

August 11, 2021

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Subject: **DRAFT** Green Hill Road Traffic Study
Blowing Rock, North Carolina

Dear Mr. Fox:

This letter provides the results of the traffic study for Green Hill Road in Blowing Rock, North Carolina. The purpose of this study is to determine potential roadway improvements to address citizen concerns regarding speeding and cut-through traffic volumes on Green Hill Road. The scope and methodology outlined in this letter was determined through coordination with the Town of Blowing Rock (Town).

Introduction

Green Hill Road is a two-lane roadway with a posted speed limit of 25 miles per hour (mph) which provides a connection between US 321 and the Blue Ridge Parkway. Green Hill Road is approximately two miles in length and primarily services residential properties but can also be used to access the Blowing Rock Country Club, Green Park Inn, and Church of the Epiphany. Green Hill Road is a state-maintained road from the Blue Ridge Parkway to just south of Wonderland Drive. The remainder of Green Hill Road from just south of Wonderland Drive to US 321 is locally maintained.

Residents on Green Hill Road have expressed their concern about the increasing traffic volumes and safety concerns on Green Hill Road. Major areas of concern include increasing cut-through traffic (vehicles that are only using Green Hill Road to travel between US 321 and the Blue Ridge Parkway without making a stop at a destination on Green Hill Road), speeding vehicles, and the intersection of Green Hill Road and Green Hill Circle. Given the resident concerns, it was determined that the traffic study would analyze current traffic volumes and available crash and speed data on Green Hill Road provided by the Blowing Rock Police Department (BRPD).

Refer to Figure 1, located in Appendix A, for a site location map.

Traffic Count Data

Traffic counts were conducted over a 13-hour period (6:00AM–7:00PM) at the intersections of Green Hill Road / US 321 and Green Hill Road / Blue Ridge Parkway on July 13, 2021, by Quality Counts, LLC. The traffic

count data collected at the study intersections captured not only vehicular traffic but identified the number of heavy trucks and other forms of transportation, such as pedestrians and bicyclists. Refer to Appendix B for the peak hour traffic volumes at the intersections of Green Hill Road / US 321 and Green Hill Road / Blue Ridge Parkway.

The peak hour signal warrant from the *Manual on Uniform Traffic Control Devices* (MUTCD) was considered at the intersections of Green Hill Road / US 321 and Green Hill Road / Blue Ridge Parkway; however, the weekday AM and PM peak hour volumes at both study intersections are lower than those necessary to warrant a traffic signal. It is not expected that these intersections would satisfy the MUTCD 8-hour and 4-hour warrants, which the North Carolina Department of Transportation (NCDOT) favors for installation of a traffic signal. These longer period warrants are not typically met for residential areas that do not meet peak hour warrants due to the distinct peak traffic periods for residential development.

Crash Data

Crash data was obtained from the BRPD along Green Hill Road within the study area. The provided crash data included a summary of crashes from March of 2013 through December of 2020. A summary of the crash data along Green Hill Road is provided in Table 1. A copy of the crash data provided by BRPD can be found in the Appendix C.

Table 1: Crash Data Location Summary

Intersection	Total Crashes
Green Hill Road at US 321	2
Green Hill Road at Village Drive	3
Green Hill Road at West Green Hill Drive	1
Green Hill Road at Green Hill Circle	1
Green Hill Road at Fairway Court	1
Green Hill Road at Green Hill Woods	1
Green Hill Road at Edge Hill Road	3
TOTAL	12

Crash data indicated that 12 crashes were reported on Green Hill Road over the eight-year period of crash data obtained by BRPD. Based on a review of the crash data, a majority of the reported crashes on Green Hill Road were likely a result of vehicles driving too fast for the conditions, the horizontal curvature of Green Hill Road, and/or narrow travel lanes. Of the 12 crashes reported, three (3) occurred at/near the intersection of Green Hill Road and Village Drive due to the sharp curve and grade of Green Hill Road at/near its intersection with Village Drive. Additionally, three (3) crashes occurred at/near the intersection of Green Hill Road and Edge

Hill Lane due to the horizontal curvature of Green Hill Road and/or narrow travel lanes at/near its intersection with Edge Hill Lane.

Speed Data

Speed data was obtained from the BRPD along Green Hill Road within the study area. The provided speed data included a summary of vehicle speeds along Green Hill Road between Heather Ridge Lane (south) and Edge Hill Lane collected in May and June of 2021. Speed and traffic volume data were collected using a speed display monitor. A summary of the speed data collected along Green Hill Road is provided in Table 2. A copy of the speed data provided by BRPD can be found in the Appendix D.

Table 2: Speed Data Summary

	Average Speed	50th Percentile Speed	85th Percentile Speed	Average Daily Traffic
Green Hill Road - Southbound	26 mph	27 mph	35 mph	381 vpd
Green Hill Road - Northbound	24 mph	25 mph	32 mph	366 vpd

Green Hill Road has a posted speed limit of 25 mph. Speed data indicated that motorists on Green Hill Road travel at an average speed of 25 mph and an 85th percentile speed of 34 mph. The 85th percentile speed is defined as the speed at which 85 percent of drivers travel at or below under free-flowing conditions past a monitored point. Based on a review of the speed data, it should be noted that drivers are traveling at faster speeds in the southbound direction due to the vertical curvature of Green Hill Road between Heather Ridge Lane (south) and Edge Hill Lane.

Stopping sight distance is defined as the distance along a roadway required for a driver to perceive and react to an object in the roadway and to brake to a complete stop before reaching the object. Stopping sight distance is directly related to vehicle speed: as a vehicle travels at increased speeds, the stopping sight distance necessary for a vehicle to come to a complete stop also increases. Due to the physical characteristics of Green Hill Road (horizontal/vertical curvature, limited sight distance, narrow travel lanes, etc.), it is critical that uniform pavement markings and signing are in place so drivers are aware of the upcoming changes in roadway geometry and to bring the focus of drivers to Green Hill Road.

Public Engagement

Public engagement efforts for the Green Hill Road Traffic Study included an online survey, hosted on ESRI’s Survey 123, and an interactive map, hosted by ESRI’s ArcGIS WebApps. Both platforms were available for public comment from May 17, 2021, through June 15, 2021. Advertising of the platforms was completed by Town staff. The public survey had a total of 222 participants, although participants were not required to answer every question on the survey, so some questions do not have 222 participants. While the interactive map had 201 input points, it should be noted that interactive map participants had no limit on the number of points they could submit; therefore the 201 input points is not necessarily representative of 201 individual participants. A summary of the survey responses and map input are provided in Appendix E.

Summary of Speeding Countermeasures

Based on a review of public comments from the residents of Green Hill Road and the speed data obtained from BRPD, speed management countermeasures were considered to determine the appropriate countermeasure(s) to reduce driver's speed while traveling along Green Hill Road.

All-Way Stop-Control (AWSC)

AWSC at intersections along Green Hill Road was considered as a speeding countermeasure; however, the Manual on Uniform Traffic Control Devices (MUTCD) Section 2B.04.05 states that “*YIELD or STOP signs should not be used for speed control.*” It is unlikely that intersections along Green Hill Road will meet the minimum volume criteria outlined in the MUTCD necessary to warrant consideration of AWSC. The addition of AWSC along Green Hill Road at intersections with minimal traffic on the side streets may result in the stop signs on Green Hill Road effectively operating under yield conditions, or drivers ignoring the traffic control altogether due to low traffic volumes on the side streets. Additionally, based on a review of crash data obtained from BRPD over the most recent eight-year period, none of the intersections along Green Hill Road meet the minimum crash criteria outlined in the MUTCD necessary to warrant consideration of AWSC.

Speed Humps

Speed humps along Green Hill Road were considered as a speeding countermeasure. Speed humps are most effective in a series to retain slower vehicle speeds over a longer distance. The Institute of Transportation Engineers (ITE) *Guidelines for the Design and Application of Speed Humps* provides specific design and application guidance for speed humps:

- Speed humps should not be placed where the roadway horizontal curvature contains a radius of less than 300 feet.
- Speed humps should not be placed where the roadway vertical curvature exceeds an 8% grade.
- Speed humps in a series should be spaced 260 feet – 500 feet apart from one another.
- Speed humps are appropriate if the posted speed limit is 30 mph or less.

Additional design and placement considerations for speed humps include proximity to the nearest intersection / private driveways, availability of street lighting, and location of drainage and utility access points. Due to the horizontal and vertical alignment of Green Hill Road in addition to the various intersecting roadways and private driveways, the placement of speed humps may prove challenging along Green Hill Road in accordance with ITE *Guidelines for the Design and Application of Speed Humps*.

Curve Delineation

Enhanced curve delineation along Green Hill Road was considered as a speeding countermeasure. By improving striping and signing along horizontal curves, drivers are more aware of the roadway's curvature and are more likely to slow down to a speed that matches the curve's perceived severity. Warning signs alert drivers to conditions that may call for a reduction in speed or an action in the interest of safety and efficient traffic operations. Examples of warning signs illustrating changes in horizontal alignment (some of which are currently placed along Green Hill Road) from the MUTCD include, but are not limited to, turn/curve signs (W1-1, 2-4), winding road (W1-5), one direction large arrow (W1-6), chevrons (W1-8), and combination horizontal alignment/intersection signs (W1-10, 10a-10e). Examples of improved striping along Green Hill Road include, but are not limited to, uniform application of white mini-skips/lane lines through

intersections/private driveways, retroreflective yellow center line and white lane line pavement markings, and yellow reflective center line markers. The goal of uniform and consistent application of enhanced curve delineation (striping and signing) along Green Hill Road is to bring the focus of drivers to Green Hill Road within their field of view so drivers are more aware of the roadway's curvature and upcoming changes in horizontal alignment.

Speed Feedback Signs

Speed feedback signs along Green Hill Road were considered as a speeding countermeasure. These portable, interactive signs display a vehicle's current speed to remind drivers to slow down and obey the posted speed limit. One (1) speed feedback sign should be placed in each direction on the straight sections of Green Hill Road (total of two (2) signs) between Edge Hill Lane and Heather Ridge Lane (north). Additionally, speed feedback signs have the functionality to record speed/traffic volume data which can be utilized by BRPD to determine peak times for speeding vehicles throughout the day to utilize for enforcement efforts.

Summary of Cut-Through Traffic Countermeasures

Based on a review of public comments from the residents of Green Hill Road, cut-through traffic countermeasures were considered to determine the appropriate countermeasure(s) to reduce cut-through traffic and commercial vehicles along Green Hill Road.

Google Maps

Google Maps bases its routing recommendations on two (2) factors: historical traffic patterns/data of the average time it takes to travel a particular section of roadway at certain times/days and real-time data from smartphones that report how fast vehicles are traveling. As a result, Google Maps may recommend Green Hill Road as an alternative route for tourists visiting the Town when the Blue Ridge Parkway is open and if there is congestion, lanes closures, and/or construction on the surrounding roadways during a certain time of day and/or day of the week. Additionally, depending on the origin and destination of a vehicle trip within Town limits, Google maps may recommend Green Hill Road as the fastest route to reach the driver's destination. Therefore, it is recommended that Town staff work with Google Maps to remove Green Hill Road as a routing alternative to reduce cut-through traffic between US 321 and the Blue Ridge Parkway

Selective Exclusion Signs

Selective exclusion signs provide notice to roadway users that State or local statutes/ordinances exclude designated types of traffic from using a particular roadway or facility. If used, selective exclusion signs shall clearly indicate the type of traffic that is excluded (MUTCD Section 2B.39). Examples of selective exclusion signs from the MUTCD include, but are not limited to, no trucks (R5-2, 2a) and no commercial vehicles (R5-4).

As drivers enter Green Hill Road from US 321 or the Blue Ridge Parkway, there is existing signing indicating "No Trucks Over 2 Axles." However, these signs may not be visible to commercial vehicles and truck traffic until they have already entered Green Hill Road in which case would be challenging for these types of vehicles to reverse course. MUTCD Section 2B.39.07 states that *"The Selective Exclusion sign should be placed on the right-hand side of the roadway at an appropriate distance from the intersection so as to be clearly visible to all road users turning into the roadway that has the exclusion."* It is recommended that the existing "No Trucks Over 2 Axles"

signing be replaced with selective exclusion signing such as no trucks (R5-2, 2a) or no commercial vehicles (R5-4).

Additionally, it is recommended that selective exclusion signing be provided in both directions on US 321 and the Blue Ridge Parkway as drivers approach Green Hill Road to provide advance notice of the traffic that is excluded from Green Hill Road. Selective exclusion signing on US 321 and the Blue Ridge Parkway could be paired with movement prohibition signs, such as no right turn (R3-1) and no left turn (R3-2) signing, to further emphasize the traffic that is excluded from Green Hill Road. MUTCD Section 2B.18.03 states that *“If No Right Turn (R3-1) signs are used, at least one should be placed either over the roadway or at the right-hand corner of the intersection.”* MUTCD Section 2B.18.04 states that *“If No Left Turn (R3-2) signs are used, at least one should be placed over the roadway, at the far left-hand corner of the intersection, on a median, or in conjunction with the STOP sign or YIELD sign located on the near right-hand corner.”*

Summary of Green Hill Road / Green Hill Circle Intersection Improvements

The intersection of Green Hill Road and Green Hill Circle operates under AWSC with painted stop bars on all three (3) approaches and stop ahead signs (W3-1) on Green Hill Road in advance of the intersection. It is recommended that a supplemental distance ahead plaque (W16-2P, 2aP) be installed on the same posts as the stop ahead signs on Green Hill Road to inform drivers of the distance to the stop sign indicated by the warning sign.

Transverse rumble strip markings are recommended on Green Hill Road in advance of the Green Hill Road and Green Hill Circle AWSC intersection. Transverse rumble strip markings consist of intermittent narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unexpected changes in alignment and conditions requiring a reduction in speed or a stop (MUTCD Section 3J.02). MUTCD Section 6F.87.08 indicates that *“Transverse rumble strips should not be placed on sharp horizontal and vertical curves.”*

Recommendations

Based on the findings of this traffic study, the following improvements are recommended along Green Hill Road within the study area:

Speeding Countermeasures

- Install two (2) speed feedback signs on Green Hill Road, one (1) in each direction, between Edge Hill Lane and Heather Ridge Lane (north).
- Install a uniform and consistent application of enhanced curve delineation using warning signs and pavement markings illustrating changes in horizontal alignment on Green Hill Road.

Cut-Through Traffic Countermeasures

- Coordinate with Google Maps to remove Green Hill Road as a routing alternative between US 321 and the Blue Ridge Parkway.
- Install selective exclusion signing on Green Hill Road and in both directions on US 321 and the Blue Ridge Parkway as drivers approach Green Hill Road.
 - Movement prohibition signing on US 321 and the Blue Ridge Parkway should also be considered as a supplement to the recommended selective exclusion signing.

Green Hill Road / Green Hill Circle Intersection Improvements

- Install supplemental distance ahead plaques on the same post as the existing stop ahead warning signs on Green Hill Road.
- Install transverse rumble strip markings on Green Hill Road in advance of the Green Hill Road / Green Hill Circle AWSC intersection.

If you should have any questions or comments regarding this letter, please feel free to contact me at (919) 872-5115.

Sincerely,

Michael Karpinski, P.E.
Traffic Engineering Project Manager
RAMEY KEMP ASSOCIATES, INC.

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Attachments: Appendix A – Figures
Appendix B – Traffic Count Data
Appendix C – Crash Data
Appendix D – Speed Data
Appendix E – Public Engagement Summary