September 2017

The 2017 North Carolina Observational Survey of Seat Belt Use

Final Report

Prepared for

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Prepared by

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ITRE

INTRODUCTION

Annual seat belt use surveys are conducted in the State of North Carolina to fulfill the requirements of the National Highway Traffic Safety Administration (NHTSA). The survey is conducted in June immediately following the Governor's Highway Safety Program (GHSP)'s *Click It or Ticket* event. The *Click It or Ticket* program in North Carolina started as a successful pilot project for similar programs nationally, and it has been conducted annually since October 1993 as an enforcement and education campaign dedicated to reducing injuries and deaths in motor vehicle collisions by increasing seat belt use.

According to the Uniform Criteria for State Observational Surveys of Seat Belt Use ("Uniform Criteria") Federal Final Rule,[1] States are required to reselect their road segments and observation sites at least once every five years. North Carolina was required to reselect its road segments and observation sites for 2017 according to the current survey design that was approved by NHTSA in April 2012.

In addition to summarizing the 2017 Seat Belt Survey results, this report provides documentation for the road segment and observation site reselection process that was followed to identify sites for vehicle and occupant observations. Observations were collected in 15 counties in North Carolina stratified by three regions (Mountains, Piedmont, and Coastal). Eight observation sites were visited in each county for a total of 120 sites.

Field observers collected seat belt use data on 25,659 drivers and 6,494 front right seat passengers for a total of 32,153 observations. Seat belt use data were unknown for 310 drivers and 411 front right seat passengers resulting in a statewide combined nonresponse rate of 2.2%, well below the 10% threshold established by the Uniform Criteria.

The 2017 weighted statewide seat belt use rate is estimated at 91.4% with a standard error of 0.4%. This standard error is within the 2.5% requirement mandated by the Uniform Criteria.

ITRE will submit required documentation to NHTSA that confirms that the 2017 North Carolina Seat Belt Survey was compliant with the Uniform Criteria. This submission will describe the data collection dates, quality check information, weights, and data used to generate estimates of statewide seat belt use.

[1] https://www.federalregister.gov/documents/2011/04/01/2011-7632/uniform-criteria-for-state-observational-surveys-of-seat-belt-use

Organization of Report

This report begins with documentation for the observation site reselection process that was conducted to identify observation sites to be approved and used for the next five-year period (2017-2021). Procedures for the selection of counties and roadway segments within counties are summarized and details on the observation sites are provided. The report then provides the 2017 Seat Belt Use Survey results, including statewide seat belt use rates and discussion of longitudinal trends. Characteristics of drivers, including by vehicle type and geographic location (e.g. region, county, and urban/rural), are also provided. Additional detailed summary tables are provided in Appendix A with results for further subgroups of interest.

Observation Site Reselection

According to the Uniform Criteria, States are required to reselect their road segments and observation sites at least once every five years. North Carolina was required to reselect their road segments and observation sites for 2017 according to the current survey design that was approved by NHTSA in April 2012. Site reselection involved a multi-step process:

1. Review previously approved survey design to determine if any changes were needed.
2. Evaluate and choose road segment sampling frame data source(s); data sources include NCDOT GIS data and US Census TIGER data.
3. Evaluate and implement optional county-level FARS 85% fatality exclusion and optional roadway-level rural local roads and other roads (unnamed roads, unpaved roads, etc.) exclusions.
4. Stratify and assign measures of size and probabilities of selection to road segments; allocate road segment sample size according to the approved survey design.
5. Select the road segment sample and perform quality control (QC) checks.
6. Determine observation point locations on sampled road segments.
7. Complete NHTSA site reselection submission package and transmit to NHTSA.
8. Implement the new road segment sample upon approval by NHTSA.

Upon review of the previously approved survey design, ITRE submitted an erratum to the approved survey design to clarify that FARS average fatality counts for three years of data (2012, 2013, and 2014) were used when applying the optional FARS 85% fatality exclusion to establish the county sampling frame for the 2017 reselection of observation sites in

compliance with the Uniform Criteria.

Since the list of counties included in the sampling frame based on the optional 85% FARS fatality exclusion and used for the first stage of selection changed since the last reselection process, the county sample was reselected. Using the approved survey design and following the aforementioned steps, new road segments were then selected from 15 North Carolina counties stratified by three regions (Mountains, Piedmont, and Coastal). Eight roadway segments were sampled from each county for a total of 120 road segments. Observation site point locations on the sampled road segments were selected deterministically by evaluating the sampled road segments in Google Earth software.

Documentation for the 120 reselected road segments, including their probabilities of selection, was provided to NHTSA for approval. The 120 sites were approved on May 5th, 2017. A copy of the approval letter is provided in Appendix B. Subsequent appendices provide additional site reselection documentation; Appendix C provides the county sampling frame used in 2017, Appendix D provides a map that shows the geographic distribution of the new sampled counties, and Appendix E provides the final approved observation sites and their associated probabilities of selection and weights.

Additional details on the survey methodology, field observer training, field data collection, and statistical procedures are provided in Appendix F.

2017 120-Site Results

The 2017 dataset consists of observations collected at 120 sites that were selected in accordance with the 2012 NHTSA-approved survey design. The 120 sites are located on a sample of roadways located in fifteen counties across North Carolina.

Table 1-1 presents the overall results of the 120-site sample of the June 2017 North Carolina Seat Belt Survey. Within the 120-site sample, the June 2017 weighted statewide seat belt use rate for drivers (D) is 91.6%, compared with 92.1% of drivers who were observed using seat belts in the June 2016 survey. The 2017 weighted statewide use rate for right front seat passengers (RF) is 91.0%, which is up from 90.4% in June 2016. The 2017 weighted use rate for drivers and front right seat passengers combined (D+RF) is 91.4% (95% CI=90.6%, 92.2%), which is slightly down from the 2016 120-site rate of 91.7% (95% CI=90.9%, 92.6%).

Table 1-1. North Carolina Seat Belt Use Rates, Unweighted and Weighted: 120-Site June 2017 Survey

Category	Unweighted	Weighted		
	Use %	Use %	SE %	Sample Size
Overall Use Rates				
Driver	91.6	91.6	0.3	25,659
Passenger	89.9	91.0	1.0	6,494
Combined	91.3	91.4	0.4	32,153
Driver Use Rates				
Urban/Rural				
Urban	92.1	91.9	0.4	20,767
Rural	89.5	90.5	0.7	4,892
Region				
Mountain	92.7	92.4	0.3	11,095
Piedmont	92.4	91.9	0.7	7,960
Coast	89.0	89.5	0.9	6,604
Vehicle Type				
Car	92.7	92.9	0.4	10,993
Van	87.5	86.4	3.4	594
Minivan	96.0	96.4	0.7	1,289
Pickup Truck	87.1	86.6	0.9	4,454
Sport-Utility Vehicle	93.9	93.5	0.5	7,055
Other	83.9	83.5	1.8	1,264
Sex of Driver				
Male	89.2	88.8	0.5	6,151
Female	94.1	94.1	0.5	4,169
Race/Ethnicity of Driver				
White	91.4	91.4	0.5	7,136
Black	89.7	89.5	1.0	2,131
Hispanic	91.9	91.2	1.6	626
Native American	84.0	82.9	2.5	50
Asian	97.3	98.1	1.5	182
Age of Driver				
16–24	90.5	89.9	1.2	912
25–44	90.6	90.0	0.7	4,584
45-64	92.0	92.7	0.4	3,445
65+	91.4	90.7	1.3	1,253
Cell Use				
Talk	4.2	4.2	0.4	434
Text	4.6	5.1	0.6	460

Several trends from past surveys are present in the June 2017 120-site survey results. These include:

- higher combined seat belt use rates among drivers and passengers of minivans (95.8%), sport utility vehicles (93.3%), and cars (92.8%), but generally lower use rates for drivers and passengers of pickup trucks (86.4%) and vans (86.3%);
- higher combined seat belt use rates for women (93.8%) than for men (88.7%); and
- lower seat belt use rate for drivers under 25 (89.9%).

The following tables further describe seat belt use trends across North Carolina. Table 1-2 shows driver (D), right front seat passenger (RF), and driver and right front seat passenger combined (D+RF) belt-use rates by county for this survey year. The observed combined (D+RF) seat belt use rates in June exceed 90% in 11 of the 15 counties surveyed in the study. The county with the lowest combined seat belt use rate was Columbus (85.2%) county. Seat belt use rates were also lower than 90% in Robeson (87.3%), Durham (88.7%), and Pender (89.5%) counties.

Table 1-2. North Carolina Seat Belt Use Rates by County, Weighted: 120-Site June 2017 Survey, 15 Counties Total

County	Driver (D)	Passenger (RF)	Combined (D+RF)	Sample Size
Alamance	93.8	94.2	93.9	2,196
Buncombe	92.2	92.2	92.2	2,777
Catawba	92.5	93.1	92.6	2,788
Cleveland	91.3	89.9	91.0	2,491
Columbus	86.2	81.6	85.2	1,570
Durham	89.4	85.9	88.7	1,813
Forsyth	95.2	96.6	95.5	1,270
Guilford	91.8	94.8	92.4	1,371
Mecklenburg	92.6	95.1	93.0	2,969
Nash	88.8	94.9	90.0	1,583
Pender	91.1	82.4	89.5	2,464
Robeson	88.8	84.4	87.3	1,322
Sampson	91.7	92.3	91.8	1,690
Wake	91.3	92.1	91.4	3,058
Wilkes	93.7	84.5	91.8	2,791

Table 1-3 provides weighted D, RF, and D+RF seat belt use estimates for each year since 2010. Seat belt use rates increased over the 8-year period for all groups. Seat belt use for drivers increased from 90.4% in 2010 to 91.6% in 2017. Seat belt use for right front seat passengers increased from 86.7% in 2010 to 91.0% in 2017, and the combined rate increased from 89.7% in 2010 to 91.4% in 2017. For the first time in 2016, there was an observed seat belt use of over 90% for both drivers and right front seat passengers resulting in a combined statewide seat belt use rate of 91.7% for the 120-site sample and 91.4% for the 200 total sites included in the study. The rate for the 200-site sample is the same combined statewide seat belt use rate observed for 2017.

Table 1-4 provides longitudinal data on observed seat belt use overall (D+RF) in North Carolina compared to the United States as a whole for the period 2002-2017. This table shows the upward trend of the combined seat belt use rate in North Carolina from 84% in 2002 to over 91% in 2017. This table also shows that the seat belt use rate in North Carolina has been consistently between five and ten percentage points higher than the national rate, with the national rate increasing from 75% in 2002 to 90% in 2016.

Table 1-5 presents longitudinal data on observed seat belt use overall (D+RF) and driver seat belt use by region, vehicle type, and sex, age, and race/ethnicity of drivers. A general consistency of several trends can be seen across the surveys from 2010 through June 2017. It appears that overall seat belt use has plateaued over the past several years. The small variation in estimates can likely be attributed to the natural variance that occurs when selecting a sample.

Table 1-3. Observed Seat Belt Use in North Carolina (%) for June, Weighted

Survey Periods	Driver (D)	Passenger (RF)	Combined (D+RF)
2010[a]	90.4	86.7	89.7
2011[b]	90.8	84.8	89.5
2012[b]	88.0	85.7	87.5
2013[b]	89.6	84.9	88.6
2014[b]	90.9	89.7	90.6
2015[b]	89.8	90.3	89.9
2016[b]	92.1	90.4	91.7
2017[b]	91.6	91.0	91.4

[a] This survey was conducted at 121 sites.

[b] This survey was conducted at 120 sites.

Table 1-4. Seat Belt Use Trends in North Carolina (%), Weighted, Compared to United States Overall

	June															
Overall (D+RF) Use Rates	2002[1]	2003[1]	2004[1]	2005[1]	2006[1]	2007[1]	2008[1]	2009[1]	2010[1]	2011[2]	2012[2]	2013[2]	2014[2]	2015[2]	2016[2]	2017[2]
North Carolina	84.1	86.1	86.1	86.7	88.5	88.8	89.8	89.5	89.7	89.5	87.5	88.6	90.6	89.9	91.7	91.4
United States*	75	79	80	82	81	82	83	84	85	84	86	87	87	89	90	**

[1] This survey was conducted at 121 sites for North Carolina.

[2] This survey was conducted at 120 sites for North Carolina.

* Nationwide rates provided by NHTSA's National Occupant Protection Use Survey (NOPUS).

** Data not yet available.

Note: Rounded estimates are available for North Carolina for the years 1998 (77%), 1999 (78%), 2000 (81%), and 2001 (83%). Comparable national data are also available for 1998 (69%), 1999 (67%), 2000 (71%), and 2001 (73%).

Table 1-5. Seat Belt Use Trends in North Carolina (%), Weighted

	June							
	2010[1]	2011[2]	2012[2]	2013[2]	2014[2]	2015[2]	2016[2]	2017[2]
Overall (D+RF) Use Rates	89.7	89.5	87.5	88.6	90.6	89.9	91.7	91.4
	Driver Use Rates							
Region								
Mountain	89.5	91.6	90.3	90.3	93.1	90.0	93.4	92.4
Piedmont	91.1	91.5	87.4	88.2	89.8	91.9	92.2	91.9
Coast	88.8	87.1	84.6	87.5	90.0	88.0	90.5	89.5
Vehicle Type								
Car	91.4	92.2	90.6	90.3	91.6	90.2	92.3	92.9
Van	79.9	80.9	77.3	83.8	86.8	85.7	90.3	86.4
Minivan	94.5	94.4	92.7	93.9	94.4	94.7	95.9	96.4
Pickup Truck	84.1	86.1	82.0	84.5	86.7	86.3	88.8	86.6
Sport-Utility Vehicle	91.6	91.8	91.0	92.8	94.1	92.0	93.8	93.5
Sex of Driver								
Male	87.8	89.5	85.5	87.9	89.2	87.8	91.1	88.8
Female	93.5	93.2	92.3	92.4	93.1	93.0	95.1	94.1
Age of Driver								
16-24	86.6	88.0	89.4	85.5	89.1	80.9	88.1	89.9
25-64	90.1	90.9	88.3	90.2	90.6	90.8	93.1	91.2
65+	96.8	93.6	88.2	95.2	95.2	89.7	93.7	90.7
Race /Ethnicity								
White	90.3	91.3	89.2	91.0	91.8	90.3	93.1	91.4
Black	89.6	89.1	85.8	85.7	88.0	89.2	91.7	89.5
Hispanic	95.4	93.5	89.6	86.5	91.2	90.4	93.6	91.2

[1] This survey was conducted at 121 sites.

[2] This survey was conducted at 120 sites.

Discussion and Conclusions

The June 2017 Seat Belt Use Study provides updated estimates of statewide seatbelt use for drivers and front right seat passengers in North Carolina. The study also provides seat belt use rates for the counties included in the sample, for subgroups defined by driver and passenger characteristics, and by vehicle type. Tables and trends in this report are based on weighted seat belt use rates. The weighted rates are the best estimators of seat belt use for the entire state and for the reported subgroups. Additional summary tables are provided in Appendix A with further results for subgroups of interest.

In addition to gathering data on seat belt use, the 2017 Seat Belt Use Survey continued to assess statewide use of cell phones while driving. The 2016 Seat Belt Use Survey was the fourth statewide survey in North Carolina to assess the use of cell phones to talk and text while driving. The weighted rate of talking on a cell phone while driving decreased from 2016 to 2017, while the weighted rate of texting on a cell phone increased from 2016 to 2017 for the 120-site NHTSA samples; the rate of talking on a cell phone while driving decreased from 6.1% in 2016 to 4.2% in 2017, and the rate of texting in North Carolina increased from 3.2% in 2016 to 5.1% in 2017.

It should be noted that it is difficult to accurately assess cell phone use while driving since a driver can use a cell phone at different times during a trip. Recent data suggests that cell phone use rates for talking while driving are higher than those observed in this study (3.8% for 2015), while cell phone use rates for texting while driving are lower than those observed in this study (2.2% for 2015).[2]

[2] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/driver_electronic_device_use_in_2015_0.pdf

APPENDIX A: DETAILED TABLES FROM THE 2017 NC SEAT BELT SURVEY 120-SITE RESULTS

Table A-1. 2017 Seat Belt Use by Time Period, Weighted

Time Period	Percent Seat Belt Use (Standard Error)		
	Driver (D)	Passenger (RF)	Combined (D + RF)
Weekday Rush	91.7 (0.6)	90.5 (1.2)	91.5 (0.6)
Weekday Non-Rush	90.7 (0.5)	90.4 (2.0)	90.7 (0.6)
Weekend	92.2 (0.5)	91.9 (1.7)	92.1 (0.8)

Table A-2. 2017 Driver Seat Belt Use for Race by Sex, Weighted

Race	Percent Seat Belt Use (Standard Error)	
	Male	Female
White	88.7 (0.9)	95.0 (0.6)
Black	87.8 (1.3)	91.4 (1.2)

Table A-3. 2017 Driver Seat Belt Use for Vehicle Type by Sex, Weighted

Vehicle Type	Percent Seat Belt Use (Standard Error)	
	Male	Female
Car	92.7 (0.7)	93.7 (0.8)
Minivan	96.7 (2.2)	97.1 (1.5)
Pickup Truck	84.0 (1.5)	86.7 (4.0)
Sport-Utility Vehicle	90.9 (1.0)	95.3 (0.7)

Table A-4. 2017 Driver Seat Belt Use for Vehicle Type by Area Type, Weighted

	Percent Seat Belt Use (Standard Error)	
Vehicle Type	Urban	Rural
Car	93.1 (0.4)	92.1 (0.8)
Minivan	96.6 (0.6)	95.8 (1.9)
Pickup Truck	86.8 (0.7)	86.2 (2.0)
Sport-Utility Vehicle	94.2 (0.6)	91.2 (1.0)

Table A-5 2017 Driver Seat Belt Use for Vehicle Type by Region, Weighted

	Percent Seat Belt Use (Standard Error)		
Vehicle Type	Mountain	Piedmont	Coast
Car	93.4 (0.5)	93.1 (0.6)	91.6 (0.9)
Minivan	94.7 (1.3)	97.1 (1.0)	98.3 (1.3)
Pickup Truck	88.6 (1.1)	87.1 (0.8)	83.1 (2.9)
Sport-Utility Vehicle	94.1 (0.7)	94.6 (0.7)	90.2 (1.6)

Table A-6. 2017 Driver Cell Use by Driver Age, Weighted

		Percent Seat Belt Use (Standard Error)	
Age of Driver	Number of Observations	Talk	Text
16-24	899	3.4 (0.9)	13.7 (2.0)
25-44	4,554	5.3 (0.6)	5.5 (0.7)
45-64	3,411	3.3 (0.4)	3.6 (0.8)
65+	1,252	1.8 (0.6)	1.5 (0.6)

APPENDIX B: 120-SITE APPROVAL LETTER FROM NHTSA

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

Region III
Delaware, District of Columbia,
Kentucky, Maryland,
North Carolina,
Virginia, West Virginia

10 S. Howard Street,
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Phone (410) 962-0090
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May 5, 2017

Don Nail, Director
Governor's Highway Safety Program
215 East Lane Street
Raleigh, NC 27601

Dear Mr. Nail:

NHTSA has completed its review of your Uniform Criteria for State Observational Surveys of Seat Belt Use Certification Form and supporting documentation, evaluating the four requirements related to the re-selection of observation sites listed in 1340.10 of the Final Rule. We are pleased to inform you that your re-selection is fully compliant with the Uniform Criteria for State Observational Surveys of Seat Belt Use.

Sincerely,

Elizabeth A. Baker, Ph.D.
Regional Administrator

cc: Daniel J. Findley, Ph.D., PE, NC State University

NHTSA
www.nhtsa.gov

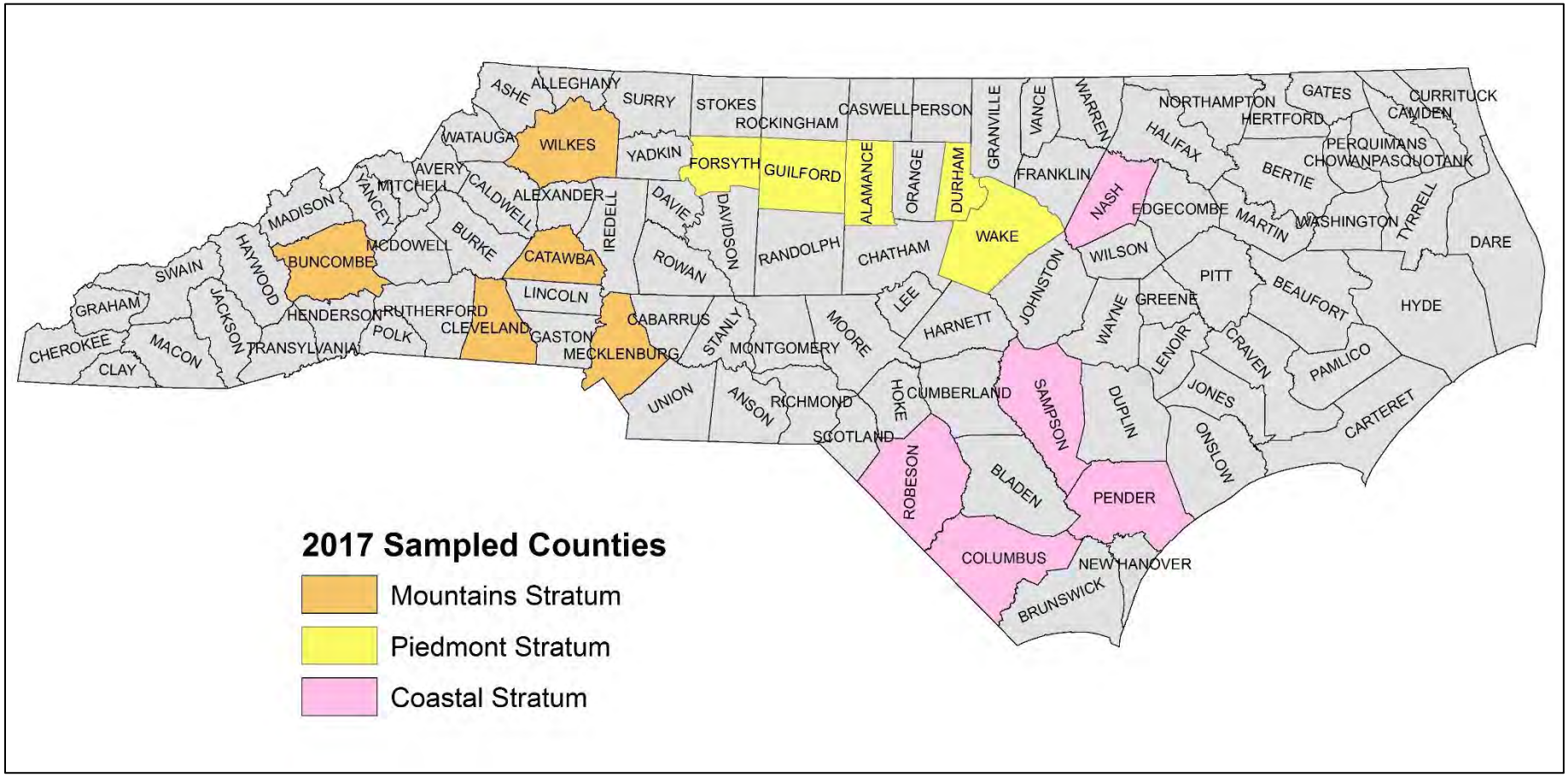
APPENDIX C: 2017 NC COUNTY SAMPLING FRAME

FARS (2012-2014)					
Counties that comprise the top 85% of North Carolina's total average fatalities for the 3-year period are included in the sampling frame per Criterion 1340.5.a.1					
State=North Carolina					
County	Average fatality counts for 3 years	Fatality percentage within the state	Cumulative fatality percentage	Region (1=Mountains; 2=Piedmont; 3=Coastal)	Probability of Selection
MECKLENBURG	70	5.4	5.4	1	1.0000
WAKE	69	5.3	10.6	2	0.6979
CUMBERLAND	51.3	3.9	14.6	2	0.5192
GUILFORD	48.7	3.7	18.3	2	0.4922
ROBESON	41.7	3.2	21.5	3	0.6404
FORSYTH	32	2.5	23.9	2	0.3237
JOHNSTON	31.7	2.4	26.4	3	0.4867
BUNCOMBE	29.7	2.3	28.6	1	0.5298
DAVIDSON	29	2.2	30.9	2	0.2933
ROWAN	27.3	2.1	33	1	0.4881
GASTON	25	1.9	34.9	1	0.4464
DURHAM	24.3	1.9	36.7	2	0.2461
HARNETT	23.7	1.8	38.5	2	0.2394
ONSLOW	23.7	1.8	40.4	3	0.3637
WAYNE	23	1.8	42.1	2	0.2326
IREDELL	22.7	1.7	43.9	1	0.4048
NASH	22.3	1.7	45.6	3	0.3432
CATAWBA	21.7	1.7	47.2	1	0.3869
RANDOLPH	21.3	1.6	48.9	2	0.2158
UNION	21.3	1.6	50.5	2	0.2158
NEW HANOVER	21	1.6	52.1	3	0.3227
COLUMBUS	20.7	1.6	53.7	3	0.3176
PITT	19.3	1.5	55.2	3	0.2971
BRUNSWICK	18	1.4	56.5	3	0.2766
CABARRUS	16	1.2	57.8	1	0.2857
SURRY	16	1.2	59	2	0.1618
ALAMANCE	15	1.1	60.1	2	0.1517
PENDER	14.7	1.1	61.3	3	0.2254
ROCKINGHAM	14.3	1.1	62.4	2	0.1450
DUPLIN	13.7	1	63.4	3	0.2100
CRAVEN	13.3	1	64.4	3	0.2049
GRANVILLE	13.3	1	65.5	2	0.1349
MOORE	13.3	1	66.5	2	0.1349

County	Average fatality counts for 3 years	Fatality percentage within the state	Cumulative fatality percentage	Region (1=Mountains; 2=Piedmont; 3=Coastal)	Probability of Selection
SAMPSON	13	1	67.5	3	0.1998
ORANGE	12.7	1	68.4	2	0.1281
CLEVELAND	12.3	0.9	69.4	1	0.2202
BEAUFORT	11.7	0.9	70.3	3	0.1793
HALIFAX	11.7	0.9	71.2	3	0.1793
WILSON	11.7	0.9	72.1	3	0.1793
HOKE	11.3	0.9	72.9	2	0.1146
BLADEN	11	0.8	73.8	3	0.1691
HENDERSON	11	0.8	74.6	1	0.1964
RUTHERFORD	11	0.8	75.5	1	0.1964
BURKE	10.7	0.8	76.3	1	0.1905
WILKES	10.7	0.8	77.1	1	0.1905
RICHMOND	10.3	0.8	77.9	2	0.1045
CHATHAM	10	0.8	78.7	2	0.1011
VANCE	10	0.8	79.4	2	0.1011
LENOIR	9.7	0.7	80.2	3	0.1486
LINCOLN	9.3	0.7	80.9	1	0.1667
EDGECOMBE	8.7	0.7	81.5	3	0.1332
LEE	8.7	0.7	82.2	2	0.0877
MCDOWELL	8.7	0.7	82.9	1	0.1548
CALDWELL	8	0.6	83.5	1	0.1429
NORTHAMPTON	8	0.6	84.1	3	0.1230
STOKES	8	0.6	84.7	2	0.0809
ANSON	7.7	0.6	85.3	2	0.0775
CARTERET	7.7	0.6	85.9	(Not included in sampling frame based on FARS 85% fatality exclusion)	
STANLY	7.7	0.6	86.5		
SCOTLAND	7.3	0.6	87		
ALEXANDER	7	0.5	87.6		
BERTIE	7	0.5	88.1		
FRANKLIN	7	0.5	88.6		
JACKSON	7	0.5	89.2		
MACON	6.7	0.5	89.7		
PERSON	6.7	0.5	90.2		
YADKIN	6.7	0.5	90.7		
MONTGOMERY	6.3	0.5	91.2		
WARREN	6	0.5	91.7		
CHEROKEE	5.7	0.4	92.1		
POLK	5.7	0.4	92.5		
TRANSYLVANIA	5.3	0.4	92.9		

County	Average fatality counts for 3 years	Fatality percentage within the state	Cumulative fatality percentage	
DAVIE	5	0.4	93.3	
HAYWOOD	5	0.4	93.7	
MARTIN	5	0.4	94.1	
PERQUIMANS	5	0.4	94.5	
DARE	4.3	0.3	94.8	
WATAUGA	4.3	0.3	95.1	
YANCEY	4.3	0.3	95.5	
GATES	4	0.3	95.8	
WASHINGTON	4	0.3	96.1	
ASHE	3.7	0.3	96.3	
CURRITUCK	3.7	0.3	96.6	
GREENE	3.7	0.3	96.9	
MADISON	3.3	0.3	97.2	(Not included in sampling frame based on FARS 85% fatality exclusion)
ALLEGHANY	3	0.2	97.4	
AVERY	3	0.2	97.6	
CASWELL	3	0.2	97.9	
GRAHAM	3	0.2	98.1	
MITCHELL	3	0.2	98.3	
PASQUOTANK	3	0.2	98.5	
SWAIN	3	0.2	98.8	
CAMDEN	2.7	0.2	99	
HERTFORD	2.3	0.2	99.2	
PAMLICO	2.3	0.2	99.3	
CHOWAN	2	0.2	99.5	
JONES	2	0.2	99.6	
TYRRELL	2	0.2	99.8	
CLAY	1.7	0.1	99.9	
HYDE	1	0.1	100	

APPENDIX D: 2017 NC SAMPLED COUNTIES MAP



APPENDIX E: 2017 OBSERVATION SITES AND WEIGHTS

County Name	Site Number	Segment Stratification	Combined Probability of Selection	Combined Weight	Final Post-Stratified Weight
ALAMANCE	00-1	Urban - Interstate	0.00552	181.21016	1.15006
ALAMANCE	00-2	Urban - Interstate	0.00470	212.87796	1.35104
ALAMANCE	00-3	Urban - Interstate	0.00447	223.73908	1.41997
ALAMANCE	00-4	Urban - Principal Arterial - Other	0.00043	2318.71909	14.71585
ALAMANCE	00-5	Urban - Minor Arterial	0.00019	5197.12899	62.81257
ALAMANCE	00-6	Urban - Minor Arterial	0.00032	3172.98402	38.34872
ALAMANCE	00-7	Urban - Major Collector	0.00020	4902.57437	24.26168
ALAMANCE	00-8	Urban - Major Collector	0.00051	1961.02975	9.70467
BUNCOMBE	10-1	Urban - Interstate	0.00308	324.93452	24.94877
BUNCOMBE	10-2	Urban - Interstate	0.00382	261.75281	20.09762
BUNCOMBE	10-3	Urban - Interstate	0.00265	376.92404	28.94058
BUNCOMBE	10-4	Urban - Interstate	0.00329	303.97100	23.33918
BUNCOMBE	10-5	Urban - Minor Arterial	0.00073	1377.99064	29.70851
BUNCOMBE	10-6	Urban - Minor Arterial	0.00157	635.99568	13.71162
BUNCOMBE	10-7	Urban - Minor Arterial	0.00109	918.66042	19.80567
BUNCOMBE	10-8	Urban - Local	0.00000	1683120.26966	27.17308
CATAWBA	17-1	Urban - Principal Arterial - Other Freeways and Expressways	0.00288	347.01692	1.97996
CATAWBA	17-2	Urban - Principal Arterial - Other Freeways and Expressways	0.00281	355.91479	2.03073
CATAWBA	17-3	Rural - Principal Arterial - Other	0.00208	481.72531	69.54839
CATAWBA	17-4	Urban - Principal Arterial - Other	0.00116	859.43388	4.90363
CATAWBA	17-5	Urban - Principal Arterial - Other	0.00031	3197.89352	18.24606
CATAWBA	17-6	Urban - Principal Arterial - Other	0.00033	2989.33525	17.05610
CATAWBA	17-7	Urban - Principal Arterial - Other	0.00167	597.86705	3.41122
CATAWBA	17-8	Urban - Local	0.00047	2108.42585	15.85096
CLEVELAND	22-1	Rural - Interstate	0.00339	294.57630	5.44700
CLEVELAND	22-2	Urban - Principal Arterial - Other Freeways and Expressways	0.00270	370.59599	6.85268
CLEVELAND	22-3	Rural - Minor Arterial	0.00083	1203.45366	41.94065
CLEVELAND	22-4	Rural - Major Collector	0.00114	877.64108	22.64423
CLEVELAND	22-5	Urban - Principal Arterial - Other	0.00282	354.03764	6.54650
CLEVELAND	22-6	Urban - Principal Arterial - Other	0.00240	417.25865	7.71552
CLEVELAND	22-7	Urban - Principal Arterial - Other	0.00214	467.32969	8.64138
CLEVELAND	22-8	Urban - Minor Arterial	0.00103	973.60351	33.93032

County Name	Site Number	Segment Stratification	Combined Probability of Selection	Combined Weight	Final Post-Stratified Weight
COLUMBUS	23-1	Rural - Principal Arterial - Other Freeways and Expressways	0.00446	224.35631	1.50688
COLUMBUS	23-2	Rural - Principal Arterial - Other Freeways and Expressways	0.00382	261.74903	1.75803
COLUMBUS	23-3	Rural - Principal Arterial - Other	0.00113	881.12293	64.61031
COLUMBUS	23-4	Rural - Minor Arterial	0.00307	326.01548	23.90582
COLUMBUS	23-5	Rural - Major Collector	0.00096	1036.76930	7.53167
COLUMBUS	23-6	Rural - Major Collector	0.00057	1768.60645	12.84814
COLUMBUS	23-7	Urban - Principal Arterial - Other	0.00442	226.06403	1.51835
COLUMBUS	23-8	Urban - Principal Arterial - Other	0.00470	212.76615	1.42904
DURHAM	31-1	Urban - Interstate	0.00256	390.15687	2.15384
DURHAM	31-2	Urban - Interstate	0.00159	627.41442	3.46360
DURHAM	31-3	Urban - Principal Arterial - Other Freeways and Expressways	0.00138	725.44792	4.00479
DURHAM	31-4	Urban - Interstate	0.00256	390.15687	2.15384
DURHAM	31-5	Urban - Minor Arterial	0.00012	8636.45478	32.72865
DURHAM	31-6	Urban - Principal Arterial - Other	0.00050	1993.02803	11.00239
DURHAM	31-7	Urban - Minor Arterial	0.00021	4710.79352	17.85199
DURHAM	31-8	Urban - Local	0.00020	5061.17666	56.61058
FORSYTH	33-1	Urban - Principal Arterial - Other Freeways and Expressways	0.00180	556.52536	3.48212
FORSYTH	33-2	Urban - Principal Arterial - Other Freeways and Expressways	0.00051	1973.13536	12.34569
FORSYTH	33-3	Urban - Principal Arterial - Other Freeways and Expressways	0.00134	748.43065	4.68285
FORSYTH	33-4	Urban - Interstate	0.00237	421.44639	2.63694
FORSYTH	33-5	Urban - Minor Arterial	0.00106	946.19652	47.41935
FORSYTH	33-6	Urban - Principal Arterial - Other	0.00092	1086.37379	6.79732
FORSYTH	33-7	Urban - Principal Arterial - Other	0.00055	1833.25576	11.47047
FORSYTH	33-8	Urban - Major Collector	0.00017	5755.87639	117.75000
GUILFORD	40-1	Rural - Principal Arterial - Other Freeways and Expressways	0.00085	1171.37701	25.67642
GUILFORD	40-2	Urban - Interstate	0.00262	381.97076	8.37275
GUILFORD	40-3	Urban - Interstate	0.00117	857.10513	18.78762
GUILFORD	40-4	Urban - Interstate	0.00125	798.66614	17.50665
GUILFORD	40-5	Urban - Principal Arterial - Other	0.00109	914.36234	20.04269
GUILFORD	40-6	Urban - Minor Arterial	0.00041	2457.34878	91.67742
GUILFORD	40-7	Urban - Principal Arterial - Other	0.00074	1355.77863	29.71848
GUILFORD	40-8	Urban - Local	0.00000	1608855.91233	67.93269

County Name	Site Number	Segment Stratification	Combined Probability of Selection	Combined Weight	Final Post-Stratified Weight
MECKLENBURG	59-1	Urban - Interstate	0.00180	555.62946	18.20865
MECKLENBURG	59-2	Urban - Interstate	0.00508	196.93196	6.45370
MECKLENBURG	59-3	Urban - Interstate	0.00215	464.40672	15.21917
MECKLENBURG	59-4	Urban - Interstate	0.00476	210.23818	6.88976
MECKLENBURG	59-5	Urban - Minor Arterial	0.00066	1515.95072	7.11290
MECKLENBURG	59-6	Urban - Minor Arterial	0.00026	3874.09630	18.17742
MECKLENBURG	59-7	Urban - Principal Arterial - Other	0.00040	2490.49048	81.61640
MECKLENBURG	59-8	Urban - Local	0.00000	2174220.00000	276.25962
NASH	63-1	Urban - Principal Arterial - Other Freeways and Expressways	0.00353	283.62808	0.84870
NASH	63-2	Urban - Principal Arterial - Other Freeways and Expressways	0.00313	319.08159	0.95479
NASH	63-3	Rural - Interstate	0.00343	291.73174	0.87295
NASH	63-4	Rural - Minor Collector	0.00010	9718.77336	52.08173
NASH	63-5	Urban - Principal Arterial - Other	0.00367	272.58742	0.81567
NASH	63-6	Urban - Principal Arterial - Other	0.00237	421.27146	1.26058
NASH	63-7	Urban - Minor Arterial	0.00057	1748.67400	113.80645
NASH	63-8	Urban - Principal Arterial - Other	0.00205	487.78801	1.45961
PENDER	70-1	Rural - Interstate	0.00610	163.88449	3.60122
PENDER	70-2	Rural - Minor Arterial	0.00137	727.95508	31.84804
PENDER	70-3	Rural - Minor Arterial	0.00107	933.98010	40.86164
PENDER	70-4	Rural - Major Collector	0.00085	1170.65239	6.44647
PENDER	70-5	Rural - Major Collector	0.00211	474.18831	2.61123
PENDER	70-6	Urban - Principal Arterial - Other	0.00767	130.31181	2.86349
PENDER	70-7	Urban - Principal Arterial - Other	0.00582	171.77466	3.77460
PENDER	70-8	Urban - Principal Arterial - Other	0.01006	99.44848	2.18530
ROBESON	77-1	Rural - Interstate	0.00828	120.73304	2.79517
ROBESON	77-2	Rural - Interstate	0.00195	511.80308	11.84910
ROBESON	77-3	Rural - Interstate	0.00701	142.68450	3.30338
ROBESON	77-4	Rural - Minor Arterial	0.00146	683.16486	170.70968
ROBESON	77-5	Rural - Major Collector	0.00079	1269.30752	0.21407
ROBESON	77-6	Urban - Principal Arterial - Other	0.00479	208.65926	4.83081
ROBESON	77-7	Urban - Local	0.00000	642731.13600	108.39968
ROBESON	77-8	Urban - Major Collector	0.00215	465.77597	0.07856

County Name	Site Number	Segment Stratification	Combined Probability of Selection	Combined Weight	Final Post-Stratified Weight
SAMPSON	81-1	Rural - Interstate	0.00519	192.62383	0.95285
SAMPSON	81-2	Rural - Interstate	0.00489	204.66282	1.01240
SAMPSON	81-3	Rural - Principal Arterial - Other	0.00306	327.08513	28.68578
SAMPSON	81-4	Rural - Minor Arterial	0.00107	934.52894	81.95938
SAMPSON	81-5	Rural - Major Collector	0.00039	2585.36047	14.71875
SAMPSON	81-6	Rural - Minor Collector	0.00039	2585.36047	14.71875
SAMPSON	81-7	Urban - Principal Arterial - Other	0.00203	491.68935	2.43223
SAMPSON	81-8	Urban - Principal Arterial - Other	0.00273	366.87590	1.81482
WAKE	91-1	Urban - Interstate	0.00116	859.77438	20.96041
WAKE	91-2	Urban - Interstate	0.00191	524.91488	12.79688
WAKE	91-3	Urban - Interstate	0.00203	493.73182	12.03667
WAKE	91-4	Urban - Minor Arterial	0.00101	986.06142	25.52317
WAKE	91-5	Urban - Minor Arterial	0.00038	2629.49711	68.06177
WAKE	91-6	Urban - Principal Arterial - Other	0.00070	1434.27115	34.96604
WAKE	91-7	Urban - Minor Arterial	0.00040	2491.10253	64.47958
WAKE	91-8	Urban - Local	0.00001	66873.65582	95.10577
WILKES	96-1	Urban - Principal Arterial - Other Freeways and Expressways	0.00200	499.73438	17.06845
WILKES	96-2	Rural - Minor Arterial	0.00036	2753.35500	22.01852
WILKES	96-3	Rural - Major Collector	0.00117	852.40575	0.00354
WILKES	96-4	Urban - Minor Arterial	0.00215	464.70278	3.71622
WILKES	96-5	Urban - Principal Arterial - Other	0.00347	288.43621	9.85155
WILKES	96-6	Urban - Minor Arterial	0.00088	1130.35811	9.03945
WILKES	96-7	Urban - Local	0.00000	2181627.00000	9.04996
WILKES	96-8	Urban - Minor Collector	0.00099	1011.80625	0.00420

APPENDIX F: SURVEY METHODOLOGY

Sampling and Weighting

Survey Design Overview

In 2017, ITRE reselected the 120-site sample to be used for the next five years for North Carolina's Observational Survey of Seat Belt Use. The new sites were selected following the survey design that was created by RTI International and approved by NHTSA in April 2012. The survey design consists of a two-stage stratified cluster design. Counties are the primary sampling units (PSUs) and road segments are the secondary sampling units (SSUs). The state was stratified into commonly used geographic regions, with an equal number of counties selected for each region. Within counties, road segments were stratified based on road type; road types were grouped according to similar fatalities and characteristics. An equal number of road segments were sampled from each county.

Sampling Procedure

Counties (PSUs) were stratified by region. Fifteen counties were sampled in total. Five counties were selected from the mountains region (Region 1), five counties were selected from the piedmont region (Region 2), and five counties were selected from the coastal region (Region 3). The new county sample is in response to a new FARS exclusion-based list of target population counties. The counties that comprised the top 85% of North Carolina's total average fatalities based on three years of FARS data comprised the sampling frame. All counties were selected with probability proportional to the total number of fatalities in 2012, 2013, and 2014 except for Mecklenburg County in the mountain region. This county was selected with certainty due to its large number of fatalities.

Road segments (SSUs) from the selected counties were stratified into five strata by road type based on the FARS data to ensure that road types with similar fatalities and characteristics were combined. These strata are summarized in Table A-7.

Table A-7. Stratification of Road Segments by Road Type

Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5
• Rural-Principal Arterial-Interstate	• Rural-Principal Arterial-Other	• Rural-Major Collector	• Urban-Principal Arterial-Other	• Urban-Collector
• Urban-Principal Arterial-Interstate	• Rural-Minor Arterial	• Rural-Minor Collector	• Urban-Minor Arterial	• Urban-Local Road or Street
• Freeways or Expressways		• Rural-Local Road or Street		

120 road segments were sampled in total. 115 road segments were selected from the most recent NCDOT GIS roadway inventory dataset with probability proportional to the Average Annual Daily Traffic (AADT) on the road segment. While the 115 road segments contained some local roads, five of the fifteen sampled counties were randomly selected to contain additional local roads sites. To achieve a representative sample of local roads in the overall road segment sample, one road segment within each of the five randomly selected counties was reserved for observation on local roads. The US Census TIGER roadway inventory dataset was used to supplement the local road segments. Fifty segments were randomly selected for each of the five counties using simple random sampling. These segments were matched against the NCDOT GIS data, and the first segment in a county that was not in the NCDOT GIS roadway inventory dataset was considered to be the selected local road segment.

The three exclusions allowed by the Uniform Criteria for State Observational Surveys of Seat Belt Use Final Rule were implemented. These exclusions are: 1) the optional FARS 85% fatality exclusion, 2) the optional rural local roads exclusion, and 3) the optional road types exclusions.

Approved Survey Design Non-Compliance with Final Rule

During the 2017 observation site reselection process, a question arose concerning the use of county-level 3-year FARS <u>total</u> fatality counts to define the FARS 85% fatality exclusion in North Carolina's initial submission. The use of FARS total fatality counts is not compliant with the Final Rule, which requires that FARS <u>average</u> fatality counts be used to define the FARS 85% fatality exclusion.

ITRE resolved this issue by submitting an erratum to the approved survey design to clarify that FARS average fatality counts for three years of data (2012, 2013, and

2014) were used when applying the optional FARS 85% fatality exclusion to establish their county sampling frame for the 2017 reselection of observation sites in compliance with the Uniform Criteria.

Weighting

Following the approved survey design, design weights were calculated as the inverse of the selection probability for each stage of sampling. The first stage weight represents the inverse of the first stage selection probability assigned to a sampled county. County selection probabilities are proportional to the total number of FARS fatalities in 2012, 2013, and 2014 for all counties except the certainty county, Mecklenburg. The second state weight represents the inverse of the second stage probability assigned to a sample roadway segment. Road segment selection probabilities are proportional to the AADT on the road segment. The final design weight for an observation site was obtained by multiplying the first stage county weight by the second stage road segment weight.

Final design weights were then post-stratified up to the total number of persons involved in FARS crashes for the most recent year of data (2015). This allows the final seat belt use rate to be a person-level exposure rate. The method used for the post-stratification adjustment is a ratio adjustment of the final design weight using factors that are defined by county and road type combination and calculated for each site. Road type is based on a collapsing of the five road type sampling strata into three analysis strata. The general post-stratification method involves:

1. Creating a table of the sum of the final design weights for each cell defined by county and road type analysis stratum.

2. Creating a table of state-level population controls using the total number of persons involved in FARS crashes where the sum of persons for each cell is defined by county and road type analysis stratum.

3. Computing the ratio of population totals divided by the sum of weights for each corresponding pair of cells.

4. Multiplying each final design weight by the appropriate cell ratio to perform the post-stratification adjustment.

Data Collection

Beginning in 2017, data collection is conducted by three teams of three field observers who are trained to collect data through direct observation. Each team of observers is assigned one region of the state for data collection. The observers collect data at the approved observation sites on the sampled road segments according to procedures included in the approved survey design. Observations are collected using standardized paper forms. Observers attempt to collect data for each qualifying passing vehicle that is stopped or nearly stopped from which reliable observations of seat belt use can be made. Observations are made over a 60 minute period during one of three data collection periods assigned to each observation site:

1. Weekday Rush: M-F from 7am to 9am or M-F from 3:30pm to 6pm
2. Weekday Non-Rush: M-F from 9am to 3:30pm
3. Weekend: Saturday or Sunday from 7am to 6pm

The first 30 minutes of data collection includes collection of driver and passenger demographic information in addition to vehicle type and seat belt use. For the last 30 minutes of data collection, only vehicle type and seat belt use information are collected. Field observers record data on all qualifying vehicles.

Field observers work in pairs under the guidance of a team lead to collect data at each observation site. Observers never work at a site alone. Team leads assist with data collection when needed.

Field observers attempt to record information as completely as possible. At the end of each data collection day, the team leads email the estimated number of observations collected at their sites to project lead staff.

Training

For 2017, training was held at the Institute for Transportation Research and Education (ITRE) in late April before the official data collection period commenced in June. Field observers were trained using a combination of classroom instruction and field work, including practice data collection at a nearby intersection. Classroom instruction included a review of observation procedures and best practices for rescheduling observations if a primary data collection location was unavailable.

Field observers were also given a brochure with a summary of the observation procedures and contact information for the project leads. Following training, each field observer is required to collect at least two hours of practice observations at an intersection near ITRE offices.

Field Work and Scheduling

A data collection schedule was created by project lead staff with input from the field observers. Each field observer was assigned to a team responsible for data collection in one region of the state. Field observers typically visited 2-3 sites per day during the official data collection period.

Each field observer was given a clipboard, standardized data collection forms, and a safety vest. Field observers were required to wear safety vests while collecting data at an observation site. Team leads carried official project documentation, including a copy of the study's Institutional Review Board (IRB) approval letter, in case they were questioned by law enforcement or others.

Throughout the official data collection period, each team lead remained in communication with project lead staff to ensure all data collection is completed on schedule and to resolve any issues that may arise in the field.

Quality Control

In compliance with the Uniform Criteria, lead project staff visit 5% of observation sites (6 total) to perform quality control (QC). Lead project staff monitor the field observer team, complete a site QC form, and take notes on any problems or concerns. Each team is visited twice during the official data collection period.

Statistical Tasks and Analysis

SAS 9.4 software is used to perform statistical tasks and analysis of the seat belt use data. A SAS program was written employing the required survey procedures to account for the complex survey design in the calculation of point estimates and variances. Data is converted into an observation-level SAS data set and input into the statistical program. Frequencies and additional outputs are reviewed for consistency and reasonableness. SAS program logs are reviewed for errors and must be free of any error messages before they are considered final.

The SAS program generates multiple tables that are output into text documents before being converted into final presentation-ready deliverables.