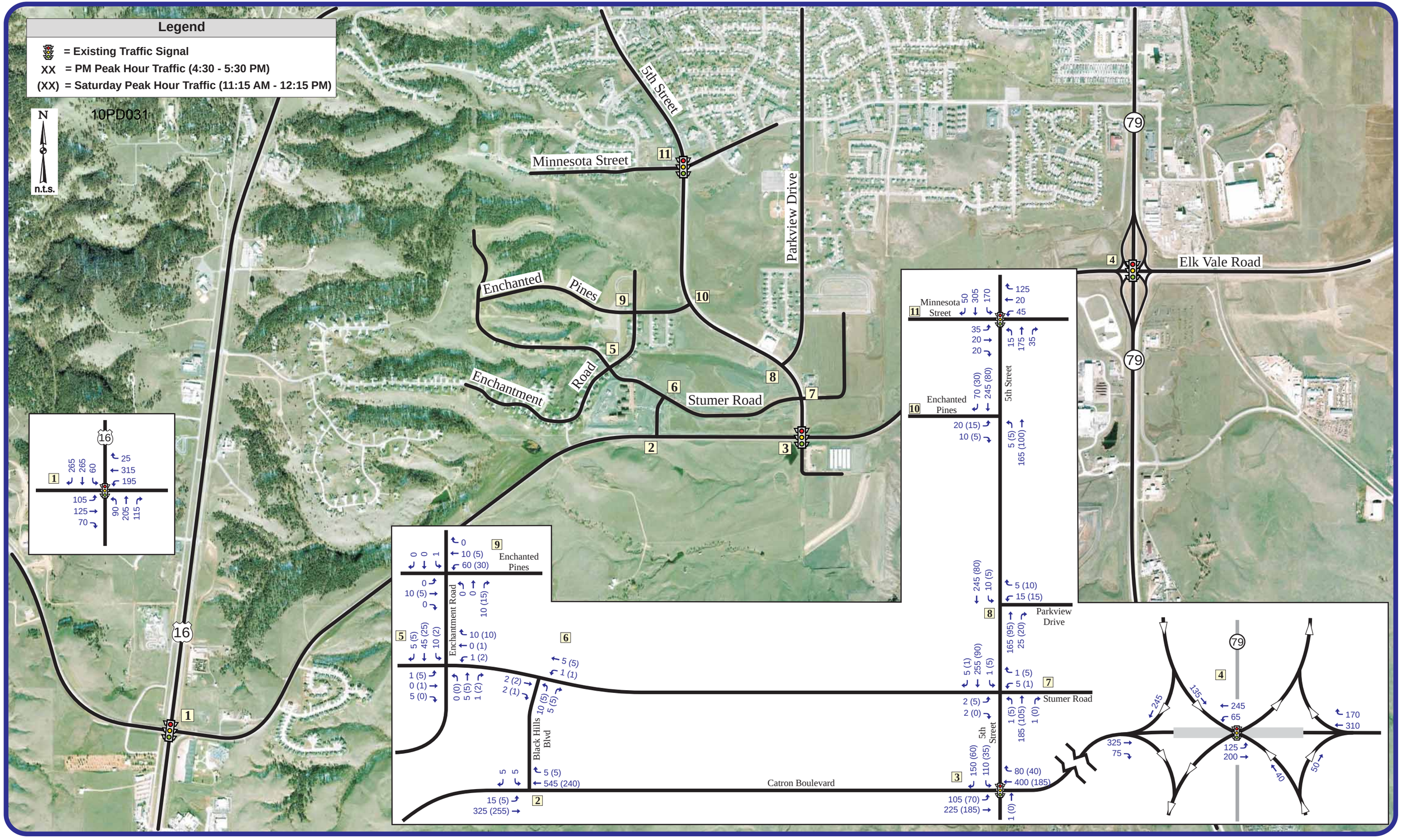


Exhibit 3: 2010 No Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

As mentioned previously, with the widening of Catron Boulevard this summer, Dan Christy Lane will be converted from a full access intersection to a right-in/right-out only intersection. As a result, motorists currently using Dan Christy Lane to make an eastbound left-turn or a southbound left-turn would be accommodated via Black Hills Boulevard. The existing traffic volumes along Enchanted Pines Drive and Enchantment Road are shown in **Figure 5**.

Based on a review of the traffic volumes, it appears that some motorists on 5th Street may be using Enchanted Pines Drive/Enchantment Road/Dan Christy Lane as a cut-thru route to by-pass the traffic signal at Catron Boulevard and 5th Street. As shown in Figure 5, there appears to be approximately 25 to 30 southbound 5th Street to westbound Catron Boulevard trips using the route as a cut-thru. Likewise, there appears to be approximately 10 to 20 eastbound Catron Boulevard to northbound 5th Street trips using the route as a cut-thru.

Thus, although the restricted access at Dan Christy Lane would require the local residents to use Black Hills Boulevard for some movements, it would actually eliminate any eastbound Catron Boulevard to northbound 5th Street cut-thru trips. The 2010 No Build Traffic Volumes were adjusted to account for the restricted access at Dan Christy Lane.

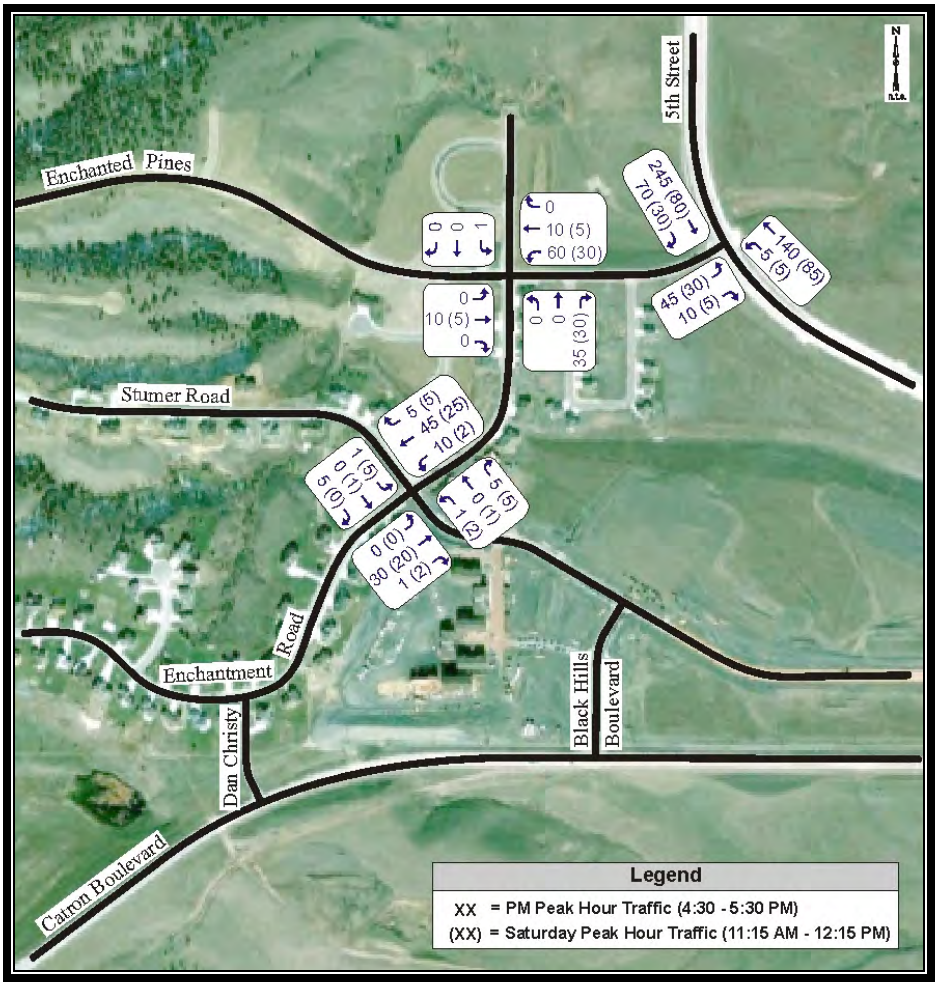


Figure 5: Enchantment Road Existing Traffic Volumes

2010 No Build Operating Conditions

The intersections within the study area were evaluated to quantify the 2010 No Build operating conditions. The analysis was completed using SYNCHRO 7, which is based upon the methodologies outlined in the "Highway Capacity Manual" (HCM) published in 2000 by the Transportation Research Board. This manual, which is used universally by highway and traffic engineers to measure roadway capacity, established six levels of traffic service: "Most Desirable" (Level A), to "Fully Loaded" (Level F).

Levels of traffic service are measures of traffic flow, which consider such factors as speed and delay time, traffic interruptions, safety, driving comfort and convenience. Level C, which is normally used for highway design, represents a roadway with volumes ranging from 70% to 80% of its capacity. However, Level D is often considered acceptable for peak period operating conditions in urban areas.

Level of Service (LOS) and vehicular delay are key Measures of Effectiveness in the analysis of traffic operations. The thresholds that define LOS are based upon the type of traffic control used at an intersection, i.e. whether it is signalized or unsignalized. For signalized and all-way stop controlled intersections, the average control delay per vehicle is estimated for each movement and aggregated for each approach and the intersection as a whole. At intersections with partial (side-street) stop control, the delay is determined for each minor movement instead of the intersection as a whole since motorists on the main road are not required to stop.

LOS is directly related to control delay. At signalized intersections, the LOS criteria differ from that at unsignalized intersections primarily because different transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes and, consequently, may experience greater delay than an unsignalized intersection. **Table 1** summarizes the LOS thresholds used in the analysis.

Table 1: Level of Service Thresholds

Level of Service (LOS)	Control Delay per Vehicle (sec/veh)	
	Signalized Intersections	*Unsignalized Intersections*
A	≤ 10	0-10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

The 2010 No Build operating conditions at the study intersections are summarized in **Table 2**. As can be seen, all of the study intersections within the immediate area operate favorably during the weekday p.m. and Saturday midday peak hours. In fact, each intersection approach operates

at LOS C or better, with the majority operating at LOS A or B during the peak hours analyzed. It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for these roadway projects was based, in part, on additional commercial development along the corridors.

Table 2: 2010 No Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	B (13.1)	B (10.2)
Westbound Catron Boulevard Approach	B (18.3)	B (14.0)
Northbound 5th Street Approach	C (26.0)	B (20.0)
Southbound 5th Street Approach	A (9.4)	A (5.6)
Overall Intersection	*B (14.5)*	*B (10.9)*
Catron Boulevard & Black Hills Boulevard (Side-Street Stop)		
Eastbound Catron Boulevard Left-Turn	A (8.8)	A (7.8)
Southbound Black Hills Boulevard Left-Turn	C (16.6)	B (11.4)
Southbound Black Hills Boulevard Right-Turn	B (10.2)	A (9.0)
5th Street & Stumer Road (Side-Street Stop)		
Eastbound Stumer Road Approach	B (11.6)	A (9.8)
Westbound Stumer Road Approach	B (11.2)	A (9.8)
Northbound 5th Street Left-Turn	A (7.8)	A (7.4)
Southbound 5th Street Left-Turn	A (7.6)	A (7.5)
Black Hills Boulevard & Stumer Road (All-Way Stop)		
Eastbound Stumer Road Approach	A (6.1)	A (6.2)
Westbound Stumer Road Approach	A (6.5)	A (6.5)
Northbound Black Hills Boulevard Approach	A (6.5)	A (6.3)
5th Street & Parkview Drive (Side-Street Stop)		
Westbound Parkview Drive Left-Turn	B (11.0)	A (9.6)
Westbound Parkview Drive Right-Turn	A (8.9)	A (8.7)
Southbound 5th Street Left-Turn	A (7.7)	A (7.5)
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	B (10.9)	A (9.4)
Northbound 5th Street Left-Turn	A (8.0)	A (7.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As requested by the City and SDDOT, the closest major intersections on 5th Street and Catron Boulevard to the study area were evaluated to assess any traffic signal timing modifications that may be necessary during the weekday p.m. peak hour. The 2010 No Build operating conditions for the perimeter intersections are summarized in **Table 3**. As can be seen, the intersections operate favorably during the weekday p.m. peak hour with each signalized intersection operating at LOS C or better. Additionally, each intersection approach operates at LOS B or C.

The three perimeter intersections all operate free. In free operation, the traffic signal runs based on its own demand and timing parameters based on the information provided by its detectors. The signal does not operate under any background cycle length. If there are no nearby traffic signals, free operation will often provide the most favorable operations.

Table 3: 2010 No Build Operating Conditions (Perimeter Intersections)

Intersection/Movement	Weekday PM Peak Hour
Catron Boulevard & Highway 16 (signalized)	
Eastbound Catron Boulevard Approach	C (21.5)
Westbound Catron Boulevard Approach	C (21.8)
Northbound Highway 16 Approach	C (22.5)
Southbound Highway 16 Approach	C (20.5)
Overall Intersection	C (21.5)
Catron Boulevard & Highway 79 (signalized)	
Eastbound Catron Boulevard Approach	B (14.3)
Westbound Catron Boulevard Approach	B (12.5)
Northbound Highway 79 Approach	B (11.3)
Southbound Highway 79 Approach	B (11.5)
Overall Intersection	*B (12.7)*
5th Street & Minnesota Street (signalized)	
Eastbound Minnesota Street Approach	B (15.7)
Westbound Minnesota Street Approach	B (10.7)
Northbound 5th Street Approach	B (18.9)
Southbound 5th Street Approach	B (10.9)
Overall Intersection	*B (13.0)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Site-Generated Traffic

Once the base roadway and traffic conditions within the study area have been established, it was then necessary to consider the traffic associated with the proposed Black Hills Center development area. As a primary step in this analysis, trip generation forecasts and directional distribution estimates for the proposed development area were generated.

As mentioned previously, a Traffic Impact Study was prepared by FHU for essentially the same development area in July 2005, then called Black Hills Estates. The FHU study considered a development area of approximately 87 acres and was based on a development plan consisting of the following uses:

- 328,000 ft^2 of retail space;
- 110,600 ft^2 of office space;
- 10,000 ft^2 of high turnover sit-down restaurant space (2 restaurants);
- 15,000 ft^2 of bank space (2 banks);
- a 15,000 ft^2 theater;
- a gas station (8 pumps);
- an 80 room motel;
- a 70 room hotel;
- 140 apartments; and
- a 64 unit assisted living facility.

However, to date, only Phase I of the apartment complex has been constructed on the site. Based on the 2005 FHU study, the previous development plan was expected to generate approximately 1,210 trips during the a.m. peak hour and 3,215 trips during the p.m. peak hour.

Trip Generation Estimate

THF Realty is now considering a revised development plan of approximately 58 acres which would include a Wal-Mart Supercenter as the major anchor. Based on the site plan provided by Wolverton and Associates, dated January 14, 2010, the revised development (58 acres) would consist of the following uses (uses were assumed for the outparcels):

- a 154,750 ft^2 Wal-Mart Supercenter;
- 90,900 ft^2 of retail space;
- 64,000 ft^2 of office space;
- 10,000 ft^2 of high turnover sit-down restaurant space (2 restaurants);
- 6,000 ft^2 of fast-food restaurant space (2 restaurants);
- a 45,000 ft^2 theater;
- an 80 room motel; and
- a 70 room hotel.

However, in order to account for the entire 87 acre development area, the adjacent parcels previously included in the FHU Study were added to the current development area. The adjacent parcels were previously assumed to include the following uses:

- a 64 unit assisted living facility (parcel between Outlot 11 and Enchantment Road);
- 62,600 ft^2 of office space (three parcels in the southwest quadrant of Fifth Street and Enchanted Pines Drive);
- a gas station (northwest quadrant of Catron Boulevard and Fifth Street);
- a bank (northwest quadrant of Catron Boulevard and Fifth Street); and
- 58 apartments (Phase II of the apartment complex).

The number of trips that would be generated by the revised Black Hills Center development area was estimated using data provided in the *Trip Generation Manual*, 8th Edition, published by the Institute of Transportation Engineers (ITE). This publication is a standard resource for transportation engineers and consists of a compilation of nationwide studies documenting the characteristics of various land uses.

It should be noted that the trip generation forecasts for the Wal-Mart Supercenter were based on a review of several sources, including the *Trip Generation Manual*, the *Nationwide Wal-Mart Supercenter Study* prepared by the Texas Transportation Institute (TTI) in 2008 which represents data from 32 stores nationwide, and the *Verify Certain ITE Trip Generation Rate Applications in South Dakota* study prepared by the SDDOT in October 2005. The various trip generation rates are summarized in **Table 4**.

Table 4: Discount Supercenter Trip Generation Rate Comparison

Period	Trip Generation Rate							
	ITE 8th Ed	TTI Study[2]	Sioux Falls[3]	Rapid City[3 4]	Pierre[3]	Spearfish[3]	Yankton[3]	Water town[3]
Weekday a.m. peak hour (7:00 - 9:00 a.m.)	1.67	1.46	1.3	NA	1.92	0.79	1.15	0.75
Weekday p.m. peak hour (4:00 - 6:00 p.m.)	4.61	4.5	5.81	8.69	9.48	3.41	4.88	3.41
Saturday midday peak hour (11:00 a.m.- 2:00 p.m.)	5.64	5.63	5.18	9.55	8.37	3.88	5.71	4.54
Weekday Daily	53.13	53.04	66.14	101.95	107.23	42.54	55.16	45.03

[1] Trip rates are trips per 1,000 square feet GFA.
[2] Nationwide Wal-Mart Supercenter Study, Texas Transportation Institute, March 2008
[3] Verify Certain ITE Trip Generation Rate Applications in South Dakota, SDDOT, October 2005
[4] Adusted to account for the exclusion of the Golden Coral restaurant

Based on discussions with the City and SDDOT staff, it was agreed that a rate between the existing Rapid City store (SDDOT Study) and the Sioux Falls store (SDDOT Study) would be used. Thus, a rate of 7.3 was utilized for both the weekday p.m. and Saturday midday peak hours. It should be noted that this rate is approximately 40% higher than the rates provide by both the *Trip Generation Manual* and the *Nationwide Wal-Mart Supercenter Study*. However, based on the existing trip generation for the Rapid City Wal-Mart, staff felt the inflated rate was appropriate at this location.

The resulting trip generation estimates for the *entire* Black Hills Center development area are summarized in **Table 5**.

Table 5: Black Hills Center Trip Generation Estimate

ITE Code	Land Use	Size	Weekday PM Peak Hour			Saturday Midday Peak Hour		
			In	Out	Total	In	Out	Total
SDDOT	Wal-Mart Supercenter	154,750 ft²	565	565	1130	565	565	1130
820	Retail Space	90,900 ft²	290	305	595	420	385	805
710	Office Space	126,600 ft²	40	180	220	25	20	45
932	HTSD Restaurant	5,000 ft²	35	20	55	65	35	100
932	HTSD Restaurant	5,000 ft²	35	20	55	65	35	100
934	Fast-Food Restaurant	3,000 ft²	55	50	105	90	85	175
934	Fast-Food Restaurant	3,000 ft²	55	50	105	90	85	170
445	Multiplex Theater	45,000 ft²	135	85	220	115	40	155
320	Motel	80 rooms	20	15	35	30	25	55
310	Hotel	70 rooms	20	20	40	30	25	55
254	Assisted Living	64 units	5	10	15	10	10	20
912	Drive-In Bank	4 lanes	55	55	110	55	60	115
945	Gas Station	12 pumps	80	80	160	100	100	200
220	Apartments (Phase II)	58 units	30	20	50	20	25	45
	Gross Total Trips		*1,420*	*1,475*	*2,895*	*1,680*	*1,495*	*3,175*
	Common Trip Reduction (15%)		*(130)*	*(135)*	*(265)*	*(165)*	*(140)*	*(305)*
	New Trips		*1,290*	*1,340*	*2,630*	*1,515*	*1,355*	*2,870*

As shown in Table 5, based on the revised development plan, the entire development area would be expected to generate a "gross" increase in trips of approximately 2,895 trips during the weekday p.m. peak hour and 3,175 trips during the Saturday midday peak hour. Based on the 2005 FHU study, the previous development plan was expected to generate approximately 3,215 trips during the p.m. peak hour. Thus, the revised plan would actually generate approximately 320 fewer trips during the weekday p.m. peak hour as compared to the 2005 trip generation estimates for the same development area.

It is important to note that ITE estimates assume each of the development's uses would be freestanding. Instead, the uses within the development area would share access to the main roadways surrounding the site and in many cases parking. Published studies show that patrons of multi-use developments often visit more than one use within the development during a single

visit. As a result, a portion of the trips generated by the development would be captured internally and not impact the external road system. To account for internal capture trips within the proposed Black Hills Center, a 15% "common trip" reduction was applied during the weekday p.m. and Saturday midday peak hours. These common trips were assigned between the respective uses along Stumer Road. It is important to note that the Wal-Mart Supercenter was considered as the anchor for the development area and, as such, a common trip reduction was not applied to the Wal-Mart in order to be conservative.

The gross trip generation shown in Table 5 was adjusted to account for common trips. As a result, the proposed Black Hills Center development area would generate 2,630 "new" trips during the weekday p.m. peak hour and 2,870 "new" trips during the Saturday peak hour.

Based on conversations with the City and SDDOT staff, it was agreed that no further reductions would be made to account for pass-by trips (traffic already present on the adjacent roads attracted to the development on their way to or from home, work or another destination). Although pass-by trips do not represent an increase in traffic along the adjacent roads, they do represent turning movements into and out of the development.

Trip Distribution Estimate

The traffic generated by the proposed Black Hills Center development was assigned to the adjoining road system based upon the site's access configuration, existing traffic patterns, anticipated operating characteristics and proximity to other Wal-Mart stores. Based on conversations with the City and SDDOT staff, it was agreed that the new trips generated by the proposed development would be oriented as follows:

- 40% to/from the west on Catron Boulevard;
- 25% to/from the east on Catron Boulevard;
- 25% to/from the north on 5th Street;
- 4% to/from the west on Stumer Road;
- 3% to/from the east on Stumer Road; and
- 3% to/from the northeast on Parkview Drive.

Based on the trip generation and distribution estimates, the site-generated traffic for the proposed Black Hills Center development area was assigned to the adjoining road system as shown in **Exhibit 4**

As can be seen, the proposed Black Hills Center development area would be expected to generate a significant increase in the volumes along Catron Boulevard and 5th Street and specifically the turning movements at the intersections of 5th Street and Catron Boulevard, 5th Street and Stumer Road and Catron Boulevard and Black Hills Boulevard.

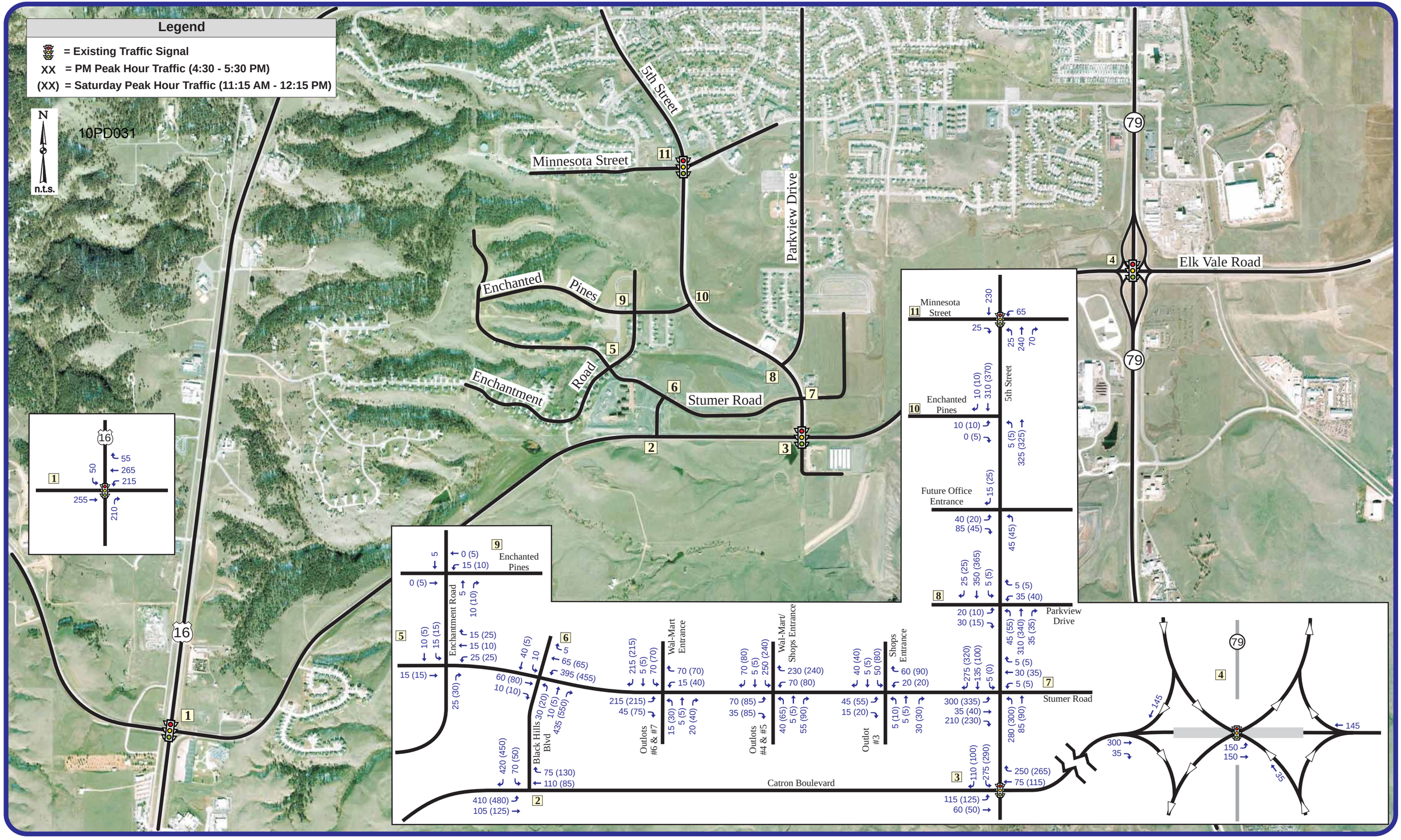


Exhibit 4: Site-Generated Trips

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
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3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2010 Build Conditions

Once the base roadway and traffic conditions have been established, the site-generated traffic associated with the proposed development area can be layered onto the system and reanalyzed so as to determine the associated impacts of the proposed development area.

Proposed Development Access

As depicted in Figure 1, the primary access for the Black Hills Center development would be via Stumer Road. Specifically access for the proposed Wal-Mart Supercenter and supporting retail shops would be via three driveways off Stumer Road. All of the drives are proposed as side-street STOP with Stumer Road having the right-of-way and the proposed driveways operated under stop control. A zoomed in view of the proposed site plan showing the three driveways serving the Wal-Mart Supercenter is shown in **Figure 6**.

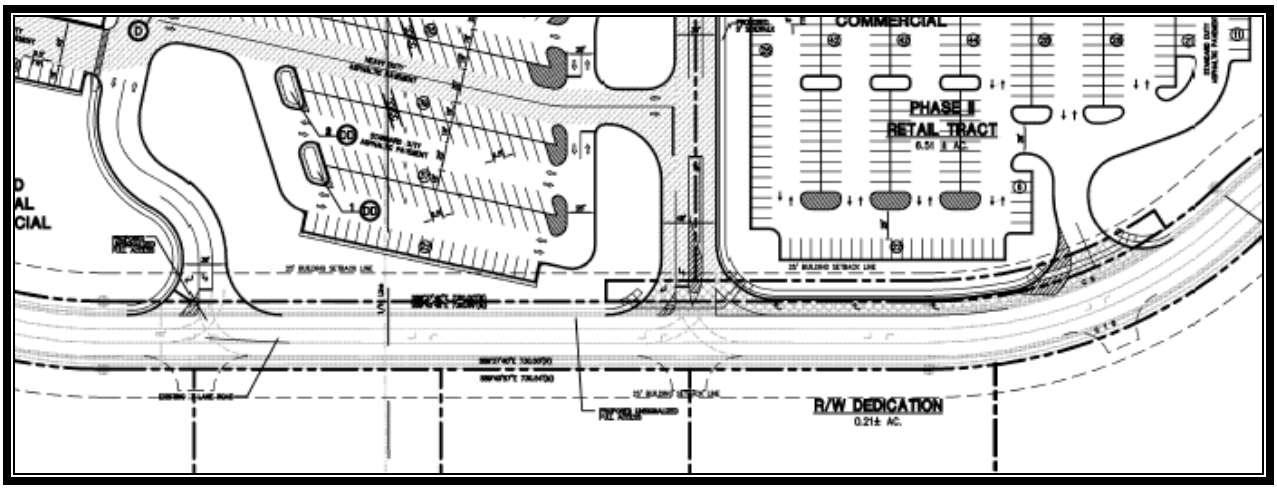

Figure 6: Proposed Access along Stumer Road

Access for Outlot 1 and the future office in the southwest quadrant of 5th Street and Enchanted Pines Drive is proposed via two existing stub access drives on 5th Street. Access for Outlot 2 is proposed on 5th Street opposite Parkview Drive and via a new driveway off Stumer Road. Access for Outlot 3 is proposed off Stumer Road opposite the access drive for the retail shops. Access for Outlots 4 and 5 is proposed via a shared access drive off Stumer Road opposite the main access for the Wal-Mart Supercenter. Access for Outlots 6 and 7 is proposed via a shared access drive off Stumer Road opposite the west access for the Wal-Mart Supercenter. Access for Outlots 8 and 9 is proposed via a shared access drive off Stumer Road. Access for Outlot 10 is proposed off Black Hills Boulevard opposite Eagle Ridge Lane. Access for Outlot 11 is proposed off Stumer Road opposite Black Hills Boulevard. Access for Outlot 12 is proposed via a new curb cut on Stumer Road and via a new curb cut on Eagle Ridge Lane. Access for Outlots 13 and 14 is proposed via a right-in/right-out on Black Hills Boulevard and via Eagle Ridge Lane.

Access for the planned future bank and gas station in the northwest quadrant of 5th Street and Catron Boulevard is platted via a right-in/right-out only on 5th Street and via Stumer Road.

2010 Build Traffic Volumes

The traffic generated by the proposed Black Hills Center development area (Exhibit 4) was aggregated with the 2010 No Build traffic volumes (Exhibit 3) to reflect the 2010 Build, or forecasted, conditions following build-out of the Black Hills Center development. **Exhibit 5** reflects the 2010 Build traffic volumes.

Traffic Signal Warrant Analysis

In order to accommodate the Black Hills Center development area, traffic signals are proposed at the intersections of Catron Boulevard with Black Hills Boulevard and 5th Street with Stumer Road. In order to verify the need for a traffic signal, signal warrant analyses were conducted by comparing forecasted traffic volumes to the standard warrants for signalization published in the *Manual on Uniform Traffic Control Devices* (MUTCD). Part Four of this manual, Highway Traffic Signals, provides eight different warrants for signalization that are based upon hourly traffic volumes, traffic operation, pedestrian volumes or accident experience. The City of Rapid City and SDDOT typically require intersections to satisfy Warrant 1 (eight hour volume) or Warrant 2 (four hour volume) before approving a new signal installation.

Warrant 1 has two conditions, "A" and "B". Condition "A" (Minimum Vehicular Volume) is intended for application where a large volume of intersecting traffic is the principal reason to consider a signal. Condition "B" (Interruption of Continuous Traffic) is intended for application where traffic volumes on a major street are so heavy that traffic on the minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. The minimum volume requirements are shown in **Figure 7**.

In the absence of eight-hour traffic counts, the 8th highest hourly volumes are commonly estimated as 55% of peak hour traffic. In this case, based on the traffic counts provided by SDDOT, the 8th highest hour represents approximately 51% of the peak hour prior to the introduction of any development traffic. However, based on the 12-hour traffic counts collected as part of the SDDOT *Verify Certain ITE Trip Generation Rate Applications in South Dakota* study, for the Rapid City, Pierre and Sioux Falls Wal-Mart stores the 8th highest hour represented approximately 65% to 75% of the peak hour. Thus, the commonly estimated 8th highest hourly volume as 55% of the peak hour traffic would provide a conservative approach.

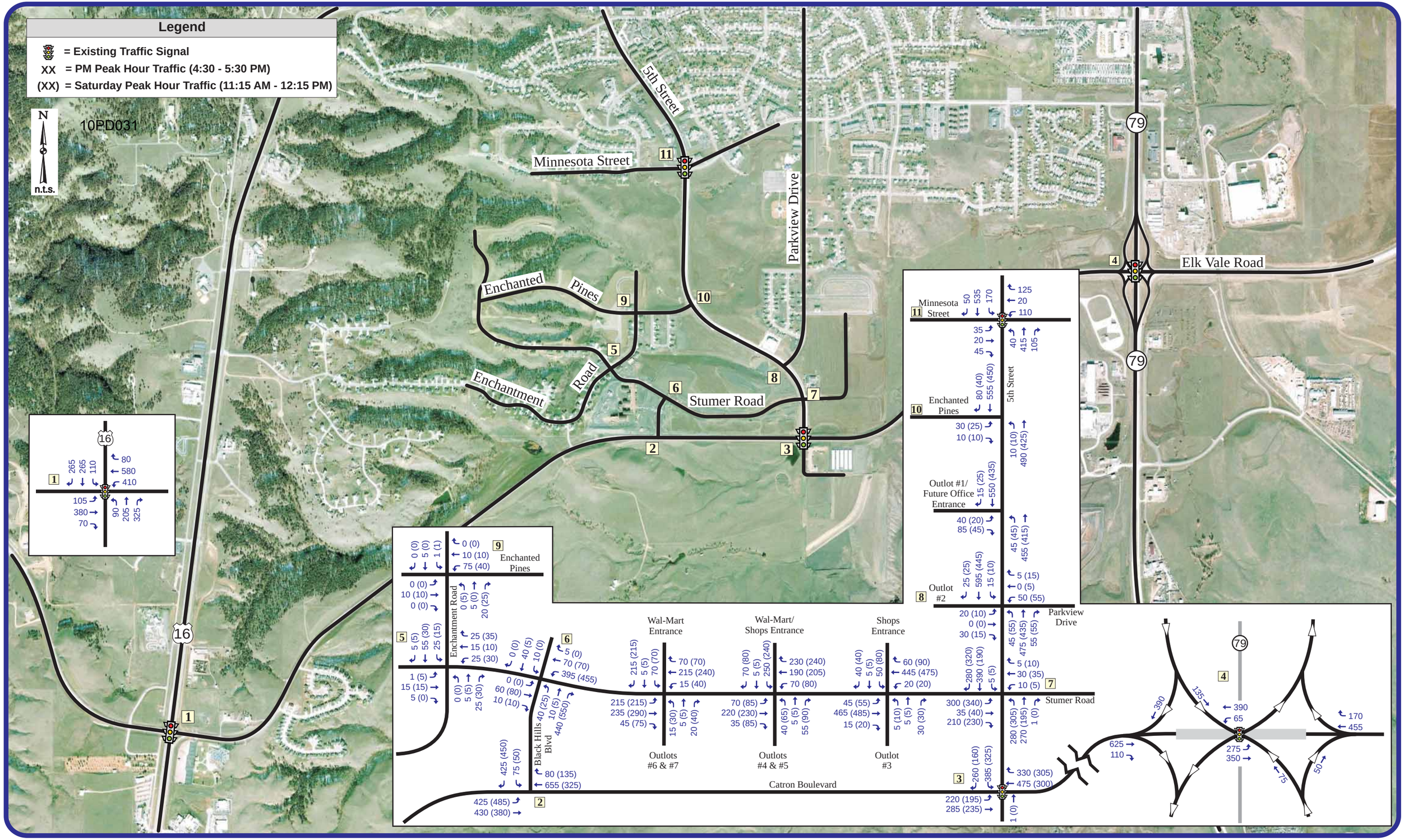

Exhibit 5: 2010 Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
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3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures
[c] May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Figure 7: MUTCD Warrant 1, Eight Hour Vehicular Volume

Catron Boulevard and Black Hills Boulevard

The intersection of Catron Boulevard with Black Hills Boulevard was evaluated to determine whether a signal would be warranted based on the addition of the site traffic volumes to the existing traffic volumes. With respect to the side-street right-turn movements, when a separate right-turn lane is provided the volume is often discounted all together or reduced. In this case, given the heavy side street right-turn volume and the speed along Catron Boulevard, we felt it was appropriate to reduce the right-turn volume by 50% for the signal warrant analysis. Additionally, reduced warrants are applicable at locations where the speed of the major street exceeds 40 mph. In this case the posted speed on Catron Boulevard is 60 mph, so the traffic volumes in the 70% column of the table shown in Figure 7 may be used.

As indicated by the 2010 Build traffic volumes, the total approach volume on Catron Boulevard would amount to 1,590 vph during the weekday p.m. peak hour, while the approach volume on Black Hills Boulevard (discounting 50% of the right-turn volume) would amount to 288 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 875 vph on Catron Boulevard and 158 vph on Black Hills Boulevard. As a result, both Warrants 1A and 1B would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the Catron Boulevard and Black Hills Boulevard intersection is warranted in accordance with the MUTCD.

5th Street and Stumer Road

The intersection of 5th Street and Stumer Road was evaluated to determine whether a signal would be warranted based on the addition of the site traffic volumes to the existing traffic volumes. In this case, as a conservative approach, the side-street right-turn volume was discounted entirely since the speed and traffic volume on 5th Street was lower. Again, based on the posted speed of 45 mph on 5th Street, the traffic volumes in the 70% column of the table shown in Figure 7 may be used.

As indicated by the 2010 Build traffic volumes, the total approach volume on 5th Street would amount to 1,085 vph during the weekday p.m. peak hour, while the approach volume on Stumer Road (discounting the right-turn volume) would amount to 340 vph. At 55% of the peak hour, the 8th highest hourly volume is estimated to be approximately 597 vph on 5th Street and 187 vph on Stumer Road. As a result, Warrants 1A would be satisfied in accordance with the reduced warrants for speeds in excess of 40 mph on the major street. Therefore, it can be concluded that signalization of the 5th Street and Stumer Road intersection is warranted in accordance with the MUTCD.

Auxiliary Lane Requirements

The need for auxiliary lanes was assessed for the intersections along 5th Street and Stumer Road to determine if auxiliary lanes are warranted per SDDOT's Roadway Design Guide. Along Catron Boulevard, right and left-turn lanes are planned as part of the widening project this year. Along 5th Street and Stumer Road, the existing center left-turn lane will be adequate to accommodate the left-turn traffic. Thus, the need for separate right-turn lanes was evaluated utilizing Figure 12-12 in the SDDOT Roadway Design Guide, depicted in **Figure 8** below.

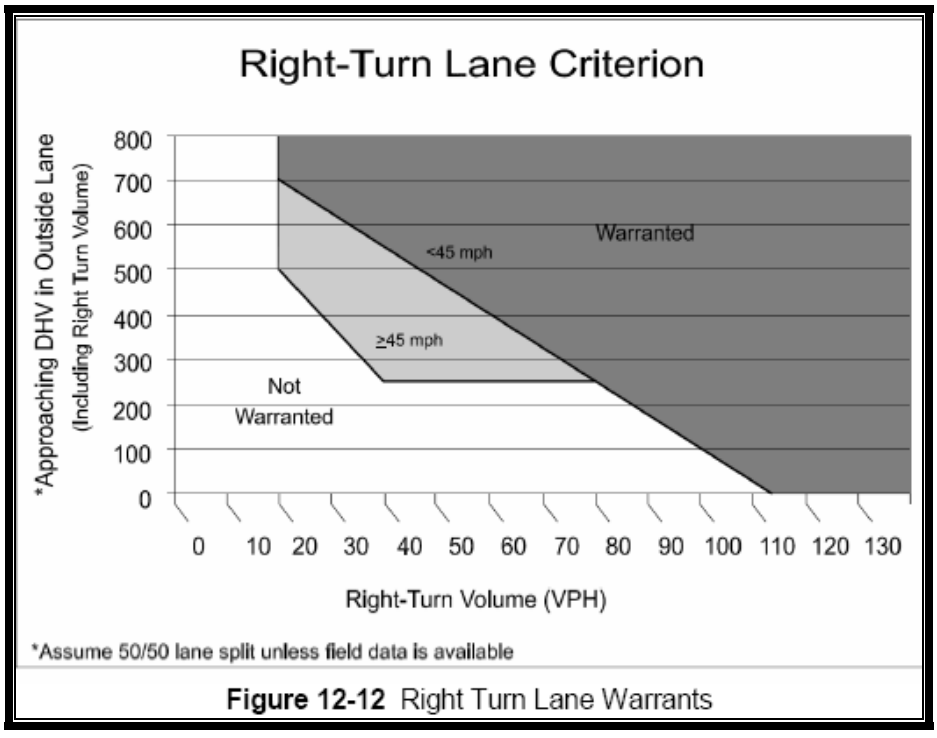

Figure 8: SDDOT Right-Turn Lane Warrants

5th Street and Parkview Drive

Based on a posted speed of 45 mph, a northbound advancing volume during the p.m. peak hour of 293 vph in the outside lane and a right-turn volume of 55 vph, a northbound right-turn lane is not warranted. Likewise, based on a southbound advancing volume during the p.m. peak hour of 323 vph in the outside lane and a right-turn volume of 25 vph, a southbound right-turn lane is not warranted.

5th Street and Enchanted Pines Drive

Based on a posted speed of 45 mph, a southbound advancing volume during the p.m. peak hour of 358 vph in the outside lane and a right-turn volume of 80 vph, a southbound right-turn lane is warranted. However, it is estimated that a portion of the 80 right turns may be cut-thru trips to Catron Boulevard via Dan Christy. Thus, a separate right-turn lane may further contribute to the ease of the southbound cut-thru traffic. Instead, it may be appropriate to consider traffic calming measures along Enchanted Pines Drive and Enchantment Road to further discourage any cut-thru traffic.

Stumer Road and Proposed Access Drives

Based on a posted speed of 25 mph, a separate westbound right-turn lane is warranted at both the main Wal-Mart/retail shops driveway and the eastern driveway serving the retail shops. It is recommended that the westbound right-turn lane at the main Wal-Mart/retail shops driveway be channelized to allow improved operation of the southbound approach exiting the Wal-Mart.

Black Hills Boulevard and Proposed Access for Outlot 10

Based on the projected traffic volumes a separate northbound right-turn lane into Outlot 10 is not warranted; however, based on the anticipated stream of northbound thru traffic from the traffic signal and the proximity of the access drive to Catron Boulevard, it is recommended that a separate northbound right-turn lane on Black Hills Boulevard into Oulot 10 be considered.

2010 Build Operating Conditions

The 2010 Build traffic volumes were reanalyzed using the same methodology as before in an effort to identify the impacts of the proposed Black Hills Center development area. **Table 6** summarizes the 2010 Build Levels of Service and average delay at each study intersection within the immediate study area during the weekday p.m. and Saturday midday peak hours.

Based on the distance between the existing traffic signal at Catron Boulevard and 5th Street and the proposed signals at 5th Street and Stumer Road and Catron Boulevard and Black Hills Boulevard, it is recommended that the three signals be coordinated to progress traffic through the intersections. A cycle length of 100 seconds was used for the weekday p.m. peak hour and a cycle length of 110 seconds was used for the Saturday midday peak hour. Additionally, in order to provide improved progression of the traffic along Catron Boulevard, the eastbound left-turn movement at 5th Street was analyzed as a lagging left-turn phase.

Table 6: 2010 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	C (28.1)	C (27.1)
Westbound Catron Boulevard Approach	C (21.8)	B (16.2)
Northbound 5th Street Approach	D (43.0)	D (48.0)
Southbound 5th Street Approach	C (22.2)	C (25.5)
Overall Intersection	*C (23.6)*	*C (22.2)*
Catron Boulevard & Black Hills Boulevard (signalized)		
Eastbound Catron Boulevard Approach	C (26.8)	C (29.8)
Westbound Catron Boulevard Approach	B (17.9)	B (10.0)
Southbound Black Hills Boulevard Approach	C (20.8)	B (19.2)
Overall Intersection	*C (22.3)*	*C (21.9)*
5th Street & Stumer Road (signalized)		
Eastbound Stumer Road Approach	C (27.8)	C (25.6)
Westbound Stumer Road Approach	D (39.6)	D (43.7)
Northbound 5th Street Approach	B (11.2)	B (12.1)
Southbound 5th Street Approach	B (16.4)	B (14.4)
Overall Intersection	*B (18.8)*	*B (18.6)*
Black Hills Boulevard & Stumer Road (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (7.4)	A (7.4)
Westbound Stumer Road Left-Turn	A (8.3)	A (8.6)
Northbound Black Hills Boulevard Left-Turn/Thru	B (13.9)	D (30.6)
Northbound Black Hills Boulevard Right-Turn	B (13.9)	B (14.4)
Southbound Black Hills Boulevard Approach	E (43.1)	C (24.6)
5th Street & Parkview Drive (Side-Street Stop)		
Eastbound Parkview Drive Approach	C (18.6)	B (14.9)
Westbound Parkview Drive Approach	D (31.8)	C (23.7)
Northbound 5th Street Left-Turn	A (9.2)	A (8.6)
Southbound 5th Street Left-Turn	A (8.6)	A (8.5)
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	C (18.7)	B (15.0)
Northbound 5th Street Left-Turn	A (9.0)	A (8.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As shown in Table 6, even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the widening project on Catron Boulevard. Both of these roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

Although the eastbound Stumer Road approach at 5th Street operates at LOS C for the weekday p.m. and Saturday midday peak hours, the left-turn 95th percentile queue is estimated at 240 feet for the p.m. peak hour and 290 feet for the Saturday peak hour, with average queues of 165 feet and 205 feet for the p.m. and Saturday peak hours respectively. The existing left-turn bay is striped to provide approximately 150 feet of storage; however, the left-turn lane transitions to a center left-turn lane effectively providing unlimited storage. Although additional storage could be accommodated within the center left turn lane, observations show that motorists at signals often do not enter the left-turn lane until the striped lane. Thus, it is recommended that the eastbound Stumer Road approach at 5th Street be restriped to provide 290 feet of storage.

As shown in Table 6, the majority of the movements at the unsignalized intersections are also anticipated to operate at acceptable levels of service for both the weekday p.m. and Saturday midday peak hours with the exception of the southbound approach at the intersection of Black Hills Boulevard and Stumer Road which is anticipated to operate at LOS E during the weekday p.m. peak hour. This southbound approach is the proposed access for Outlot 11. In order to more effectively accommodate the forecasted traffic volumes, the current all-way STOP control was changed to reflect side-street STOP conditions with Black Hills Boulevard/Outlot 11 operated under stop control and Stumer Road maintaining the right-of-way. Consequently, as stated, the southbound approach would operate at LOS E during the weekday p.m. peak hour.

As an alternative, a single-lane roundabout was considered for the intersection of Black Hills Boulevard and Stumer Road. The results of the roundabout analysis are summarized in **Table 7** which include an option with a northbound right-turn by-pass lane. The 95th percentile queue for each approach is also shown in the table.

As shown in Table 7, a roundabout would provide LOS A for all approaches for both the weekday p.m. and Saturday midday peak hours. Given that the intersection would operate at LOS A, the addition of a northbound right-turn by-pass lane would not provide any measurable difference in the operations, though the northbound queues would slightly decrease. Consequently, a northbound right-turn by-pass lane is not necessary should a roundabout be chosen as the preferred control for the Black Hills Boulevard and Stumer Road intersection.

Table 7: Stumer Road and Black Hills Boulevard Roundabout Analysis

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Black Hills Boulevard & Stumer Road (Roundabout)		
Eastbound Stumer Road Approach	A (3.7) [20']	A (3.9) [25']
Westbound Stumer Road Approach	A (5.1) [95']	A (5.0) [105']
Northbound Black Hills Boulevard Approach	A (1.8) [110']	A (1.9) [150']
Southbound Outlot 11 Approach	A (5.1) [20']	A (5.0) [20']
Overall Intersection	*A (3.5)*	*A (3.4)*
Black Hills Boulevard & Stumer Road (Roundabout with a Northbound By-Pass Lane)		
Eastbound Stumer Road Approach	A (3.7) [20']	A (3.9) [25']
Westbound Stumer Road Approach	A (5.1) [95']	A (5.0) [105']
Northbound Black Hills Boulevard Approach	A (1.4) [85']	A (1.3) [125']
Southbound Outlot 11 Approach	A (5.1) [20']	A (5.0) [20']
Overall Intersection	*A (3.3)*	*A (3.2)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle) [95th percentile queue]

The primary access drives along Stumer Road serving the proposed Black Hills Center, and specifically the Wal-Mart Supercenter, were analyzed using the same methodology as before in an effort to identify any necessary improvements at the access drives. **Table 8** summarizes the 2010 Build Levels of Service and average delay at each of the access drives during the weekday p.m. and Saturday midday peak hours.

As shown in Table 8, the majority of the movements at the access drives are anticipated to operate at acceptable levels of service for both the weekday p.m. and Saturday midday peak hours with the exception of the southbound approach at the main entrance for the Wal-Mart which is anticipated to operate at LOS E with approximately 49 seconds of delay during the Saturday midday peak hour.

Although not ideal, LOS E is often anticipated at unsignalized intersections within retail centers during the peak periods. Additionally, given that the condition is only anticipated during the Saturday peak hour, and the fact that there are alternative means to access Stumer Road, this operation is not considered critical. In this case, there are alternative routes out of the Wal-Mart Supercenter and retail shops to access Stumer Road. For instance, both the driveway to the east and west of this drive are anticipated to operate at LOS C during the Saturday midday peak hour. Consequently, during peak shopping times on a Saturday, motorists may disperse to the adjacent drives to exit the center if the delays at the main entrance are longer than the alternative routes.

Table 8: 2010 Build Operating Conditions (Access Driveways)

Intersection/Movement	Weekday PM Peak Hour	Saturday Midday Peak Hour
Stumer Road & West Wal-Mart Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (8.5)	A (8.6)
Westbound Stumer Road Left-Turn	A (7.9)	A (8.2)
Northbound Outlot 6/7 Approach	C (18.0)	D (26.2)
Southbound Wal-Mart Drive Approach	B (14.5)	C (16.9)
Stumer Road & East Wal-Mart Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (7.8)	A (7.9)
Westbound Stumer Road Left-Turn	A (8.0)	A (8.2)
Northbound Outlot 4/5 Approach	B (13.1)	C (15.9)
Southbound Wal-Mart/Shops Drive Approach	D (27.8)	E (48.7)
Stumer Road & Retail Shops Driveway (Side-Street Stop)		
Eastbound Stumer Road Left-Turn	A (8.7)	A (9.1)
Westbound Stumer Road Left-Turn	A (8.5)	A (8.6)
Northbound Outlot 3 Approach	B (13.3)	B (14.5)
Southbound Retail Shops Drive Approach	C (17.1)	C (21.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

The perimeter intersections on 5th Street and Catron Boulevard were reanalyzed for the 2010 Build traffic volumes in an effort to identify any potential timing changes needed at the intersections as a result of the proposed Black Hills Center development. **Table 9** summarizes the 2010 Build Levels of Service and average delay at the perimeter intersections during the weekday p.m. peak hour.

As mentioned previously, the three perimeter intersections all operate free. Although a new traffic signal is proposed on Catron Boulevard at Black Hills Boulevard that would be coordinated with the existing signal at 5th Street, given the distance to the perimeter intersections on Catron Boulevard coordination with the signals at Highway 16 and Highway 79 would not be recommended.

The signal at Highway 16 is approximately 1.8 miles west of the proposed signal at Black Hills Boulevard, while the signal at Highway 79 is approximately 1.2 miles east of the existing signal at 5th Street. With distances in excess of one mile, it is difficult to maintain a platoon of traffic in order to realize the benefits of signal coordination. Furthermore, maintaining free operation would provide the most favorable traffic conditions.

Likewise, the signal at 5th Street and Minnesota Street is approximately 4,600 feet north of the proposed signal at Stumer Road. Thus, it is recommended that this intersection continue to operate free as well.

Table 9: 2010 Build Operating Conditions (Perimeter Intersections)

Intersection/Movement	Weekday PM Peak Hour
Catron Boulevard & Highway 16 (signalized)	
Eastbound Catron Boulevard Approach	D (42.0)
Westbound Catron Boulevard Approach	C (27.9)
Northbound Highway 16 Approach	C (32.1)
Southbound Highway 16 Approach	C (33.8)
Overall Intersection	C (32.8)
Catron Boulevard & Highway 79 (signalized)	
Eastbound Catron Boulevard Approach	B (17.3)
Westbound Catron Boulevard Approach	C (21.2)
Northbound Highway 79 Approach	B (15.9)
Southbound Highway 79 Approach	B (14.7)
Overall Intersection	*B (17.7)*
5th Street & Stumer Road (signalized)	
Eastbound Stumer Road Approach	B (14.6)
Westbound Stumer Road Approach	B (13.2)
Northbound 5th Street Approach	B (18.4)
Southbound 5th Street Approach	B (15.2)
Overall Intersection	*B (15.9)*

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Future Access Drives on Stumer Road

Based on Rapid City's Street Design Criteria Manual, the desired distance between driveways along high volume collectors in commercial areas is 200 feet of full vertical curb (measured from the near radius point to near radius point). However where this spacing cannot be attained, a minimum of 105 feet is required on streets with a posted speed of 25 mph like Stumer Road.

The access along Stumer Road, as depicted in the current site plan shown in Exhibit 1, exceeds the desired spacing of 200 feet. Ideally, the access for adjoining outlots could share one access drive onto Stumer Road. However, as specific users are identified, there may be a need to modify the access along Stumer Road from that shown in the current site plan. In general, any modifications to the access should, at a minimum, provide 105 feet of separation and ideally provide the desired 200 feet.

However, based on the anticipated 95th percentile queues of approximately 240 to 290 feet for the eastbound approach of Stumer Road at 5th Street, it is recommended that full access for Outlot 2 and the future bank/gas station be located a minimum of 290 feet from 5th Street.

2030 Build Conditions

In an effort to determine the ability of the area road system to accommodate long-term traffic demands, "Design Year" 2030 traffic conditions were evaluated.

2030 No Build and Build Traffic Volumes

As discussed with the City, the 2025 No Build traffic volumes presented in the FHU study were increased to account for an additional five years of background traffic growth. As directed by the City, the traffic volumes on Catron Boulevard, 5th Street and Stumer Road were increased by approximately 10%, accounting for an annual growth of approximately 2% per year for years 2025 to 2030. The traffic volumes on Parkview Drive were increased by approximately 5%, accounting for an annual growth of approximately 1% per year for years 2025 to 2030. The 2030 No Build Traffic Volumes are depicted in **Exhibit 6**.

The site-generated trips associated with the proposed Black Hills Center development area were aggregated with the 2030 No Build traffic volumes, resulting in the 2030 Build traffic forecast depicted in **Exhibit 7**.

2030 Build Operating Conditions

The 2030 Build traffic volumes were analyzed using the same methodology applied to the previous scenarios. The results of the 2030 Build operating conditions are summarized in **Table 10**.

By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and Black Hills Boulevard requires additional green time for the northbound approach that was not required in the 2010 Build conditions. As a result of the fourth leg and the increased background traffic, the two intersections would decline to LOS D overall with several movements operating near capacity.

In order to provide improved operating conditions at the intersection of Catron Boulevard and Black Hills Boulevard, it may be necessary to provide eastbound dual-left turn lanes on Catron Boulevard into the Black Hills development area. Furthermore, in order to accommodate eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road. Given the majority of the left-turn motorists are destined to a right turn onto Stumer Road (approximately 600 feet north of the intersection), the dual left-turn lane would have some reduced benefit due to the uneven lane utilization of the second turn lane. The results of the improved 2030 Build operating conditions are also summarized in Table 10.

Likewise, in order to provide improved operating conditions at the intersection of Catron Boulevard and 5th Street, it may be necessary to provide southbound dual-left turn lanes on 5th Street at Catron Boulevard. The results of the improved 2030 Build operating conditions are also summarized in Table 10.

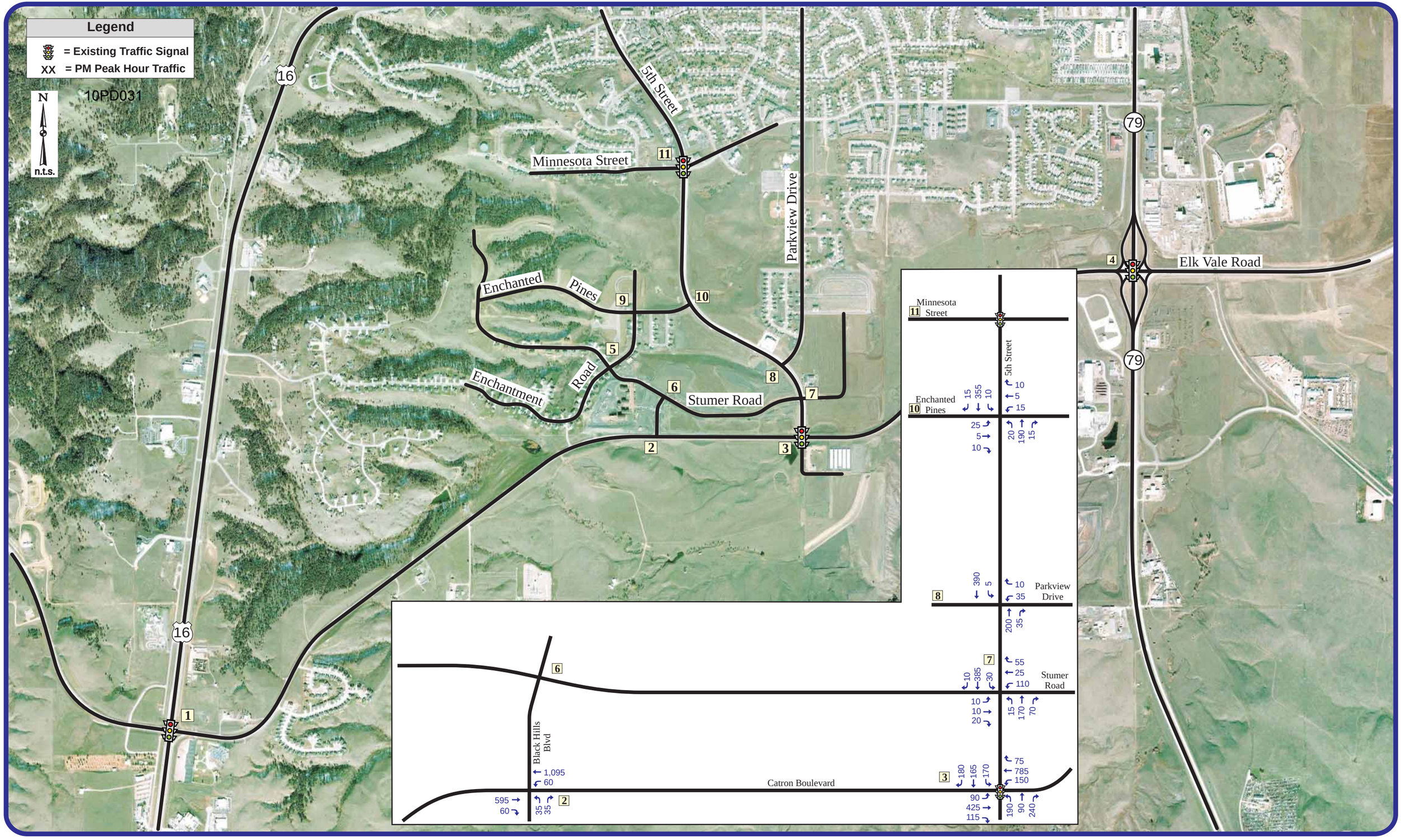

Exhibit 6: 2030 No Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

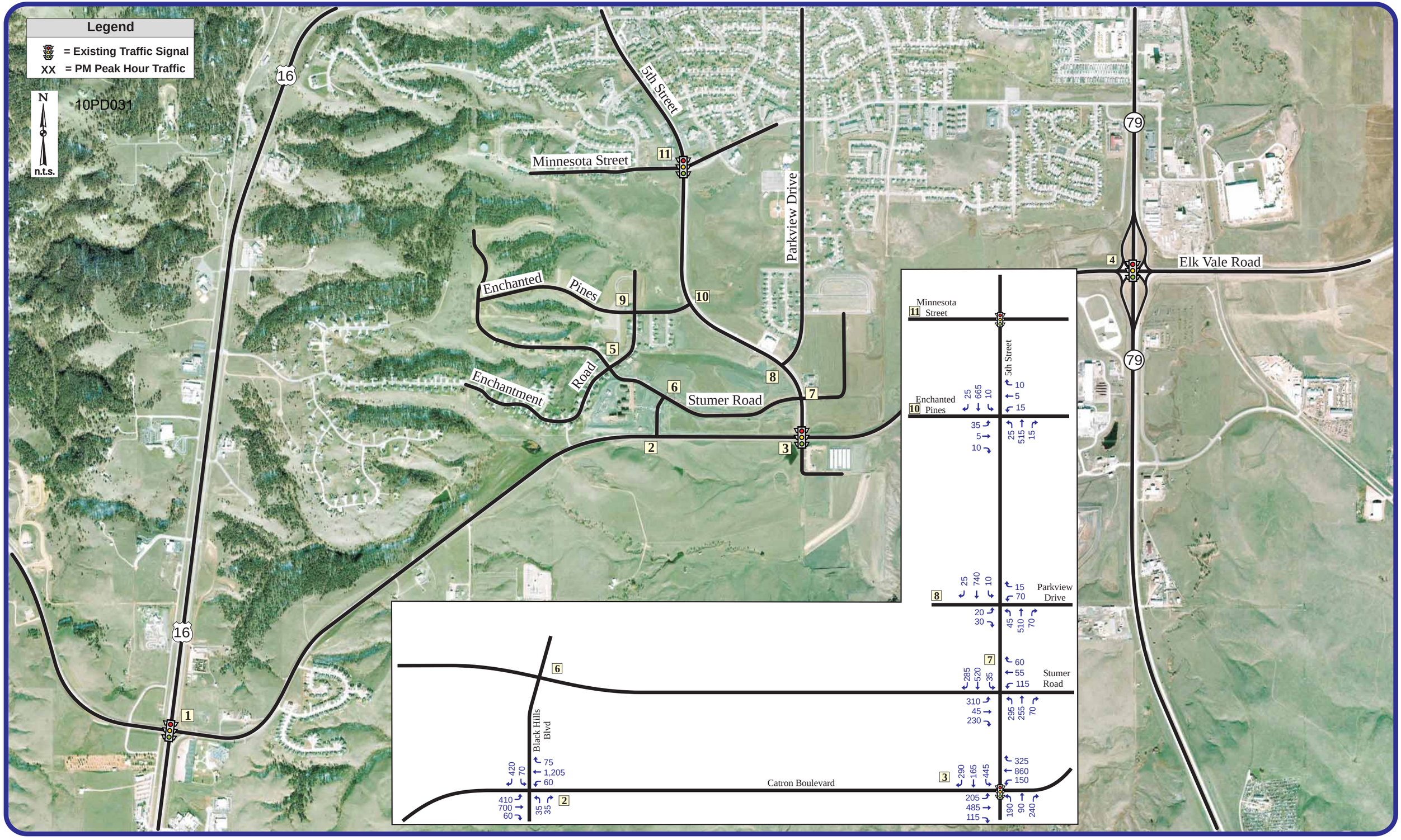

Exhibit 7: 2030 Build Traffic Volumes

Black Hills Center Traffic Impact Study
Rapid City, South Dakota
Job# 005-10
3/16/10

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Table 10: 2030 Build Operating Conditions

Intersection/Movement	Weekday PM Peak Hour	Weekday PM Peak Hour (Improved)
Catron Boulevard & 5th Street (signalized)		
Eastbound Catron Boulevard Approach	C (34.2)	C (26.4)
Westbound Catron Boulevard Approach	D (48.1)	D (44.0)
Northbound 5th Street Approach	C (29.8)	C (31.9)
Southbound 5th Street Approach	D (53.0)	C (30.9)
Overall Intersection	*D (43.5)*	*C (34.9)*
Catron Boulevard & Black Hills Boulevard (signalized)		
Eastbound Catron Boulevard Approach	D (45.5)	C (31.3)
Westbound Catron Boulevard Approach	D (42.0)	C (32.4)
Northbound Black Hills Boulevard Approach	D (47.4)	D (47.4)
Southbound Black Hills Boulevard Approach	D (43.6)	D (46.7)
Overall Intersection	*D (43.7)*	*C (34.6)*
5th Street & Stumer Road (signalized)		
Eastbound Stumer Road Approach	C (32.1)	NA
Westbound Stumer Road Approach	D (45.7)	NA
Northbound 5th Street Approach	B (18.7)	NA
Southbound 5th Street Approach	C (23.3)	NA
Overall Intersection	*C (26.3)*	NA
5th Street & Parkview Drive (Side-Street Stop)		
Eastbound Parkview Drive Approach	C (24.0)	NA
Westbound Parkview Drive Left-Turn	E (49.1)	NA
Northbound 5th Street Left-Turn	A (9.8)	NA
Southbound 5th Street Left-Turn	A (8.8)	NA
5th Street & Enchanted Pines Drive (Side-Street Stop)		
Eastbound Enchanted Pines Drive Approach	C (16.8)	NA
Westbound Enchanted Pines Drive Approach	B (14.3)	NA
Northbound 5th Street Left-Turn	A (9.3)	NA
Southbound 5th Street Left-Turn	A (8.7)	NA

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Conclusions

Crawford, Bunte, Brammeier prepared the preceding study to address the traffic impacts associated with the proposed Black Hills Center commercial development in Rapid City, South Dakota. The following sections summarize the findings and recommendations of the scenarios analyzed.

2010 No Build Conditions

Based on the evaluation of the 2010 No Build conditions, all of the study intersections had overall favorable operating conditions during the weekday p.m. and Saturday midday peak hours with each intersection approach operating at LOS C or better with the majority operating at LOS A or B during the peak hours.

It is apparent that the recent extension of 5th Street and the planned widening of Catron Boulevard will provide significant excess capacity on the roadway network. In fact, the need for these programmed roadway projects was based, in part, on additional commercial development along the corridors.

2010 Build Conditions

Traffic forecasts were prepared for the proposed development, which is expected to generate a total of 2,630 *new* trips during the weekday p.m. peak hour and 2,870 *new* trips during the Saturday midday peak hour.

In order to accommodate the proposed development traffic, the following roadway and traffic control improvements are recommended:

- Signalize the intersection of Catron Boulevard and Black Hills Boulevard.
- Signalize the intersection of 5th Street and Stumer Road.
- Coordinate the two proposed traffic signals with the existing traffic signal at Catron Boulevard and 5th Street.
- Convert the existing all-way STOP at Stumer Road and Black Hills Boulevard to a side-street STOP condition with Black Hills Boulevard operated under stop control and Stumer Road maintaining the right-of-way. Alternatively, a single-lane roundabout would also provide favorable operations.
- Construct a separate westbound right-turn lane on Stumer Road at the main Wal-Mart drive. This right-turn movement should be channelized.
- Construct a separate westbound right-turn lane at the east driveway serving the retail shops.
- Consider providing a separate northbound right-turn lane on Black Hills Boulevard at Outlot 10.
- Restripe the eastbound Stumer Road approach at 5th Street to provide 290 feet of left-turn storage.

- Maintain free operation for the three perimeter traffic signals at Highway 16 and Catron Boulevard, Highway 79 and Catron Boulevard, and 5th Street and Minnesota Street.

The 2010 Build traffic volumes were reanalyzed in an effort to identify the impacts of the proposed development and to evaluate the adequacy of the proposed roadway and traffic control improvements to mitigate those impacts. The evaluation reflected the implementation of the proposed improvements noted above.

Even with the substantial increase in the traffic volumes within the study area, all of the signalized intersections are anticipated to operate at LOS C or better for both the weekday p.m. and Saturday midday peak hours. These favorable operations were actually expected given the five lane roadway on 5th Street and the widening project on Catron Boulevard. Both of these roadways were designed taking into account the potential future commercial within the 5th Street and Catron Boulevard corridors.

2030 Build Conditions

"Design Year" 2030 traffic conditions were evaluated in an effort to determine the ability of the area road system to accommodate long-term traffic demands. By year 2030, it is anticipated that both Black Hills Boulevard and 5th Street would extend south of Catron Boulevard. The addition of a fourth leg to the intersections of Catron Boulevard with 5th Street and with Black Hills Boulevard introduces additional signal phases not required in the 2010 Build conditions. As a result of the fourth leg and the increased background traffic, the two intersections would decline to LOS D overall with several movements operating near capacity.

Consequently, the following roadway improvements may be necessary to accommodate the 2030 traffic conditions:

- Consider providing eastbound dual-left turn lanes on Catron Boulevard at Black Hills Boulevard. In order to accommodate the eastbound dual left-turns, Black Hills Boulevard would require two northbound through lanes from Catron Boulevard to Stumer Road.
- Consider providing southbound dual-left turn lanes on 5th Street at Catron Boulevard.

With the implementation of the above roadway improvements, all of the signalized intersections would operate at LOS C during the weekday p.m. peak hour.

10PD031

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