

Evaluation of Traffic and Safety Characteristics of Country Club Avenue in Kenwood Neighborhood



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DISCLAIMER

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Florida State University.

METRIC CONVERSION FACTORS

1 ft = 0.3048 m

1 mph = 1.609 km/h

EXECUTIVE SUMMARY

Background

At the request of the City of Fort Walton Beach, traffic safety and operating characteristics of some streets in the Kenwood neighborhood were reviewed. Kenwood Neighborhood is sandwiched on the north by the Eglin Air Force Base, on the east by Garmier Bayou, on the south by Dons Bayou, and on the west by Lewis Turner Boulevard. The neighborhood is largely residential and is comprised of single family homes and multiple family complexes. There are three K-12 schools in this neighborhood – that is, Kenwood Elementary School, Pryor Middle School, and Choctawhatchee High School. The existence of school children in this area adds to the concern for highway safety by residents, particularly on the Country Club Avenue which carries a substantial amount of traffic as revealed by recent traffic volume surveys and accident experience.

Objectives

The overall goal of this study was to investigate traffic operations and safety characteristics of a network of roadways in the Kenwood neighborhood. Consistent with this goal, the objectives of this study were to quantify speed and volume characteristics of “through” traffic using the neighborhood streets to access Lewis Turner Boulevard and Racetrack Road, which are the major arterial roadways in the area; and to investigate traffic calming and other improvement measures aimed at alleviating safety and operational problems, particularly on Country Club Avenue which, together with Mooney Road, were observed to be the main streets preferred by “through” traffic as cut through roadways.

Findings

The results of traffic studies showed that Lewis Turner Boulevard and Racetrack Road are the major arterials surrounding the neighborhood each carrying approximately 30,000 vehicles per day. The review of 5-year accident data showed that a total of 13 accidents were reported to have occurred in this neighborhood but no definitive trend in crash type was observed from the data. However, 11 of the 13 reported crashes occurred on Country Club Avenue (five) and Mooney Road (six). The through traffic intending to access Lewis Turner Boulevard and Racetrack Road use Kenwood neighborhood streets, particularly Country Club Avenue, as cut through streets. Traffic data collected on Country Club Avenue show that it carries on the average 3,000 vehicles per day with an 85th percentile speed in excess of 35 miles per hour. Two out of three “through” drivers choose the Country Club Avenue over Mooney Road as a cut through street. In addition, the operating speed data showed that, on the average, seven out of ten drivers exceed the 25 MPH speed limit on Country Club Avenue. From data analysis, it can be surmised that the level of traffic volume and the prevailing traffic speeds are quite high for a roadway with geometrics and neighborhood character resembling those seen on Country Club Avenue.

Evaluation of Alternatives

Five alternative engineering improvement strategies aimed at reducing traffic volumes and lowering traffic speeds along the Country Club Avenue were analyzed. The alternatives were: (i) the installation of state route signs directing through traffic to Racetrack Road and Lewis Turner Boulevard; (ii) the installation of radar speed feedback signs on Country Club Avenue in the school zone area; (iii) the installation of “chicane” traffic calming islands on the tangent section of Country Club Avenue; (iv) the installation of speed tables on the tangent section of Country Club Avenue, and (v) splitting the Country Club Avenue at Rue De Le Roi Street. All alternatives were carefully analyzed in terms of their effectiveness in reducing traffic volume and/or traffic speed, cost, ease of implementation, and preservation of neighborhood aesthetics. The predicted effectiveness of each alternative was graded either as LOW, MODERATE, or HIGH as shown in Table 1.

Table 1. Summary of Improvement Alternatives Considered

	Alternative	Predicted Effectiveness	Initial Cost
1.	Install signs directing through traffic to SR 188 and to SR 189	LOW	\$1,000
2.	Install Radar Driver Speed Feedback Signs on Country Club Avenue	MODERATE	\$8,000
3.	Install “Chicanes” on Country Club Avenue	HIGH	\$20,000
4.	Install Speed Tables on Country Club Avenue	HIGH	\$30,000
5.	Split Country Club Avenue at Rue De Le Roi Street	MODERATE	\$15,000

Recommendations

As shown in Table 1 above, the alternatives that are likely to have high impact on improving operations along Country Club Avenue are the installation of chicanes or speed tables. It is predicted that the implementation of either of these two alternatives would result in significant speed reduction and lowering of the high level of traffic volume that currently passes through Country Club Avenue. However, some residents in neighborhoods around the United States in which speed tables were installed have complained of increased traffic noise and increased emergency vehicles’ response time. The installation of chicanes seems to be the most cost-effective alternative with an added benefit of preserving neighborhood aesthetics. It is therefore recommended that the installation of chicanes on Country Club Avenue between Wedgewood Lane and Mooney SE should be considered for implementation by the City of Fort Walton Beach.

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1. INTRODUCTION

Fort Walton Beach is a coastal city located in Okaloosa County, northwest Florida. In 2010, the US Census Bureau estimated the city to have a population of approximately 20,000 people. The city is home to Eglin Air Force Base, which is the world's largest US Department of Defense installation, spanning 724 square miles with a \$7 billion annual impact to the local economy. The city boasts of traditional neighborhoods located along the shorelines and bayous of the Gulf of Mexico, one of which is Kenwood neighborhood. Figure 1 shows the vicinity characteristics of part of the Kenwood neighborhood.



Figure 1. Vicinity Characteristics of Kenwood Neighborhood (Source: Google Maps)

Kenwood Neighborhood is sandwiched on the north by the Eglin Air Force Base, on the east by Garmier Bayou, on the south by Dons Bayou, and on the west by Lewis Turner Boulevard. The neighborhood is largely residential and is comprised of single family homes and multiple family complexes. There are three K-12 schools in this neighborhood – that is, Kenwood Elementary School, Pryor Middle School, and Choctawhatchee High School. The existence of school children in this area adds to the concern for safety by residents on the Country Club Avenue which carries a substantial amount of traffic as revealed by recent traffic volume surveys and accident experience. In fact, a very profile traffic accident resulting in the death of a high school student living on Country Club Avenue was reported in the local newspaper, *North West Florida Daily News*, on June 24, 2010 (Ref. 1). The investigating police officer indicated that speeding was likely a contributing factor to the accident.

2. STUDY OBJECTIVES

The overall goal of this study was to investigate traffic operations and safety characteristics of a network of roadways in the Kenwood neighborhood. Consistent with this goal, the objectives of this study were to quantify through-traffic driving between Lewis Turner Boulevard and Racetrack Road in terms of traffic volume and speed and to investigate traffic calming and other improvement measures that can assist in alleviating safety and operations hurdles, particularly on Country Club Avenue and Mooney Road, which are the main roads used by motorists as cut through roadways in this neighborhood.

3. METHODOLOGY

In order to achieve the desired objectives, the methodology used in conducting the study was to perform a number of tasks that included collecting field data; analyzing traffic and safety data; reviewing traffic calming measures appropriate for the neighborhood and that have the potential to be effective in improving safety and calming traffic; and, if necessary, recommending engineering improvements on Kenwood neighborhood roadways. The field data that were deemed relevant to the study included geometric characteristics data; signs and pavement markings; traffic volume (in terms of AADT and turning movement counts at critical intersections); operating speed characteristics; travel time data on Country Club Avenue, Fairway Avenue, Powell Drive, and Mooney Road; and traffic accidents history on the entire road network in the area displayed in Figure 1. The following sections describe the data collection process as well as the analysis of the field data that were collected in the course of the study.

4. GEOMETRIC CHARACTERISTICS

The two major arterial roads running somewhat parallel to each other on the north and on the south side of Kenwood neighborhood are Lewis Turner Boulevard (SR 189) and Racetrack Road (SR 188). Both are four-lane divided highways with adequate geometric characteristics. The posted speed limits on SR 189 and SR 188 in the vicinity of Kenwood neighborhood are 45 MPH and 40 MPH, respectively. There are a number of streets in Kenwood neighborhood that run perpendicular to Lewis Turner Boulevard and Racetrack Road. These roads are Country Club Avenue, Golf Course Drive, Fairway Avenue, Powell Drive, and Mooney Road. However, the roadways that seem to be used by “through traffic” to access Lewis Turner Boulevard and Racetrack Road are the Country Club Avenue and Mooney Road. Thus, the collection of geometric characteristics and other data was concentrated on these two roadways.

Country Club Avenue is a two-lane two-way highway with a yellow centerline striping and white edge markings. Along most of its length, Country Club Avenue has sidewalk only on one side of the street, that is, the left side of the southbound direction. Travel lane widths along Country Club Avenue vary but typically are close to 9 feet and 8 inches wide. The existing sidewalk on the average is 5 feet wide and is separated from the travel way by approximately 7 feet of landscaped buffer. Unlike Mooney Road, Country Club Avenue has no curbs-and-gutter

geometry on most of its length. Figure 2 shows the predominant cross section of Country Club Avenue, facing south. A driver driving south on Country Club Avenue is faced with a horizontal curve after passing Rue De Le Roi Street intersection. The horizontal curve has adequate sight horizontal distance and has chevron alignment signs placed to provide positive guidance to drivers. The Country Club Avenue intersects six streets, the characteristics of which are displayed in Appendix A.



Figure 2. Typical Country Club Avenue Cross Section

All six intersections on Country Club Avenue shown in Appendix A are of T-intersection type. Traffic turning into Country Club Avenue from Mooney Road are required to stop at Wedgewood Lane and at Eagle Street intersections. There are 3-way stop-controlled signs installed at all approaches at Wedgewood Lane and at Eagle Street intersections. The lane markings and traffic signs on Country Club Avenue appear to be visible and adequate for an attentive driver. At each entrance of Country Club Avenue there are signs indicating that through buses and trucks are not allowed. 25 MPH speed limit signs are also installed at a number of locations on this avenue and are fairly visible to drivers turning into Country Club Avenue from either direction. There are a number of “Watch for Pedestrians” and “Pedestrians Crossing” signs installed on this road. There is a school zone marking with a standard yellow school crossing sign installed in the middle of the tangent section of Country Club Avenue, i.e., between Wedgewood Lane and Mooney Road SE.

Mooney Road is a looping roadway forming a perimeter around Kenwood neighborhood on the east side. This road intersects Country Club Avenue twice as was shown in Figure 1. The typical cross section that predominates throughout Mooney Road is shown in Figure 3.



Figure 3. Typical Cross Section on Mooney Road

As seen in Figure 3, Mooney Road has a curb-and-gutter urban design with sidewalks installed on both sides of the street. The travel lanes are on the average 10 feet 3 inches wide. The sidewalks are on the average 5 feet wide with an average buffer separation of over one foot from the edge of the curb. Property fences and hedges along Mooney Road have an average offset of 20 feet from the edge of the curb.

There are number of traffic signs on Mooney Road warning of school zones and crossings, warning of horizontal curves, and alerting drivers of legal speed limit. Drivers driving along Mooney Road are required to stop only once – that is, at its intersection with Garnier’s Post Road where a 3-way STOP sign is installed at each approach. There are two speed limit zones on Mooney Road, i.e., 25 MPH between Country Club SE intersection and Garnier’s Post Road; and 35 MPH from Garnier’s Post Road to Country Club NE intersection. However, it should be noted that the geometric characteristics of Mooney Road in both speed zones are virtually the same except for the existence of a horizontal curve in the 25 MPH speed zone.

Table 1 below summarizes the key technical features that have an influence on safety and operations along the two major cut-through roadways in the Kenwood neighborhood. These key features include the length of each roadway measured from their two intersections, the posted

speed limit, the number of stops along the route, presence of sidewalks, and the number of intersecting streets. There are other features that tend to influence a driver's choice of a route and driving speed but these features will be discussed later.

Table 1. Summary of Key Geometric Features

Roadway	Length	Posted Speed	No. of Stops	Presence of Sidewalks	Intersecting Streets
Country Club Ave.	0.82 mi	25 MPH	2	One side	6
Mooney Road	1.74 mi	<u>Between CC S and Garnier's Post Road</u> 25 MPH	1	Both sides	25
		<u>Between Garnier's Post Road and CC N</u> 35 MPH			

5. TRAFFIC OPERATING CHARACTERISTICS

The traffic operating characteristics of interest in this study were volume, speed, and travel time. Speed – and travel time, which is a reciprocal of speed – tend to be used by most drivers as important factors in choosing a route between an origin and a destination. Traffic volume is also an important element in route choice, but even more critical from safety standpoint, traffic volume has a negative influence on safety, particularly on residential neighborhoods. Traffic conflicts on a road increase proportionally with the increase in traffic volume, particularly if the road is not designed to carry a higher level of traffic volume. The following sections discuss in detail the characteristics of traffic operations data that were collected.

5.1 Volume Characteristics

The major traffic arterial roads with substantial amount of traffic are Lewis Turner Boulevard (SR 189) –located on the north side of Kenwood neighborhood – running in the east-west direction and Racetrack Road (SR 188) also running east-west but situated on the south side of the Kenwood neighborhood (see Figure 1). According to year 2009 traffic information published by the Statistics Office of the Florida Department of Transportation, traffic counting stations installed on Lewis Turner Boulevard and Racetrack Road provided traffic data summarized in Table 2.

Table 2. Traffic Volume Summary (Ref. 2)

Roadway	Location of Volume Count	AADT	K-30
Lewis Turner Boulevard (SR 189)	0.44 miles west of Mooney Road	28,828	11.25
Racetrack Road (SR 188)	0.37 miles west of Mooney Road	29,000	10.66
Mooney Road NE	Between Lewis Turner Boulevard and Country Club Avenue	4,600	10.66
Mooney Road SE	300 feet north of Racetrack Road	5,086	10.66
Country Club Avenue	265 feet north of Mooney Rd SE	3,000	10.66

The annual average daily traffic (AADT) on both roadways is approximately 29,000 vehicles per day. Since both Lewis Turner Boulevard and Racetrack Road run almost parallel to each other in the vicinity of Kenwood neighborhood, it seems that commuters wanting to connect between these two roadways end up using either Mooney Road or Country Club Avenue as a short-cut between these two major highways. Indeed, the Florida Department of Transportation traffic data further shows that Country Club Avenue carries an average of 3,000 vehicles per day with Mooney Road carrying about 2,000 vehicles per day. A sample traffic study conducted on Friday, April 22, 2011 confirmed that a substantial number of drivers use Country Club Avenue as a cut through roadway given its direct connection between Lewis Turner Boulevard and Racetrack Road in contrast to Mooney Road which is a winding road as was seen in Figure 1 above. The results of the sample study are displayed in Figure 4.

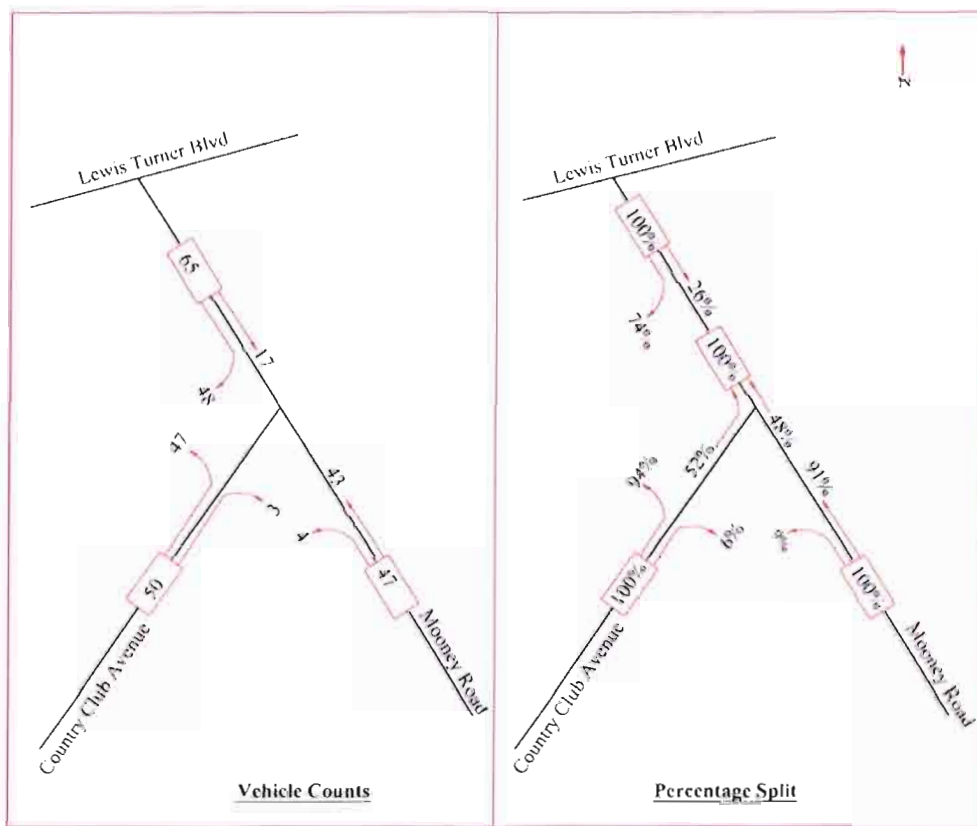


Figure 4. Traffic Split Between Country Club Avenue and Mooney Road

The data displayed in Figure 4 were collected on a typical weekday, i.e., Friday, April 22, 2011 from 9 a.m. to 10 a.m. when K-12 schools were in session. The data show that on the average three out of four vehicles coming from Lewis Turner Boulevard turn right into the Country Club Avenue. Also, on the average one out of two vehicles heading towards Lewis Turner Road emanates from the Country Club Avenue. Again, as indicated in Table 1, the average daily traffic on Country Club Avenue is 3,000 vehicles per day. With the K₃₀-factor being 10.66%, this suggests that approximately 320 vehicles traveling during a regular morning peak hour (7 a.m. to 9 a.m.) and evening peak hour (4 p.m. to 6 p.m.) use Country Club Avenue.

5.2 Speed Characteristics

The City of Fort Walton Beach conducted a traffic study in which continuous volume and speed data were collected from August 2 through 5, 2010 using pneumatic tube counters. The counters were installed at various locations along Country Club Avenue. The results quoted herein as seen in Table 3 are from the counter that was installed approximately 250 feet north of the south-side intersection of Mooney Road and Country Club Avenue.

Table 3. Speed Distribution on Country Club Avenue (Ref. 3)

Characteristic	Northbound	Southbound
Speed limit	25 MPH	25 MPH
Average Speed	29 MPH	32 MPH
85 th Percentile Speed	36 MPH	40 MPH
% Exceeding Speed Limit	66%	81%
Minimum Observed	5 MPH	5 MPH
Maximum Observed	98 MPH	98 MPH
10-mph pace	22 – 32 MPH	27 – 37 MPH
% of vehicles in pace	57%	52%

Closer examination of data displayed in Table 3 shows that the 85th percentile speed in the northbound and southbound directions are respectively 11 and 15 miles per hour above the speed limit. Other statistical measures, i.e. average speed, pace, and percent exceeding speed limit clearly reveal that there is a speeding problem on this stretch of Country Club Avenue. Even of more concern is the fact that in both northbound and southbound directions two drivers were recorded to be driving at 98 miles per hour, a speed which is highly inappropriate and dangerous for a residential street.

5.3 Travel Time Characteristics

One of the factors influencing regular commuters to select a particular route is the shortness of travel time on that route compared to other alternative routes. This especially true during morning and evening peak hours as commuters are trying to get to work or home as fast as possible. Currently, a driver on Lewis Turner Boulevard intending to access Racetrack Road (and vice versa) has a choice of up to four viable routes in Kenwood neighborhood. The routes are Country Club Avenue, Fairway Avenue, Powell Drive, and Mooney Road. Table 4 shows these routes and their physical lengths.

The travel time data on these routes were collected using a GPS data logger which logs the GPS coordinates and the time along the route being driven. The ArcGIS shape files for Kenwood neighborhood were acquired from the Okaloosa County Government, GIS Division. The GPS data were overlaid on the GIS shape files and travel times between various points were calculated. Five travel time runs were conducted on each route during the morning peak hour between 7:30 a.m. and 8:30 a.m. and the average travel time was calculated. All times were

measured from the Country Club Avenue/Mooney Road SE intersection as the starting point to the Country Club Avenue/Mooney Road NE intersection as the ending point. The average travel times are also depicted on Table 4.

Table 4. Average Peak Hour Travel Times on Potential Cut Through Streets

Cut Through Alternative		No. of Stops	Length	Travel Time
1.	Country Club Avenue	2	0.82 mi.	120 sec
2.	Fairway Avenue (thru Powell Drive and Wedgewood Lane on the north side)	4	1.16 mi	166 sec
3.	Powell Drive (connecting with Fairway Avenue on the south side)	4*	1.13 mi	173 sec
4.	Mooney Road	1	1.74 mi.	199 sec

*The YIELD sign at the intersection of Powell Drive and Fairway Avenue is counted as a STOP sign.

The results in Table 4 confirm why drivers choose Country Club Avenue over Mooney Road, i.e., it gives them a shorter travel time. The data in Table 4 further show that Fairway Avenue and Powell Drive have the potential to be used as cut through streets given that they have shorter travel time than Mooney Road. If traffic calming measures were to be implemented on Country Club Avenue, it is possible that some drivers knowledgeable with this neighborhood might divert to Powell Drive and Fairway Avenue. However, in driving these two routes, the researchers found that there were too many twist and turns (including four stops) which might discourage some drivers from using Powell Drive and Fairway Avenue as cut through streets.

5.4 Level of Service Analysis

Analysis of the level of service (LOS) of a roadway is aimed at relating demand to the available roadway capacity. The Highway Capacity Manual (HCM) has procedures that can be used for the analysis of level of service (Ref. 4). Although both Country Club Avenue and Mooney Road are residential streets with important access functions in the neighborhood, they however do carry a substantial amount of through traffic and they can therefore be considered to be minor arterials for the purposes of level of service analysis. Both streets do not specifically fit into either design category of the HCM Urban Street analysis procedure but the Design Category III, i.e., Intermediate Category is close enough in giving an overview of the existing levels of service on both roadways. To the extent that HCM Urban Street procedure requires “signalized intersection” control delay, the stop-controlled intersections’ control delay data were collected in the field and substituted for signalized intersections’ control delay in the HCM analysis procedure.

The resulting HCM analysis worksheets are displayed in Appendix B. The results show that the overall level of service of Country Club Avenue is LOS B while the overall level of service on Mooney Road is LOS A. Country Club Avenue is 0.82-mile long from its intersection with Mooney Road in the north to its intersection with Mooney Road in the south. Mooney Road is 1.74-mile long measured between its two intersecting points with Country Club Avenue.

Since control delay is a main input into the HCM procedures of determining level of service, the presence of two stop-controlled intersections on Country Club Avenue compared to only one on Mooney Road degrades the level of service on Country Club Avenue. From the level of service analysis, it can be surmised that operations on Country Club Avenue during the peak hours are more congested than on Mooney Road during the same hours. It should be noted that Country Club Avenue carries an average of 3,000 vehicles per day while Mooney Road carries an average of only 2,000 vehicles per day.

6. TRAFFIC ACCIDENTS HISTORY

Traffic accidents that occurred on Kenwood neighborhood roadways were reviewed to determine if there are any trends or patterns that can be mitigated by engineering improvements or enforcement strategies. The accident data encompassing year 2004 through year 2008 – i.e., 5-year period – were downloaded from Crash Analysis Reporting (CAR) database which is maintained by the Florida Department of Transportation, Safety Office. It is noteworthy that at the time of the analysis year 2008 was the latest year in which data were available for Okaloosa County. Information displayed in Figure 5 and Appendix C tables show that a total of 13 crashes were reported in Kenwood neighborhood in the 5-year period out of which 10 were property damage only crashes while three crashes involved some sort of injury, though none was fatal¹.



Figure 5. Topology of Crashes Occurring in Kenwood Neighborhood

¹ It should be noted that if the data were to include year 2010, a fatal crash was reported to have occurred on the Country Club Avenue. Overspeeding was cited as a contributing factor to the accident.

The most predominant type of collision was angle crashes (3). Other type of collisions reported were a vehicle backing into another vehicle; vehicle hitting a sign post or a tree; and five other crash types which were not well defined in the CAR database. From the crash summary data, it can be surmised that there does not seem to be a trend in any of the crash types but it should be noted that Country Club Avenue and Mooney Road accounted for 11 of 13 crashes that were reported in the neighborhood streets. A detailed and careful analysis of crashes up to the most recent year is recommended in light of the fact that a fatal crash was reported on Country Club Avenue in 2010.

7. DISCUSSION OF THE RESULTS OF DATA ANALYSES

The aggregate analysis of operational data shows that between 66 and 75 percent of traffic intending to connect between Lewis Turner Boulevard and Racetrack Road use Country Club Avenue as a short cut. As indicated earlier, Mooney Road is a winding road while Country Club Avenue is almost a straight shot between Lewis Turner Boulevard and Racetrack Road. Volume and speed analysis showed that these two traffic variables are too high for a residential neighborhood with size and character similar to that of the Country Club Avenue. In addition, Country Club Avenue is about half the length of Mooney Road but has almost the same number of accidents as Mooney Road probably because of its high traffic volume.

The major thrust of any improvement strategy must be to reduce vehicular traffic on Country Club Avenue and to reduce the prevailing operating speeds of vehicles using Country Club Avenue at all times of the day. The current level of traffic volume on Country Club Avenue – that is, roughly 3,000 vehicles per day which translates into 320 vehicles per peak hour – is quite high and is bound to occasionally result into vehicle-to-vehicle conflicts or vehicle-to-pedestrian conflicts in view of the fact that sidewalk exists only on one side of the road. In addition, a portion of Country Club Avenue between Wedgewood Lane and Mooney Road SE is too straight, allowing drivers to pick up speed, i.e., over 10 miles per hour above the 25 MPH speed limit posted in both directions of Country Club Avenue.

While it is clear that any traffic calming measure implemented on Country Club Avenue will divert traffic to Mooney Road, this outcome is considered desirable based on the fact that the property offsets on Mooney Road are wider than on Country Club Avenue and the roadway, i.e., Mooney Road, has sidewalks on both sides. Thus, pedestrians and cyclists on Mooney Road do not need to cross the road to access sidewalks. Mooney Road also has curb-and-gutter design which provides additional protection to sidewalk users from errant vehicles. Furthermore, the travel lanes on Mooney Road are wider by about 6 inches compared to those on Country Club Avenue.

Consistent with the above philosophy of reducing traffic volume and speed on Country Club Avenue, a number of alternatives were considered as discussed in the following section. Each alternative was considered on its own merit and its ability to accomplish traffic volume and speed reduction was quantified based on the preponderance of evidence gathered from the review of traffic engineering literature. While the merit of each alternative is considered

separately, it should be noted that each alternative can be implemented in conjunction with another alternative. In other words, the alternatives are not mutually exclusive.

8. ALTERNATIVE IMPROVEMENT STRATEGIES

The following sections discuss the four alternative improvement strategies that were considered. All the alternatives were weighed by their ability to reduce traffic operational and safety difficulties on Country Club Avenue. The effectiveness of each alternative was graded as LOW, MODERATE, or HIGH based on information acquired from the literature.

8.1 Alternative 1 – Install Signs Directing “Through Traffic” to SR 188 and SR 189

The State Route 188 and 189 signs to be installed along Mooney Road close to its intersection with Country Club Avenue are intended to direct through traffic to use Mooney Road as the major road connecting Racetrack Road (SR 188) and Lewis Turner Boulevard (SR 189). The two signs will be located prior to the Country Club Avenue intersections with Mooney Road as illustrated in Figure 6.



Figure 6. Recommended State Route Signs on Mooney Road

The two signs are estimated to cost approximately \$1,000 in material and labor costs. Given that the majority of road users in this area are regular commuters who already know the area, we estimate that the effectiveness of these signs in terms of diverting traffic from Country Club Avenue will be LOW.

8.2 Alternative 2 – Install Radar Speed Feedback Sign on Country Club Avenue

The radar speed feedback signs are finding increasing use across the United States, particularly in school zones. The assembly is designed to give drivers a feedback of their speed in comparison with the prevailing speed limit, and hopefully the driver will slow down to a safe speed. Because law enforcement officers cannot be expected to constantly monitor vehicle speeds at a particular location, the radar speed feedback sign serve to supplement regular enforcement of speed limits alerting drivers to specific driving behavior. Figure 7 shows how a radar speed feedback sign installed on Country Club Avenue would look like.



Figure 7. Radar Speed Feedback Sign

A permanent installation of a radar speed feedback sign is advisable since most studies show that drivers revert back to old behavior, i.e., speeding, once a sign installed on temporary basis is removed. Most studies reported in literature were on temporary installation. While the temporary installed signs seemed to be effective particularly in reducing the percentage of drivers exceeding the speed limit, there was insufficient literature on the effectiveness of permanent installation of these signs. It can safely be said that these signs will be effective during peak hours and when K-12 school is in session but long term efficacy during off-peak hours might be questionable. Therefore we rate the likely effectiveness of the installation of these signs as MODERATE. The cost associated with the installation, excluding annual maintenance costs, is around \$4,000 per sign for a total of \$8,000 for two signs, one in each direction.

8.3 Alternative 3 – Install Chicanes on Country Club Avenue

This alternative calls for installing chicanes² on Country Avenue in the tangent section between Wedgewood Lane and Mooney Road SE as illustrated in Figure 8. The purpose of the chicanes is to negatively influence traffic speed by forcing drivers to slow down due to one-lane geometry and S-curve shape of the resulting travel way. Because of the reduction in speed forced by roadway geometry, it is envisioned that some drivers who use Country Club Avenue as a short cut in order to save time will find other alternatives thus resulting in the reduction in traffic volume on this road as well.



Figure 8. Chicane Installation on Country Club Avenue

Numerous studies conducted around the United States have found chicanes, if properly installed, are effective in reducing both traffic speed and traffic volumes on residential streets. Based on the synthesis of the results of these studies, we are estimating that traffic volume on Country Club Avenue will be reduced by about 50 percent and the operating speed will change appreciably because the straight portion of Country Club Avenue will physically be turned into an S-curved section forcing remaining vehicles to slow down. We therefore rate the predicted effectiveness of this alternative as HIGH. The cost to install the chicanes is estimated at \$20,000.

² Chicane is a form of traffic calming measure which narrows a street to form S-shaped curves using protruding islands.

The implementation of this alternative should be accompanied by removing all lane markings – i.e., the yellow centerline pavement striping and the white edge markings – throughout Country Club Avenue. In addition, the right turn radius leading into Country Club Avenue from Mooney Road NE should be reduced and the pavement in the area reclaimed by landscaping as illustrated in Appendix Figure D-1. The idea is to make Country Club Avenue look like a residential street and drive like a residential street.

8.4 Alternative 4 – Install Speed Tables on Country Club Avenue

Implementation of this alternative will involve installing speed tables in the tangent section of Country Club Avenue between Wedgewood Lane and Mooney Road SE as illustrated in Figure 9. In the United States, most local agencies implement speed tables with a height of 3 to 4 inches and a travel length of 22 feet. Speed tables generally consist of 10 foot plateau with 6 foot approaches on either side that can be straight, parabolic or sinusoidal in profile.



Figure 9. A Speed Table on Country Club Avenue.

The reduction of operating speeds depends on the spacing of the speed tables. To achieve a reduction of operating speed on Country Club Avenue to around 25 mph, a spacing of 200 to 250 feet is recommended. This will result in approximately 12 to 15 speed tables along this stretch of Country Club Avenue. Studies of long term performance of speed tables around the United States have found that properly designed speed tables are effective in reducing average speed by as much as 30 percent. Similarly, reduction in volume has also been documented particularly when the speed tables were installed in areas where parallel routes exist for affected vehicles to divert to. The predicted effectiveness of speed tables in reducing speed and volume on Country Club Avenue is hereby graded as HIGH. However, it should be noted that speed

tables have the disadvantage of reducing emergency vehicles response time by about three to five seconds per table. In addition, some residents where speed tables have been installed complain of increased traffic noise and reduction of neighborhood aesthetics due to increased traffic signs and lane markings. The predicted cost of installing each speed table is \$2,000 to a high-end total of \$30,000. It is worth noting that this alternative was also evaluated for possible implementation on Country Club Avenue by the Engineering & Utility Services Department of the City of Fort Walton Beach (Ref. 3).

8.5 Alternative 5 – Split Country Club Avenue at Rue De Le Roi Street

This alternative considers splitting the Country Club Avenue at Rue De Le Roi Street by creating three cul-de-sac arrangements as illustrated in Figure 10. This improvement alternative will deny through traffic direct access to both ends of Country Club Avenue. However, the split will open up Fairway Avenue and Powell Drive as alternative cut-through roadways in which a through driver may use these roadways to access both ends of Mooney Road. At this point, it is difficult to predict what percentage of drivers would divert to Fairway Avenue or Powell Drive. We therefore rate the effectiveness of this alternative as MODERATE based on its potential of reducing traffic volume on Country Club Avenue. However, longitudinal observation of traffic behavior will be needed and further traffic calming measures may be needed should it be found that some appreciable levels of cut-through traffic diverted to Fairway Avenue and Powell Drive. In terms of cost, this alternative is likely to cost approximately \$15,000 to implement.



Figure 10. Cul-de-sac at Rue De Le Roi Street

Table 5 below summarizes the alternative improvement measures discussed above. The table shows the alternative with its intended purpose, predicted longitudinal effectiveness, and the estimated construction cost of the alternative.

Table 5. Summary of Improvement Alternatives Considered

Alternative		Purpose	Predicted Effectiveness	Initial Cost
1.	Install signs directing through traffic to SR 188 and to SR 189	To reduce “through” traffic volume on Country Club Avenue	LOW	\$1,000
2.	Install Radar Driver Speed Feedback Signs on Country Club Avenue	To reduce percentage of drivers exceeding the speed limit	MODERATE	\$8,000
3.	Install “Chicanes” on Country Club Avenue	To reduce both traffic volume and vehicle speeds on Country Club Avenue	HIGH	\$20,000*
4.	Install Speed Tables on Country Club Avenue	To reduce vehicle speeds and possibly traffic volume on Country Club Avenue	HIGH	\$30,000
5.	Split Country Club Avenue at Rue De Le Roi Street	To reduce “through” traffic volume on Country Club Avenue	MODERATE	\$15,000

*The cost does not include suggested intersection improvement and removal of lane markings.

9. CONCLUSIONS AND RECOMMENDATIONS

At the request of the City of Fort Walton Beach, the study reported herein was aimed at reviewing traffic operations and safety characteristics of a number of streets in the Kenwood neighborhood. The review of traffic operations showed that Lewis Turner Boulevard and Racetrack Road are major arterials surrounding the neighborhood and through traffic wanting to access these two major highways use Kenwood neighborhood streets, particularly the Country Club Avenue, as cross streets. The review of traffic data collected on Country Club Avenue showed that it carries around 3,000 vehicles per day with an 85th percentile speed in excess of 35 miles per hour. In addition, the data showed that on the average seven out of ten drivers exceed the 25 MPH speed limit posted at various locations along the Country Club Avenue. Clearly, both traffic volume and operating speeds are high for a roadway with geometrics and neighborhood character similar to Country Club Avenue. The review of 5-year traffic crash data showed that a total of 13 crashes were reported to have occurred in Kenwood neighborhood from 2004 to 2009. However, the analysis of crashes did not show any trend in accident type although Country Club Avenue and Mooney Road accounted for 11 of the 13 reported crashes.

Five alternatives aimed at alleviating the high levels of traffic and operating speeds along Country Club Avenue were considered. The alternatives considered were the installation of state route signs directing through traffic to use Mooney Road to access Racetrack Road and Lewis

Turner Boulevard, installation of radar driver speed feedback signs on Country Club Avenue, installation of chicanes on Country Club Avenue, installation of speed tables on Country Club Avenue, and splitting the Country Club Avenue at Rue De Le Roi Street. All alternatives were carefully analyzed in terms of their likely effectiveness in reducing traffic volume and/or traffic speed on Country Club Avenue. The effectiveness of each alternative was graded either as LOW, MODERATE, or HIGH. The alternative that is likely to be highly effective in reducing speed and volume while preserving neighborhood aesthetics is the installation of chicanes along the straight portion of Country Club Avenue. It is therefore recommended that the City should consider implementing this alternative along this residential road.

REFERENCES

1. <http://www.nwfdailynews.com/news/killed-30313-walton-beach.html> as viewed on May 4, 2011.
2. *2009 Florida Traffic Information and Highway Data*, Florida Department of Transportation, Tallahassee, Florida, 2009.
3. *Traffic Study Results for Country Club Avenue*, City of Fort Walton Beach Memorandum from Engineering & Utility Services Director to the City Manager, Fort Walton Beach, Florida, November 5, 2010.
4. *Highway Capacity Manual*, Transportation Research Board, National Research Council, Washington, D.C., 2000.
5. *Manual on Uniform Traffic Control Devices, Millennium Edition*, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 2000.

**APPENDIX A -- Characteristics of Streets Intersecting Country
Club Avenue**

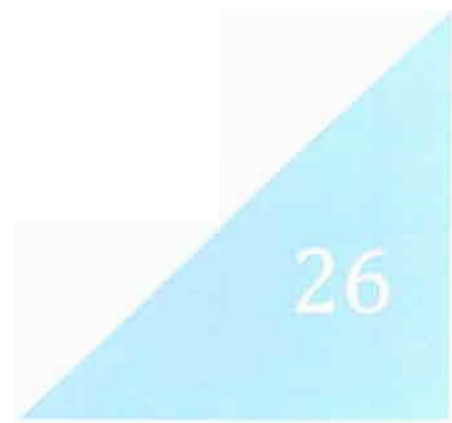




Figure A-1. Intersection of Country Club Avenue and Mooney Road NE



Figure A-2. Intersection of Country Club Avenue and Rue De Le Roi Street



Figure A-3. Intersection of Country Club Avenue and Wedgewood Lane



Figure A-4. Intersection of Country Club Avenue and Club Place.



Figure A-5. Intersection of Country Club Avenue and Eagle Street



Figure A-6. Intersection of Country Club Avenue SE and Mooney Road facing east

APPENDIX B -- Level of Service (LOS) Analysis

Table B-1. Level of Service Analysis – Country Club Avenue

URBAN STREET WORKSHEET #1								
General Information				Site Information				
Analyst	Ren Moses			Urban Street	Country Club Avenue			
Agency/Co.	Fort Walton Beach City Project			Direction of Travel	South-bound			
Date Performed	06/15/2011			Jurisdiction				
Time Period	Peak Hour			Analysis Year	2011			
Project Description:								
Input Parameters								
Analysis Period(h) T = 0.25	Segments							
	1	2	3	4	5	6	7	8
Cycle length, C (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eff. green to cycle ratio, g/C	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
v/c ratio for lane group, X	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cap of lane group, c (veh/h)	0	0	0	0	0	0	0	0
Pct Veh on Gr., PVG								
Arrival type, AT	4	4	4	4	4	4	4	4
Unit extension, UE (sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Length of segment, L (mi)	0.18	0.09	0.09	0.26	0.20			
Initial queue, Q _b (veh)	0	0	0	0	0	0	0	0
Urban street class, SC	3	3	3	3	3	3	3	3
Free-flow speed, FSS (mi/h)	35	35	35	35	35	35	35	35
Running time, TR (s)	23.5	13.2	13.2	30.8	25.6			
Other delay, (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Computation								
Uniform delay, d ₁ (s)								
Incremental delay adj, k								
Upstream filtering adj factor, l	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Incremental delay, d ₂ (s)								
Initial queue delay, d ₃ (s)	0	0	0	0	0	0	0	0
Progression adj factor, PF								
Control delay, d (s)	0.0	6.0	0.0	8.0	0.0			
Segment LOS Determination								
Travel time, ST (s)	23.5	19.2	13.2	38.8	25.6			
Travel speed, SA (mi/h)	27.5	16.8	24.5	24.1	28.1			
Segment LOS	B	D	B	B	B			
Urban Street LOS Determination								
Total travel time (s)	120.4							
Total length (mi)	0.82							
Total travel speed, SA (mi/h)	24.5							
Total urban street LOS	B							

Table B-2. Level of Service Analysis – Mooney Road

URBAN STREET WORKSHEET #1								
General Information				Site Information				
Analyst	Ren Moses			Urban Street	Mooney Road			
Agency/Co.	Fort Walton Beach City Project			Direction of Travel	South-bound			
Date Performed	06/15/2011			Jurisdiction				
Time Period	7:30 a.m. to 8:30 a.m.			Analysis Year	2011			
Project Description:								
Input Parameters								
Analysis Period(h) T = 0.25	Segments							
	1	2	3	4	5	6	7	8
Cycle length, C (s)	0.0	0.0						
Eff. green to cycle ratio, g/C	0.000	0.000						
v/c ratio for lane group, X	0.000	0.000						
Cap of lane group, c (veh/h)	0	0						
Pct Veh on Grn., PVG								
Arrival type, AT	4	4						
Unit extension, UE (sec)	0.0	0.0						
Length of segment, L (mi)	0.81	0.93						
Initial queue, Q _b (veh)	0	0						
Urban street class, SC	3	3						
Free-flow speed, FSS (mi/h)	35	30						
Running time, TR (s)	83.4	111.6						
Other delay, (s)	0.0	0.0						
Delay Computation								
Uniform delay, d ₁ (s)								
Incremental delay adj, k								
Upstream filtering adj factor, l	1.000	1.000						
Incremental delay, d ₂ (s)								
Initial queue delay, d ₃ (s)	0	0						
Progression adj factor, PF								
Control delay, d (s)	5.0	0.0						
Segment LOS Determination								
Travel time, ST (s)	88.4	111.6						
Travel speed, SA (mi/h)	33.0	30.0						
Segment LOS	A	A						
Urban Street LOS Determination								
Total travel time (s)	200.0							
Total length (mi)	1.74							
Total travel speed, SA (mi/h)	31.3							
Total urban street LOS	A							

APPENDIX C -- Crash Data

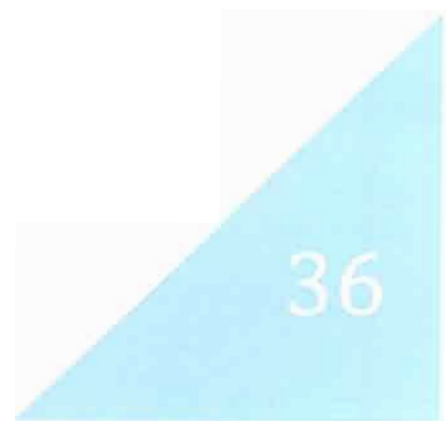


Table C-1. Date of Occurrence of the Crashes

TOWN NAME	ON ROAD	FROM	TO	CRASH DATE
FORT WALTON BEACH	COUNTRY CLUB AVE NE	MOONEY RD NE	RUE DE LE ROI ST NE	16-Sep-06
FORT WALTON BEACH	COUNTRY CLUB AVE NE	MOONEY RD NE	RUE DE LE ROI ST NE	27-Aug-06
FORT WALTON BEACH	COUNTRY CLUB AVE NE	RUE DE LE ROI ST NE	WEDGEWOOD LN NE	18-Aug-05
FORT WALTON BEACH	COUNTRY CLUB AVE NE	WEDGEWOOD LN NE	EAGLE ST NE	05-Nov-08
FORT WALTON BEACH	COUNTRY CLUB AVE NE	WEDGEWOOD LN NE	EAGLE ST NE	07-Jun-07
FORT WALTON BEACH	COUNTRY CLUB AVE NE	EAGLE ST NE	MOONEY RD NE	
FORT WALTON BEACH	GOLF COURSE DR NE	FAIRWAY AVE NE	EAGLE ST NE	
FORT WALTON BEACH	GOLF COURSE DR NE	EAGLE ST NE	CLUB PI NE	
FORT WALTON BEACH	FAIRWAY AVE NE	WEDGEWOOD LN NE	GOLF COURSE DR NE	
FORT WALTON BEACH	FAIRWAY AVE NE	GOLF COURSE DR NE	RODNEY AVE NW	
FORT WALTON BEACH	FAIRWAY AVE NE	RODNEY AVE NW	EAGLE ST NE	08-Oct-04
FORT WALTON BEACH	FAIRWAY AVE NE	EAGLE ST NE	POWELL DR NE	
FORT WALTON BEACH	FAIRWAY AVE NE	POWELL DR NE	MOONEY RD NE	
FORT WALTON BEACH	POWELL DR NE	MOONEY RD NE	WEDGEWOOD LN NE	
FORT WALTON BEACH	POWELL DR NE	WEDGEWOOD LN NE	GIBBS AVE	
FORT WALTON BEACH	POWELL DR NE	GIBBS AVE	RODNEY AVE NE	
FORT WALTON BEACH	POWELL DR NE	RODNEY AVE NE	EAGLE ST NE/CAMBORNE AVE NE	
FORT WALTON BEACH	POWELL DR NE	EAGLE ST NE/CAMBORNE AVE NE	FAIRWAY AVE NE	27-Mar-06
FORT WALTON BEACH	EAGLE ST NE/CAMBORNE AVE NE	COUNTRY CLUB AVE NE	GOLF COURSE DR NE	
FORT WALTON BEACH	EAGLE ST NE/CAMBORNE AVE NE	GOLF COURSE DR NE	FAIRWAY AVE NE	
FORT WALTON BEACH	EAGLE ST NE/CAMBORNE AVE NE	FAIRWAY AVE NE	POWELL DR NE	
FORT WALTON BEACH	EAGLE ST NE/CAMBORNE AVE NE	POWELL DR NE	COVINGTON PI NE	
FORT WALTON BEACH	EAGLE ST NE/CAMBORNE AVE NE	COVINGTON PI NE	MOONEY RD NE	
FORT WALTON BEACH	MERIONETH DR NE	MOONEY RD NE	COVINGTON PI NE	
FORT WALTON BEACH	MERIONETH DR NE	COVINGTON PI NE	CAMBRIDGE AVE NE	
FORT WALTON BEACH	MERIONETH DR NE	CAMBRIDGE AVE NE	CARLYLE CT NE	
FORT WALTON BEACH	MERIONETH DR NE	CARLYLE CT NE	MOONEY RD NE	
FORT WALTON BEACH	MOONEY RD NE	COUNTRY CLUB AVE NE	MELANIE LN	
FORT WALTON BEACH	MOONEY RD NE	MELANIE LN	RUE DE LE ROI NE	22-Sep-04
FORT WALTON BEACH	MOONEY RD NE	RUE DE LE ROI NE	POWELL DR NE	09-Dec-07
FORT WALTON BEACH	MOONEY RD NE	POWELL DR NE	KAREN A VE	
FORT WALTON BEACH	MOONEY RD NE	KAREN A VE	KRIS AVE NE	
FORT WALTON BEACH	MOONEY RD NE	KRIS AVE NE	KATHY AVE	
FORT WALTON BEACH	MOONEY RD NE	KATHY AVE	BURTON AVE NE	
FORT WALTON BEACH	MOONEY RD NE	BURTON AVE NE	STAMFORD AVE NE	26-Dec-04
FORT WALTON BEACH	MOONEY RD NE	STAMFORD AVE NE	BEDFORD PI NE	
FORT WALTON BEACH	MOONEY RD NE	BEDFORD PI NE	BRIGHTON CT NE	

TOWN NAME	ON ROAD	FROM	TO	CRASH DATE
FORT WALTON BEACH	MOONEY RD NE	BRIGHTON CT NE	EARLS CT NE	02-Oct-06
FORT WALTON BEACH	MOONEY RD NE	BRIGHTON CT NE	EARLS CT NE	13-Mar-07
FORT WALTON BEACH	MOONEY RD NE	EARLS CT NE	WINDSOR LN	
FORT WALTON BEACH	MOONEY RD NE	WINDSOR LN	MERIONETH DR NE	
FORT WALTON BEACH	MOONEY RD NE	MERIONETH DR NE	TREE POINT DR	
FORT WALTON BEACH	MOONEY RD NE	TREE POINT DR	STAFFORD CIR NE	
FORT WALTON BEACH	MOONEY RD NE	STAFFORD CIR NE	WAGONWHEEL RD	
FORT WALTON BEACH	MOONEY RD NE	WAGONWHEEL RD	IPSWICH CIR/ TROY CIR NE	
FORT WALTON BEACH	MOONEY RD NE	IPSWICH CIR/ TROY CIR NE	CAMBRIDGE AVE NE/TROY CIR NE	31-Mar-05
FORT WALTON BEACH	MOONEY RD NE	CAMBRIDGE AVE NE/TROY CIR NE	TWIN BAY DR/ROXANNA RD	
FORT WALTON BEACH	MOONEY RD NE	TWIN BAY DR/ROXANNA RD	MERIONETH DR NE	
FORT WALTON BEACH	MOONEY RD NE	MERIONETH DR NE	CAMBRIDGE AVE NE/PEMBROKE PI NE	
FORT WALTON BEACH	MOONEY RD NE	CAMBRIDGE AVE NE/PEMBROKE PI NE	FAIRWAY AVE NE	
FORT WALTON BEACH	MOONEY RD NE	FAIRWAY AVE NE	COUNTRY CLUB AVE NE	
FORT WALTON BEACH	MOONEY RD NE	COUNTRY CLUB AVE NE	LINWOOD RD NW	
FORT WALTON BEACH	MOONEY RD NE	LINWOOD RD NW	SHERWOOD RD NW	

Table C-2. Crashes Categorized by Injury Type

ON ROAD	FROM	TO	PDO	Possible injury	Injury Type		Total
					Incapacitating	Non-Incapacitating	
COUNTRY CLUB AVE NE	MOONEY RD NE	RUE DE LE ROI ST NE	2	0	0	0	2
COUNTRY CLUB AVE NE	RUE DE LE ROI ST NE	WEDGEWOOD LN NE	1	0	0	0	1
COUNTRY CLUB AVE NE	WEDGEWOOD LN NE	EAGLE ST NE	1	1	0	0	2
COUNTRY CLUB AVE NE	EAGLE ST NE	MOONEY RD NE	0	0	0	0	0
GOLF COURSE DR NE	FAIRWAY AVE NE	EAGLE ST NE	0	0	0	0	0
GOLF COURSE DR NE	EAGLE ST NE	CLUB PI NE	0	0	0	0	0
FAIRWAY AVE NE	WEDGEWOOD LN NE	GOLF COURSE DR NE	0	0	0	0	0
FAIRWAY AVE NE	GOLF COURSE DR NE	RODNEY AVE NW	0	0	0	0	0
FAIRWAY AVE NE	RODNEY AVE NW	EAGLE ST NE	1	0	0	0	1
FAIRWAY AVE NE	EAGLE ST NE	POWELL DR NE	0	0	0	0	0
FAIRWAY AVE NE	POWELL DR NE	MOONEY RD NE	0	0	0	0	0
POWELL DR NE	MOONEY RD NE	WEDGEWOOD LN NE	0	0	0	0	0
POWELL DR NE	WEDGEWOOD LN NE	GIBBS AVE	0	0	0	0	0
POWELL DR NE	GIBBS AVE	RODNEY AVE NE	0	0	0	0	0
POWELL DR NE	RODNEY AVE NE	EAGLE ST NE/CAMBORNE AVE NE	1	0	0	0	1
EAGLE ST NE/CAMBORNE AVE NE	COUNTRY CLUB AVE NE	GOLF COURSE DR NE	0	0	0	0	0
EAGLE ST NE/CAMBORNE AVE NE	GOLF COURSE DR NE	FAIRWAY AVE NE	0	0	0	0	0
EAGLE ST NE/CAMBORNE AVE NE	FAIRWAY AVE NE	POWELL DR NE	0	0	0	0	0
EAGLE ST NE/CAMBORNE AVE NE	POWELL DR NE	COVINGTON PI NE	0	0	0	0	0
EAGLE ST NE/CAMBORNE AVE NE	COVINGTON PI NE	MOONEY RD NE	0	0	0	0	0
MERIONETH DR NE	MOONEY RD NE	COVINGTON PI NE	0	0	0	0	0
MERIONETH DR NE	COVINGTON PI NE	CAMBRIDGE AVE NE	0	0	0	0	0
MERIONETH DR NE	CAMBRIDGE AVE NE	CARLYLE CT NE	0	0	0	0	0
MERIONETH DR NE	CARLYLE CT NE	MOONEY RD NE	0	0	0	0	0
MOONEY RD NE	COUNTRY CLUB AVE NE	MELANIE LN	0	0	0	0	0
MOONEY RD NE	MELANIE LN	RUE DE LE ROI NE	1	0	0	0	1
MOONEY RD NE	RUE DE LE ROI NE	POWELL DR NE	1	0	0	0	1
MOONEY RD NE	POWELL DR NE	KRIS AVE NE	0	0	0	0	0
MOONEY RD NE	KRIS AVE NE	KATHY AVE	0	0	0	0	0
MOONEY RD NE	KATHY AVE	BURTON AVE NE	0	0	0	0	0
MOONEY RD NE	BURTON AVE NE	STAMFORD AVE NE	0	0	0	1	1
MOONEY RD NE	STAMFORD AVE NE	BEDFORD PI NE	0	0	0	0	0
MOONEY RD NE	BEDFORD PI NE	BRIGHTON CT NE	0	0	0	0	0
MOONEY RD NE	BRIGHTON CT NE	EARLS CT NE	2	0	0	0	2
MOONEY RD NE	EARLS CT NE	WINDSOR LN	0	0	0	0	0
MOONEY RD NE	WINDSOR LN	MERIONETH DR NE	0	0	0	0	0

ON ROAD	FROM	TO	PDO	Possible injury	Injury Type		Total
					Non-Incapacitating	Incapacitating	
MOONEY RD NE	MERIONETH DR NE	TREE POINT DR	0	0	0	0	0
MOONEY RD NE	TREE POINT DR	STAFFORD CIR NE	0	0	0	0	0
MOONEY RD NE	STAFFORD CIR NE	WAGONWHEEL RD	0	0	0	0	0
MOONEY RD NE	WAGONWHEEL RD	IPSWICH CIR/ TROY CIR NE	0	0	0	0	0
MOONEY RD NE	IPSWICH CIR/ TROY CIR NE	CAMBRIDGE AVE NE/TROY CIR NE	0	0	0	1	1
MOONEY RD NE	CAMBRIDGE AVE NE/TROY CIR NE	TWIN BAY DR/ROXANNA RD	0	0	0	0	0
MOONEY RD NE	TWIN BAY DR/ROXANNA RD	MERIONETH DR NE	0	0	0	0	0
MOONEY RD NE	MERIONETH DR NE	CAMBRIDGE AVE NE/PEMBROKE PI NE	0	0	0	0	0
MOONEY RD NE	CAMBRIDGE AVE NE/PEMBROKE PI NE	FAIRWAY AVE NE	0	0	0	0	0
MOONEY RD NE	FAIRWAY AVE NE	COUNTRY CLUB AVE NE	0	0	0	0	0
MOONEY RD NE	COUNTRY CLUB AVE NE	LINWOOD RD N/W	0	0	0	0	0
MOONEY RD NE	LINWOOD RD N/W	SHERWOOD RD N/W	0	0	0	0	0
		Total	10	1	0	2	13



(a) Existing turning radius



(b) Reduced turning radius

Figure D-1. Turning Radius at the Mooney Road/Country Club Avenue intersection