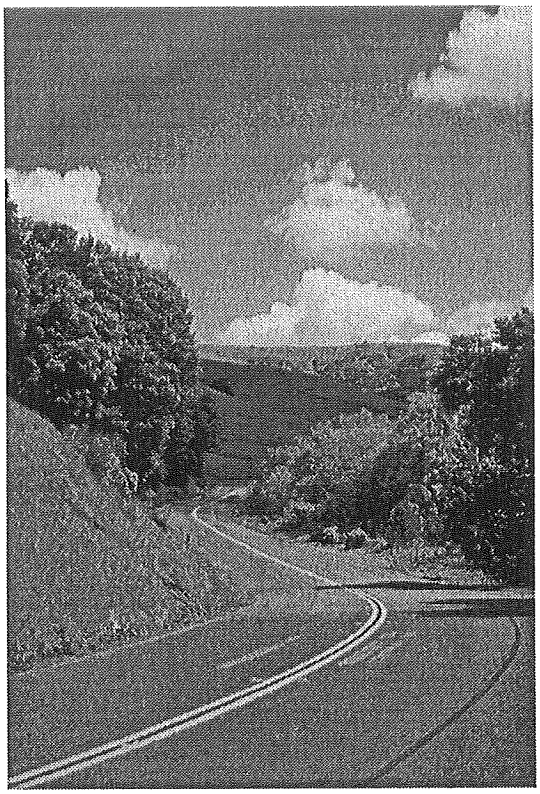
ROUTE 311
CORRIDOR STUDY
From Hanging Rock to New Castle



Prepared by the Staff
of the
Fifth Planning District Commission

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This report was prepared by the staff of the Fifth Planning District Commission through the assistance of the United States Department of Transportation, Federal Highway Administration and the Virginia Department of Transportation.

The contents of this report reflect the view of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or the policy of the Federal Highway Administration nor the Virginia Department of Transportation. This report does not constitute a standard, specification or regulation.

Federal Highway Administration and Virginia Department of Transportation acceptance of this report as fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements, nor does it constitute approval of their location and design, nor commitment to fund any such improvements. Additional project level environmental assessments and/or studies of alternatives may be necessary.

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EXECUTIVE SUMMARY

Route 311 is the main transportation facility connecting Craig County, as well as the Bradshaw, Masons Cove and Catawba areas of Roanoke County, to the urban core of the Roanoke Valley and the rest of the east coast via Interstate 81. Route 311 has also become a popular commuting facility between Montgomery County and the Roanoke Valley. Resident and government concerns have been heightened in recent years due to increased congestion and unsafe conditions. This study documents existing conditions between Hanging Rock in Roanoke County and New Castle in Craig County, identifies problems and makes recommendations to improve Route 311 both in terms of safety and convenience.

Between 1979 and 1991, the traffic volume on the segment of Route 311 between Route 419 and Route 779 grew by 44 percent, volume on the segment between Route 779 and Route 785 grew by 28 percent and volume on the segment between Route 785 and Route 42 grew by 35 percent. The segment of Route 311 between Route 419 and Route 779 carries, historically, more than twice the traffic volume of the other two segments. The data also show that this is the fastest growing segment of Route 311. This is to be expected as it is closest to the urban core of the Roanoke Valley with its jobs, services and transportation connections to the rest of the east coast.

Average travel speeds drop noticeably on Route 311 between Route 864 and Route 779 and between Route 619 and approximately one mile north of Route 619. The first decrease can be explained by the fact that this segment of Route 311 crosses over Catawba Mountain. Route 311 over Catawba Mountain has a very steep grade with no passing lanes or zones. Also, Route 311 has several horizontal curves going over Catawba Mountain which slows traffic. Further, there is a parking lot located at the top of the mountain providing access to the Appalachian Trail. Vehicle movement in and out of this parking lot also has a slowing effect on average travel speed. The second decrease can be explained by the presence of several sharp curves, narrow lanes and almost no shoulder, all of which contribute to the slowing of average travel speed.

The findings of a two-lane highway level-of-service analysis indicate that Route 311 between Hanging Rock and the Roanoke and Craig County boundary is very heavily congested during the peak hour. There are few or no opportunities to pass during this time period. The likelihood of accidents is heightened by this condition, not only because many vehicles are travelling at high speeds at close spacing, but also because motorists become frustrated with the inability to pass and are more likely to risk passing at an unsafe time.

The results of a signalized intersection level-of-service analysis show that the intersection of Route 419 and Route 311 is functioning at an unsatisfactory level during both the morning and evening peak hours. Traffic volumes for some movements through the intersection are so heavy that not all vehicles are getting through the intersection during the allotted green phase of the signal cycle. This leads to queuing and long vehicle delay. The results of an unsignalized intersection level-of-service analysis indicate that the intersections of Route 311 and Routes 740, 779 and 864 are currently functioning at a satisfactory level.

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CHAPTER 1

INTRODUCTION

Background

One of the largest stumbling blocks to development in Craig County is its relative isolation from it's neighboring communities, particularly from the regional urban core in the Roanoke Valley. Route 311, functionally classified a rural major collector as well as a state scenic by-way, is the main transportation facility which connects Craig County, as well as the Bradshaw, Masons Cove and Catawba areas of Roanoke County, to the urban core of the Roanoke Valley and the rest of the east coast via Interstate 81. Route 311 has also become a popular commuting facility for residents of Montgomery County who work in the Roanoke Valley and vice-versa.

Route 311 is, however, a two-lane highway which winds its way through mountainous and rolling terrain. Resident and government concerns have been heightened in recent years due to increased congestion and unsafe conditions. Further, there are conflicting opinions with regard to the desirability of improving Route 311 so it can continue to act as a commuter thoroughfare. Craig County would be greatly benefitted both in terms of commercial development and residential relocation if Route 311 were dramatically improved. Roanoke County, on the other hand, has specifically designated the communities along Route 311 as being rural village or rural preserve. This indicates that Roanoke County would strongly prefer to maintain the rural character of the Bradshaw, Masons Cove and Catawba areas in part through the maintenance of the rural character of Route 311.

The study area for this report is confined to the 19.2 mile segment of Route 311 between Hanging Rock in Roanoke County and the Town of New Castle in Craig County. This segment includes several unsignalized intersections, one signalized intersection and a major topographical barrier in the form of Catawba Mountain. The study area can be seen on Map 1.

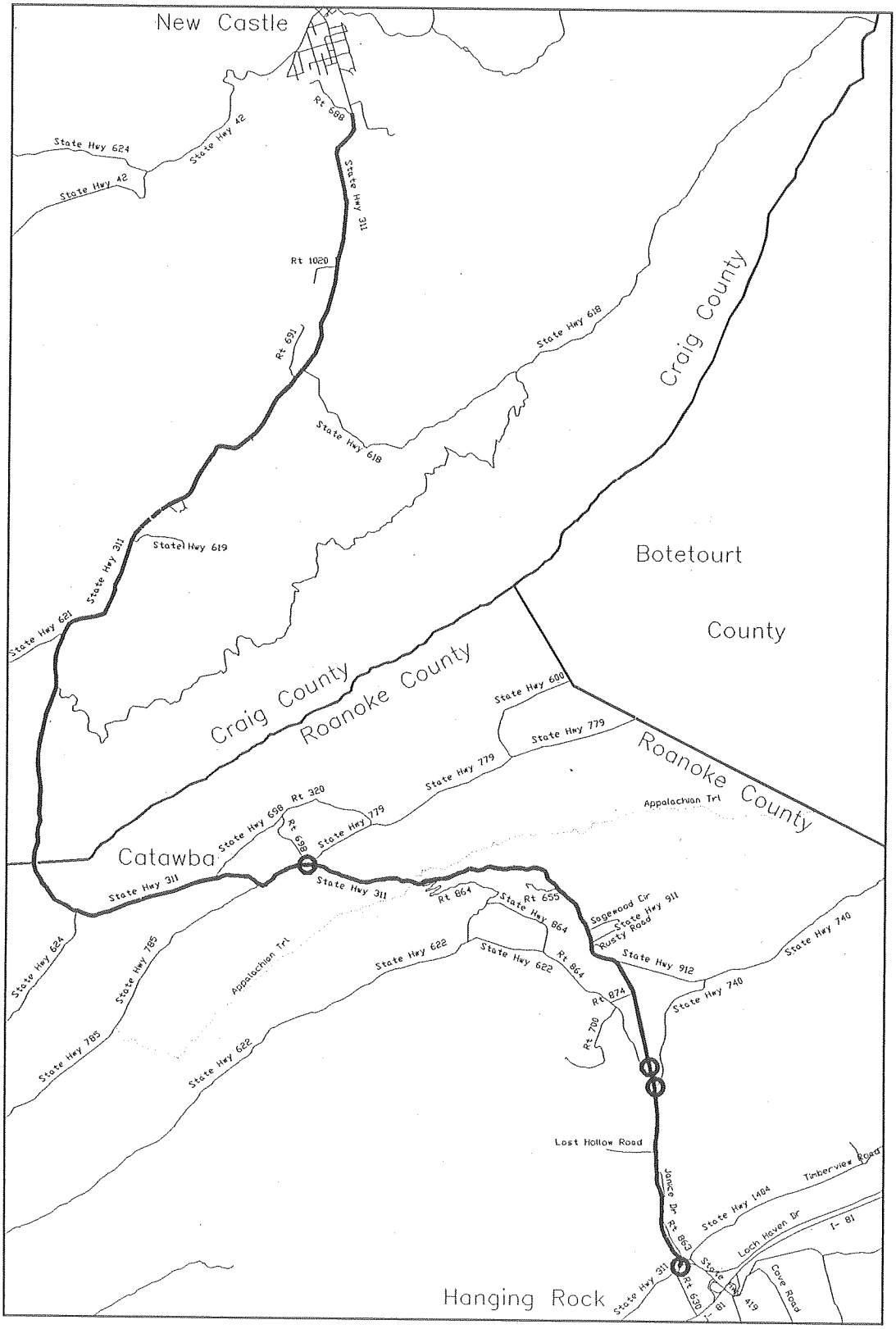
Goals and Objectives

The goals of the Route 311 Corridor Study are to document existing conditions, identify problems in the study area and make recommendations which will improve travel on this route both in terms of safety and convenience. These goals can be achieved by addressing both general and site specific deficiencies in the facility and providing recommendations to improve those identified deficiencies keeping in mind the needs of both local and through traffic.

Study Approach

The study approach was to rely on field surveys conducted by the staff of the Fifth Planning District Commission, traffic counts, accident data, intersection delay data, school bus routing data and other background information supplied through interviews with local officials and

Route 311 Corridor Study Area



Legend

Rt 311

Traffic Count Location

Scale 1"=8000'

Fifth Planning District Commission

W N E S

Map 1

The length of Route 311 which falls in the study area has only one signalized intersection in it at the southernmost intersection in the study area with Electric Road (Route 419). Several other state routes intersect Route 311 within the study area forming unsignalized intersections. These roads include: Dutch Oven Road (863), Janee Drive (Route 765), Carvins Cove Road (Route 740), Bradshaw Road (Route 864), Plunckett Road (874), Absolom Smith Road (Route 912), Sagewood Circle (Route 911), Oakey Dolin Road (Route 655), Old Catawba Road (Route 864), Catawba Creek Road (779), Blacksburg Road (785), Keffer Road (698), Newport Road (624), Route 621, Route 692, Route 619 , Route 691, Route 618, Route 1020, Route 688 and several small state routes just south of the New Castle Town line which serve as local residential streets. There are other small private roads and driveways which also intersect Route 311 within the boundaries of the study area.

Portions of Route 311 in the study area pass through the flood plains of both Mason's Creek in Roanoke County and Craig Creek in Craig County. The current land uses along the Route 311 corridor consist mostly of rural residential, agricultural and low density commercial. Also, the Jefferson National Forest is within close proximity of the study area and the Appalachian Trail crosses Route 311 in Roanoke County at the Summit of Catawba Mountain.

Commercial and residential development is strongly encouraged in the Route 311 corridor in Craig County, but no future land use plan has been developed for Craig County. The Roanoke County comprehensive plan, on the other hand, specifically designates the areas of land in the Route 311 corridor as rural village or rural preserve. Both of these designations discourage suburban forms of development which is often brought on through an improvement in services, including transportation services. It is generally accepted that there exists a strong link between transportation and land use. Often an improvement in transportation services increases dramatically the pressure to develop land on and near the improved transportation facility. Residents of the Bradshaw, Masons Cove and Catawba areas of Roanoke County value the rural character of their communities and may not support the suburbanization of their corner of Roanoke County.

The traffic volume on the segment of Route 311 between Route 419 and Route 779 grew by 44 percent between 1979 and 1991 with an average annual growth rate of 3 percent. The traffic volume on the segment of Route 311 between Route 779 and Route 785 grew by 28 percent between 1979 and 1991 with an average annual growth rate of 2 percent. The traffic volume on the segment of Route 311 between Route 785 and Route 42 (which is located within the Town of New Castle just north of the study area) grew by 35 percent between 1979 and 1991 with an average annual growth rate of 3 percent.

The data contained in Table 1 confirm that the segment of Route 311 between Route 419 and Route 779 carries, historically, more than twice the traffic volume than the other two segments for which data was available. The data also show that the growth rates of traffic volume also vary between segments with the fastest growing segment of Route 311 being that segment between Route 419 and Route 779. This pattern is to be expected as this segment is closest to the urban core of the Roanoke Valley with its jobs, services and transportation connections to the rest of the east coast. This also reflects the increased commuter traffic between Montgomery County and the Roanoke Valley, particularly on Bradshaw Road (Route 864).

In the spring of 1995, 24-hour counts were taken by VDOT at different locations on Route 311 within the study area. These four count locations were: 1) just north of Route 419, 2) just south of Route 779, 3) at the Roanoke/Craig County Line, and 4) just north of Route 621. The counts include both northbound and southbound traffic. All four counts were taken for two consecutive 24-hour periods. The average 24-hour count at each location were as follows: 1) 11,271 vehicles at the location just north of Route 419, 2) 6,038 vehicles just south of Route 779, 3) 4,229 vehicles at the Roanoke/Craig County Line, and 4) 3,880 vehicles just north of Route 621. These counts further confirm that the traffic volumes increase dramatically on Route 311 as it approaches the intersection with Route 419. This is particularly true on the segment of Route 311 south of Catawba Mountain.

VDOT forecasts for year 2015 (based on 1987 ADT) indicate that the southern portion of the Route 311 corridor will continue to carry higher volumes of traffic than the northern portion. A comparison of Table 1 and Table 2 indicate VDOT forecasts for the year 2015 are low assuming that traffic volume growth on Route 311 continues at a constant rate. VDOT traffic volume forecasts for Route 311 are shown in Table 2.

Table 3: Roadway Geometric Data For Route 311 Between Hanging Rock And New Castle

Roadway Segment		Number of Lanes	Pavement Width (feet)	Lane Width (feet)	Posted Speed Limit	Average Travel Speed	Shoulder Width	
From Route	To Route						Left	Right
419	.25 miles north of 419	2	24	12	45	- - -	2	4
.25 miles north of 419	North inters. of 864	2	20	10	55	52	2	4
North inters. 864	.18 miles north of 779	2	22	11	55	42	2	4
.18 miles north of 779	Craig County Line	2	24	12	55	54	4	3
Craig County Line	619	2	24	12	55	50	1	1
619	.87 miles north of 619	2	20	10	55	42	1	1
.87 miles north of 619	.8 miles south of 618	2	24	12	55	- - -	1	1
.8 miles south of 618	.08 miles north of 618	2	20	10	55	- - -	1	1
.08 miles north of 618	.70 miles north of 618	2	24	12	55	- - -	2	2
.70 miles north of 618	640	2	20	10	55	55	1	1

* Route 640 is located north of the study area

stop in both directions on undivided highways for a loading or unloading school bus and wait until the school bus has stopped flashing its red lights indicating that children are safely out of the way of traffic. Further, state law requires school buses to stop within at least one mile of a child's home. In both Roanoke and Craig Counties, school buses stop at the end of children's driveways because of the lack of sidewalks or adequately wide shoulders along Route 311 where it would be safe for children to walk to a safe location for a school bus to pick-up or discharge them. School bus stop locations change from year to year depending on where children of school age live. Changes occur due to graduation, children becoming old enough to attend school and the normal relocation of households with school age children. It is therefore very difficult to pinpoint where problem locations, both in terms of safety and delay, exist with regard to school bus traffic and stops.

There are two Craig County school buses which operate on Route 311 in the study area. These two buses run between 7:45 and 8:30 in the morning and 3:30 and 4:15 in the afternoon. Both buses make stops on Route 311 to pick-up and discharge school children. These locations change from year to year for the reasons mentioned above. This makes the task of pinpointing problem locations on Route 311 in Craig County difficult with regard to school bus circulation. There is a sign located north of the Roanoke County border in Craig County notifying motorists of the potential presence of stopped school buses. There are also a few signs on Route 311 indicating the location of school bus stops, but it is unclear whether these are current stops or past stops which are no longer used.

While there have been no accidents on Route 311 in recent memory involving a school bus, there have been close calls in which vehicles have stopped short or been entirely unable to stop for loading or unloading school buses due to inadequate sight distances. While there are many locations on the Craig County segment of Route 311 in the study area where geometric conditions obscure the lines of sight to such a point as to make stopping for a loading or unloading school bus difficult, two of the worst locations include a tight curve located just north of Route 619 at the Mountain View Church and the intersection with Route 691 where a bank on the west side of Route 311 and a curve in Route 311 itself obscure northbound motorists vision.

Both school bus drivers upon noticing a build up of vehicles behind them will pull off the road in order to allow the queue to pass. There are, however, few safe locations where this maneuver can safely take place. Also, if there are pullovers wide enough to accommodate a school bus with adequate sight distance to allow a school bus to both decelerate and pullover and to accelerate and reenter the stream of traffic, then that location is probably a good candidate to be a passing zone in which case vehicles can pass a slow moving school bus without necessitating its pulling over in the first place.

There are four Roanoke County school buses which operate on Route 311 in the study area. These four buses run between the hours of 7:00 and 7:50 in the morning and 2:05 and 3:45 in the afternoon. The four school buses currently make a combined 17 stops on Route 311 to pick-up or discharge children. As stated previously, these school bus stops are subject to change on a

The HCM classifies highway service quality using six levels of service: A, B, C, D, E and F. It is important to understand what each level of service represents. They are described below:

LOS A represents the highest quality of traffic service and would result in average speeds approaching 60 miles per hour on two-lane highways. The passing frequency required to maintain these speeds has not reached a demanding level. Passing demand is well below passing capacity and almost no platoons of three or more vehicles are observed. Drivers would be delayed no more than 30 percent of the time by slow-moving vehicles.

LOS B represents the region of traffic flow wherein speeds of 55 miles per hour or slightly higher are expected on level terrain. Passing demand needed to maintain desired speeds becomes significant and approximately equals the passing capacity at the lower boundary of LOS B. Drivers are delayed up to 45 percent of the time on average.

LOS C represents conditions characterized by increases in traffic flow resulting in noticeable increases in platoon formation, platoon size and frequency of passing impediment. Average speed still exceeds 52 miles per hour on level terrain even though unrestricted passing demand exceeds passing capacity. While traffic flow is stable, it is becoming susceptible to congestion due to turning traffic and slow-moving vehicles. Percent time delays are up to 60 percent.

LOS D represents conditions characterized by unstable traffic flow. Passing demand is very high while passing capacity approaches zero. Mean platoon sizes of 5 to 10 vehicles are common although speeds up to 50 miles per hour can still be maintained under ideal conditions. The fraction of no passing zones along the roadway section usually has little influence on passing. Turning vehicles and/or roadside distractions cause major shockwaves in the traffic stream. The percentage of time motorists are delayed approaches 75 percent.

LOS E represents traffic flow conditions on two-lane highways having a percent time delay of greater than 75 percent. Even under ideal conditions speeds will drop to below 50 miles per hour. Passing is virtually impossible and platooning becomes intense when slower vehicles or other interruptions are encountered. The highest volume attainable under LOS E defines the capacity of the highway. Under ideal conditions, capacity for a two-lane highway is 2,800 passenger car equivalents (passenger car equivalents take into account the differences between heavy vehicles and passenger cars for the purposes of calculating a level-of-service) per hour. Prevailing conditions such as terrain and directional split can lower the ideal capacity.

LOS F represents heavily congested flow with traffic demand exceeding capacity. Volumes are lower than capacity and speeds are below capacity speed.

negative effect on motorists commuting from Craig, Montgomery and Roanoke Counties to the Roanoke Valley as well as businesses in Craig and Roanoke Counties which depend on Route 311 for market access.

Segments 4 and 5 are operating during peak hour at a level-of-service C and D, respectively. This indicates that these two segments are functioning at an acceptable level. It should be noted, however, that the HCS model only accepts speeds of 60 miles per hour and higher for the design speed variable. This does not, therefore, allow the model to take into account lower design speeds at Route 311 locations with sharp horizontal curvature which lowers the carrying capacity of the facility. There are several sharp horizontal and vertical curves along Route 311 in the study area. This is particularly true of the two segments in Craig County. The levels-of-service calculated for this study may have been impacted negatively to some degree had it been possible to account for the curvature of the roadway in the HCS model.

Intersection Level Of Service Analysis

Signalized Intersections

There is one signalized intersection located within the study area. That intersection is located at the southern terminus of the study area where Route 419 (Electric Road) intersects Route 311. The HCM states that, "the signalized intersection is one of the most complex locations in a traffic system. Signalized intersection analysis must consider a wide variety of prevailing conditions, including the amount and distribution of traffic movements, traffic composition, geometric characteristics and the details of intersection signalization."

The concepts of capacity and level-of-service are central to the analysis of signalized intersections, as they are for all types of transportation facilities. In intersection analysis, however, the two concepts are not as strongly correlated as they are for other facility types. For signalized intersections, both LOS and capacity are analyzed separately, and are not simply related to each other. Both concepts must be fully considered to evaluate the overall operation of a signalized intersection.

Capacity analysis of intersections results in the computation of a volume to capacity ratio (v/c) for individual movements and a composite ratio for the sum of critical movements or lane groups within the intersection. The v/c ratio is the actual or projected rate of flow on an approach or designated group of lanes during a peak 15-minute interval divided by the capacity of the approach or designated group of lanes. Capacity is defined in the HCM as being the maximum rate of flow (for the subject approach) which may pass through the intersection under prevailing traffic, roadway and signalization conditions. For example, if the volume for a particular movement was 80 vehicles for a given 15-minute period and the capacity of that approach was 100 vehicles for any given 15-minute period, the v/c ratio would be 80/100 or .8. If the v/c ratio for a given approach equals 1, that approach is said to be at capacity indicating that no more traffic can be comfortably accommodated by that approach during that given time period.

Table 5: Level-Of-Service Analysis for the Intersection of Route 419 and Route 311

Morning Peak Hour 7:15-8:15 AM	Northbound Traffic	Southbound Traffic		Eastbound Traffic	Westbound Traffic
Critical Movement	LTR	LT	R	LTR	LTR
Lane Group V/C Ratio	0.33	1.26	0.28	0.24	0.47
Lane Group Delay	34.5	*	12.0	10.0	21.6
Lane Group LOS	D	*	B	B	C
Composite Approach Delay	34.5	*		10.0	21.6
Composite Approach LOS	D	*		B	C
Evening Peak 4:45-5:45 PM	Northbound Traffic	Southbound Traffic		Eastbound Traffic	Westbound Traffic
Critical Movement	LTR	LT	R	LTR	LTR
Lane Group V/C Ratio	0.57	0.47	0.13	0.61	1.31
Lane Group Delay	38.0	23.7	11.0	14.0	*
Lane Group LOS	D	C	B	B	*
Composite Approach Delay	38.0	20.0		14.0	*
Composite Approach LOS	D	C		B	*
* Intersection LOS and Capacity Meaningless When V/C Exceeds 1.2					

L represents a left turn movement - T represents a through movement - R represents a right turn movement - combinations of these letters represent a shared for more than one movement through the intersection, i.e. LTR represents a shared approach from which a left, right or through movement can be made by an approaching vehicle

The results of the HCS intersection analysis conclude that this intersection is functioning at a level-of-service F during both the morning and the evening peak hour. HCS abandons the actual calculation of an overall intersection LOS or capacity when an approach is so oversaturated that the v/c ratio exceeds 1.2 as is the case for this intersection during both the morning and evening peak hours.

The analysis reveals that the southbound left-through movement from Route 311 north of the intersection is over capacity during the morning peak hour. In other words, the traffic volume for that movement through the intersection is so heavy that not all of the vehicles are getting through the intersection during the green phase for that movement. This leads to queuing and long vehicle delay, possibly two or more cycle lengths. Based on volume data collected in the field, it

secondary routes carry over 1,000 vehicles a day. Bradshaw Road (Route 864) carries 3,176 vehicles per day, while Carvins Cove Road (Route 740) carries 1,181 and Catawba Creek Road (Route 779) carries 1,016 vehicles per day. These intersections were selected for closer analysis.

At most unsignalized intersections, as is the case with the three intersections under review in this study, Stop and Yield signs are used to assign the right-of-way to one street. The right-of-way is usually assigned to the road with the highest volume of traffic, in this case Route 311. This designation forces drivers on the controlled street to judgementally select gaps in the major street flow through which to execute crossing and turning maneuvers. Thus, the capacity of the controlled legs is based on two factors: 1) the distribution of gaps in the major street traffic stream, and 2) driver judgement in selecting gaps through which to execute their desired maneuvers. See chapter 10 of the HCM for a more detailed discussion of gap acceptance theory.

Analysis of unsignalized Stop or Yield controlled intersections result in the computation of a solution for the capacity of each lane on the minor approaches. LOS criteria are related to a very general series of delay ranges. It is therefore not possible to directly compare an unsignalized LOS with a signalized intersection analysis LOS in terms of specific delay values. LOS criteria for unsignalized intersections are given in Table 6 and are based on the reserve capacity of the lane in question (this table is based on a table in the HCM on page 10-9).

Table 6: Level-Of-Service Criteria for Unsignalized Intersections

Reserve Capacity (pcph)	LOS	Expected Delay To Minor Street Traffic
400 and higher	A	Little Or No Delay
300 - 399	B	Short Traffic Delays
200 - 299	C	Average Traffic Delays
100 - 199	D	Long Traffic Delays
0 - 99	E	Very Long Traffic Delays
*	F	*

* is used when demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause sever congestion affecting other traffic movements in the intersection. This condition usually warrants improvement to the intersection - pcph stands for passenger car equivalents per hour

A level-of-service and capacity analysis was conducted for the intersections of Carvins Cove Road (Route 740), Bradshaw Road (Route 864) and Catawba Creek Road (Route 779) and Route 311 using HCS. The analysis was conducted for both the morning and evening peak hour. All three are T-intersections and there are therefore no through movements to be analyzed from the minor street. HCS determines capacity and LOS for both individual critical movements and for shared approaches if a single lane is utilized for more than one critical movement.

increase in the future which will shrink the number of available gaps in the traffic stream. It would be prudent to reexamine this intersection again in a few years with an eye toward making improvements at that time.

Table 8 presents the Bradshaw Road (Route 864) and Route 311 intersection analysis results.

Table 8: Level-Of-Service Analysis for the Intersection of Route 864 and Route 311

Morning Peak Hour 7:15 - 8:15 AM	Critical Movements (measurements in pcph)		
	Minor Street		Major Street
	Eastbound Left	Eastbound Right	Northbound Left
Flow Rate	3	328	92
Actual Movement Capacity	219	486	615
Movement Reserve Capacity	216	158	523
Movement LOS	C	D	A
Afternoon Peak Hour 5:00 - 6:00 PM	**Critical Movements (measurements in pcph)**		
	Minor Street		Major Street
	Eastbound Left	Eastbound Right	Northbound Left
Flow Rate	5	107	234
Actual Movement Capacity	141	737	903
Movement Reserve Capacity	136	630	668
Movement LOS	D	A	A

pcph stands for passenger car equivalents per hour

The HCS results indicate that all movements through this intersection are currently functioning at a satisfactory level. The analysis reveals that vehicles making the left turning movement from Bradshaw Road to northbound Route 311 experience long delays while waiting to find a gap in the Route 311 traffic flow. Given the low demand for this movement through the intersection, these findings present no cause for concern. This is particularly true given the fact that the left and the right turn movement from Bradshaw Road do not share an approach lane which means that the delay experienced by the left turn movement is not also experienced by the right turn movement. The other critical movements at this intersection experience little to no delay at all.

Table 9 presents the Catawba Creek Road (Route 779) and Route 311 intersection analysis results.

Traffic Accident Analysis

Several agencies respond to accidents on Route 311. All reported accidents are stored in a database maintained by VDOT. All accident data analyzed in this study was obtained from the Traffic Engineering Division of VDOT. The accident data pertains to all reported accidents on Route 311 between Hanging Rock and New Castle and covers the three year time period between January 1, 1992 and December 31, 1994.

It should be noted that VDOT computers alert VDOT staff of unusual and significant trends in the accident data. This alert prompts VDOT staff to conduct an investigation of the specific trend involved and to take appropriate measures to alleviate the situation where warranted.

Table 10 through 18 present the following information: accidents by time of day, accidents by lighting type by year, accidents by severity type by year, accidents by major factor, accidents by month of year, accidents by day of week, accidents by location by year, accidents by collision type and year and accidents by surface condition by year.

Table 10: Route 311 Accidents By Time Of Day

AM	Accidents	PM	Accidents
00:00 - 00:59	2	12:00 - 12:59	6
1:00 - 1:59	3	13:00 - 13:59	3
2:00 - 2:59	9	14:00 - 14:59	5
3:00 - 3:59	1	15:00 - 15:59	7
4:00 - 4:59	2	16:00 - 16:59	6
5:00 - 5:59	3	17:00 - 17:59	8
6:00 - 6:59	7	18:00 - 18:59	4
7:00 - 7:59	4	19:00 - 19:59	4
8:00 - 8:59	5	20:00 - 20:59	3
9:00 - 9:59	5	21:00 - 21:59	3
10:00 - 10:59	7	22:00 - 22:59	3
11:00 - 11:59	4	23:00 - 23:59	6

Table 14: Route 311 Accidents By Month Of Year

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
12	10	5	8	7	6	10	12	11	11	10	8	110

Table 15: Route 311 Accidents By Day Of Week

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
14	14	13	15	16	23	15

Table 16: Route 311 Accidents By Location

Route 311 Segment		Segment Length (miles)		Year 19-			Total		Accident per Mile	
From	To			92	93	94				
Route 419	Route 740	1.8	4.1	2	4	9	15	29	5.0	7
Route 740	Route 864 (South)	0.2		2	1	1	4		20.0	
Route 864 (South)	Route 655	2.1		3	3	4	10		4.8	
Route 655	Route 864 (North)	1.4	2.6	3	3	0	6	10	4.3	3.8
Route 864 (North)	Route 779	1.2		1	1	2	4		3.3	
Route 779	Route 785	0.5	3.1	1	3	1	5	22	10.0	7.1
Route 785	Route 624	1.9		3	3	4	10		5.3	
Route 624	Roanoke/Craig Boundary	0.7		2	2	3	7		10.0	
Roanoke/Craig Boundary	Route 621	2.2	2.2	7	1	4	12	12	5.5	5.5
Route 621	Route 619	1.5	7.2	0	3	0	3	37	2.0	5.2
Route 619	Route 618	2.2		7	6	8	21		9.5	
Route 618	New Castle	3.5		5	7	1	13		3.7	
Total		19.2		36	37	37	110		110	

Note: accidents occurring at "To" intersections are included in the next segment count. For example, accidents occurring at the intersection of Route 419 are included in the accident count for the 419 to 740 segment, but accidents at Route 740 are included in the 740 to 864 segment. The larger segments separated by the thick lines in the table correspond with the five road segments analyzed for level-of-service and capacity earlier in this study.

Of the 110 accidents which occurred during the three year analysis period, 75 of them (almost 70 percent) occurred on a dry road surface. Just over half of the 110 accidents (56) occurred in full daylight.

No particular trend seemed to exist with regard to the time of day an accident occurred, although there seemed to be a very small rise in the number of accidents occurring during the evening commuting peak period. More accidents occurred on Saturdays than on any other day of the week, but not so many more as to be considered significant. August and January shared the honor of being the worst months in terms of having the highest number of accidents. In general, however, no discernable trend presented itself with regard to the months in which accidents occurred.

The majority of accidents were either rear end collisions or collisions with fixed objects off the road. Also, almost half of all 110 accidents reviewed were caused by some form of driver inattention. This is consistent with the findings for collision type as rear ends and the striking of objects off the road are most often caused through driver inattention to driving conditions. Driver inattention is also, according to VDOT officials, the most often listed major factor for accidents because it covers the widest variety of possible causes. For example, an accident caused by a driver tuning his radio and an accident caused by a driver failing to yield the right of way at a yield sign would both be listed as driver inattention accidents.

The analysis of accidents by location (Table 13) reveals that the segment of road with the highest number of accidents (21) was the 2.2 mile segment between Route 619 and Route 618 in Craig County, which is part of segment 5 as analyzed for level-of-service earlier in this study. This is due to the number of sharp horizontal and vertical curves, including a particularly sharp curve at the Mountain View Church just north of Route 619. Also, the majority of the accidents occurring on this segment are rear end collisions, indicating that accidents are occurring because cars slowing to navigate the sharp curves are being struck from behind by following cars either from driver inattention or excessive speed. This finding is bolstered by an earlier finding in the Roadway Physical Geometry Analysis which found that average travel speeds on this same segment of Route 311 are noticeably lower than for the rest of the corridor. Motorists tend to slow down on this segment in order to negotiate the sharp curves. These same sharp curves are more likely to lead to an accident given any miscalculation, inattention or excessive speed on the part of the motorist.

In terms of accidents per mile, the most dangerous segment of road on Route 311 is the 0.2 mile segment between Carvins Cove Road and Bradshaw Road. This is a high traffic volume location where many turning movements are executed which heightens the likelihood of accidents. Also, the broader segment between Catawba Creek Road and the Roanoke and Craig County boundary has a fairly high rate of accidents per mile. This segment of road has similar turning activity as the segment between Carvins Cove Road and Bradshaw Road, having three busy intersections lying within it. Both of these intersections were reviewed for the possible inclusion of a traffic signal based on accident data using the accident experience warrant contained in the ***Manual On***

CHAPTER 4

TRANSPORTATION IMPROVEMENT ELEMENTS

The Transportation Improvement Element coordinates research findings and analysis results to provide localities with a workable list of potential corridor improvement elements. Efforts are made to ensure that only feasible, acceptable and potentially effective solutions are considered. Candidate actions are refined into detailed physical, operational and other necessary changes tailored to specific problems and locations. Improvement recommendations should be coordinated with the ***Six-Year Improvement Program*** and local land use and economic development policies so that these improvements are in harmony with other initiatives and may be given funds for implementation.

The following are recommendations to improve the Route 311 corridor both in terms of safety conditions and the ability of the facility to accommodate both current and future traffic volumes. This list includes some recommendations which, if implemented, would be very expensive and require significant construction. These recommendations were made only after careful consideration of less expensive alternatives. It should be noted that these recommendations are made based solely on the transportation analysis made as part of this study and do not take into account the potential environmental, land-use and other socio-economic impacts and costs which may be associated with their implementation. It is suggested that environmental, land-use and other cost/benefit analyses be conducted prior to the implementation of any of the more substantial and expensive of the following recommendations. Further, members of the community should be given an opportunity to participate in the decision making process with regard to the implementation of any suggested transportation improvements in the Route 311 corridor. Also, not all recommendations need to be implemented in order to improve conditions on Route 311. Incremental implementation of lower cost less intrusive improvements may be adequate to improve conditions over the short run. Recommendations are given in physical sequence starting from the southern boundary of the study area.

- **Intersection of Route 419 and Route 311:** (The second and third recommendation for this intersection would work best if implemented jointly)

  Install a "No Right On Red" sign at the northbound approach to the intersection from the Orange Market in order to reduce interference with left turning vehicles from the southbound approach,

  Adjust signal phasing in order to allow more green time for the southbound left turn movement through the intersection from Route 311 to Route 419, and

  Add an exclusive right turn only lane at the westbound approach to the intersection from Route 419 in order to accommodate the high demand for this movement. This improvement would be expensive and require significant construction.

- **Route 311 Between Route 619 and Route 618:**

  Straighten and widen road to remove sharp horizontal and vertical curves in order to improve safety and average speed of through vehicles. Cut banks on inside of sharp horizontal curves where widening and straightening is not feasible to improve lines of sight in order to improve safety. This improvement would be expensive and require significant construction.