MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

HIGHWAY 97 AND BAILEY ROAD ENGINEERING SAFETY REVIEW

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Prepared By: Nam Nguyen, P. Eng.
Transportation Engineer
Ministry of Transportation and Infrastructure

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The Ministry of Transportation and Infrastructure has conducted an engineering safety review of the Highway 97 and Bailey Road intersection. The Highway 97 and Bailey Road Engineering Safety Review includes consultation with the RCMP and ICBC, site visits, site geometry evaluation, traffic counts, traffic analysis, speed surveys, collision analysis and recommendations to improve safety at the intersection.

Highway 97 between College Way and Bailey Road was reconstructed from a 2-lane highway to a 4-lane highway in 1985 to 100 km/h Ministry guidelines. Modifications to the intersection since 1985 include changes to the channelization to allow higher speed turns onto Highway 97. Current Ministry stopping sight distance guidelines are met for the posted speed limit, the intersection is signed according to Ministry guidelines and receives regular maintenance.

Highway 97 carries approximately 16,000 vehicles/day between College Way and Bailey Road, increasing to 17,000 vehicles/day in the summer. All legs and traffic movements of the Highway 97 and Bailey Road intersection operate under capacity. The through traffic volume on Highway 97 accounts for more than 90% of traffic at the intersection during the peak hour of the Monday, June 28, 2010 traffic count at Bailey Road. The high percentage of through volume on Highway 97 does not result in long queues on Bailey Road. The through lanes on Highway 97 operate between 13% and 27% of capacity and provide adequate gaps for the turning movements from Bailey Road. The left turn volume from Bailey Board onto Highway 97 is less than 20% of the required volume that would warrant a signal.

The posted speed limit for Highway 97 at Bailey Road is 90 km/h. A speed survey conducted on Monday, June 28, 2010 shows the 85th percentile operating speed southbound towards Lake Country/Kelowna is 111 km/h, 108 km/h northbound towards Vernon and 109 km/h in both directions. Drivers are over-driving on Highway 97 by Bailey Road. Less than 15% of drivers in both directions on Highway 97 are driving to the posted speed limit.

The collision history for the most recent 10 years of complete data, 2000-2009, from the Ministry database was analyzed. 76 collisions were recorded to the Highway 97 and Bailey Road intersection during the 2000-2009 study period. There were 2 fatal collisions, 34 injury collisions and 40 property damage only (PDO) collisions. The major contributing factors from the collision records coded to the Highway 97 and Bailey Road intersection are speed and driver error. The majority of collisions are single vehicle collisions. The major collision type is Run Off Road. Driver error is the major contributing factor in the Run Off Road collisions.

A fatal Rear End collision involving a motorcycle and commercial vehicle traveling south occurred on August 27, 2009. There was 1 additional PDO Rear End collision southbound. 4 PDO Rear End collisions occurred northbound.

Intersection angle collisions have a lower frequency at Highway 97 and Bailey Road. 3 collisions involved a left turn from Bailey Road, including a fatal collision on April 12, 2006. The other 2 collisions were an injury and PDO. 1 PDO collision involved a right turn from Bailey Road. 3 collisions involved a left turn from Highway 97 onto Bailey Road, 2 injury and 1 PDO. A recent fatal angle collision occurred at the intersection, outside of the study period. The collision occurred on June 7, 2010 and involved a vehicle entering Highway 97 from Bailey Road and a vehicle traveling south towards Lake Country/Kelowna on Highway 97.

The recommendations are targeted at the major collision type and contributing factors.

It is recommended that speed reader boards be installed in both directions on Highway 97 approaching Bailey Road in an effort to reduce driver speeds. Decreased speeds could lead to a reduction in collision severity and frequency. Speed enforcement by the Highway 97 and Bailey Road intersection should be discussed with the RCMP.

It is recommended that the conspicuity of the intersection be increased in an effort to target driver error. Intersection conspicuity can be achieved through installation of a flashing beacon, enhancement of the signs at and approaching the Highway 97 and Bailey Road intersection, installation of transverse rumble strips and repainting of the pavement markings on Bailey Road.

The flashing beacon at the intersection would flash amber for Highway 97 drivers. The height of flashing amber would provide better advanced notice of the intersection for users on the grades approaching Bailey Road. The flashing beacon will flash red for Bailey Road drivers. This would reinforce the stop and yield signs at Bailey Road.

The reflectivity of the signs should be increased, larger signs should be considered and the placement of the signs should be reviewed. Sign enhancement would better alert drivers on both Highway 97 and Bailey Road to the upcoming intersection.

Repainting the pavement markings and installing transverse rumble strips on Bailey Road would alert the drivers to the upcoming intersection at Highway 97. The transverse rumble strips are a tactile warning device that would reinforce the visual cues provided by the signs and flashing beacon.

Construction of new and extension of existing turning lanes could reduce vehicle conflicts between turning vehicles and through traffic. After the first set on of intersection improvements, an acceleration lane for the right turn from Bailey Road onto Highway 97 could be constructed, the right turn taper from Highway 97 onto Bailey Road be could be reconstructed to an acceleration lane and the northbound deceleration lane for left turns from Highway 97 onto Bailey Road could be extended.

2. INTRODUCTION

The Ministry of Transportation and Infrastructure has conducted an engineering safety review of the Highway 97 and Bailey Road intersection. The Highway 97 and Bailey Road Engineering Safety Review includes consultation with the RCMP and ICBC, site visits, site geometry evaluation, traffic counts, traffic capacity analysis, speed surveys and collision analysis.

Highway 97 between College Way in Vernon and Oyama Road in Lake Country is a 4-lane, 90 km/h highway approximately 17 km long. There are 8 unsignalized intersections between College Way and Oyama Road. The highway was constructed to 100 km/h Ministry guidelines in 1985 and carries approximately 16,000 vehicles/day, increasing to 17,000 vehicles/day during the summer. Intersections modifications have been made since 1985. Modifications include changes to the channelization to allow higher speed turns onto Highway 97.

The intersection at Highway 97 and Bailey Road is located approximately 8 km south of the College Way intersection, the most southerly signalized intersection in this area. Refer to Figure 2.

Figure 2: Map of Bailey Road Intersection

3. INTERSECTION LAYOUT

The Highway 97 and Bailey Road intersection is an illuminated four legged unsignalized intersection. The intersection design and signs are consistent with Ministry guidelines. There are horizontal curves and vertical grades on both Highway 97 and Bailey Road.

Highway 97 has a right turn deceleration taper southbound onto Bailey Road. There left turn slots, raised medians in both directions on Highway 97 and guardrail south of the intersection. Highway 97 and the medians are signed to Ministry guidelines and include amber flashers. There are rock bluffs both north and south of the intersection.

Bailey Road is an undivided 2-lane road that connects to Commonage Road and accesses Predator Ridge. There is a right turn taper and guardrail on the eastbound lane that extends onto Highway 97. Bailey Road also has traffic islands and is signed to Ministry guidelines.

The east leg is an undivided 2-lane private access to one residence and a farm.

Figure 3.1: Highway 97 and Bailey Road Intersection

Figure 3.2: Bailey Road Left Turning Vehicle View North

Figure 3.3: Bailey Road Left Turning Vehicle View South

Figure 3.4: Bailey Road Right Turning Vehicle View North

Figure 3.5: Bailey Road Right Turn onto Highway 97

Figure 3.6: Bailey Road Eastbound View Approaching Highway 97

Figure 3.7: Highway 97 Southbound View Approaching Bailey Road

4. ENGINEERING SAFETY REVIEW TASKS

This engineering safety review consists of:

- Site Visits
- Geometric Survey
- Speed Survey
- Traffic Analysis
- Collision Analysis
- Stakeholder Consultation

5. SITE VISITS

Site visits were conducted on Monday, June 28, 2010 to conduct traffic counts and a speed survey; and between Monday, July 12, 2010 and Tuesday, July 13 to conduct a geometric survey. Traffic and site conditions were observed in addition to the data collection.

6. TRAFFIC ANALYSIS

Traffic volumes at Bailey Road and Highway 97, and Bailey Road and Commonage Road were collected on Monday, June 28, 2010

6.1. HIGHWAY 97 AND BAILEY ROAD

	Hwy 97 Northbound			Hwy 97 Southbound			Bailey Rd Eastbound			Bailey Rd Westbound			Intersection
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
8:00	42	503	0	0	479	14	2	2	30	0	1	0	1073
11:00	29	502	1	0	507	17	9	0	25	0	0	0	1090
12:00	48	529	1	0	500	27	12	0	23	0	0	0	1141
15:00	43	621	0	0	609	21	10	0	51	0	0	0	1356
16:00	47	626	1	0	645	11	14	0	52	0	0	1	1397
17:00	57	625	1	0	561	20	9	0	32	0	0	3	1306

Table 6.1: Highway 97 and Bailey Road Hourly Turning Movement Volumes

Peak volumes were observed during the 16:00 hour. Through traffic on Highway 97 is the highest volume movement. Peak hour through volume on Highway 97 was 1271 vehicles.

The left turn movement from Bailey Road onto Highway 97 was recorded at 14 vehicles during the 16:00 peak hour. The right turn movement from Bailey Road heading south towards Lake Country and Kelowna is higher at 52 vehicles during the 16:00 peak hour.

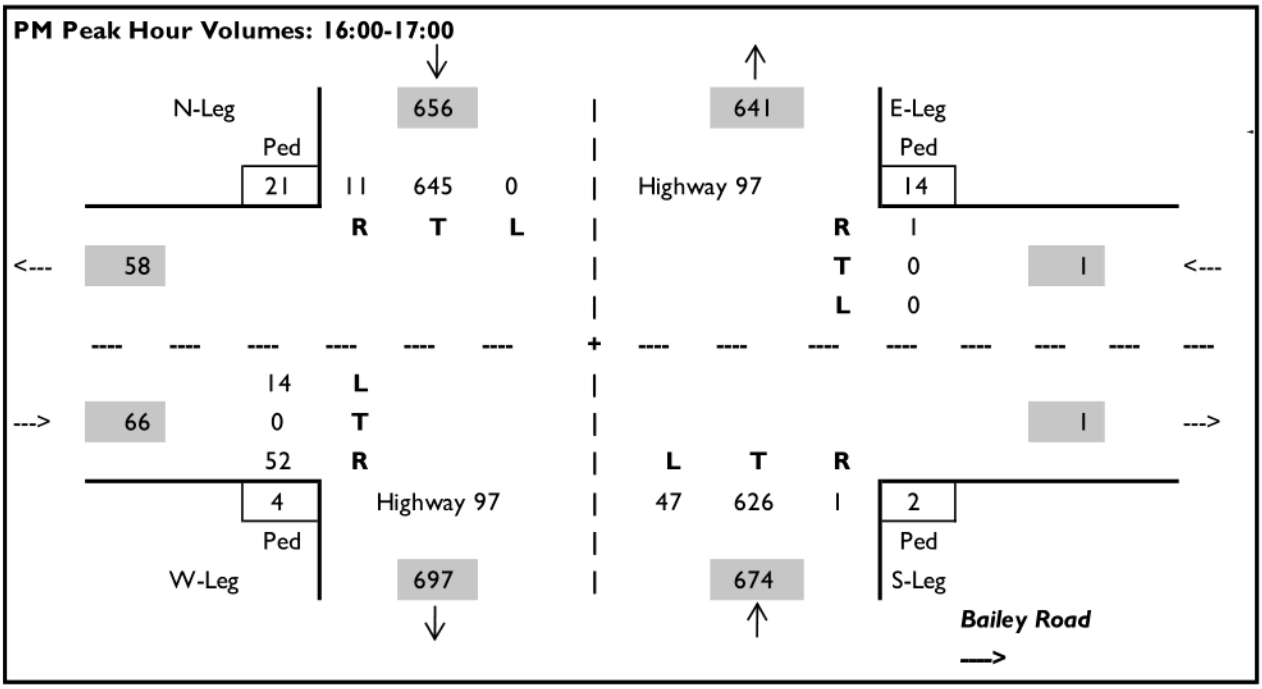

Figure 6.1.1: PM Peak Hour Volumes 16:00-17:00

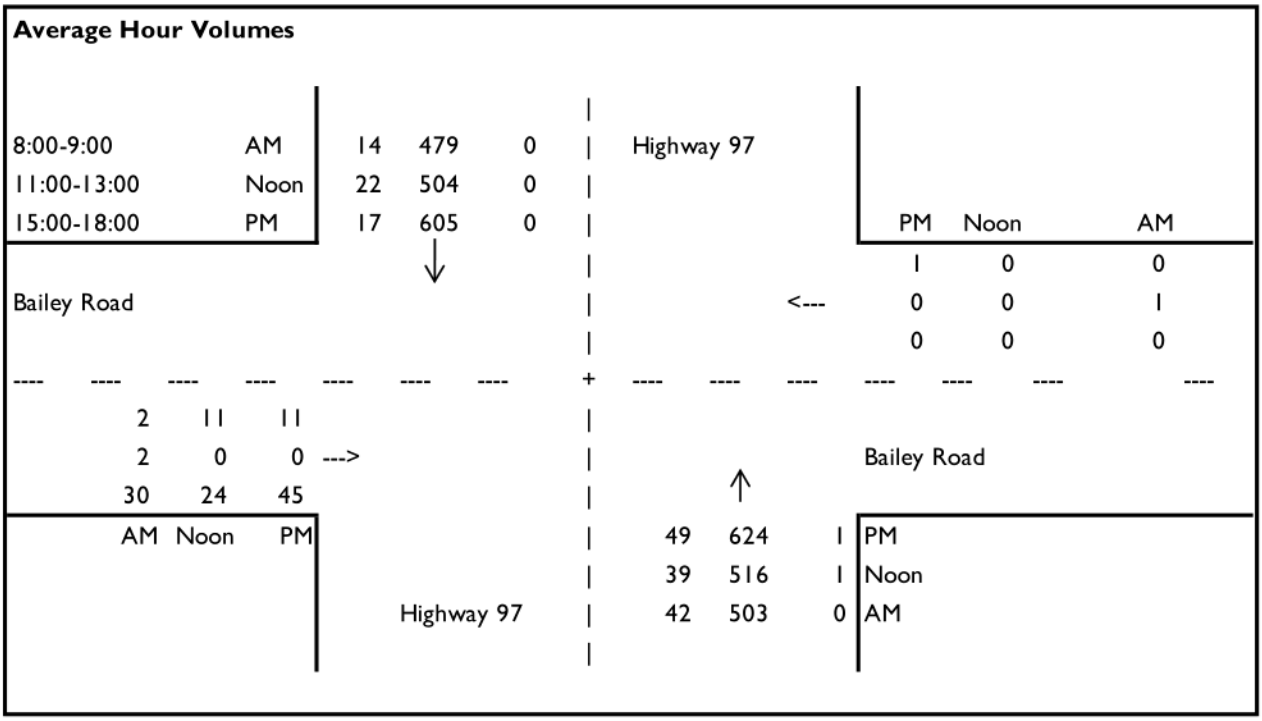

Figure 6.1.2: Average Hour Volumes

The traffic count at Highway 97 and Bailey Road was used to evaluate intersection capacity, queues, required gaps for turning vehicles and the Ministry Signal Warrant.

All legs and traffic movements of the Highway 97 and Bailey Road intersection operate below capacity.

The through traffic volume on Highway 97 accounts for more than 90% of traffic at the intersection during the peak hour of the traffic count at Bailey Road. The high percentage of through volume on Highway 97 does not result in long queues on Bailey Road. The through lanes on Highway 97 operate between 13% and 27% of capacity and provide adequate gaps for the turning movements from Bailey Road. A queue of 1 passenger vehicle or less is experienced by 95% of vehicles traveling from Bailey Road onto Highway 97. A gap of 7.6 seconds (190 m) is required to make the left turn and 6.4 seconds (160 m) is required for the right turn from Bailey Road.

Volumes on Bailey Road are low and do not satisfy the Ministry Signal Warrant. The left turn volume from Bailey Road onto Highway 97 is less than 20% of the required volume that would warrant a signal.

6.2. BAILEY ROAD AND COMMONAGE ROAD

	Commonage Rd Northbound			Commonage Rd Southbound			Bailey Rd Westbound			Intersection
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
8:00	0	59	16	24	34	0	28	0	16	161
11:00	0	40	16	22	55	0	23	0	14	156
12:00	0	60	22	15	40	0	42	0	23	180
15:00										N/A
16:00	0	73	43	27	58	0	15	0	44	217
17:00	0	40	18	24	66	0	24	0	53	173

Note: Traffic volumes not collected for 15:00 hour

Table 6.2: Bailey Road and Commonage Road Hourly Turning Movement Volumes

Commonage Road was upgraded in 2006 from Predator Ridge to Vernon. It operates at a high level of service, at a maximum of 7% of capacity. Capacity to carry additional traffic potentially re-routed from Highway 97 and Bailey Road is available on Commonage Road

7. GEOMETRIC SURVEY

A geometric survey was conducted on July 12 and 13, 2010. The survey captured geometric features of the Highway 97 and Bailey Road intersection: grades, superelevation, horizontal curves, sight distances, road width, and road side objects such as signs and light posts.

The geometric survey confirmed that the intersection was designed to Ministry guidelines. Superelevation, lane widths and sight distances all meet Ministry guidelines. The superelevation is 6% and lane widths are a minimum 3.6 m wide.

Ministry highways are designed to stopping sight distance guidelines. Stopping sight distance is the distance traveled while a driver perceives a situation requiring a stop, realizes stopping is necessary, brakes, and then comes to a stop. The northbound grade on Highway 97 approaching Bailey Road provides approximately 360 m of sight distance. This exceeds the Ministry 90 km/h stopping sight distance guidelines for northbound vehicles on Highway 97 that need to stop at Bailey Road.

The grade southbound on Highway 97 approaching Bailey Road provides 191 m of sight distance. The available sight distance was calculated from the horizontal curve, grade and superelevation of Highway 97 using Ministry engineering software. This meets the 90 km/h Ministry guidelines for stopping sight distance of 190 m.

The available sight distance for vehicles turning from Bailey Road onto Highway 97 is approximately 210 m. This is equivalent to 8.4 seconds at 90 km/h. This satisfies the required the required gaps for turning movements from Section 6.1.

8. SPEED SURVEY

The posted speed limit on Highway 97 at Bailey Road is 90 km/h. A speed survey was conducted at Bailey Road on Monday, June 28, 2010. Figure 8 shows the location of the radar gun and the area were vehicle speeds were collected. Table 8 displays the results of the speed survey.

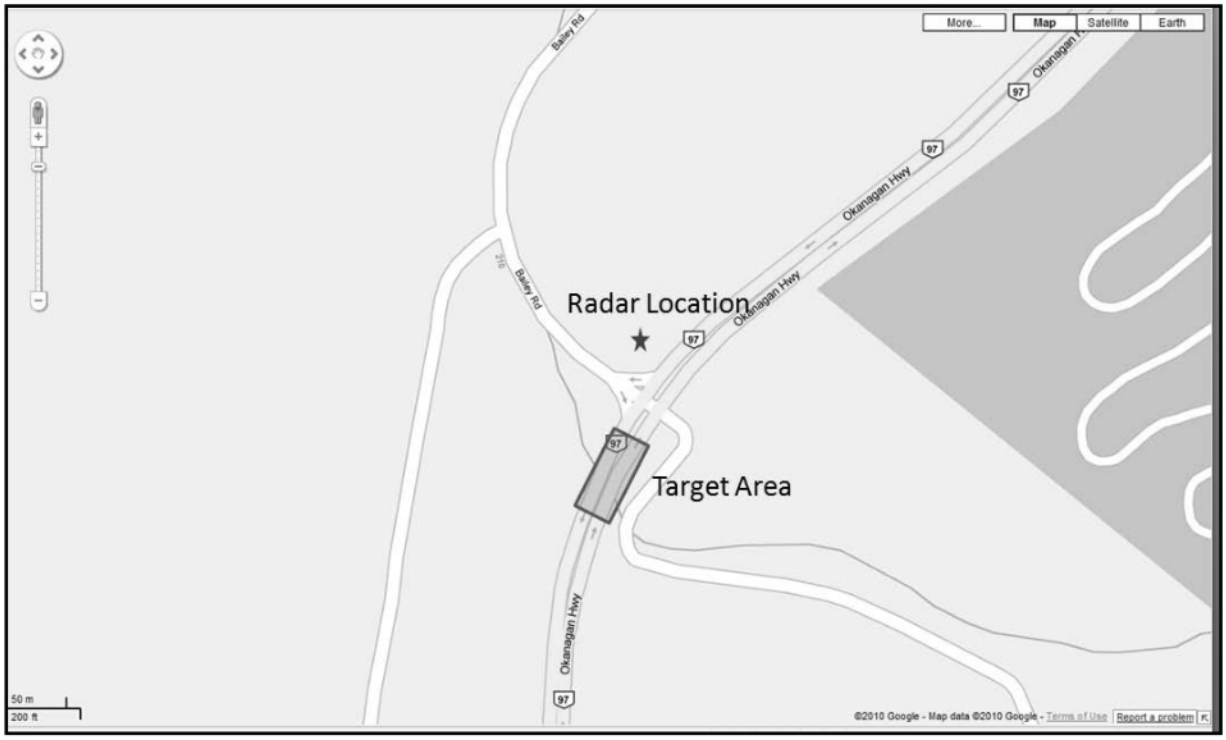

Figure 8: Speed Survey Target Area

	DIRECTION OF TRAVEL		
	HIGHWAY 97 NORTHBOUND	HIGHWAY 97 SOUTHBOUND	BOTH
Posted Speed	**90 km/h**	**90 km/h**	**90 km/h**
Total Vehicles	100	100	200
Minimum Speed	82 km/h	81 km/h	81 km/h
Maximum Speed	126 km/h	128 km/h	128 km/h
Average speed	100 km/h	102 km/h	101 km/h
50th Percentile	99 km/h	101 km/h	101 km/h
85th Percentile	**108 km/h**	**111 km/h**	**109 km/h**

Table 8: Highway 97 and Bailey Road Speed Survey Results

The 85th percentile speed is 108 km/h northbound, 111 km/h southbound and 109 km/h in both directions. The speeds are consistent with other speed surveys conducted in the area surrounding Bailey Road.

For a speed survey conducted on June 17, 2009 at Highway 97 and Crystal Waters Road the 85th percentile speed both northbound and southbound was 108 km/h in each direction.

For a speed survey conducted on June 17, 2009 at Highway 97 and Birnie Road the 85th percentile speed was 108 km/h northbound, 102 km/h southbound, and 104 km/h for both directions.

Drivers are over-driving on Highway 97 by Bailey Road. The 85th percentile operating speeds were 18 km/h to 21 km/h above the 90 km//h posted speed. Less than 15% of drivers in both directions are driving at or below the posted speed limit.

9. COLLISION ANALYSIS

9.1 MINISTRY COLLISION DATABASE

The Ministry collision database dates back to 1987. The data originates from the RCMP MV6020 collision record form and the Ministry database contains RCMP reported collisions. The data from the MV6020 form is sent to ICBC and then from ICBC to the Ministry. There is a lag between collision occurrence and population of data in the Ministry database.

9.2 COLLISION HISTORY

There are 76 collision records in the Ministry collision database within 100 m of the Highway 97 and Bailey Road database for the 10 year period between January 1, 2000 and December 31, 2009. There is a high level of consistency between ICBC and Ministry collision data. RCMP data was not available at the time of the engineering safety review. Ministry collision records are used for the collision analysis.

9.2.1 2000-2009 Study Period

The study period is the most recent 10 years of complete of data available. It is standard practice to choose such a study period for safety reviews. Collisions may have occurred at the intersection since the end date of the study period.

1 of the 76 collisions makes note that the collision occurred 2 km south of Bailey Road. The collision occurring 2 km south of Bailey Rd is omitted from the collision analysis. 1 collision was incorrectly coded away from the Highway 97 and Bailey Road intersection. This collision is included in the collision analysis. The yearly collision history between 2000 and 2009 at Highway 97 and Bailey Road is shown in Table 9.2.1.

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
NUMBER OF COLLISIONS	5	5	2	8	14	10	12	9	5	6

Table 9.2.1: Yearly Collision History at Highway 97 and Bailey Road 2000-2009

The corrected set of 76 collisions recorded to the Highway 97 and Bailey Road intersection was evaluated in further detail. The number of collisions has decreased since 2006. (Commonage Road from Predator Ridge to Vernon was upgraded and paved in 2006.)

There are 2 fatal collision records between 2000 and 2009.

A fatal collision occurred on August 27, 2009 at 8:55 pm. A Rear End collision occurred between a motorcycle and commercial vehicle south of the Highway 97 and Bailey Road intersection. The collision occurred during dry and clear road and weather conditions.

A fatal collision occurred on April 12, 2006 at 10:13 am. The Intersection 90 collision involved a vehicle entering Highway 97 from Bailey Road that and a southbound vehicle on Highway 97. The collision occurred during dry and cloudy road and weather conditions.

9.2.2 1987-1999 Pre-Study Period

There are 30 collision records from 1987-1999. This period starts at the beginning of the Ministry database and ends prior to the 10 year study period of the Highway 97 and Bailey Road Engineering Safety Review. The yearly collision history between 1987 and 1999 at Highway 97 and Bailey Road is shown in Table 9.2.2.

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NUMBER OF COLLISIONS	1	0	1	0	1	4	0	0	8	3	3	6	3

Table 9.2.2: Yearly Collision History at Highway 97 and Bailey Road 1987-1999

There was 1 fatal collision between 1987 and 1999. The fatal collision occurred on December 26, 1998 at 11:12 am. The collision occurred during snow and cloudy road and weather conditions. 3 vehicles were involved in a Run Off Road collision northbound on Highway 97.

9.3 COLLISION DISTRIBUTION

The severity distribution of the 76 collisions at Highway 97 and Bailey Road is:

- Fatal: 2 collisions (2.6%)
- Injury: 34 collisions (44.73%)
- Property Damage Only (PDO): 40 collisions (52.6%)

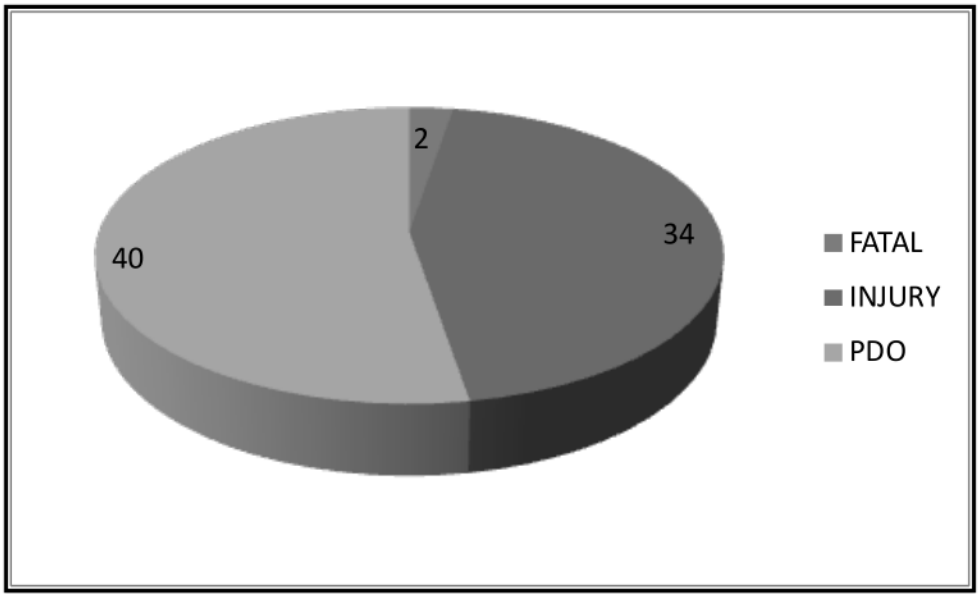

Figure 9.3.1: Highway 97 and Bailey Road Collision Severity Distribution

The distribution of collision types of the 76 collisions at Highway 97 and Bailey Road is:

- 42 Run Off Road (55.3%) – 16 Left (21.1%), 26 Right (34.2%)
- 17 Unknown Type (22.4%)
- 7 Intersection Angle (9.2%)
- 6 Rear End (7.9%)
- 2 Head On (2.6%)
- 1 Sideswipe (1.3%)
- 1 Overtaking (1.3%)

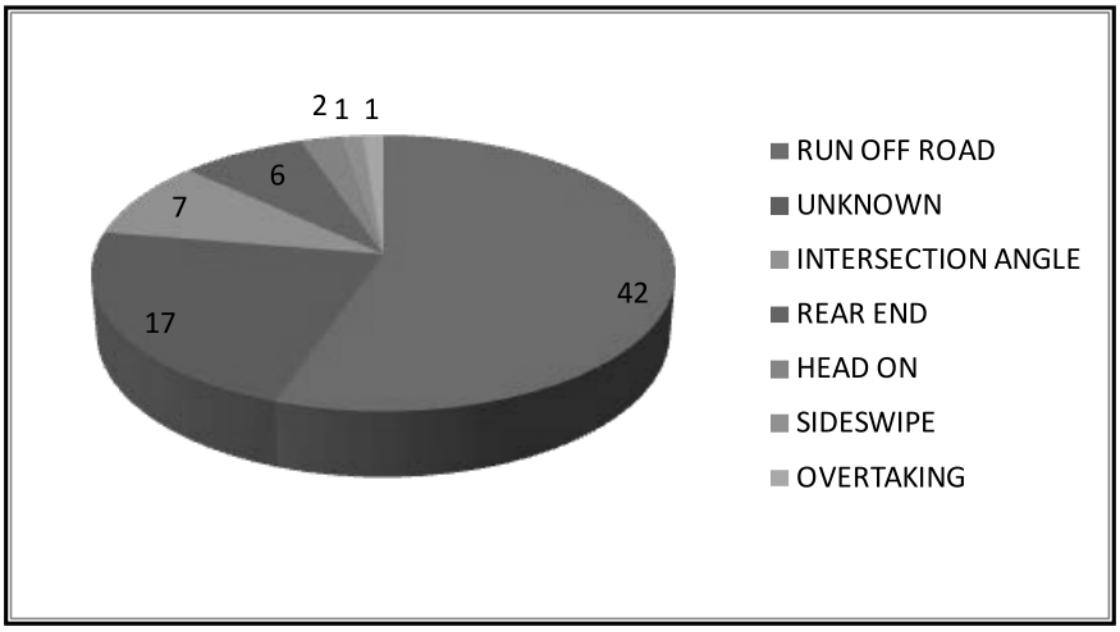

Figure 9.3.2: Highway 97 and Bailey Road Collision Type Distribution

Run Off Road is the major collision type. 26 of the Run Off Road collisions have the primary vehicle traveling south, 16 of the Run Off Road collisions have the primary vehicle traveling north. The second most common collision type is of Unknown or uncategorized type.

The collision diagram will help determine if the turning maneuvers for the intersection angle collisions are made from Highway 97 or Bailey Road. Please refer to Figure 9.5.

9.4 COLLISION CONTRIBUTING FACTORS

Primary Contributing Factors:

- Speed was the primary contributing factor in 17 (22.4%) collisions
- Driver error was the primary contributing factor in 13 (17.1%) collisions
- Wild animals were the primary contributing factor in 10 (13.2%) collisions
- Weather was the primary contributing factor in 9 (11.8%) collisions
- Alcohol was the primary contributing factor in 8 (10.5%) collisions

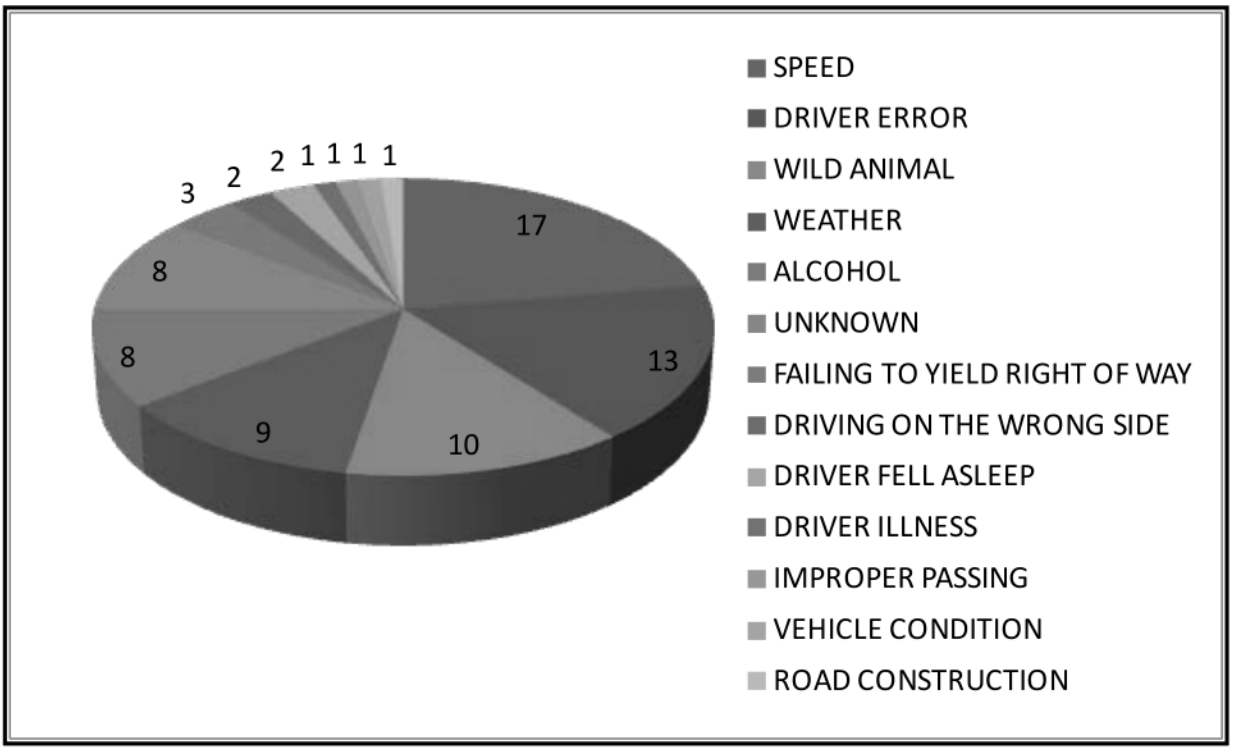

Figure 9.4.1: Primary Collision Contributing Factors

Driver, Road Environment, and Vehicle Contributing Factors:

- The primary contributing factor was attributed to drivers in 47 (61.8%) collisions
- The primary contributing factor was attributed to road environment in 20 (26.3%) collisions
- The primary contributing factor was attributed to vehicles in 1 (1.3%) collision
- The primary contributing factor was unknown in 8 (10.5%) collisions

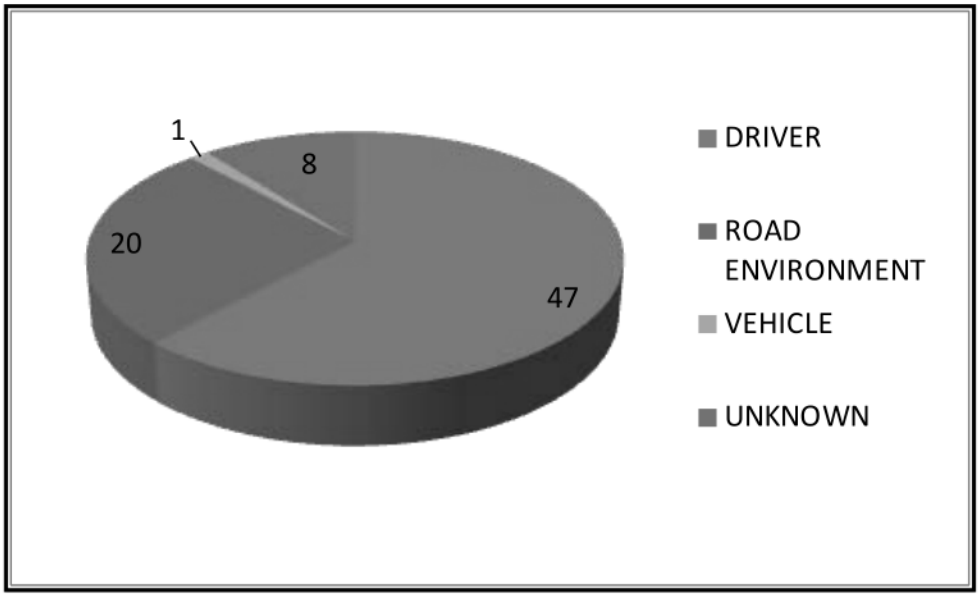

Figure 9.4.2: Driver, Road Environment and Vehicle Contributing Factors

Other Collision Details:

- 54 collisions (72.0%) involved 1 vehicle
  - 38 Run Off Road
    - 28 of the single vehicle Run Off Road collisions were attributed to speed, driver error or alcohol
  - 14 Unknown
  - 2 Wildlife
- 22 collisions (28.9%) involved multiple vehicles
  - 7 Angle
  - 6 Rear End
  - 4 Run Off Road
  - 4 Unknown
  - 1 Overtaking
  - 1 Sideswipe
- 21 collisions (27.6%) occurred between 8 pm and 4 am

9.5 COLLISION DIAGRAM

The collision records and engineering judgment was used to construct a collision diagram. The distribution of collision types for the 76 collisions is not identical to Figure 9.3.2. For example, the 2 Head On collisions listed in Figure 9.3.2 were single vehicle collisions involving wildlife. These collisions are represented as Wildlife collisions in the collision diagram.

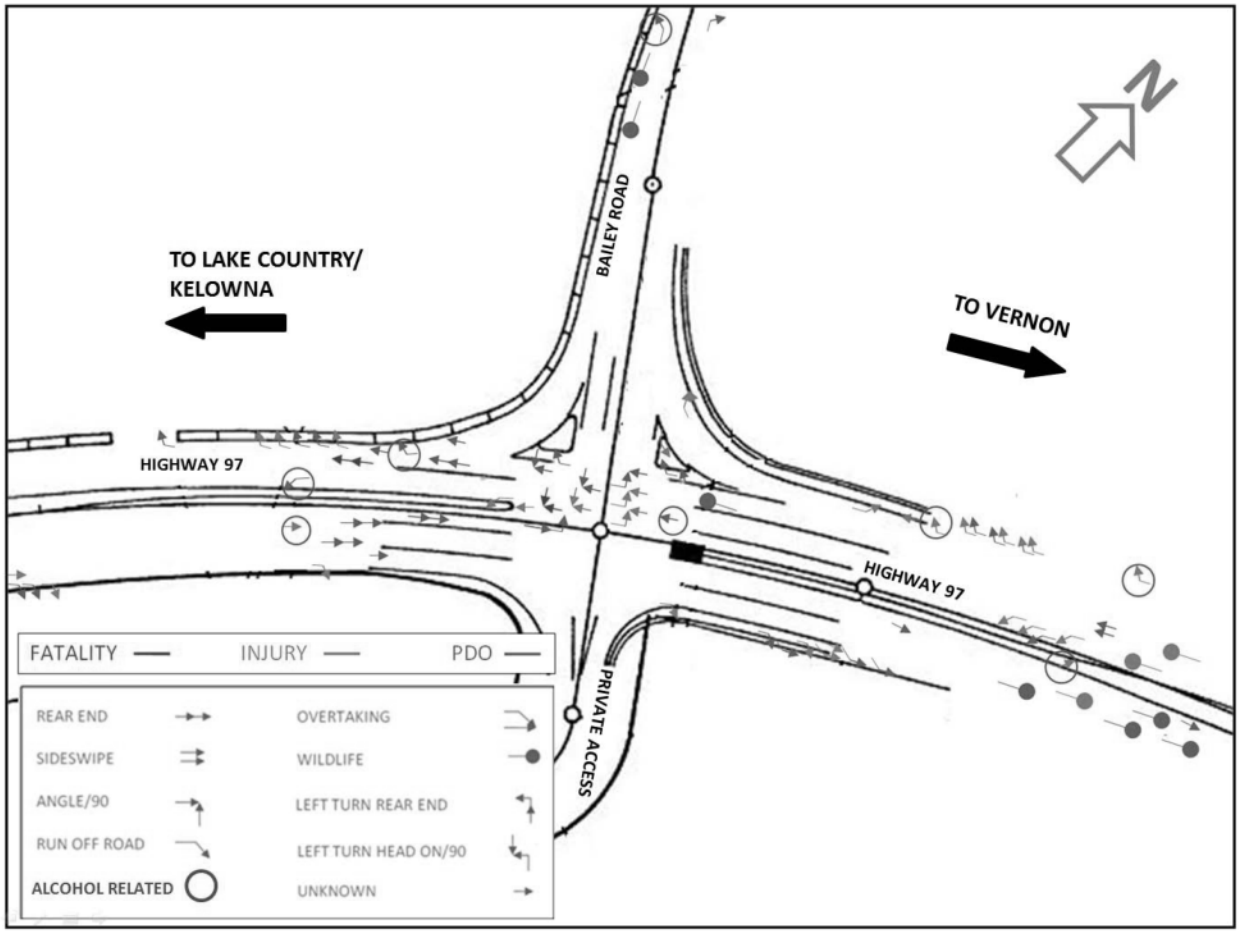

Figure 9.5: Collision Diagram

Run Off Road collisions are the major collision type. There is a higher occurrence of Run Off Road collisions than all other collisions combined. The southbound lane has a higher occurrence of Run Off Road collisions than the northbound lane. Run Off roads are occurring by the rock face and guardrail.

There are 10 collisions that involve wildlife. Wildlife warning signs exist north of the intersection.

Intersection angle collisions involved turning movements from both Highway 97 and Bailey Road. 3 collisions involved a left turn from Bailey Road, including a fatal collision on April 12, 2006. 1 collision involved a right turn from Bailey Road and 3 collisions involved a left turn from Highway 97.

Rear End collisions occurred south of the intersection. A fatal Rear End collision involving a motorcycle and commercial vehicle traveling south occurred on August 27, 2009. There was 1 additional Rear End collision southbound. 4 Rear End collisions occurred northbound.

10. STAKEHOLDER CONSULTATION

Discussions were held with external stakeholders consisting of RCMP, ICBC and concerned residents. These stakeholder discussions took place prior to and during the site visits. Collision frequency, collision severity and speed were commonly mentioned by stakeholders as safety issues at the Highway 97 and Bailey Road intersection. The left turn movement out of Bailey towards Vernon was mentioned by multiple stakeholders as a movement of safety concern.

11. DISCUSSION

Highway 97 was designed to Ministry stopping sight distance guidelines. Ministry stopping sight distance guidelines are met for the posted 90 km/h speed limit. Lane widths and superelevation also meet Ministry guidelines. Vehicles at Bailey Road have the required sight distance for gaps in traffic to make turns on to Highway 97.

The Highway 97 and Bailey Road intersection operates under capacity. The major movement is the through movement in both directions on Highway 97. The through movement accounts for more than 90% of traffic at the intersection during the 16:00-17:00 peak hour of the Monday, June 28, 2010 traffic count. The left turn movement from Bailey Road peaked at 14 vehicles during the peak hour which is less than 20% of the volume that would warrant a signal.

The posted speed limit on Highway 97 at Bailey Road is 90 km/h. Operating speeds on Highway 97 based on Ministry speed surveys are 12 km/h to 21 km/h above the posted speed limit. The speed survey conducted on Monday, June 28, 2010 showed that the operating speeds at Bailey Road were 18 km/h to 21 km/h above the posted speed limit. Less than 15% of drivers drove to the posted speed limit. The RCMP has recently patrolled Highway 97 in the area of the Bailey Road enforcing the 90 km/h posted speed limit.

Artificially lowering the speed limit has little effect on driver behavior. A study[1] investigated the effects of raising and lowering the speed limit at 100 experimental sites on highways in 22 US states. A summary of the results indicated that raising or lowering the speed limits had little effect on the driver's speed choice, and did not lead to and statistically significant changes in either total or severe collisions. Therefore, arbitrarily posted reduced speed zones are not likely to operate effectively.

1. Parker, M. R. Jr., "Effects of Raising and Lowering Speed Limits on Selected Roadway Sections." FHWA-RD-92-084, (1997)

The major contributing factors from the collision records coded to the Highway 97 and Bailey Road intersection are speed and driver error. The majority of collisions involved a single vehicle and the major collision type is Run Off Road type. Of the 76 collisions recorded at Highway 97 and Bailey Road, 52 were single vehicle and 42 are Run Off Road. Driver error is the major contributing factor in the Run Off Road collisions. Speed and alcohol involvement are the next most prominent contributing factors of the Run Off Road collisions. Turning movements from Bailey Road are not explicitly prominent in the Run Off Road collisions however, some of the Run Off Road collisions could be (partially) attributed to turning vehicles from and onto Bailey Road.

It is difficult to say what is causing the Run Off Road collisions. The prevalence of Run Off Road collisions suggest that drivers are performing avoidance maneuvers within the vicinity of the intersection. Lane changes could also be a contributing movement but anecdotally, the lane change movement was not noted to be a common occurrence at Bailey Road. Anecdotally, 3 “close calls” were observed during the Monday, June 28, 2010 traffic counts. These “close calls” involved a vehicle turning right from Bailey Road onto Highway 97 heading towards Lake Country/Kelowna. Southbound vehicles traveling straight through the intersection on Highway 97 were braking or swerving to avoid these vehicles.

A fatal Rear End collision involving a motorcycle and commercial vehicle traveling south occurred on August 27, 2009. There was 1 additional Rear End collision southbound. 4 Rear End collisions occurred northbound. The recorded Rear End collisions could be attributed to slower vehicles turning onto Highway 97 from Bailey Road. The left turn movement northbound from Highway 97 onto Bailey Road could be contributing to the recorded Rear End collisions northbound. Avoidance of other vehicles directly upstream could also be a factor.

Intersection angle collisions have a much lower frequency but tend be more severe than Run Off Road collisions. Intersection angle collisions involved turning movements from both Highway 97 and Bailey Road. 3 collisions involved a left turn from Bailey Road, including a fatal collision on April 12, 2006. The other 2 collisions were an injury and PDO. 1 PDO collision involved a right turn from Bailey Road. There is evidence that drivers are not obeying the Stop and Yield signs at Bailey Road. 3 collisions involved a left turn from Highway 97 onto Bailey Road, 2 injury and 1 PDO.

Efforts should be made to reduce speed and driver error, and to provide better notice of the intersection to drivers on Highway 97 and Bailey Road. Geometric intersection improvements could reduce vehicle conflicts between turning vehicles and through traffic. Intersection improvements that do not involve movement restrictions should be considered. External stakeholders should be consulted for options that include movement restrictions.

12. RECOMMENDATIONS

Run Off Road collisions are the major collision type and speed and driver error are the major contributing factors in the collision records. A combination of measures can be implemented to target the major collision type and contributing factors.

It is recommended that speed reader boards be installed in both directions on Highway 97 approaching Bailey Road in an effort to reduce driver speeds. Decreased speeds could lead to a reduction in collision severity and frequency, and provide larger gaps for vehicles turning from Bailey Road.

It is recommended that the conspicuity of the intersection be increased in an effort to target driver error. Intersection conspicuity can be achieved through installation of a flashing beacon, enhancement of the signs at and approaching the Highway 97 intersection, installation of transverse rumble strips and repainting of the pavement markings on Bailey Road.

The flashing beacon at the intersection would flash amber for Highway 97 drivers. The height of flashing amber would provide better notice of the intersection for users on the grades approaching Bailey Road. The flashing beacon would flash red for Bailey Road drivers. This would reinforce the stop sign at Bailey Road.

The reflectivity of the signs should be increased, larger signs should be considered and the placement of the signs should be reviewed. Sign enhancement would better alert drivers on both Highway 97 and Bailey Road to the upcoming intersection.

Repainting the pavement markings and installing transverse rumble strips on Bailey Road would alert the drivers to the upcoming intersection at Highway 97. The transverse rumble strips are a tactile warning device that would reinforce the visual cues provided by the signs and flashing beacon.

Lowering the posted speed limit and signalization of the intersection are not recommended.

The recommended intersection improvements would target the major collision type and contributing factors. The effects of the intersection improvements should be monitored. Other options for Highway 97 and Bailey Road can be considered.

Construction of new and extension of existing turning lanes could reduce vehicle conflicts between turning vehicles and through traffic. An acceleration lane for the right turn from Bailey Road onto Highway 97 could be constructed, the right turn taper from Bailey Road onto Highway 97 be could be reconstructed to an acceleration lane and the northbound deceleration lane left turn from Highway 97 onto Bailey Road could be extended.

APPENDIX A: FATAL COLLISIONS 1987-2010

Fatalities at Highway 97 and Bailey Road

June 7, 2010*
Collision Type: Intersection 90
Number of Vehicles: 2
Number of Fatalities: 1
1st Contributing Factor: N/A
Time: 17:11
Road and Weather Condition: Dry and Clear
Direction: East

A vehicle on Bailey Road was either turning left or going through the intersection when it was hit by a southbound vehicle.

August 27, 2009
Collision Type: Rear End
Number of Vehicles: 2
Number of Fatalities: 1
1st Contributing Factor: N/A
Time: 20:55
Road and Weather Condition: Dry and Clear
Direction: South

A rear end collision occurred between a motorcycle and commercial vehicle south of the Highway 97 and Bailey Road intersection.

April 12, 2006**
Collision Type: Intersection 90
Number of Vehicles: 2
Number of Fatalities: 1
1st Contributing Factor: Driver Error
Time: 10:13
Road and Weather Condition: Dry and Cloudy
Direction: East

A vehicle on Bailey Road was either turning left or going through the intersection when it was hit by a southbound vehicle.

** Collision occurred outside the 2000-2009 study period*
*** Collision was added to the Highway 97 and Bailey Road collision records for the 2000-2009 study period*

December 26, 1998*
Collision Type: Off Road Left
Number of Vehicles: 3
Number of Fatalities: 1
1st Contributing Factor: N/A
Time: 11:12
Road and Weather Condition: Snow and Cloudy
Direction: North

Fatalities within 5 km of Highway 97 and Bailey Road

These fatalities are not recorded at Highway 97 and Bailey Road. These collisions are recorded 1 km or more away from the Highway 97 and Bailey Road intersection.

September 4, 2005
Location: 2 km north of Bailey Road
Collision Type: Head On
Number of Vehicles: 2
Number of Fatalities: 4
1st Contributing Factor: Driving on Wrong Side of Road
Time: 03:11
Road and Weather Condition: Dry and Cloudy
Direction: North

January 16, 2002
Location: 1 km south of Bailey Road
Collision Type: Head On
Number of Vehicles: 2
Number of Fatalities: 1
1st Contributing Factor: Unsafe Speed
Time: 14:46
Road and Weather Condition: Slush and Clear
Direction: South

July 11, 1997
Location: 1.1 km south of Bailey Road
Collision Type: Run Off Road Right
Number of Vehicles: 1
Number of Fatalities: 2
1st Contributing Factor: Alcohol Involvement
Time: 03:55
Road and Weather Condition: Dry and Clear
Direction: North

February 14, 1996
Location: 2.4 km north of Bailey Road
Collision Type: Head On
Number of Vehicles: 2
Number of Fatalities: 1
1st Contributing Factor: Unknown
Time: 8:19
Road and Weather Condition: Wet and Clear
Direction: South

APPENDIX B: SPEED SURVEY CHARTS

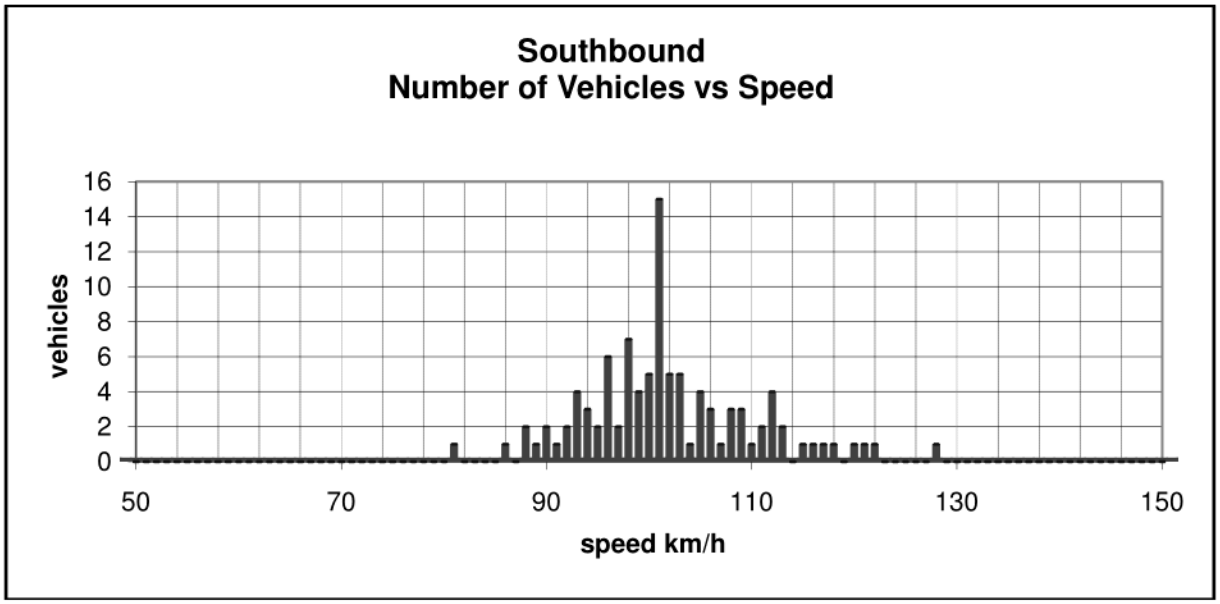

FIGURE A1: Highway 97 and Bailey Road Speed Distribution Southbound

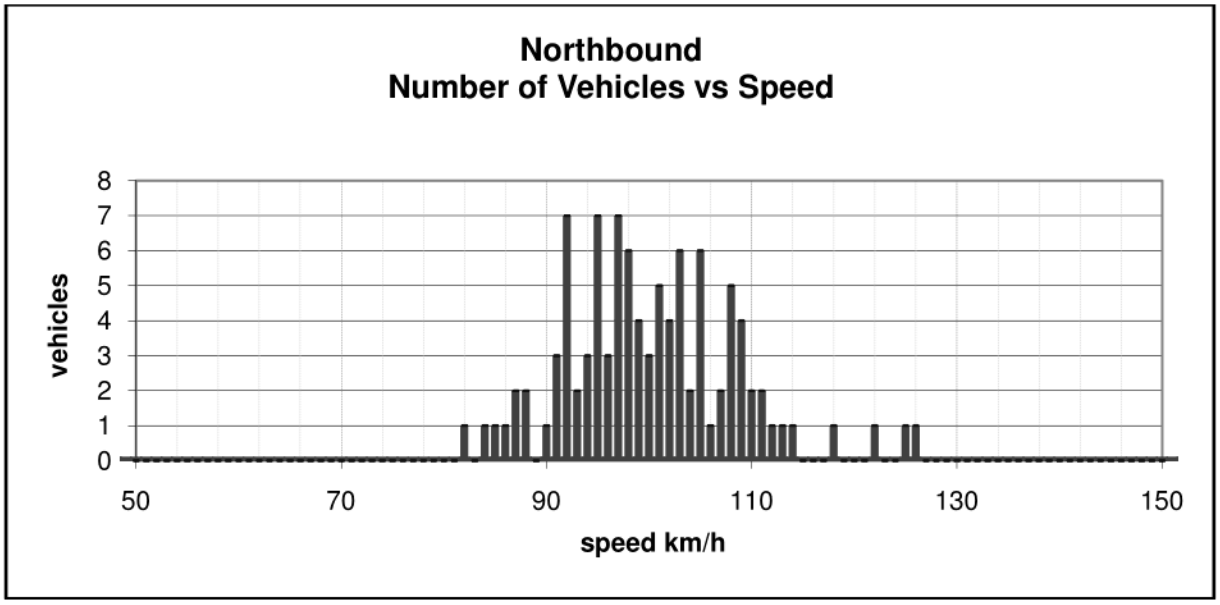

FIGURE A2: Highway 97 and Bailey Road Speed Distribution Northbound

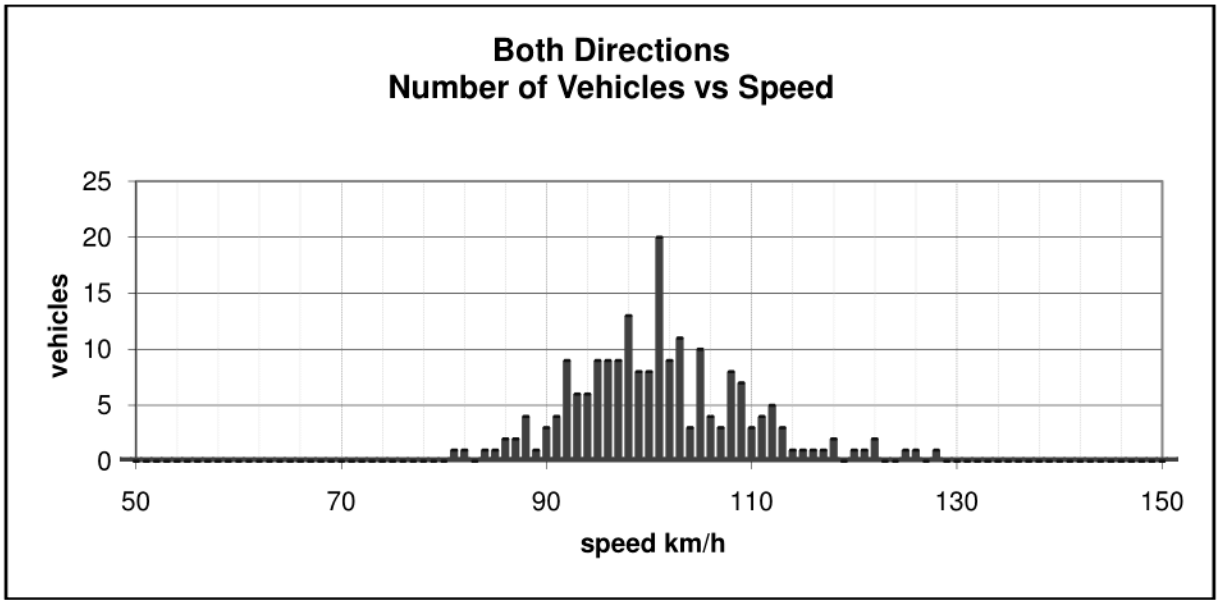

Figure A3: Highway 97 and Bailey Road Speed Distribution Both Directions

APPENDIX C: MINISTRY COLLISION DATA

Data from the Ministry collision database includes a variety of fields, including:

- Km Mark
- Location Code
- Collision Type
- Collision Severity
- Vehicle Direction
- Contributing Factors
- Surface Condition
- Weather

Sample Data

Collision Summary Report

Highway	Segment	Km	Collision Case #	Collision Date	Time	Collision Type	Total Killed	Total Injury	Tot Veh	Primary Occurrence	Location Type	First Contributing Factor for First Vehicle	Road Surface Condition	Weather Conditions	Direction Travel V1	Travel V2
97	1220	35.5	R3392746	2003-10-04	15:50	PDO	0	0	1	Other	Btwn intersection/exchs	Wild animal	Dry	Clear	North	
97	1220	35.5	R3390723	2003-10-16	08:53	PDO	0	0	1	Head on	Btwn intersection/exchs	Wild animal	Wet	Cloudy	North	
97	1220	35.5	R3392665	2003-11-25	13:30	PDO	0	0	1	Off road right	Btwn intersection/exchs	Driving without due care	Slush	Snowing/sleet	South	
97	1220	35.5	R3392850	2003-12-13	11:54	INJ	0	2	1	Off road right	Btwn intersection/exchs	Unsafe speed	Wet	Cloudy	South	
97	1220	35.5	R3179568	2003-12-30	13:42	INJ	0	1	1	Off road right	Btwn intersection/exchs	Unsafe speed	Slush	Snowing/sleet	South	
97	1220	35.5	R3392787	2004-01-07	07:56	INJ	0	3	1	Off road right	Btwn intersection/exchs	Unsafe speed	Snow	Snowing/sleet	South	
97	1220	35.5	R3390779	2004-01-07	11:02	INJ	0	1	2	Overtaking	Exit deceleration lane	Other	Ice	Snowing/sleet	Parked	Unknown
97	1220	35.5	R3389982	2004-01-22	16:36	PDO	0	0	1	Off road right	Btwn intersection/exchs	Unsafe speed	Slush	Snowing/sleet	South	
97	1220	35.5	R3390858	2004-01-26	12:33	INJ	0	1	1	Off road left	Btwn intersection/exchs	Driving on wrong side of road	Slush	Cloudy	South	
97	1220	35.5	R3392791	2004-01-31	07:57	INJ	0	1	1	Off road left	Btwn intersection/exchs	Unsafe speed	Ice	Cloudy	South	
97	1220	35.5	R3392794	2004-02-17	02:26	INJ	0	1	1	Off road right	Btwn intersection/exchs	Alcohol involvement	Ice	Cloudy	South	
97	1220	35.5	R3541707	2004-05-12	15:21	INJ	0	2	2	Left turn 90'	At intersection	Driver inattentive	Dry	Cloudy	North	South
97	1220	35.5	R3527057	2004-06-22	17:49	PDO	0	0	2	Rear end	At intersection	Driver inattentive	Dry	Clear	North	North
97	1220	35.5	R3552932	2004-06-30	16:39	PDO	0	0	1	Off road right	Btwn intersection/exchs	Road condition (ice,snow,slush	Wet	Raining	South	
97	1220	35.5	R3553087	2004-07-24	03:37	PDO	0	0	1	Other	Int road&driveway/alley	Wild animal	Dry	Clear	South	
97	1220	35.5	R3552937	2004-08-13	17:41	PDO	0	0	1	Other	Btwn intersection/exchs	Other	Dry	Clear	North	
97	1220	35.5	R3553186	2004-09-11	10:04	PDO	0	0	1	Other	Btwn intersection/exchs	Not applicable	Wet	Cloudy	North	
97	1220	35.5	R3553198	2004-11-01	07:17	PDO	0	0	2	Left turn head on	At intersection	Exceeding speed limit	Dry	Clear	South	West
97	1220	35.5	R3650405	2004-11-29	17:26	INJ	0	1	1	Off road left	Btwn intersection/exchs	Wild animal	Dry	Cloudy	South	
97	1220	35.5	R3650248	2005-01-19	:	PDO	0	0	2	Rear end	Btwn intersection/exchs	Weather (fog,sleet,rain,snow)	Snow	Cloudy	North	North
97	1220	35.5	R3835763	2005-05-05	08:00	INJ	0	1	1	Intersection 90'	At intersection	Not applicable	Dry	Cloudy	South	
97	1220	35.5	R3650686	2005-05-20	22:14	PDO	0	0	2	Off road left	Btwn intersection/exchs	Alcohol suspected	Dry	Cloudy	North	South
97	1220	35.5	R3835619	2005-07-15	14:00	PDO	0	0	1	Off road right	Btwn intersection/exchs Off highway	Driver inattentive	Wet	Unknown	West	

Report Date: 2010-07-29
User: IDIR\NNGUYEN
Environment: PRD

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Report Number: CIS-003

Figure A4: Sample Collision Report