CITY OF RAPID CITY

RAPID CITY, SOUTH DAKOTA 57701

Public Works Department

Engineering Services Division

300 Sixth Street

Telephone: (605) 394-4154 FAX: (605) 355-3083

Web: www.rcgov.org

MEMORANDUM

TO: Dale Tech
City Engineer

FROM: John Less
Traffic Engineer

SUBJECT: 5th Street Pedestrian Crossing Study
Fairmont Boulevard to Oakland Street

DATE: October 5, 2009

BACKGROUND

This pedestrian crossing evaluation was completed as per a citizen request (see Attachment #1). The request also asked that consideration be given to reducing the existing 5th St. speed limit and enacting a reduced speed limit during worship times at the Cathedral of Our Lady of Perpetual Help. The Cathedral also sent a letter of support for the initial request (see Attachment #2). Both requests cited as justification the December 20, 2008 pedestrian crash fatality that occurred at the 5th St./Oakland St. intersection. A location map is included as Attachment #3 and an aerial view of the study area is included as Attachment #4.

PEDESTRIAN CRASH HISTORY

Crash records for 1998 to 2008 were reviewed for pedestrian crashes at the study location. The December 20, 2008 fatality was the only pedestrian crash that occurred in the ten-year review period.

Crash records for 5th St. between Minnesota St. and St. Patrick St. were reviewed for 2002 to 2008. No pedestrian crashes occurred in the seven-year review period.

CROSSING LOCATION EVALUATION

Presently, a number of Cathedral parishioners use the St. Elizabeth Seton School parking lot on the east side of 5th St. and cross 5th St. using a walkway to the street. This crossing location is approximately 280-feet from the signalized crosswalk at Fairmont Boulevard/Cathedral Drive and is not delineated by pavement markings or signs.

The Federal Highway Administration's (FHWA) *Pedestrian Facilities Users Guide* includes a recommendation that, "Marked crosswalks should not be installed in close proximity to traffic signals, since pedestrians should be encouraged to cross at the signal in most situations." The Guide does not include a suggested minimum distance, however, a survey of other agencies' guidelines indicate that 300 to 400-feet is an appropriate value. Since the subject location falls below this range, it is not recommended to be a candidate for a formal pedestrian crossing. The remainder of this study will instead focus on the Oakland St. intersection.

PEDESTRIAN VOLUME EVALUATION

Pedestrian crossing information from the St. Elizabeth Seton parking lot was provided by the requesting citizen and was collected on Saturday, 05/23/09 and Sunday, 05/24/09. City staff collected pedestrian crossing information at Oakland St. on Thursday, 08/20/09, Saturday, 08/21/09 and Sunday, 08/22/09 and 09/13/09. The aggregate pedestrian volumes were used in the evaluation of the Oakland St. intersection under the assumption that all of the parking lot users would use a formal crosswalk at Oakland St.; the combined volumes are summarized as follows:

	COMBINED PEDESTRIAN CROSSING VOLUME		
HOUR BEGINNING	**THURSDAY**	**SATURDAY**	**SUNDAY**
6 AM	2	-	-
7 AM	1	-	25
8 AM	1	-	18
9 AM	0	-	10
10 AM	0	-	40
11 AM	1	-	35
12 PM	1	-	10
1 PM	2	-	2
2 PM	0	0	25
3 PM	0	0	26
4 PM	2	2	-
5 PM	0	25	-
6 PM	0	25	-
7 PM	0	0	-
8 PM	2	0	-
9 PM	3	-	-
TOTAL VOLUME	**15**	**52**	**191**

The *Pedestrian Facilities Users Guide* and other references recommend that there be at least 20 pedestrian crossings at a location for a crosswalk to be considered. While this minimum is not met during an average weekday, it is met for seven hours during the weekend worship times.

CROSSING TREATMENT

A summary of 5th St. traffic volumes is included as Attachment #5. The National Cooperative Highway Research Program's *Report 562: Improving Pedestrian Safety at Unsignalized Crossings* includes a procedure for determining appropriate crossing treatments. Both the Saturday and Sunday peak pedestrian hours were evaluated; the calculated total pedestrian delay is 2.0 hours. The associated worksheets are included as Attachments #6 and #7. Assuming a low expected driver compliance level for yielding to pedestrians in the crosswalk, the suggested treatment categories are either "Enhanced" or "Active". The *Report* definitions for each are as follows:

> Enhanced: This category includes those devices that enhance the visibility of the crossing location and pedestrians waiting to cross. Warning signs, markings, or beacons in this category are present or active at the crossing location at all times.
>
> Active: Also called "active when present," this category includes those devices designed to display a warning only when pedestrians are present or crossing the street.

Given that the calculated delay falls very near the lower limit of the presented range, an enhanced treatment is appropriate.

SPEED LIMIT

The posted speed limit for 5th St. in the study area is 30 MPH. Speed studies on adjacent sections of 5th St. had been done in 2004 and 2007 with average speeds ranging from 28.1 MPH to 31.9 MPH. The range of 85th percentile speeds was 33.5 MPH to 36 MPH; the 85th percentile speed is the speed at which 85% of drivers are moving at or below and is generally accepted as the speed that a prudent and reasonable driver will operate their vehicle at when taking into consideration such factors as road and weather conditions, traffic volumes, adjacent obstructions and distractions. The Manual on Uniform Traffic Control Devices (2003) suggests that, "When a speed limit is to be posted, it should be within 5 mph of the 85th-percentile speed of free-flowing traffic."

Current South Dakota law allows for the posting of variable speed limits within established school zones. No reference could be found for establishing variable speed limits in other contexts within the United States.

LIGHTING

The Police Department's report for the December 20, 2008 crash included in the "Contributing Factors" section a comment that the existing street lighting "did not illuminate the pedestrian to south bound traffic." Our own review confirmed that someone wearing dark clothing would be minimally illuminated by the existing lights.

CONCLUSIONS/RECOMMENDATIONS

1) The crash history for 1998 to 2008 included one pedestrian crash at the study location. Between 2002 and 2008 no pedestrian crashes occurred on 5th St. between Minnesota St. and St. Patrick St.

2) Speed data collected for past studies on 5th St. at the Rapid City Regional Hospital pedestrian crossing to the south and 5thSt. at St. Cloud St. to the north indicate that the operating speed correlates well with the posted speed limit. Lowering the speed limit between Fairmont Blvd. and St. Patrick St. is not recommended as compliance would be problematic.

3) Current State law only allows for posting variable speed limits in established school zones to coincide with arrival and dismissal time. Establishing a special speed zone is not recommended as compliance would be problematic and enforcement may not withstand legal challenge.

4) The existing street lights near the study area should be supplemented through a combination of additional lights, increased luminaire output and revised luminaire distribution patterns.

5) As part of the street light enhancements, a marked crosswalk with advance signing should be established on the south side of Oakland St. ADA compliant approach ramps should be constructed as part of the crosswalk work.

6) The sidewalk approach from the St. Elizabeth Seton parking lot to 5th St. should be removed from the right-of-way. Additionally, the Cathedral of Our Lady of Perpetual Help should encourage their parishioners to use the signalized crossing at Fairmont Blvd. or the proposed crosswalk at Oakland St.

ATTACHMENT #1

July 15, 2009

Mr. John Less
Traffic Engineer
City of Rapid City
Engineering Services
300 Sixth Street
Rapid City, SD 57701

Dear Mr. Less:

On Saturday December 20, 2008 at approximately 5:10 p.m., while walking to church, my father in-law, Mr. John Langenfeld was run over and killed by a motorist. John was attempting to cross 5th Street, just south of the Oakland Street intersection (See Figure 1). On 5/23/09 and 5/24/09 I monitored pedestrian traffic in the area shown in Figure 1 and those findings are given below. Finally, I offer possible solutions to keep the tragedy of last December from being repeated.

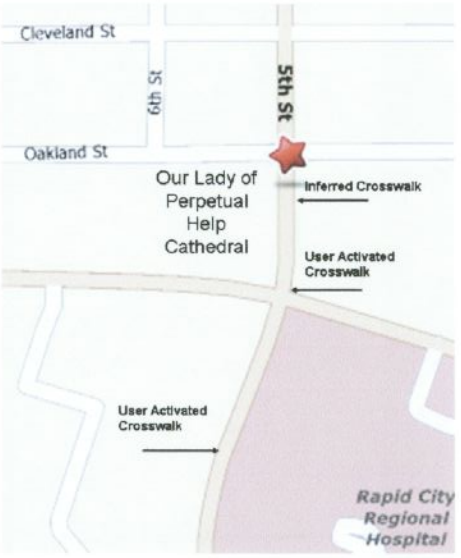


Figure 1. Map showing crosswalks near Our Lady of Perpetual Help Cathedral.

Existing Crosswalks

There exists a pedestrian-activated crosswalk just south of the 5th Street/Cathedral Drive intersection. This crosswalk is specifically for pedestrians crossing between the medical clinics on the west side of 5th Street and Rapid City Regional Hospital.

Another pedestrian-activated crosswalk exists at the intersection of 5th Street and Cathedral Drive. This crosswalk well serves both Rapid City Regional Hospital and St. Elizabeth Seton

School. It could be argued that this crosswalk should serve those, like John Langenfeld, attempting to reach the Cathedral from the north, but data that I collected will show later that this is not the case.

Cathedral Pedestrian Crossing

The majority of visitors to the Cathedral are those that attend regularly scheduled weekend services and those for funerals and weddings which are scheduled individually. Figure 2 shows the cars parked on 5/23/09 for the 5:30 p.m. Saturday services.

Figure 2. Cars parked in the St. Elizabeth Seton School parking lot east of the Cathedral 5/23/09.

The majority of those who parked in the lot used an existing sidewalk running east to west on the edge of the lot. This inferred crossing area is clearly shown in Figure 3. Figure 4 shows a family dodging cars in 5th Street after using the inferred crosswalk.

Figure 3. Inferred crossing sidewalk from the parking lot east of the Cathedral.

In addition to those that cross in the area shown in Figure 4 some (those who live in the adjacent neighborhoods) cross directly at the Oakland/5th Street intersection. Figure 5 shows a family

running across the Oakland/5th Street intersection to avoid on-coming vehicles. While the still shown in Figures 3 and 4 clearly indicate pedestrian traffic in jeopardy they in no way capture the running, dodging, bobbing and weaving I witnessed while observing pedestrians trying to cross this busy area on 5/23/09 and 5/24/09.

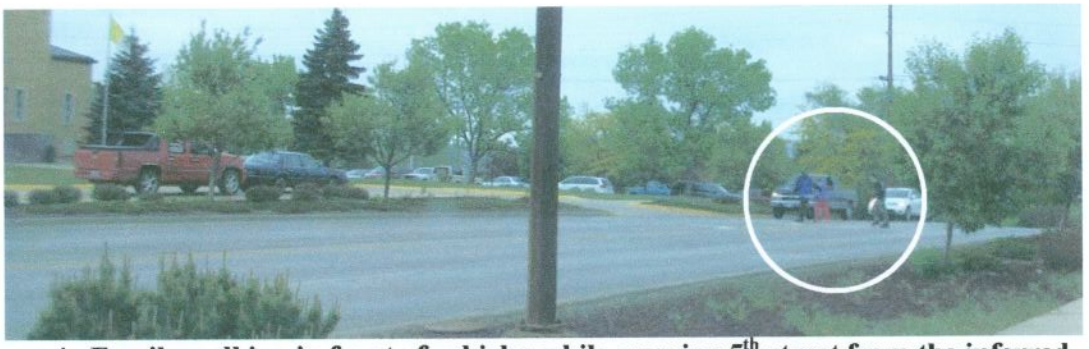


Figure 4. Family walking in front of vehicles while crossing 5th street from the inferred crossing area.

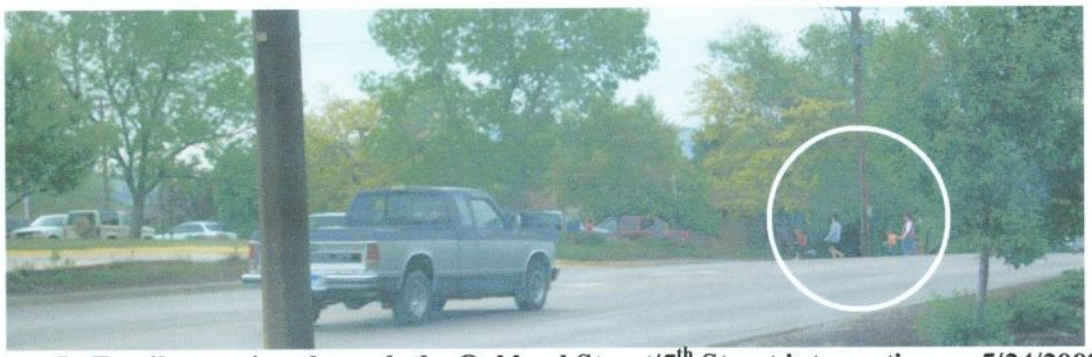


Figure 5. Family running through the Oakland Street/5th Street intersection on 5/24/2009.

As mentioned above, on 5/23/09 and 5/24/09 I monitored the pedestrian traffic at the regularly scheduled weekend services (Saturday: 5:30 p.m.; Sunday: 8:00 a.m., 10:30 a.m. and 5:30 p.m.). Table 1 below summarizes the pedestrian traffic that I witnessed.

Table 1. Pedestrian traffic across 5th Street on 5/23/09 and 5/24/09.

Date	Service Time	# of pedestrians crossing from east lot (total)	# of pedestrians crossing Cathedral Drive/5th Street Intersection
5/23/09	5:30 p.m.	23 (46)	0
5/24/09	8:00 a.m.	14 (28)	0
5/24/09	10:30 a.m.	25 (50)	0
5/24/09	5:30 p.m.	20 (40)	0

On 5/23/09 and 5/24/09 a total of 82 pedestrians initially crossed 5th Street between the Oakland Street intersection and the inferred crossing area. Once they returned to their cars (or homes) this total doubled to 164 pedestrian crossings. *In comparison, there were no crossings at the*

Cathedral Drive/5th Street intersection. Clearly, the only regularly used crossing area for weekend services is on the north side of the block nearest Oakland Street. Using the data in Table 1 as a basis, there are over 8,000 pedestrian crossings at or near the Oakland Street/5th Street intersection per year. This estimate does not include special services like weddings and funerals. *When one considers these special services one can reasonably estimate that over 10,000 pedestrians attempt to cross 5th Street near the Oakland Street intersection per year.*

While this number alone is quite sobering, consider the fact that for roughly 50% of the year the crossings for the 5:30 p.m. weekend services are done in partial or total darkness, further compounding the safety of the pedestrians. This was the case on December 20th, 2008.

After observing the pedestrian traffic I quickly reached the conclusion that if changes are not made more pedestrians will be hit by motorists while attempting to cross in front of the Cathedral.

Possible Solutions

I fully appreciate the need for "traffic flow" around this busy area, however I cannot accept that faster traffic flow should risk human life.

I offer the following suggestions to address this problem:

- Install a user activated crosswalk at the inferred crosswalk shown in Figure 3.
- Reduce the speed limit from the current 30 mph to 25 mph (or less).
- Install automated flashing lights (reduces speed limit to 15 mph) that coincide with the start and end periods of the weekend services.

Of all of the listed suggestions I believe the installation of a user-activated light, as was done for the medical clinic/Regional Hospital pedestrian traffic, is by far the best alternative.

I ask that you carefully consider my findings and suggested solutions. I look forward to your response.

Sincerely,

Jon J. Kellar

Mr. Jon J. Kellar
93 Windslow Drive
Rapid City, SD 57701
(605) 342-2916
jjkellar@msn.com

cc. Mr. Dale Tech, Mr. Ron Weifenbach

PW101309-12

ATTACHMENT #2

Cathedral
OF OUR LADY OF PERPETUAL HELP

September 25, 2009

Mr. John Less
Traffic Engineer
300 6th St.
Rapid City, SD 57701

Dear Mr. Less,

I am the rector of the Cathedral of Our Lady of Perpetual Help which sits on the corner of 5th St. and Fairmont Blvd. or Cathedral Dr. Some weeks ago you received a letter from Jon Kellar on behalf of the Langenfeld family asking that the city look into making the crosswalks on 5th St. at Oakland St. safer for pedestrians. This request was made because John Langefeld, Jon Kellar's father-in-law, was hit by a car while crossing that street in December of 2008. I just wanted to write and encourage the city to look into this matter. I think it is important to do what we can to avoid that type of accident from happening again. Thank you for your time and attention in looking into this matter.

Sincerely in Christ,

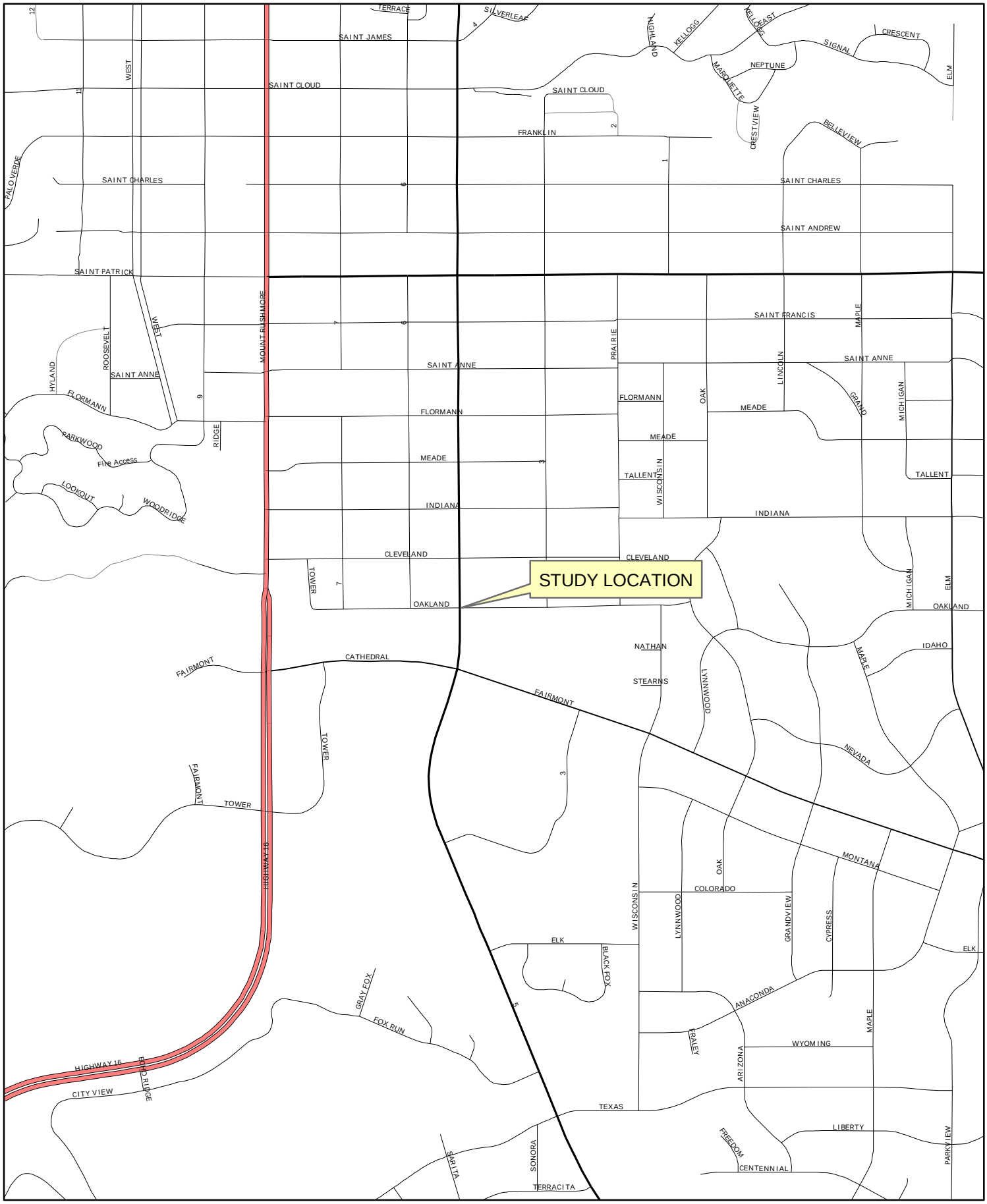
Fr. Michel Mulloy
Rector

520 CATHEDRAL DRIVE - RAPID CITY, SOUTH DAKOTA 57701-5499
PHONE: 605-342-0507 WWW.CATHEDRALOLPH.ORG FAX: 605-721-5986

PW101309-12

ATTACHMENT #3

STUDY LOCATION MAP



ATTACHMENT #4

AERIAL VIEW OF STUDY LOCATION

ATTACHMENT # 5

5TH ST. (FAIRMONT BLVD. TO OAKLAND ST.)												
DAILY TRAFFIC VOLUME SUMMARY												
		WEEKDAY				SATURDAY				SUNDAY		
HOUR BEGINNING		NB	SB	TOTAL		NB	SB	TOTAL		NB	SB	TOTAL
0000		49	53	102		76	57	133		67	79	146
0100		17	29	46		34	43	77		45	47	92
0200		14	37	51		22	32	54		24	29	53
0300		15	33	48		15	13	28		13	19	32
0400		28	32	60		16	27	43		19	22	41
0500		100	131	231		49	57	106		38	39	77
0600		222	293	515		101	138	239		62	79	141
0700		576	519	1095		222	149	371		164	139	303
0800		520	507	1027		362	246	608		282	153	435
0900		497	521	1018		441	387	828		325	284	609
1000		559	593	1152		427	425	852		393	372	765
1100		653	663	1316		483	482	965		360	429	789
1200		768	756	1524		448	476	924		423	381	804
1300		613	723	1336		398	432	830		315	395	710
1400		633	823	1456		423	443	866		320	386	706
1500		700	775	1475		397	407	804		356	370	726
1600		758	810	1568		363	419	782		304	372	676
1700		681	826	1507		395	451	846		377	379	756
1800		540	544	1084		375	389	764		336	421	757
1900		446	400	846		308	330	638		203	282	485
2000		354	356	710		205	283	488		164	214	378
2100		268	331	599		163	217	380		134	144	278
2200		145	184	329		142	209	351		96	86	182
2300		102	119	221		111	119	230		58	42	100
TOTAL		9258	10058	19316		5976	6231	12207		4878	5163	10041

ATTACHMENT #6

WORKSHEET 1: PEAK-HOUR, 35 MPH (55 KM/H) OR LESS

Analyst and Site Information		
Analyst: J. LESS Analysis Date: SEPT. 2009 Data Collection Date:	Major Street: 5th ST Minor Street or Location: OAKLAND Peak Hour: SATURDAY 1700	
Step 1: Select worksheet (speed reflects posted or statutory speed limit or 85th percentile speed on the major street): a) Worksheet 1 – 35 mph (55 km/h) or less b) Worksheet 2 – exceeds 35 mph (55 km/h), communities with less than 10,000, or where major transit stop exists		
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?		
Peak-hour pedestrian volume (ped/h), V_p	2a	25
If *2a* ≥ 20 ped/h, then go to Step 3.		
If *2a* < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.		
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?		
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$	3a	846
Minimum signal warrant volume for peak hour (use *3a* for $V_{maj\text{-}s}$), SC SC = (0.00021 $V_{maj\text{-}s}^2$ – 0.74072 $V_{maj\text{-}s}$ + 734.125)/0.75 OR [(0.00021 $3a^2$ – 0.74072 *3a* + 734.125)/0.75]	3b	343
If *3b* < 133, then enter 133. If *3b* ≥ 133, then enter *3b*.	3c	343
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50 percent; otherwise enter *3c*.	3d	343
If *2a* ≥ *3d*, then the warrant has been met and a traffic signal should be considered if not within 300 ft (91 m) of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.		
Step 4: Estimate pedestrian delay.		
Pedestrian crossing distance, curb to curb (ft), L	4a	52
Pedestrian walking speed (ft/s), S_p	4b	3.5
Pedestrian start-up time and end clearance time (s), t_s	4c	3
Critical gap required for crossing pedestrian (s), $t_c = (L/S_p) + t_s$ OR [(*4a*/*4b*) + *4c*)]	4d	17.9
Major road volume, total both approaches or approach being crossed if median refuge island is present during peak hour (veh/h), $V_{maj\text{-}d}$	4e	846
Major road flow rate (veh/s), $v = V_{maj\text{-}d}/3600$ OR [*4e/3600*]	4f	0.24
Average pedestrian delay (s/person), $d_p = (e^{v\,tc} - v\,t_c - 1)/v$ OR $[(e^{4f \times 4d} - 4f \times 4d - 1)/4f]$	4g	283.8
Total pedestrian delay (h), $D_p = (d_p \times V_p)/3{,}600$ OR [(*4g*×*2a*)/3600] (this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment – assumes 0% compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.	4h	2.0
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.		
Expected motorist compliance at pedestrian crossings in region, Comp = high or low	5a	LOW

Total Pedestrian Delay, D_p (from *4h*) and Motorist Compliance, Comp (from *5a*)	**Treatment Category** (see Descriptions of Sample Treatments for examples)
$D_p \geq 21.3$ h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = low	RED
1.3 h ≤ D_p < 5.3 h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = high	ACTIVE OR ENHANCED
D_p < 1.3 h (Comp = high or low)	CROSSWALK

Figure A-2. Worksheet 1.

ATTACHMENT #7

WORKSHEET 1: PEAK-HOUR, 35 MPH (55 KM/H) OR LESS

Analyst and Site Information			
Analyst: J. LESS Analysis Date: SEPT. 2009 Data Collection Date:		Major Street: 5TH ST. Minor Street or Location: CATHEDRAL XING Peak Hour: 1000, SUNDAY	
Step 1: Select worksheet (speed reflects posted or statutory speed limit or 85th percentile speed on the major street): a) Worksheet 1 – 35 mph (55 km/h) or less b) Worksheet 2 – exceeds 35 mph (55 km/h), communities with less than 10,000, or where major transit stop exists			
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	40
If *2a* ≥ 20 ped/h, then go to Step 3.			
If *2a* < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.			
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	765
Minimum signal warrant volume for peak hour (use *3a* for $V_{maj\text{-}s}$), SC SC = (0.00021 $V_{maj\text{-}s}^2$ – 0.74072 $V_{maj\text{-}s}$ + 734.125)/0.75 OR [(0.00021 $3a^2$ – 0.74072 *3a* + 734.125)/0.75]		*3b*	387
If *3b* < 133, then enter 133. If *3b* ≥ 133, then enter *3b*.		*3c*	387
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50 percent; otherwise enter *3c*.		*3d*	387
If *2a* ≥ *3d*, then the warrant has been met and a traffic signal should be considered if not within 300 ft (91 m) of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	52
Pedestrian walking speed (ft/s), S_p		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s		*4c*	3
Critical gap required for crossing pedestrian (s), $t_c = (L/S_p) + t_s$ OR [(*4a*/*4b*) + *4c*)]		*4d*	17.9
Major road volume, total both approaches or approach being crossed if median refuge island is present during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	765
Major road flow rate (veh/s), $v = V_{maj\text{-}d}/3600$ OR [*4e*/*3600*]		*4f*	0.21
Average pedestrian delay (s/person), $d_p = (e^{v\,tc} - v\,t_c - 1)/v$ OR $[(e^{4f \times 4d} - 4f \times 4d - 1)/4f]$		*4g*	181.7
Total pedestrian delay (h), $D_p = (d_p \times V_p)/3{,}600$ OR [(*4g*×*2a*)/3600] (this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment – assumes 0% compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.		*4h*	2.0
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region, Comp = high or low		*5a*	LOW

Total Pedestrian Delay, D_p (from *4h*) and Motorist Compliance, Comp (from *5a*)	**Treatment Category** (see Descriptions of Sample Treatments for examples)
$D_p \geq 21.3$ h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = low	RED
1.3 h ≤ D_p < 5.3 h (Comp = high or low) OR 5.3 h ≤ D_p < 21.3 h and Comp = high	ACTIVE OR ENHANCED
D_p < 1.3 h (Comp = high or low)	CROSSWALK

Figure A-2. Worksheet 1.