OIL COUNTY TRAFFIC SAFETY SURVEY, 2012

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Prepared for:

Traffic Safety Office, Safety Division
North Dakota Department of Transportation

September 2012

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

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1. INTRODUCTION

Over time, road usage in western North Dakota has changed. Interstate, highway, and low-volume unpaved roads have been used with greater frequency because of increased agricultural production and a growing energy sector. This evolution is especially evident in a 17-county region where oil extraction methods have recently improved production economics. Roads once used only for local access and agricultural purposes are now being used at high volumes to serve expanding oil production. Oil companies, oil workers, commercial trucks, and industrial equipment associated with oil and gas development all use these roads to access oil drilling and production sites. This has led to not only an increase in the traffic volume, but an increase in the number of overweight and oversized vehicles on the road as well. As a result, a number of roads are in poor condition and many others are deteriorating rapidly.

The oil region of North Dakota occupies 17 counties in the western part of the state: Billings, Bottineau, Bowman, Burke, Divide, Dunn, Golden Valley, McHenry, McKenzie, McLean, Mercer, Mountrail, Renville, Slope, Stark, Ward, and Williams. The oil region is home to three of the largest cities in the state: Minot, Dickinson, and Williston. Because of the expanding energy sector, the region has experienced various social, economic, and environmental changes to rapid population growth, an influx of labor and job-seekers, and improved economic development.

Although the expanding oil industry in North Dakota has resulted in many benefits, an increased public safety risk associated with increased traffic is evident in the number and severity of crashes in the region. An example is illustrated in Figure 1.1, where crash incidence trends in the central core of the oil region show exponential growth, especially for more serious crashes. The central core consists of the four highest producing oil counties: Mountrail, McKenzie, Dunn, and Williams. This core is defined based on activity reported by the North Dakota State Industrial Commission Oil and Gas Division (Table 1.1). With the exception of Ward County, it is important to note that the vehicle miles traveled (VMT) in these four counties is much higher than all other areas in the oil region. This implies that increased oil activity in these four counties is amplifying the number of miles traveled by drivers in these counties. Consequently, when more miles are driven, there is a greater chance of a crash. This may partially explain why crash rates in these four counties are considerably higher than in other portions of North Dakota.

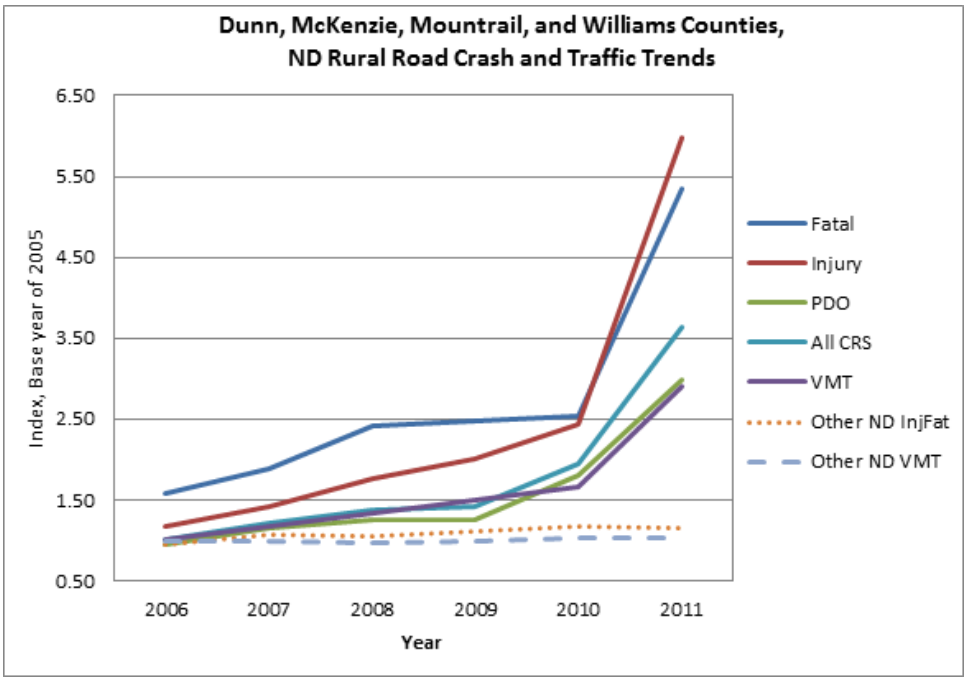

Figure 1.1 Crash Trend for Oil Central Core and Other Areas

Moreover, when these four counties are compared to the other areas of North Dakota, it becomes apparent that driving conditions there are much more dangerous than in other parts of the state. Using 2005 as a base year, Figure 1.1 highlights how the number of fatalities, injuries, and crashes that resulted in property-damage-only increased considerably in recent years. When compared to other parts of the state, it is clear that the rate of injuries and fatalities in these four counties is considerably higher than in other parts of the state.

Large truck crashes are another factor that can be examined to compare and contrast counties. The counties in the central core have had similar trends during the study period. In all four counties, the number of large trucks involved in crashes remained relatively stable from 2004 through 2009. After 2009, however, the number of large trucks involved in crashes in those four counties rose significantly (Figure 1.2). Note that none of the 17 western North Dakota oil counties reduced the number of crashes involving large trucks from 2004 to 2011.

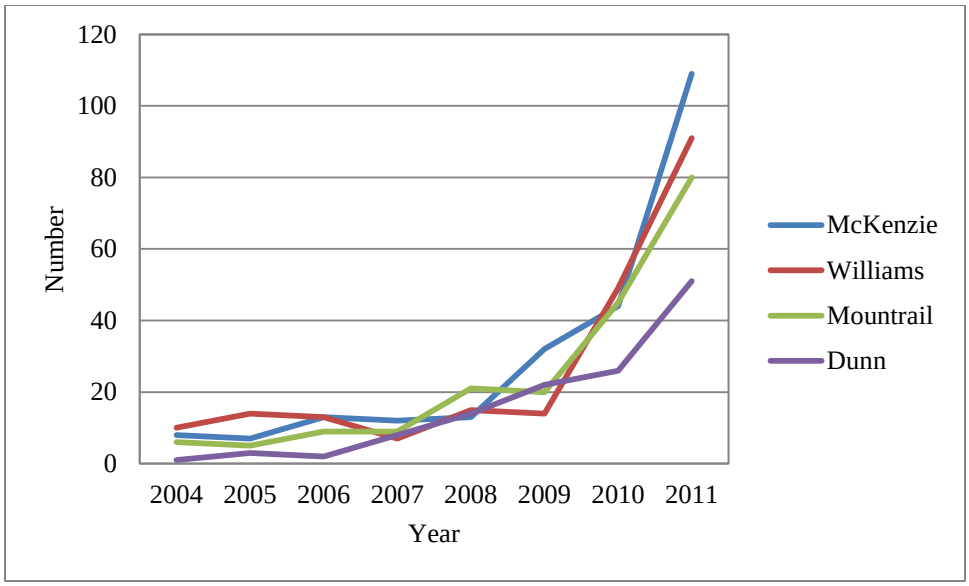

Figure 1.2 Large Truck Crash Involvement, by Central Core Counties

When factored together, the change in large truck crashes for the central core resembles an exponential growth curve (Figure 1.3). These four counties increased from just 25 large truck crashes in 2004 to 331 in 2011, an increase of 1,224%. The prevalence of large truck crashes, particularly in these four counties, may be a factor in negative perceptions of highway safety in the region.

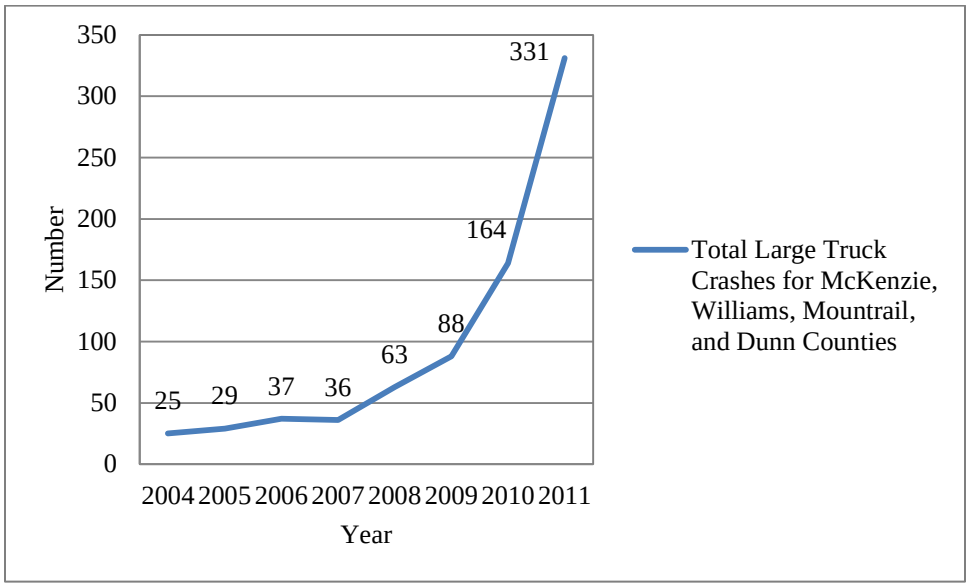

Figure 1.3 Total of Large Truck Crashes in Central Core Counties

Driving factors such as these have prompted stakeholders such as the North Dakota Department of Transportation, the North Dakota Petroleum Council, and the North Dakota Highway Patrol to take action to encourage safety on the roadway. One example of this action is the public awareness campaign known as *ProgressZone: Moving Forward Safely*. It calls for drivers to be more careful when driving through the 17 western North Dakota oil counties. The campaign utilizes billboards, newspapers, and broadcasts to promote four key messages: “Pass with Caution,” “Be Patient. Slow Down,” “Buckle Up. Every Time.” and “Roads Shared. Lives Spared.”

The sharp increase in travel volumes, shift in traffic mix, and large increases in traffic crashes have transformed the travel environment in the oil region of western North Dakota. This research report aims to address two key goals related to improving traffic safety in the region: (1) to examine public perceptions of traffic safety issues and priorities in the state’s oil producing region; and (2) to understand the efficacy of public education, specifically *ProgressZone: Moving Forward Safely* as a safety intervention with its focus on large truck/passenger vehicle interaction. The following section provides context for the survey discussion that is presented in section five. Sections three and four provide information on the method and survey response. Some crash facts that are related to the survey focus are provided in section six. The final sections are the conclusion and discussion for the survey.

2. BACKGROUND

As the oil region of North Dakota has grown, so too has the literature studying the impacts of its growth. Studies concerning population growth, economic revenue, oil freight, oil transportation, crash data, and traffic congestion in the area have become more prevalent with the continued economic growth of the region. The following literature review explores the geography, growth, and development of the 17-county area and also presents background information regarding the *ProgressZone: Moving Forward Safely* campaign.

2.1 Western North Dakota Oil Region Geography

The 17-county "Western North Dakota Oil Region" is defined by its proximity to economically viable oil formations (Figure 2.1). Currently, the three main formations that define the oil producing region of western North Dakota are the Bakken Oil Play, the Three Forks Formation, and the Birdbear Formation. All have different levels of drilling and production. The Bakken Oil Play takes up a significant portion of Saskatchewan, Manitoba, South Dakota, and North Dakota (Figure 2.2). According to the U.S. Geological Society, the Bakken Oil Play has a mean undiscovered volume of 3.65 billion barrels of oil (Pollastro et al 2008). Presently, the Bakken

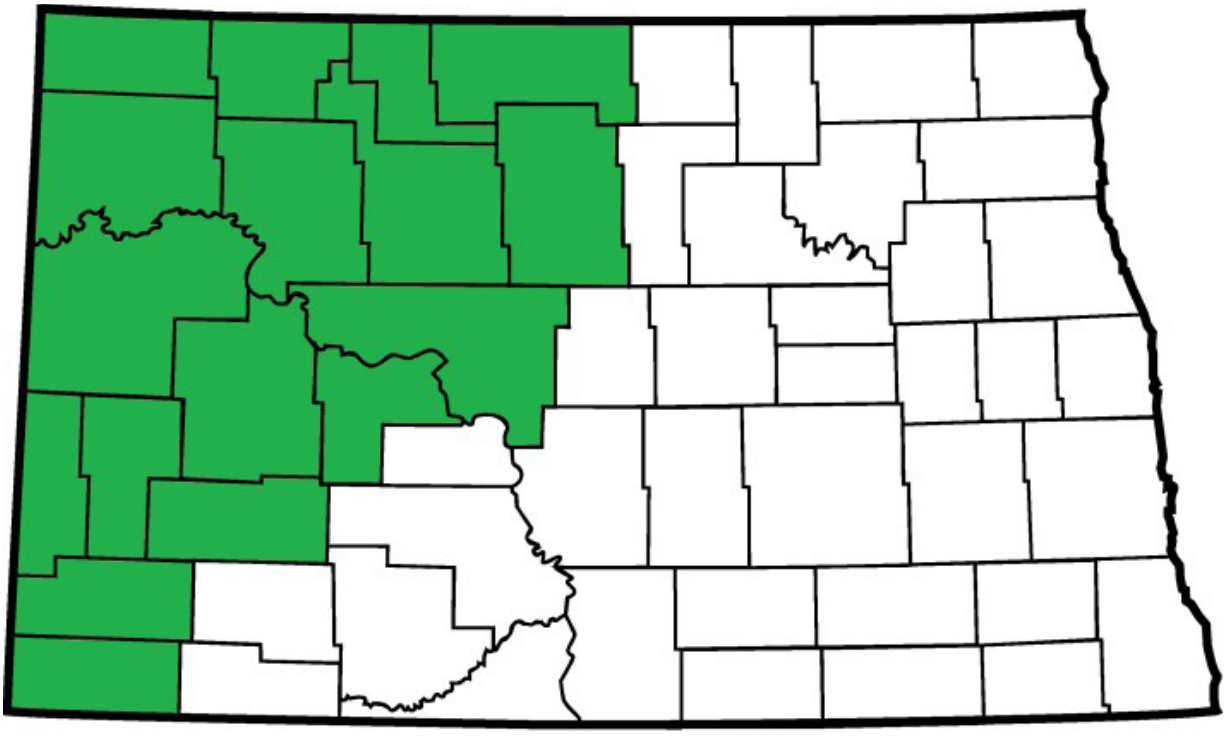

Figure 2.1 17-County Oil Region of Western North Dakota

Oil Play produces roughly 400,000 barrels per day, although that number is expected to be closer to 1 million in a few years (St. Anthony 2011). The Three Forks "is made up of sand and porous rock directly below North Dakota's portion of the Bakken formation, where oil-producing rock is sandwiched between layers of shale about 2 miles underground" (Beitsch 2010). It is believed that 2 billion barrels of recoverable oil lie in the Three Forks Formation (Sonnenberg et al 2011). The Birdbear Formation "lies on top of the Duperow Formation and beneath the Three Forks Formation in the central part of the Williston Basin or beneath the Lodgepole Formation along the margins of the basin where the Three Forks is not present" (LeFever 2009). Drilling and oil production is newer to this formation: "before 2007, only 11 wells had produced from the Birdbear Formation with a cumulative output of about 26,000 m^3 of oil. By May 2010, the number of wells with Birdbear production history had increased to 37 with total oil production of almost 107,000 m^3" (Yang and Kent 2010). Although the three formations share a similar geography, the drilling and production activity that takes place varies from formation to formation.

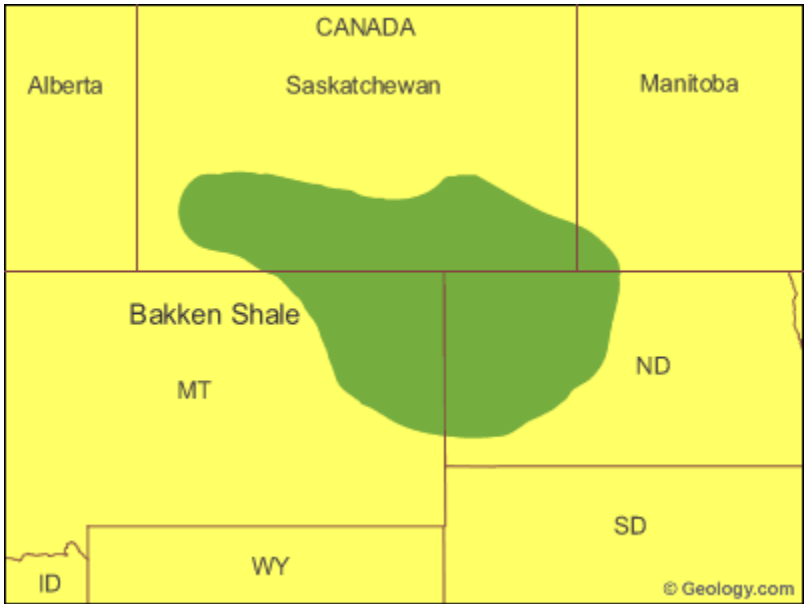

Figure 2.2 Location of Bakken Oil Play (USGS 2008)

2.2 Growth and Development of the Oil Industry

The North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division report that oil development in North Dakota has expanded rapidly over the last decade (NDIC 2011) (Figure 2.3). A majority of the oil development has taken place in the western portion of the state. It is this part of the state – specifically 17 North Dakota counties – that produce the majority of North Dakota's oil. The North Dakota State Industrial Commission released numerous statistics concerning oil development in this part of the state (NDIC 2011).

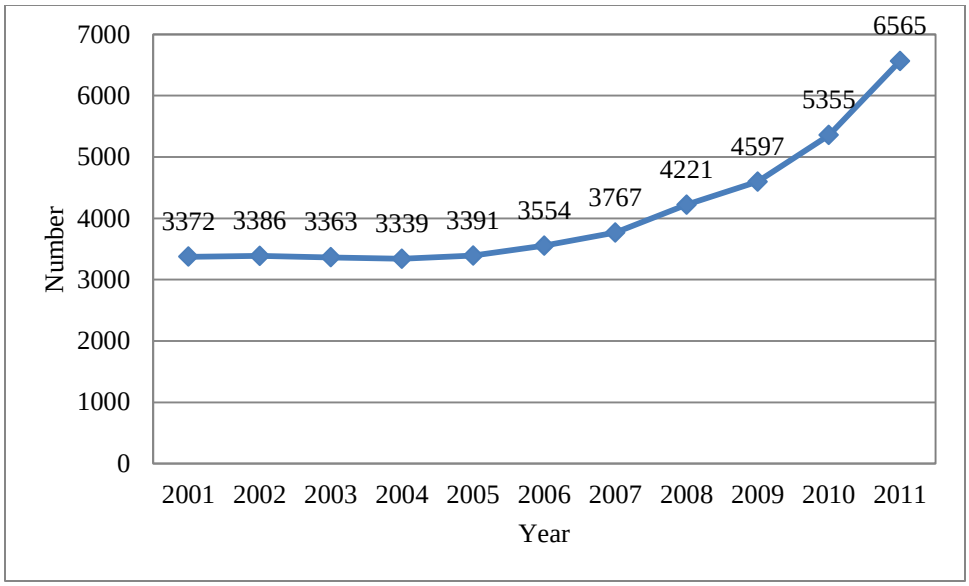

Figure 2.3 Active Oil Wells in North Dakota (NDIC 2011)

These 17 counties accounted for a significant portion of oil production in March of 2012 (Table 2.1). In addition to making significant contributions to North Dakota oil production, these 17 counties also face unique impacts with regard to state and local roads because of oil development (Table 2.2, Table 2.3). The reality is that an increase in demand for oil has led to an increase in the use of local low- and high-volume roads, many of which were not designed for heavy oil truck traffic. The most common reason that infrastructural problems arise is because of the sheer

Table 2.1 Western North Dakota Oil Production, March 2012

COUNTY	RANKING	BARRELS	WELLS	AVERAGE PRODUCTION PER WELL
Mountrail	1	5,528,174	1,194	4,630
McKenzie	2	4,103,221	1,337	3,069
Dunn	3	2,705,853	752	3,598
Williams	4	2,597,687	880	2,952
Bowman	5	823,837	531	1,551
Divide	6	599,994	293	2,048
Billings	7	396,467	456	869
Stark	8	313,579	105	2,986
Burke	9	296,667	431	688
Bottineau	10	154,375	511	302
McLean	11	112,891	32	3,528
Golden Valley	12	77,923	75	1,039
Renville	13	71,782	277	259
Slope	14	49,897	19	2,626
Ward	15	5,004	12	417
McHenry	16	1,930	15	129
Mercer	17	0	0	0
TOTAL		17,839,281	6,920	2,578

Source: North Dakota State Industrial Commission 2012

volume and weight of the vehicles associated with oil development (NDDOT LTAP 2011). The North Dakota Department of Transportation estimates that for each vertical oil well drilled, 400 truck loads are needed throughout implementation and maintenance (NDDOT 2010). Additionally, for each horizontal well drilled, anywhere from 600 to 1,000 truck loads are required.

Based on extensive analysis of surface and base layer thickness, the materials of those layers, the amount of cracking and deterioration of the surface layer, underlying soil conditions, and the graded width of the road, the Upper Great Plains Transportation Institute concluded that approximately 958 miles of paved roads and 12,718 miles of unpaved roads are impacted by oil development (UGPTI 2010) (Table 2.2, Table 2.3). These impacts include additional maintenance costs, unforeseen maintenance costs, surface cracking, road deterioration, damages to grading, damages to drainage, reconstruction, and overhead expenditures (UGPTI 2010).

Table 2.2 Conditions of Paved Roads Affected by Oil Development

Road Condition	Miles	Percent Miles	Cumulative Miles	Cumulative Percent
Very Good	60.8	6.3%	60.8	6.3%
Good	496.1	51.8%	556.9	58.1%
Fair	333.6	34.8%	890.5	92.9%
Poor	38.2	4.0%	928.7	96.9%
Very Poor	29.7	3.1%	958.4	100%

Source: Upper Great Plains Transportation Institute 2010

Table 2.3 Conditions of Unpaved Roads Affected by Oil Development

Road Condition	Miles	Percent Miles	Cumulative Miles	Cumulative Percent
Very Good	118.2	0.9%	118.2	0.9%
Good	4,601.9	36.18%	4,720.1	37.1%
Fair	7,374.2	57.98%	12,094.3	95.1%
Poor	574.3	4.52%	12,668.6	99.6%
Very Poor	49.3	0.4%	12,717.9	100%

Source: Upper Great Plains Transportation Institute 2010

In general, truck loads consist of heavy duty vehicles and objects that are significantly over the size and weight limits of low-volume rural roads (NDDOT 2008) (Table 2.4). The main impacts of the overweight loads and heavy duty vehicles on road networks are damages to the crown and rutting (Skorseth and Selim 2000). The weight of the vehicles gradually diminishes the crown. As the crown decreases, water accumulation and traffic can soften the crust, create a rut, develop potholes, and, eventually, result in washboard conditions that make the road dangerous year round.

Table 2.4 Overweight Loads During Oil Development and Maintenance

Load Type (and number needed)	Weight (lbs.)
Generator House (3)	111,180
Shaker Tank/Pit	122,000
Suction Tank	131,000
Mud Pump (2)	164,000
Shaker Skid	111,760
Draw Works	130,880
Hydraulic Unit	127,640
Tool Room Junk Box	124,140
BOP Skid	138,680
Top Dog House	117,000
Crown Section	140,000
Derrick	159,000
VFD House	130,100
Mud Boat	114,380
Substructure	136,000
Centerpiece	139,440
Choke Manifold	126,000
MCC House	145,160
BOP Setting Machine	111,000

Source: North Dakota Department of Transportation 2008

2.3 Truck Traffic on Western North Dakota Roads

The Upper Great Plains Transportation Institute analyzed the impacts that oil and gas development have had on western North Dakota's roads (UGPTI 2010). The institute's analysis revealed that trucks make up a significant portion of traffic in oil counties in the western part of the state. Table 2.5 outlines truck traffic on major county roads for this region. The table shows that – of the 15 western North Dakota oil counties studied – the mean number of trucks on the road each day is 61 (UGPTI 2010). Table 2.6 reveals that – above and beyond volume – the number of trucks on the road in western North Dakota is also a significant proportion of the traffic. As a whole, in the 15 oil counties that were studied, trucks comprised an average of 42% of the average daily traffic (UGPTI 2010).

This is a considerable increase in a relatively short span of time. The same study from the Upper Great Plains Transportation Institute discussed a 2008 survey which analyzed 2007 truck traffic data to establish a baseline of average ADT and percent truck traffic on roads in North Dakota's oil region. The survey found that between 2008 and 2010 the percentage of trucks on collector roads increased from 18% in 2008 to 39% in the same exact counties by 2010 (UGPTI 2010).

Table 2.5 Average Trucks per Day on Major County Roads

County	Road Segments Observed	Minimum	Mean	Maximum
Billings	9	4	31	80
Bottineau	3	48	68	86
Bowman	6	30	125	233
Burke	6	4	22	66
Divide	3	28	96	172
Dunn	10	12	61	198
Golden Valley	5	23	38	50
McHenry	4	7	21	40
McKenzie	12	14	97	253
Mercer	3	1	3	6
Mountrail	12	12	65	252
Slope	4	7	17	34
Stark	5	9	26	62
Ward	6	24	105	217
Williams	11	10	68	312
All	**99**	**1**	**61**	**312**

Source: Upper Great Plains Transportation Institute 2010

Table 2.6 Percent Trucks and Multi-Unit Trucks on Major County Roads

County	Trucks as a Percent of ADT	Multi-Units as a Percent of Trucks
Billings	49	23
Bottineau	24	38
Bowman	62	24
Burke	43	72
Divide	54	63
Dunn	46	46
Golden Valley	42	31
McHenry	15	38
McKenzie	51	52
Mercer	14	8
Mountrail	49	49
Slope	37	28
Stark	24	42
Ward	26	35
Williams	51	56
All	**42**	**44**

Source: Upper Great Plains Transportation Institute 2010

2.4 Crashes and Fatalities on Oil Region Roads

The Upper Great Plains Transportation Institute analyzed crash trends in the oil region of North Dakota from 2007 to 2011. This research revealed that the total number of crashes and injuries has increased significantly during this time in the North Dakota oil region (Table 2.7).

Table 2.7 Oil County Crash Events from 2007 to 2011

YEAR	TOTAL CRASHES	INJURIES	FATALITIES	TOTAL ESTIMATED DOLLAR LOSS*
2011	5,509	1,118	63	$192.9 Million
2010	3,909	847	33	$121.8 Million
2009	3,203	725	46	$126.0 Million
2008	2,962	652	38	$109.6 Million
2007	2,669	602	31	$95.4 Million

Source: Upper Great Plains Transportation Institute 2012
*Total estimated dollar loss includes fatal, injury, and property-damage-only crashes. Values for estimated dollar loss as reported in NDDOT 2010 Crash Summary.

There may be a correlation between the increase in active oil wells and the increase in vehicular crashes and injuries: both grew in number substantially from 2007 to 2011. One trend that has been particularly notable over the last five years is of the increase in large truck involvement in crashes on rural roads. Of the crashes that took place between 2007 and 2011, the Upper Great Plains Transportation Institute research revealed that – as the number of active oil wells increased – so too did the proportion of crashes involving oil trucks on rural roads (Figure 2.4). The percentage of truck crashes on rural roads has increased in all but one of the last five years. With the exception of 2007, the percentage of trucks involved in rural road crashes in North Dakota's oil counties has outpaced the statewide average.

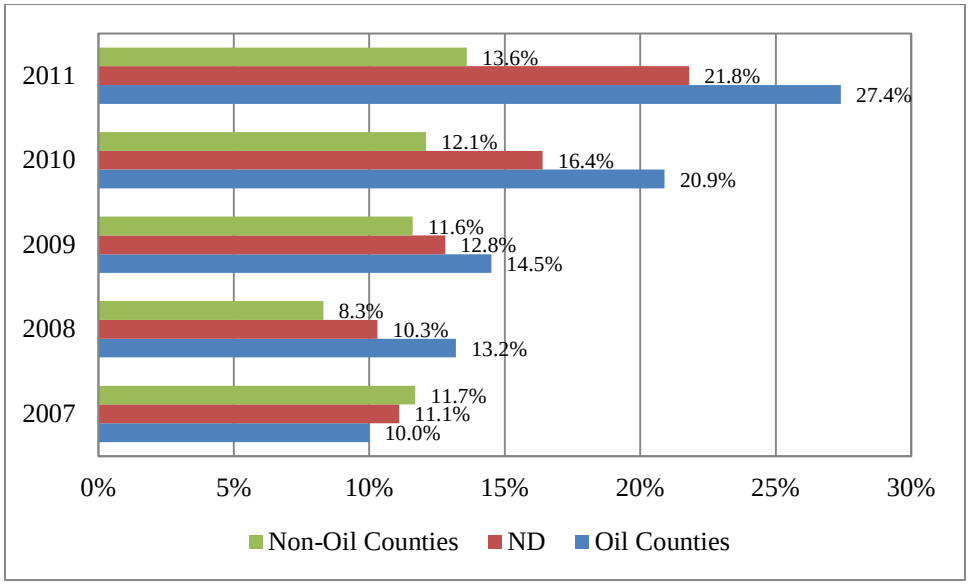

Figure 2.4 Truck Crashes as Percent of All Rural Road Crashes

2.5 *ProgressZone: Moving Forward Safely* as a Safety Intervention in Western North Dakota Oil Counties

Traffic safety interventions are generally formed under four approaches: policy, enforcement, education, and media. All intervention approaches have been used with varying degrees of success in addressing issues such as seat belt usage, impaired driving, and speeding. The approach with *ProgressZone: Moving Forward Safely* is a combination of the education and media strategies designed to target residents within a specific region with awareness and education on safe driving behaviors. These strategies, which are primarily associated with public education and perceptions, have proven successful in past applications (Shults et al 2004, Houston and Richardson 2006, Hedlund et al 2008, and Nichols et al 2008).

In 2011, the North Dakota Department of Transportation (NDDOT) worked in coordination with various state agencies and concerned organizations to create a public awareness effort to promote traffic safety in western North Dakota (NDPC 2011). The effort, called *ProgressZone: Moving Forward Safely*, is a campaign that urges motorists driving in North Dakota's oil country to be patient and exercise caution while traveling in this part of the state. Four messages were displayed on billboards and advertising to remind drivers in this part of the state to use extra caution while driving on oil region roads. The four messages are "Pass With Caution.," "Be Patient. Slow Down!," "Buckle Up. Every Time.," and "Roads Shared. Lives Spared." (Wehrman 2011). National Highway Traffic Safety Administration funds were used to develop the campaign theme and materials. Other funds were used for billboard placement and for paid media placement. Figure 2.5 shows an example of one such billboard that was used in oil counties in western North Dakota.

The program addresses the concerns that come with increases in volumes of traffic and greater truck/passenger vehicle interaction (NDPC 2011). Projections show that although billions of dollars in road construction, gas plants, and pipelines are planned over the next five years, congestion in the oil region will get worse. Consequently, understanding safety impacts of this campaign is important in future traffic safety resource decisions (Donovan 2011).

Figure 2.5 A *ProgressZone: Moving Forward Safely* Billboard (photo courtesy of NDPC)

2.6 Gaps in the Literature

There are two key gaps in the literature that must be addressed. First, although some studies have gauged motorists' ratings of overall safety and road conditions, none have focused exclusively on western North Dakota oil counties. Whereas some studies have split the state of North Dakota into various sections, those sections were often based on regional or geographic determinations; they are generally not split based on oil/non-oil development. Second, no study has examined perceptions of the *ProgressZone: Moving Forward Safely* program as it relates to improving road safety and understanding safety issues in terms of large truck/passenger vehicle interaction. The remainder of this study will focus specifically on these two gaps in the literature.

3. METHOD

A mail survey was selected as the method for the oil traffic safety survey. A draft survey was designed by blending questions related to traffic safety, *ProgressZone: Moving Forward Safely* goals, and issues specifically pertaining to oil traffic and oil development. Industry partners provided input regarding questions to include in the final survey. The mailing to drivers included a cover letter which invited participation and explained the goals of the survey. The survey was mailed to drivers on April 6, 2012, and was open to response until May 1, 2012.

The state driver licensing division used the 17-county oil region driver population for the sampling. Initially, the mailing list provided by the North Dakota Department of Transportation consisted of 2,700 driver addresses. Prior to mailing, 41 addresses were removed from the list because they were in counties outside of the 17-county oil region focus area. Thus, 2,659 addresses were verified for a final mailing list. Of these, 10 were flagged as addresses of individuals who had moved and had not provided a new forwarding address, 2 were flagged as "unmailable," and 22 were flagged as "problem" addresses that were not mailed. Ultimately, 2,623 surveys were mailed. Three of the 2,623 initial surveys that were mailed were unable to be forwarded to a current address and were subsequently returned by the post office. Of the 2,620 successfully mailed, 781 responses were obtained. From the 781 responses, 2 responses had zip codes that were either out-of-state or unverifiable. Of the useable survey responses received, 779 were verified as North Dakota responses and form the valid driver response sample used in the analysis.

The sample size was based on a 95% confidence interval, with a 5% confidence level. The expected response rate was estimated at 20%. Although mail survey response is generally low – 10% is not uncommon – a slightly better response rate was expected due to the parameters used in the survey design and administration. These parameters included keeping the survey to a single page, including "Upper Great Plains Transportation Institute, North Dakota State University" letterhead, and using UGPTI mail envelopes. Moreover, given the timeliness with regard to development in the region and the profound traffic changes it has brought to the 17 western counties, it was expected that an above-average response would be obtained.

A proportionate stratified random sample was used to select drivers. The North Dakota driver population was stratified by county boundaries. Individuals living in the 17 western oil counties had no greater than a 3.5% chance of receiving a survey. The greatest number of surveys was sent to Williams, Stark, and Ward counties, respectively. This aligns with the fact that these three counties are home to the three largest cities in the oil region: Williston, Dickinson, and Minot. Although a random sample of the 17 western oil counties was obtained for the survey mailing, the sample was not representative of the population in those counties (Table 3.1). Males were overrepresented in the sample. Whereas the population over age 18 of the 17 western North Dakota oil counties is 51 percent male and 49 percent female, the sample used for this study had rates that were 62 percent male and 38 percent female. Moreover, the proportion of drivers in each age cohort did not mirror the real-life proportion of the counties. The sample was underrepresented in terms of drivers 44 years of age and younger. In contrast, drivers over the age of 55 and under the age of 74 were overrepresented in the sample when compared to their actual proportion of the population in the oil counties. Drivers between the ages of 45 and 54

received 22.0 percent of the surveys that were mailed, a number that is relatively close to their actual proportion, 19.1 percent. Drivers in the 75+ age cohort received 13.8 percent of mailed surveys and are 10.5 percent of the population in the 17 counties, numbers that satisfactorily represent this demographic.

Table 3.1 Mailing Sample and State Driver Population by Age

Age Group	Surveys Mailed	Percent of Sample Mailed	Oil County Population	Percent of 18+ Oil County Population
18-24	86	3.2	17,486	13.4
25-34	285	10.7	21,976	16.9
35-44	212	8.0	18,087	13.9
45-54	584	22.0	24,914	19.1
55-64	637	24.0	21,292	16.4
65-74	488	18.4	12,730	9.8
75+	366	13.8	13,637	10.5

Source: US Census Bureau 2010 Census

4. RESPONSE

Survey response rate was 29.7%, with 779 valid responses received from the sample mailing to 2,620 drivers. As expected, the proportion of responses by age cohort increased with age: there were substantially more older drivers in the sample than those under the age of 45 (Table 4.1). This was likely because a smaller proportion of younger drivers received the survey compared to the higher proportion of elderly drivers who received it. Note that the sample of valid responses obtained from this study is not representative of the 17 western North Dakota oil counties: a much lower proportion of drivers under the age of 45 are in the sample than are in the population. Similarly, the portion of drivers over the age of 44 and under the age of 74 that make up the sample is much higher than the actual proportion of individuals in this age group in the 17 county oil region. The 75+ age cohort comprises 10.3 percent of the sample, a number that accurately reflects their proportion (10.5 percent) of the oil region population. Also consider that the total number of responses from the 18-24 age cohort is not large enough to be extrapolated to fit the 17 western North Dakota oil counties. In general, at least 30 valid responses are required for data to be considered representative of a particular demographic. Thus, any conclusions made for the 18-24 age cohort cannot be considered indicative of the entire 18-24 year-old population in this portion of the state.

Table 4.1 Valid Survey Responses and State Driver Population by Age

Age Group	Valid Surveys	Percent of Sample Received	Oil County Population	Percent of 18+ Oil County Population
18-24	12	1.5	17,486	13.4
25-34	49	6.3	21,976	16.9
35-44	55	7.1	18,087	13.9
45-54	193	24.8	24,914	19.1
55-64	220	28.2	21,292	16.4
65-74	168	21.6	12,730	9.8
75+	80	10.3	13,637	10.5

Source: US Census Bureau 2010 Census
Frequency Missing = 2

In terms of gender, the sample consists of 58.3% males and 41.7% females (Table 4.2). When factoring for both gender and age, it becomes apparent that males aged 18-24, females aged 18-24, females aged 25-34, and males aged 35-44 all have less than 30 responses for their respective demographics. Thus, conclusions made for these particular groups cannot be extrapolated to represent the entire population.

Table 4.2 Survey Response by Age and Gender

Age	Male	Female	Total
18-24	6 (50.0%)	6 (50.0%)	12
25-34	30 (61.2%)	19 (38.8%)	49
35-44	24 (43.6%)	31 (56.4%)	55
45-54	113 (58.5%)	80 (41.5%)	193
55-64	137 (62.3%)	83 (37.7%)	220
65-74	104 (62.7%)	62 (37.3%)	166
75+	38 (47.5%)	42 (52.5%)	80
Total	**452 (58.3%)**	**323 (41.7%)**	**775**

Frequency Missing = 4

5. RESULTS

Survey responses offer important insight into driver perceptions, attitudes, and behaviors regarding traffic conditions in the oil region. Simple frequency analysis of ordinal and dichotomous survey responses provides a baseline of driver views and behaviors. In addition, the scale responses were transformed to ordinal values to quantify responses between scale extremes. This allows for statistical testing of relationships, means, and tests of significance. Quantitative scale definitions are provided in Table 5.1.

Table 5.1 Quantitative Scale Definitions for Responses

Q#	Question	Scale	Conversion Values
1	Safety Now vs. 5 Years Ago	1-5	1=Much Less Safe to 5=Much Safer
2	Pay for Message System	0-1	0=No, 1=Yes
3	Sudden Brake/Swerve	0-1	0=No, 1=Yes
4	Law Enforcement Presence	0-1	0=No, 1=Yes
5	Meet/Pass Large Trucks	1-5	1=Never to 5=Daily
6a	Safety Passing Large Trucks	1-5	1=Very Unsafe to 5=Very Safe
6b	Being Passed by Trucks	1-5	1=Very Unsafe to 5=Very Safe
8a	Seat Belt Use in Town	1-5	1=Never to 5=Always
8b	Seat Belt Use Over 30 MPH	1-5	1=Never to 5=Always
9	On 65 MPH Road, Over 70	1-5	1=Never to 5=Always
10	*ProgressZone: Moving Forward Safely* Ads	0-1	0=No, 1=Yes
11	Behavior After *ProgressZone: Moving Forward Safely* Ads	0-1	0=No, 1=Yes
12a	RSH Passing with Caution	0-1	0=No, 1=Yes
12b	RSH Slowing Down	0-1	0=No, 1=Yes
12c	RSH Buckling Up	0-1	0=No, 1=Yes
12d	RSH Sharing the Road	0-1	0=No, 1=Yes
13a	Signage of Traffic Rules	1-4	1=Least Important to 4=Most Important
13b	Law Enforcement Presence	1-4	1=Least Important to 4=Most Important
13c	Driver Awareness	1-4	1=Least Important to 4=Most Important
13d	Truck/Car Interaction	1-4	1=Least Important to 4=Most Important

5.1 Perceptions of Safety in the 17 Oil Counties

Four questions focused on safety conditions in the 17 western North Dakota oil counties. Response frequencies for these four questions are provided in Table 5.2. Responses show that a majority of drivers do not feel safer driving now than they did five years ago. A clear majority, 88.8%, reported that they either feel “less safe” or “much less safe.” Only 1.4% of respondents indicated that driving conditions had improved in the last five years by answering that they either feel “much safer” or “somewhat safer” while driving. Roughly 10% of drivers indicated that they feel the same level of safety while driving compared to the safety they felt five years ago. With regard to braking suddenly, treated here as a crash avoidance maneuver measure, 73.3% of respondents revealed that they have had to brake or swerve to avoid a crash at least once within the last three months.

Table 5.2 Perceptions of Safety Responses

Question Number	Survey Question	Responses				
1	How safe do you feel driving in your area compared to five years ago?					
		Much Safer	Somewhat Safer	Same	Less Safe	Much Less Safe
		0.8%	0.6%	9.7%	33.2%	55.6%
2	Would you pay for a messaging system to alert drivers of heavy traffic or incidents to help drivers?					
				Yes	No	
				26.6%	73.4%	
3	Have you had to brake suddenly or swerve to avoid a crash in the past 3 months?					
				Yes	No	
				73.3%	26.7%	
4	Do you think more law enforcement visibility would reduce crashes?					
				Yes	No	
				71.4%	28.6%	

In terms of using two different strategies for reducing crashes, driver response was mixed. A majority of drivers were not willing to pay for a messaging system that would alert them of heavy traffic or other traffic incidents as a self-management tool. Only 26.6% of drivers approved of paying for such a system. However, in terms of a crash reduction strategy, a majority, 71.4%, indicated that more law enforcement visibility would have a positive effect on reducing the number of crashes in the oil region.

To study relationships beyond response rates, measures of association can be calculated for responses. The Pearson Coefficient measures the strength of association between two variables; in this case, it measures responses to how drivers perceive safety on oil roads. Correlation coefficients range from -1 to +1, with values close to these extremes indicating stronger relationships. Relationships between -0.5 and +0.5 are considered weak and do not explain a relationship. For example, although the “sudden brake/swerve” and “more police presence” variables do have positive relationship at Pearson Corr. = 0.184, the correlation measure shows that less than 4% of their variability is shared. Although all four of the questions relating to perceived safety on oil roads are statistically significant at the 1% level, all but one of these relationships has a correlation either less than -0.5 or greater than 0.5.

The only values producing a substantive relationship are for how one perceives safety compared to five years ago and having to suddenly brake or swerve to avoid a crash (Pearson Corr. = -.519, $p<0.0001$, $n=760$) (Table 5.3). These two variables share 27% of their variability. This is a logical relationship: drivers who have had to brake or swerve suddenly to avoid a crash are likely to consider that an unsafe experience and thus may have a higher tendency to view the roads as being less safe when compared to five years ago. The two variables show a positive relationship with one another: if a driver has had to brake suddenly or swerve to avoid a crash, that driver is more likely to think that the roads are less safe compared to five years prior.

Table 5.3 Correlations and Significance Values in Safety Perception Questions

	Q1	Q2	Q3	Q4
Q1: Safety now vs. five years ago	1	-.137** <.000	**-.519**** **<.000**	-.184** <.000
Q2: Pay for message alerts		1	.119** .002	.193** .000
Q3: Sudden brake/swerve			1	.184** .000
Q4: More police presence				1

**Significant at the 1% level
Note: correlations between -0.5 and 0.5 indicate a very weak relationship, so other relationships are not addressed in this study

5.2 Perceptions of Large Truck/Passenger Vehicle Interaction

Based on driver response, roughly four in five drivers in the 17 western North Dakota oil counties meet or pass a large truck on a daily basis (Table 5.4). Only 2% of drivers reported meeting trucks on the roadway less than once per month or not at all.

Table 5.4 Responses to Large Truck/Passenger Vehicle Interaction Questions

Question #	Question	Response				
5	How often do you meet/pass large trucks while driving?					
		Daily	Few times per week	Few times per month	<1/Month	Never
		79.4%	12.5%	6.0%	1.5%	0.5%
6a	How safe do you feel when passing large trucks?					
		V. Safe	Sw. Safe	Neutral	Unsafe	V. Unsafe
		4.0%	20.4%	21.8%	32.4%	21.3%
6b	How safe do you feel when being passed by large trucks?					
		V. Safe	Sw. Safe	Neutral	Unsafe	V. Unsafe
		2.8%	12.9%	18.7%	37.4%	28.3%
7a	For a trip that typically takes you 20 minutes, how much longer would you drive to travel a route with fewer large oil trucks?					
		5 minutes	10 minutes	20+ minutes	Would not change route	
		17.9%	39.2%	18.8%	24.1%	
7b	For a trip that typically takes you 20 minutes, how much longer would you drive to travel a route with better signage and surface conditions?					
		5 minutes	10 minutes	20+ minutes	Would not change route	
		18.2%	39.5%	19.0%	23.3%	

In terms of perceived safety, a majority of drivers felt unsafe when passing or being passed by large trucks. Over half (53.7%) of all drivers indicated that they felt either “unsafe” or “very unsafe” while passing large trucks in the 17 western oil counties. Similarly, 65.7% of drivers felt either “unsafe” or “very unsafe” while being passed by large trucks. Roughly one in four (24.4%) drivers said that they felt either “somewhat safe” or “very safe” passing trucks. Only 15.7% indicated that they felt this way when being passed by a large oil truck.

Drivers were also asked about their willingness to drive for a longer amount of time if it meant less interaction with large trucks or driving on roads with better driving conditions. Results were similar across the two variables when drivers were asked about willingness to add travel time to a trip that would typically take 20 minutes (Figure 5.1). From responses, 18% of drivers would drive five additional minutes if it meant taking a route that had fewer oil trucks or better signage and surface conditions. As the most common response, 40% of drivers would increase travel time by half to avoid truck interaction. Somewhat surprisingly, 19% of drivers would double their travel time – driving more than forty minutes instead of a normal twenty minutes – to travel a route with fewer trucks or better driving conditions. About one in four drivers said that they would not change their current driving patterns to avoid trucks or take a route with better road conditions.

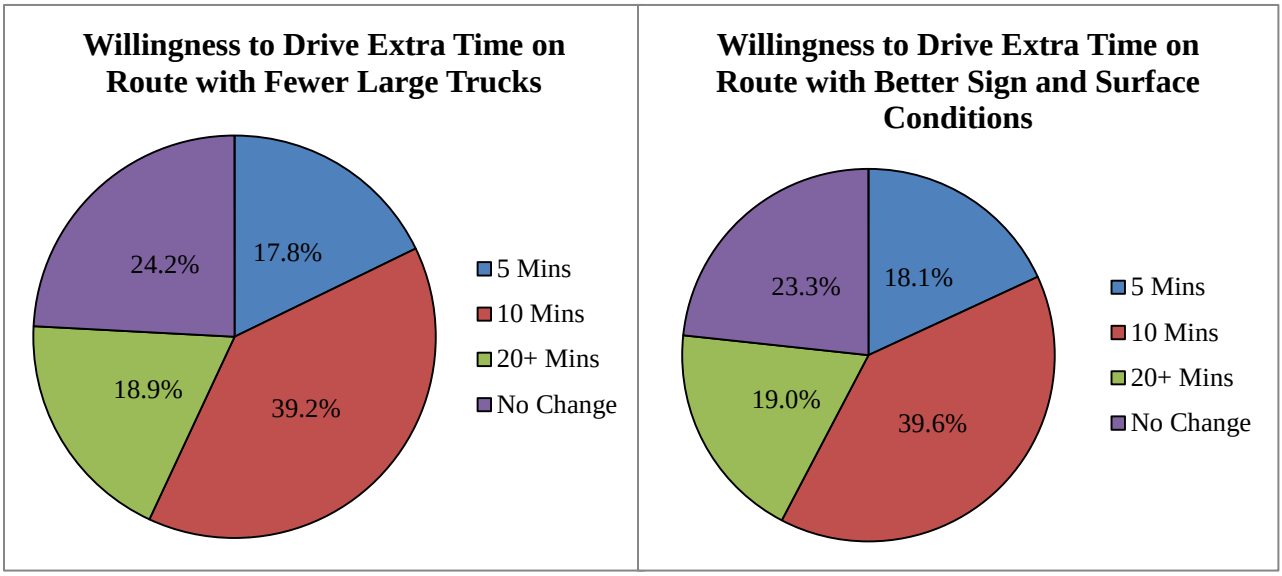

Figure 5.1 Willingness to Increase Travel Time, Considering a Current 20-Minute Trip

It appears as though age plays a role in determining how safe one feels on the road and the likelihood that one will travel further out of the way to avoid oil traffic. Based on the responses from this sample, age is inversely related to perceived danger when passing or being passed by large oil trucks: as age increases, respondents are more likely to feel safer when passing or being passed by large trucks (Table 5.5). Individuals aged 18-24 felt the least safe when passing or being passed by large trucks while driving. Respondents aged 65-74 and respondents over the age of 75 felt safest in these driving conditions, respectively.

Table 5.5 Mean Values of Passing/Being Passed by Trucks, by Age

	Age						
Question #	18-24	25-34	35-44	45-54	55-64	65-74	75+
6A	2.0**	2.5	2.4	2.5	2.5	2.6	2.6
6B	1.9**	2.1	2.1	2.2	2.2	2.3	2.5

**Estimate may be uncertain due to limited sample size

Although there is a disparity between the largest and smallest values among the age cohorts, the differences in these values are not statistically significant. A test for equality of means showed that for perceived safety when passing a large truck, the 18-24 and 65-74 age groups, which had the largest disparity between mean values of 2.0 and 2.6, respectively, were not statistically significant in terms of their safety perception tending towards unsafe (F=0.755, df=6, p=0.606). Regarding perception of safety when being passed by a large truck, findings are similar; no significant difference is found in responses from 18-24 year-olds and those over the age of 75 – the two groups with the biggest difference in mean values (F=1.448, df=6, p=0.194). This suggests that in both cases differences in perceptions of safety when passing or being passed by large trucks are not due to age but instead are due to other variables.

Although all of the relationships between questions five and six are statistically significant at the 1% level, there is only one that has a substantive relationship within the three variables studied (Table 5.6). This relationship is between question 6A and 6B. The relationship between questions 6A and 6B is strong and positively correlated (Pearson Corr. = .741, p<.001, n=753). This indicates that as one feels safe passing large trucks, one is more likely to also feel safe being passed by large trucks.

Table 5.6 Correlations and Significance Values in Passenger Vehicle/Large Truck Interaction

	Q5	Q6A	Q6B
Q5: Meet/Pass Large Trucks	1	-.163** .000	-.267** .000
Q6A: Safety Passing Trucks		1	**.741** .000**
Q6B: Safety Being Passed by Large Trucks			1

**Correlation is significant at the 1% level

Two other relationships should be noted, although they are not substantive. The correlation between how often one meets or passes a large truck and how safe one feels passing trucks (-.163) is comparable to the correlation between how often one meets or passes a large truck and how safe one feels being passed by said truck (-.267). The correlation indicates that as one meets or passes large trucks more often, one feels less safe passing or being passed by said trucks. This implies that exposure to large trucks determines feelings about safety.

5.3 Driver Behavior

Two questions examined driver behavior as related to seat belt use and speeding (Figure Figure 5.2). Based on driver response indicating that they “always” or “nearly always” buckle up in town, 86.4% of drivers wear a seat belt regularly while driving in town. A higher proportion, 93.0%, either “always” or “nearly always” wear a seat belt when traveling in a vehicle going over 30 miles per hour. Only 6.1% of drivers reported “rarely” or “never” wearing a seat belt

while in town. An even smaller portion of drivers, 1.9%, reported “rarely” or “never” using a safety belt while driving in a vehicle traveling at least 30 miles per hour.

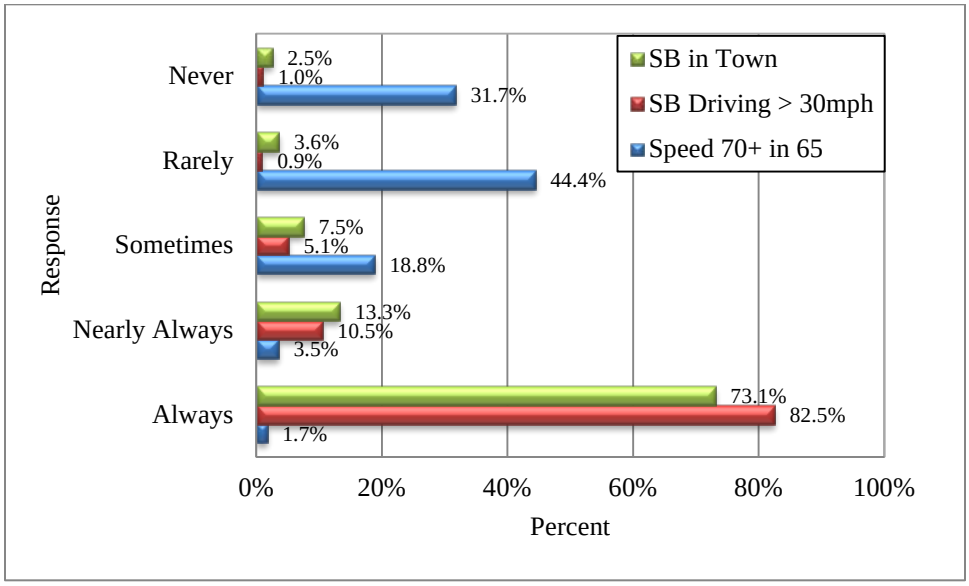

Figure 5.2 Driver Behavior Response: Seat Belt Use and Speeding

Self-reported speeding tendencies were comparable to results of seat belt use. In this survey, 5.2% of drivers reported that they “always” or “nearly always” have the dangerous driving habit of traveling at least 70 miles per hour in a 65 mile per hour zone. A majority of drivers, 76.1%, reported that they “rarely” or “never” driver faster than 70 miles per hour on a road with a speed limit of 65 miles per hour. The biggest contrast between behaviors of seat belt use and speeding tendencies came from drivers who reported the median value of “sometimes” engaging in a dangerous driving practice. Whereas only 7.5% and 5.1% of drivers reported that they “sometimes” drive in town without using a seat belt or drive in a vehicle traveling over 30 miles per hour without a seat belt, respectively, nearly one-fifth of drivers indicated that they “sometimes” travel in excess of 70 miles per hour on a road with a posted speed limit of 65 miles per hour.

All relationships between seat belt use in town, seat belt use while driving over 30 miles per hour, and tendency to drive faster than 70 miles per hour in a 65 mile per hour zone are significant at the 1% level (Table 5.7). The correlations between variables show that speed and seat belt risk behaviors are not strongly related. Moreover, the environment in which one is driving does not explain seat belt use. Only one relationship is substantive with a strong, positive correlation. The relationship between questions 8A and 8B suggest that drivers who are more likely to use a seat belt while driving in town, are also more likely to use a seat belt while traveling in a vehicle driving more than 30 miles per hour (Pearson Corr.=.757, $p<.0001$, $n=763$). This is reasonable as high seat belt use is often associated with habitual use. Although all other relationships were statistically significant, none had correlations that revealed a strong association among the variables.

Table 5.7 Correlations and Significance Values in Speeding and Seat Belt Use

	Q8A	Q8B	Q9
Q8A: SB Use in Town	1	**.757****	-.167**
		.000	.000
Q8B: SB Use Traveling Over 30 MPH		1	-.141**
			.000
Q9: Driving Over 70 MPH on a 65 MPH Road			1

**Correlation is significant at the 1% level

5.4 Impact of Public Awareness as a Safety Strategy: *ProgressZone: Moving Forward Safely*

The survey highlighted driver familiarity with the *ProgressZone: Moving Forward Safely* safety campaign through a series of questions. Drivers were asked whether they had read, seen, or heard the safety messages being promoted by the *ProgressZone: Moving Forward Safely* initiative. Drivers were also asked if they had subsequently changed their driving behavior after seeing such ads.

As a whole, 31.2% of respondents indicated that they had seen the bright yellow billboard advertisements. Of these drivers that had seen the safety messages, 42.9% said that they changed their driving behaviors as a result of the safety campaign. Thus, among all of the drivers within this sample, roughly 13.4% of respondents positively changed their driving behaviors as a direct result of the *ProgressZone: Moving Forward Safely* ads (Figure 5.3).

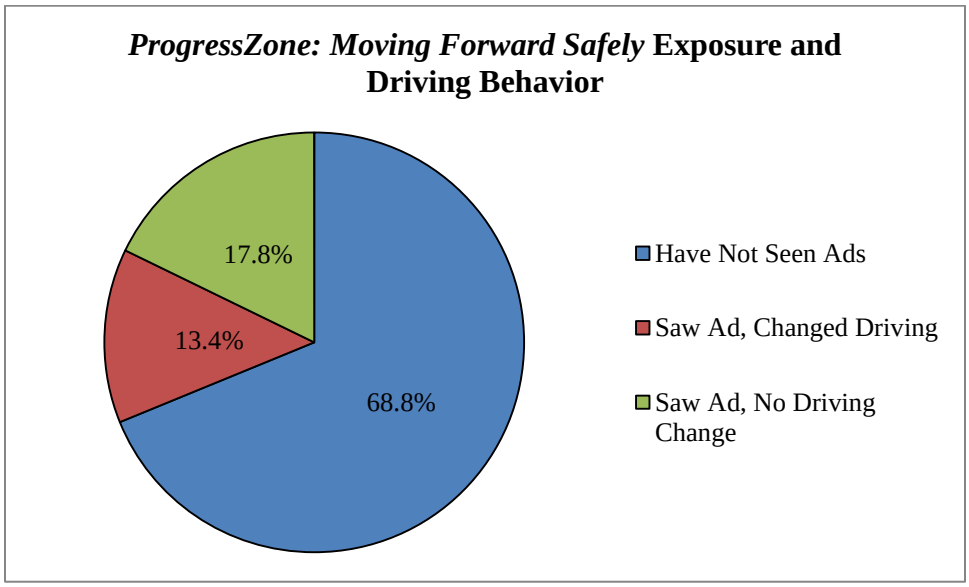

Figure 5.3 Exposure to *ProgressZone: Moving Forward Safely* Ads and Behavior Change

Although detail was not available about deployment of the *ProgressZone: Moving Forward Safely* campaign, exposure to safety messages on billboards appears to be linked with where drivers live within the oil region. Over half (56.2%) of all drivers who had seen a *ProgressZone: Moving Forward Safely* advertisement lived in Stark, Ward, and Williams counties. This suggests that *ProgressZone: Moving Forward Safely* may have been targeting these three counties – a logical conclusion given the fact that they are home to the three largest cities in the oil region: Dickinson, Minot, and Williston, respectively. Moreover, if McKenzie, Mercer, and Mountrail counties are included with the three aforementioned counties, the total proportion of drivers who saw the *ProgressZone: Moving Forward Safely* ads increases to 79.3% (Table 5.8). In other words, approximately four out of every five drivers who saw a *ProgressZone: Moving Forward Safely* ad lived in only 6 of the 17 western North Dakota oil counties.

In addition to asking respondents about their exposure to *ProgressZone: Moving Forward Safely* advertising, drivers were also asked if they had recently read, seen, or heard safety messages relating to four themes: passing with caution, slowing down, buckling up, and sharing the road. Although not explicitly stated in the survey, these four themes are the focus of the *ProgressZone: Moving Forward Safely* safety campaign. Results were mixed. Less than one-half of respondents had recently read, seen, or heard safety messages related to passing with caution and slowing down. More than four of every five drivers had read, seen, or heard safety advertisements related to buckling up, although this may have been due to other seat belt campaigns that reached the state of North Dakota. For example, the state of North Dakota is involved in a national campaign conducted by the USDOT referred to as *Click It or Ticket*. Because the state of North Dakota participates in this national campaign for local media placement and enforcement, it may explain why exposure levels to this message were especially high. Only 28.3% of drivers were exposed to traffic safety announcements concerning sharing the road (Table 5.9).

Table 5.8 Exposure to *ProgressZone: Moving Forward Safely* Ads, by County

	Q11: Did you change your driving behavior after seeing *ProgressZone: Moving Forward Safely* ads?						
COUNTY	YES (#)	NO (#)	YES* (%)	NO* (%)	DID NOT SEE ADS (#)	DID NOT SEE ADS (%)**	TOTAL (#)
Billings	2	0	100%	0%	3	60.0%	5
Bottineau	2	5	28.6%	71.4%	24	77.4%	31
Bowman	3	7	30.0%	70.0%	26	72.2%	36
Divide	1	4	20.0%	80.0%	2	28.6%	7
Dunn	3	6	33.3%	66.7%	10	52.6%	19
G. Valley	1	0	100%	0%	3	75.0%	4
McHenry	3	2	60.0%	40.0%	21	80.8%	26
McKenzie	7	13	35.0%	65.0%	28	58.3%	48
McLean	3	5	37.5%	62.5%	41	83.7%	49
Mercer	9	9	50.0%	50.0%	37	67.3%	55
Mountrail	8	10	44.4%	55.6%	45	71.4%	63
Renville	1	1	50.0%	50.0%	4	66.7%	6
Slope	0	1	0%	100%	3	75.0%	4
Stark	26	29	47.3%	52.7%	95	63.3%	150
Ward	13	12	52.0%	48.0%	64	71.9%	89
Williams	18	38	32.1%	68.9%	100	64.1%	156
Total	100	142			506		748

*"Yes" and "No" percentages calculated based on those who saw ads
**"Did Not See Ads" percentage calculated based on all responses from county
Frequency Missing: 31

Table 5.9 Exposure to Safety Messages

QUESTION		
Have you recently read, seen, or heard traffic safety ads relating to…	YES	NO
Passing with caution?	42.2%	57.8%
Slowing down?	46.2%	53.8%
Buckling up?	83.8%	16.2%
Sharing the road?	28.3%	71.7%

Exposure to these four safety messages came from a variety of media outlets. Roughly 37% of respondents indicated that billboards were the leading source of exposure to messages advising drivers to "pass with caution." About 14%, 12%, and 10% of drivers were exposed to this particular safety message via television, other public advertising, and radio advertising, respectively, with 23.2% of respondents learning about this safety message from two or more sources.

Table 5.10 Exposure to Safety Messages, by Counties with Most Exposure to *ProgressZone: Moving Forward Safely*

COUNTY	Pass with Caution		Slow Down		Buckle Up		Share the Road	
	Yes	No	Yes	No	Yes	No	Yes	No
Williams	45.5% (66)	54.5% (79)	51.7% (77)	48.3% (72)	84.9% (129)	15.1% (23)	31.5% (46)	68.5% (100)
Stark	42.3% (58)	57.7% (79)	45.1% (65)	54.9% (79)	84.8% (128)	15.2% (23)	27.0% (37)	73.0% (100)
Ward	26.5% (22)	73.5% (61)	32.9% (28)	67.1% (57)	79.1% (68)	20.9% (18)	26.2% (22)	73.8% (62)
Mountrail	38.7% (24)	61.3% (38)	50.8% (32)	49.2% (31)	69.8% (44)	30.2% (19)	26.7% (16)	73.3% (44)
Mercer	45.3% (24)	54.7% (29)	47.2% (25)	52.8% (28)	87.0% (47	13.0% (7)	45.3% (24)	54.7% (29)
McKenzie	58.0% (29)	42.0% (21)	43.8% (21)	56.3% (27)	76.0% (38)	24.0% (12)	22.9% (11)	77.1% (37)
All Others	41.7% (75)	58.3% (105)	46.3% (82)	53.7% (95)	90.1% (173)	9.9% (19)	24.4% (43)	75.6% (133)

Like exposure to "pass with caution" messages, the most common source of exposure to messages that relate to "slowing down" were from billboards. Roughly one-fourth of respondents indicated that they were exposed to these messages from billboards. About 17% and 16% of exposure to this safety message came from radio and television advertising, respectively. Roughly ten percent of respondents indicated that they learned about this safety message from other advertising sources. 7.9% of drivers read, saw, or heard about slowing down from a combination of television and radio sources.

Exposure to messages relating to "buckling up" came from many different combinations of sources. About two in every nine (22.3%) drivers read, saw, or heard traffic safety messages about buckling up from the television. Roughly one-fifth of drivers were exposed to this message from billboards. Approximately half (49.2%) of the respondents learned about buckling up from two or more sources. About one-eighth (12.2%) of drivers indicated that they learned about buckling up from a combination of television, radio, print, and billboard advertising. Among the four safety messages studied in this survey, buckling up was by far the most recognized by respondents. Again, this may be related to various seat belt campaigns that are currently being conducted. In addition to *ProgressZone: Moving Forward Safely*, the state of North Dakota is actively involved in a national seat belt campaign called *Click It or Ticket* that is currently being conducted by the USDOT. Since the state of North Dakota participates in this national campaign for local media placement and enforcement, it may explain exposure rates to this safety topic are much higher than other themes.

About a quarter of respondents indicated that television was the most common source of exposure to advertisements related to "sharing the road." Approximately one in five (18.6%) drivers learned about this safety strategy from billboards. Roughly 13% were exposed to this safety strategy from radio advertising. One-third (32.2%) of responses show that exposure to this particular safety message came from at least two different sources.

5.5 Driver-Reported Priorities

Drivers were asked to rank their priorities for four issues that may be targeted in traffic safety: improved road signage, increased law enforcement presence, heightened driver awareness, and education for truck/passenger car interaction. Road signage is important in providing drivers information needed for navigation and vehicle control (Rasanen and Hornberry 2006). Increased law enforcement presence has been proven as a traffic safety intervention that reduces crime, reduces the fear of a crime occurring, and provides the public with a greater sense of security and safety (NHTSA 2001). Driver awareness is also a critical element in traffic safety. Driver expectations, perceptions, and distractions can create a significant risk for both the driver and others on the road. The size/mass relationship of large trucks and passenger vehicles, along with operational differences such as acceleration/deceleration times and turning radiuses, heighten the risk of a crash taking place (UGPTI 2012). The survey asked drivers to rank these four issues on a scale from one to four, with one being least important and four being most important.

Results show that driver awareness is clearly seen as the most important issue to drivers. Over half, 58.4%, of respondents ranked it as most important of the four issues presented. Similarly, the lowest proportion, 5.9%, ranked driver awareness as least important. This congruity suggests that driver awareness is, in fact, the most important issue facing North Dakota drivers in the oil region (Figure 5.4).

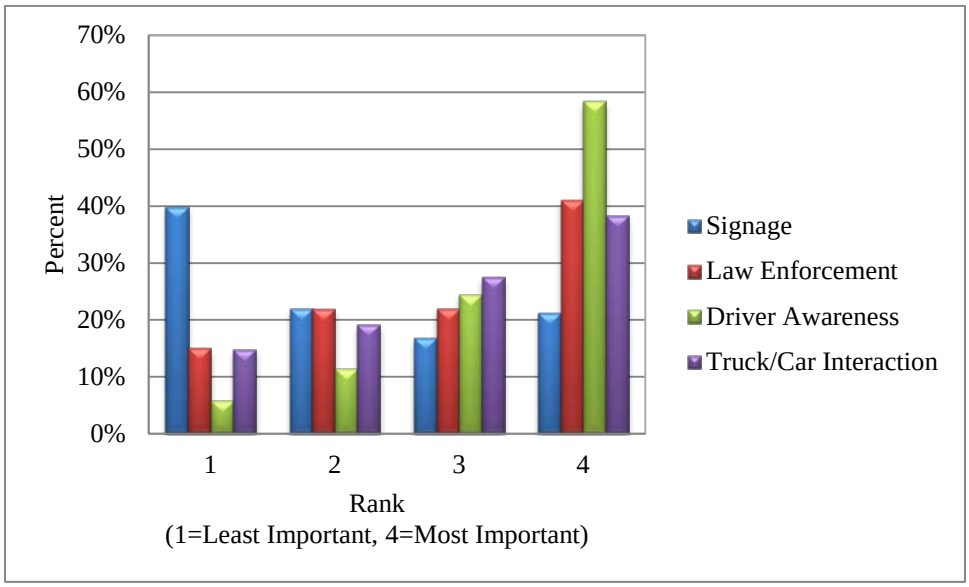

Figure 5.4 Driver Safety Priorities for Traffic Safety

A majority of drivers perceived three issues to be important, based on the proportion of those who ranked the issues as a 3 or 4, respectively. 63.1% of respondents ranked law enforcement presence as being either most important or second-most important. A similar proportion, 65.9%, ranked passenger vehicle/large truck interaction as their most important or second-most important issue. A clear majority, 83.0%, believed that driver awareness was a top priority.

Unlike these three issues, a majority of drivers did not think that signage related to traffic rules was of the highest priority. In fact, 62.0% of those sampled ranked signage related to traffic rules as either least important or second-least important among the issues presented to them. The proportion of individuals who ranked signage last was substantially higher than the other three issues presented in this section of the survey. Whereas only 15.0%, 5.9%, and 14.8% of respondents ranked law enforcement presence, driver awareness, and passenger vehicle/large truck interaction as the least important, respectively, 39.9% of those surveyed believed that signage related to traffic rules was least important as a traffic safety priority.

The mean values of traffic safety priorities reflect these findings. Given the ordinal scale used in the survey, the median value of responses is a theoretical 2.5. Thus, all mean values above 2.5 reflect a majority of respondents viewing that issue as either the most or second-most important issue. A mean value below 2.5 suggests that a majority of respondents view the safety issue as either the second-least or least important issue (Table 5.11).

Table 5.11 Mean Values of Traffic Safety Priorities

QUESTION	MEAN VALUE
How do you rank the following issues as priorities for traffic safety?	(1=Least 4=Most)
Signage related to traffic rules	2.2
Law enforcement presence	2.9
Driver awareness	3.4
Truck/passenger car interaction	2.9

In addition to general population insight, the potential to focus traffic safety efforts for more efficient resource use may be possible. For instance, some significant differences between males and females were found related to risk behaviors and tendencies. Of the questions posed in this survey, responses were found to be significantly different between men and women for six questions (Table 5.12). Perceptions of safety when passing large trucks or being passed by large trucks had statistically significant differences between men and women. For both passing and being passed by large trucks, women felt less safe than their male counterparts. Females tend to report safer driving practices than their male counterparts. Women have a higher tendency to wear their seat belts while traveling in town and on higher speed roads. Female driver responses for both using a seat belt in town and wearing a seat belt while traveling faster than 30 miles per hour were statistically significant at the 1% level, respectively ($t=-3.812$, $df=769$, $p<.001$; $t=-4.486$, $df=761$, $p<.001$).

Table 5.12 Differences in Mean Driver Views and Behaviors, by Gender

QUESTION	SCALE[1]	ALL DRIVERS	MALE	FEMALE	SIGNIFICANCE
Safety vs. 5 yrs. Ago	1-5	1.58	1.61	1.53	
Message system	0-1	0.27	0.28	0.26	
Sudden brake/swerve	0-1	0.73	0.75	0.71	
LE visibility	0-1	0.71	0.73	0.70	
Meet/pass trucks	1-5	4.69	4.74	4.61	**
Safe passing trucks	1-5	2.53	2.60	2.43	*
Safe being passed	1-5	2.24	2.25	2.23	
SB use in town	1-5	4.51	4.40	4.67	**
SB use over 30 MPH	1-5	4.72	4.63	4.85	**
Drive >70 in a 65	1-5	1.99	2.06	1.90	*
ProgressZone: Moving Forward Safely ads	0-1	0.31	0.31	0.31	
Passing with caution	0-1	0.42	0.45	0.38	
Slowing down	0-1	0.46	0.49	0.43	
Buckling up	0-1	0.84	0.82	0.86	
Sharing the road	0-1	0.28	0.30	0.26	
Signage to traffic rules	1-4	2.19	2.19	2.19	
LE presence	1-4	2.89	2.96	2.80	*
Driver awareness	1-4	3.35	3.34	3.37	
Truck/car interaction	1-4	2.89	2.87	2.92	

*Significant difference at the 5% level for Pearson's R 2-sided test
**Significant difference at the 1% level for Pearson's R 2-sided test
[1]Please refer to Table 5.1 Quantitative Scale Definitions for Responses

In addition to seat belt use, there were also statistically significant differences between how men and women perceive speeding and the presence of law enforcement personnel on the road. Based on this sample, men have a greater tendency to drive faster than 70 miles per hour on a road with a posted speed limit of 65 mph ($t=2.418$, $df=772$, $p=.016$). Clearly, men engage in dangerous driving behaviors more often than women. The final statistically significant difference between males and females relates to ranking law enforcement presence as a traffic safety priority. Men ranked law enforcement presence with a mean value of 2.96, suggesting that it is a very important traffic safety influence for this particular group. Similarly, women ranked the presence of law enforcement personnel slightly lower – its mean was 2.80 among those sampled – but the difference between the two groups was statistically significant at the 5% level ($t=1.969$, $df=755$, $p=.049$).

Table 5.13 highlights mean response values by the seven age groups studied in this survey. The table suggests that extreme values tend to be associated with the youngest and oldest age cohorts, respectively. Of the 19 variables studied, eight (42.1%) have statistically significant differences between reported mean values across all age groups. Clearly, as indicated by this sample, age is a determinant of views and behaviors related to driving safety.

Table 5.13 Mean Values of Responses, by Age

QUESTION	SCALE[1]	AGE GROUP AND CORRESPONDING MEAN VALUE						
		18-24[#]	25-34	35-44	45-54	55-64	65-74	75+
Safety vs. 5 yrs. Ago	1-5	1.4**	1.4**	1.3**	1.5**	1.6**	1.6**	1.9**
Message system	0-1	0.3	0.2	0.2	0.3	0.2	0.3	0.4
Sudden brake/swerve	0-1	1.0**	0.8**	0.9**	0.8**	0.7**	0.7**	0.5**
LE visibility	0-1	0.4*	0.7*	0.7*	0.7*	0.7*	0.8*	0.8*
Meet/pass trucks	1-5	4.9**	4.8**	4.9**	4.8**	4.7**	4.6**	4.3**
Safe passing trucks	1-5	2.0	2.5	2.4	2.5	2.5	2.6	2.6
Safe being passed	1-5	1.9	2.1	2.1	2.2	2.2	2.3	2.5
SB use in town	1-5	3.8	4.6	4.5	4.5	4.5	4.5	4.7
SB use over 30 MPH	1-5	4.7	4.7	4.7	4.7	4.7	4.7	4.8
Drive >70 in a 65	1-5	2.7**	2.3**	2.5**	2.1**	1.9**	1.8**	1.7**
ProgressZone: Moving Forward Safely ads	0-1	0.3**	0.3**	0.4**	0.3**	0.4**	0.3**	0.1**
Passing with caution	0-1	0.4	0.3	0.4	0.4	0.4	0.5	0.4
Slowing down	0-1	0.4	0.4	0.4	0.4	0.4	0.5	0.5
Buckling up	0-1	0.8	0.8	0.8	0.8	0.8	0.8	0.9
Sharing the road	0-1	0.3	0.3	0.2	0.3	0.3	0.2	0.2
Signage, traffic rules	1-4	2.3**	1.9**	1.9**	2.1**	2.1**	2.5**	2.5**
LE presence	1-4	2.3**	2.7**	2.8**	2.8**	2.9**	3.2**	2.9**
Driver awareness	1-4	3.4	3.4	3.3	3.3	3.4	3.4	3.4
Truck/car interaction	1-4	2.8	2.7	2.8	2.9	2.9	3.0	2.8

*Relationship is statistically significant at the 5% level across age groups
**Relationship is statistically significant at the 1% level across age groups
#Estimate may be uncertain due to limited sample size from this demographic
[1]Please refer to Table 5.1 Quantitative Scale Definitions for Responses

Knowing that views and behaviors towards safety vary significantly across age groups is useful in targeting specific demographics with safety messages and intervention strategies. For example, the need to suddenly brake or swerve to avoid a crash appears to decrease with age. Perhaps more attention needs to be given to younger drivers with regard to defensive driving techniques. Similarly, older drivers were significantly less likely to have recognized messages about *ProgressZone: Moving Forward Safely* and its safety initiatives (F=3.685, df=6, p=0.001). This difference suggests that there is some disconnect between how the elderly driver population learned about *ProgressZone: Moving Forward Safely* and how the other age groups became familiar with it. Another important area to notice is that younger drivers were less likely to think that increased law enforcement visibility reduces crashes (F=2.170, df=6, p=0.044). Traffic safety messages relating to law enforcement presence is clearly less influential on younger drivers than on their older counterparts.

6. CRASH DATA

In addition to survey data, crash reports were collected for the 17 western North Dakota oil counties from 2004 to 2011. Rural road data was queried specifically to track the total number of crashes, the number of vehicles involved in each crash, large truck crash rates, and crash severity – including injuries, fatalities, or property-damage-only (PDO) crashes. The results of the crash data are compelling: nearly all crash statistics have increased considerably since 2004, with spikes in every major crash statistic occurring in 2011.

For all 17 western oil counties, fatalities increased 118.5% from 2004 to 2011. During the time frame studied, the lowest number of fatalities, 27, occurred in 2004 and the highest number, 59, occurred in 2011 (Figure 6.1). Although there were instances in 2006 – 2007 and 2009 – 2010 in which the number of fatalities decreased from the previous year, the overall trend in western North Dakota oil county fatality rates suggests that the increase in traffic fatalities has coincided with the increase in oil development. This may explain why many respondents in the survey indicated that they felt less safe driving presently compared to how they felt driving just five years ago.

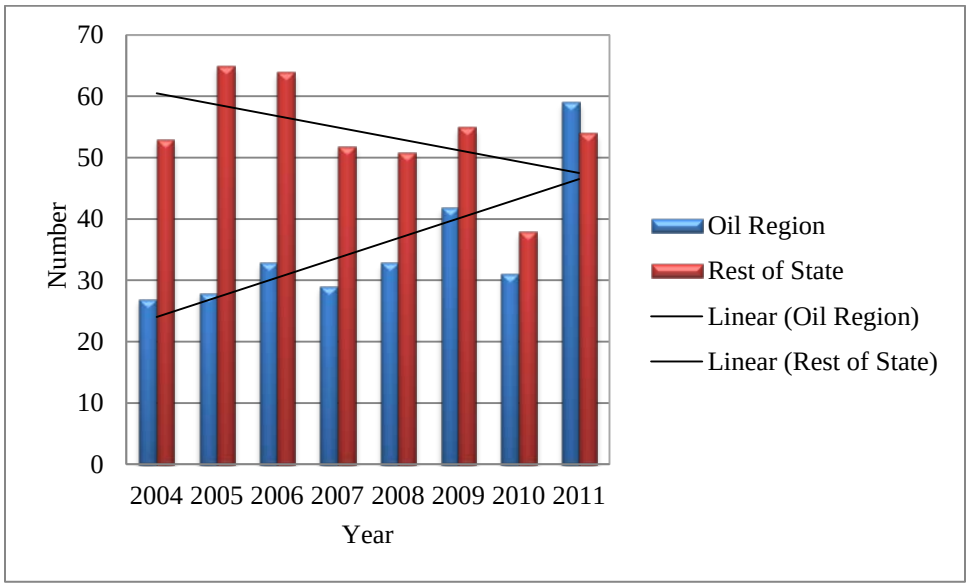

Figure 6.1 Total Number of Fatalities, 2004 - 2011

Compared to the rest of the state, traffic fatality trends in the oil region differ – non-statistically proven trend lines are included to illustrate the contrast. Whereas the number of traffic fatalities in the oil region more than doubled compared to 2004 and peaked in 2011, the number of traffic fatalities in the rest of the state remained relatively stable and peaked in 2005. One similarity between the oil region and the rest of the state is that both groups had a spike in the number of fatalities that occurred in 2011 compared to 2010: fatalities in the oil region jumped from 31 to 59 and fatalities in the rest of the state increased from 38 to 54.

Similarly, 2011 was the only year in the time frame studied in which the number of traffic fatalities in the oil region outpaced the number of traffic fatalities in the rest of the state. This is especially alarming given the underlying population and the annual vehicle miles traveled

(VMT) attributed to the two groups. The 17 oil counties have a population of 167,901, which is one-third the size of the rest of the state (504,690). Thus, in the 17 county oil region, there were 35.1 fatalities per 100,000 individuals, much greater than the 10.7 fatalities per 100,000 individuals that took place in the rest of the state in 2011. Moreover, the 17 oil counties had a smaller share of North Dakota's annual vehicle miles traveled (3,329,980,000) compared to the rest of the state (5,836,306,000). The 17 county region experienced 1.77 fatalities per 100 million VMT in 2011, a rate that was almost twice as high as the rest of the state which had 0.93 fatalities per 100 million VMT. Both statistics suggest that driving was more dangerous in the oil counties than in the rest of North Dakota. Note that fatalities, while increasing, are still largely episodic in nature and are difficult to use for assessing traffic safety issues and strategies.

Like fatalities in the western oil region, injuries that result from car crashes have increased significantly as well (Figure 6.2). During the 2004 to 2011 time frame studied in this report, the total number of non-fatal injuries resulting from traffic crashes in oil counties increased 149% from 295 to 735. The total number of non-fatal injuries in the 17 western oil counties increased every year from 2005 to 2011 and may be a direct factor in why some drivers surveyed feel less safe and favor increased driver awareness and more law enforcement presence as potential strategies to lower overall crash rates.

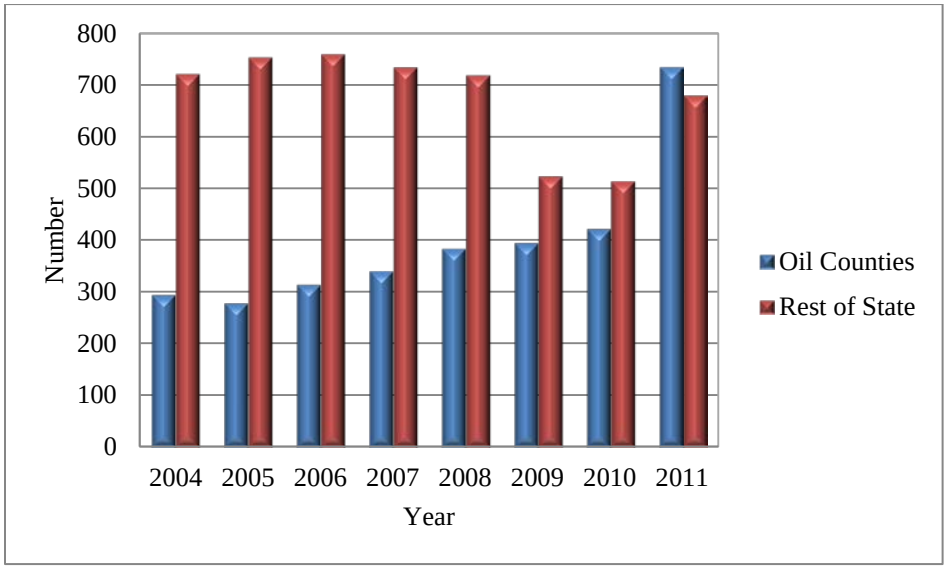

Figure 6.2 Total Number of Injuries, 2004 - 2011

The total number of non-fatal injuries in the rest of the state, however, decreased 5.8% from 722 injures in 2004 to 680 injuries in 2011. Both the 17 county oil region and the rest of the state had experienced spikes in the total number of injuries resulting from crashes between 2010 and 2011. The first and only year in the time period studied in which there were more injuries in the oil region than there were in the remainder of the state was 2011. Based on population figures, there were 437.8 injury crashes per 100,000 individuals in the 17 oil counties in 2011. This rate was much higher than the 134.7 injury crashes per 100,000 individuals that took place in the rest of the state. Similarly, there were 22.1 injury crashes per 100,000,000 VMT in the oil counties, almost twice as many as in other parts of the state (11.7 injury crashes per 100,000,000 VMT).

These numbers suggest that driving was more dangerous in 2011 in the oil region than it was in the rest of North Dakota.

With increases in oil development come increases in the number of trucks and heavy machinery required to extract and transport natural resources. As one would expect, a higher number of oil wells and increased production has led to an increased prevalence of large trucks. This has resulted in a higher propensity for trucks to become involved in traffic crashes. The representation in terms of exposure is not known since VMT is not reported by vehicle class for the 17 oil counties. The eight year data trend for large trucks involved in crashes appears to mirror that of an exponential growth curve (Figure 6 3). From 2004 to 2011 the total number of large trucks involved in crashes increased just over 483%. Within the last three years alone there has been a 210% increase in the total number of trucks involved in a crash.

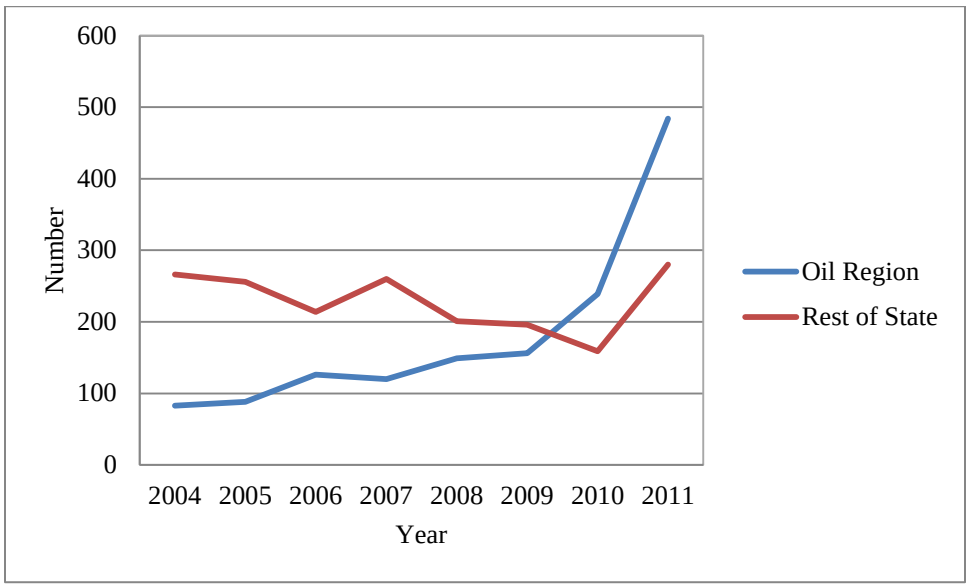

Figure 6.3 Large Truck Crash Trends, 2004 - 2011

In addition to all 17 western oil counties, one can investigate how crash trends differ among counties within the region. The five counties with the highest increases in crash rates per 100,000 population between 2004 and 2011, considering all traffic crash events, were McKenzie, Dunn, Mountrail, Burke, and Williams, respectively (Figure 6.4). All five counties had similar experiences over the time frame studied: the total number of crashes remained relatively stable from 2004 to 2009 but spiked in the period immediately following 2009. Over the eight years studied, the crash rate in McKenzie County more than tripled from 1,903 crashes per 100,000 population in 2004 to 6,038 crashes per 100,000 population in 2011. Burke County had the smallest increase in crash incidence among these five counties, although crash rates more than doubled from 1,677 per 100,000 in 2004 to 3,506 per 100,000 in 2011.

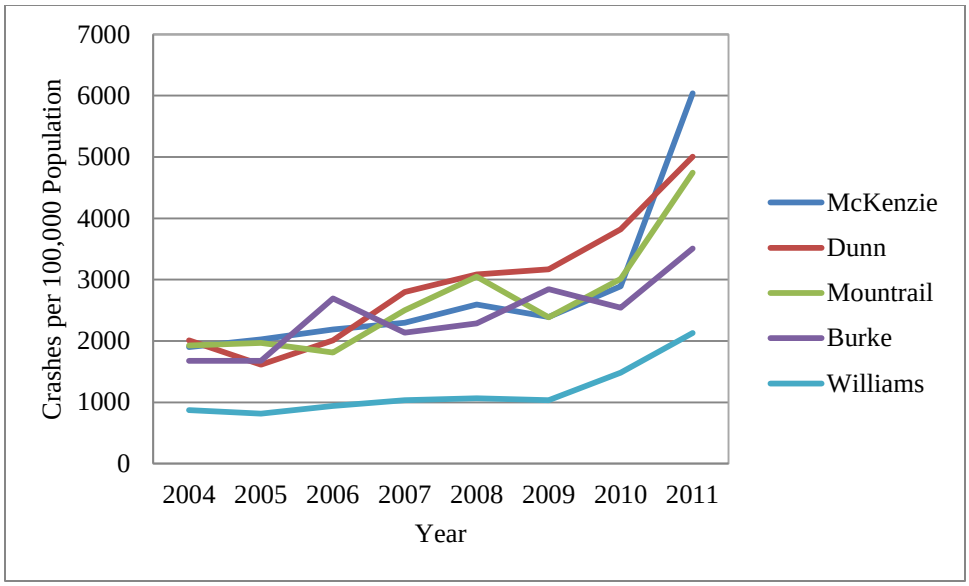

Figure 6.4 Increases in Total Traffic Crashes, by County

Note that six counties in the oil region had decreased crash rates per 100,000 population between 2004 and 2011 (Figure 6.5). Bottineau County had the most significant decrease between 2004 and 2011. Whereas this county had a crash rate of 3,578 per 100,000 population in 2004, there were only 1,944 crashes per 100,000 population in 2011, a decrease of 45.7%. Mercer County had numbers comparable to those in Bottineau County: from 2004 to 2011 the total number of crashes per 100,000 population decreased from 2,564 to 1,531, a 40.3% reduction. Of these six counties, McHenry County had the lowest rate of crash improvement. The number of crashes per 100,000 population in 2004 and 2011 only decreased from 4,115 to 3,448. Nonetheless, that was a 16.2% reduction and a stark contrast to the other 11 counties in the region. Although all six of these counties reduced the total number of crashes from 2004 to 2011, the short-term trend from 2010 to 2011 parallels the rest of the region. Just as other counties in the region saw a drastic spike in crash rates during the 2010 to 2011 time frame, these six counties either had moderate spikes or virtually no change in crash rates during this period.

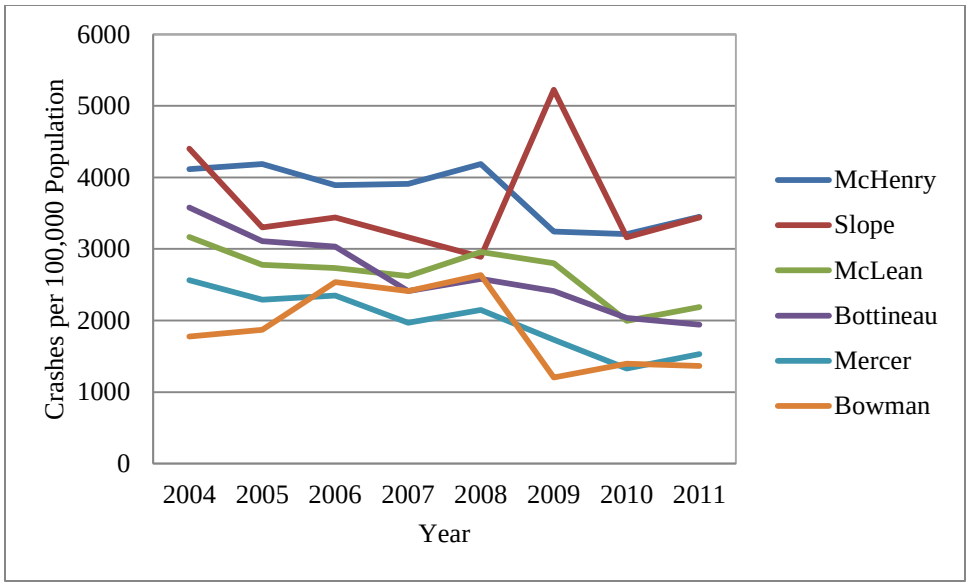

Figure 6.5 Decreases in Total Traffic Crashes, by County

7. CONCLUSION

It is evident that the driving environment in the 17 western North Dakota oil counties is noticeably different than in other parts of the state. Whereas other parts of the state have experience traffic growth related to many different factors, this particular area of the state has seen extensive growth surrounding one specific issue: the development of the oil industry. This development has coincided with drastic increases in population, job opportunities, and economic prosperity. As individuals flock to the 17 western oil counties, increased traffic including more personal vehicles, large trucks, oil trucks, and heavy machinery is being experienced.

As a whole, responses from the survey show that local residents in the oil region perceive driving conditions to be unsafe. Most drivers believed that to improve safety on oil roads law enforcement presence needs to be increased. In addition to perceptions, responses indicate that some behaviors – such as seat belt use and speeding – can be improved via greater compliance. It is undeniable that *ProgressZone: Moving Forward Safely*, an initiative geared specifically towards encouraging safe driving behaviors in the oil region, has had some positive influence. Although not directly recognized by a majority of the residents surveyed, its core messages of passing with caution, slowing down, buckling up, and sharing the road were widely recognized by drivers, perhaps in conjunction with other driver safety efforts. Drivers did reportedly change behaviors after exposure to these messages.

An examination of crash data in the 17 county oil region revealed that the total number of crashes, injuries, fatalities, PDO crashes, and the number of large trucks involved in crashes has increased substantially since 2004. Some crash patterns, such as the total number of large trucks involved in crashes, appear to be increasing at a rate comparable to that of an exponential growth curve. Moreover, every major crash statistic has seen a considerable spike between 2009 and 2011. This likely has a direct impact on driver views, attitudes, behaviors, and perceptions and may go hand-in-hand with why many drivers view roads in the oil region as being unsafe.

It should be reiterated that not all individual counties within the oil region had worsening crash statistics from 2004 to 2011 using 2004 as a baseline year. However, all 17 counties within the oil region had either a spike in crash rates or little-to-no improvement between 2010 and 2011, suggesting driving conditions in the region during this most recent interval were particularly dangerous. Based on projections for continued oil drilling and extraction at this heightened level, the higher-density, industrial driving environment is expected to continue. Therefore, public safety efforts focused on traffic safety are necessary to slow and reverse current trends in crash injury and economic loss.

8. DISCUSSION

Future research can be improved by integrating more responses from specific groups into the survey. Although the survey was mailed to numerous residents in the 17 western North Dakota oil counties, responses varied greatly from county-to-county. Billings, Burke, Divide, Dunn, Golden Valley, McHenry, Renville, and Slope counties all had fewer than 30 responses. Thus, the responses obtained from these areas could not be extrapolated to fit the rest of the population and should not be considered representative of the true sentiments and perceptions held by drivers from those respective counties. Similarly, there were not enough responses from the 18-24 age cohort to consider their responses as representative of the entire 18-24 population in the oil region. Future research could benefit by intentionally over-sampling these groups in order to ensure that all demographics within the oil region are included. In addition, focus groups with communities or businesses may be useful in gaining additional insight.

In addition, future research may benefit from integrating non-North Dakota residents into this survey through creel techniques or private company participation. The boom of the oil industry in western North Dakota has attracted temporary workers and businesses from Canada, Montana, South Dakota, eastern North Dakota, Minnesota, and other areas as well. Including non-western North Dakotans would provide an outside voice to better understand if perceptions of poor driving conditions are accurate across all residents or if they are simply a product of locals experiencing changing driving conditions firsthand.

While new insights may be gained with future driver contact, it seems prudent to expand or discuss alternative strategies for increasing travel safety in the oil region. Public health outreach using the *ProgressZone: Moving Forward Safely* platform may be one outlet for delivering the message, especially to females and older drivers. Work with private companies in educating their workers about safe practices for maneuvering in traffic with increasing truck density may be another beneficial endeavor. If not already identified in the deployment, school and community events may also be good venues for reaching young drivers with messages specific to oil region traffic safety issues such as how to safely interact with trucks.

Beyond the public awareness and education strategies, deterrence methods may be considered based on successful experiences elsewhere. For instance, traffic surcharges may be useful in discouraging risky driving behavior such as driving too fast, following too close, and improper passing. Some jurisdictions have successfully instituted surcharges on existing traffic fees for moving violations. The surcharges collected are generally then dedicated to an associated cause such as emergency medical services or traumatic brain injury fund. An example is Douglas County, Colorado where a Victim Assistance and Law Enforcement (VICE) surcharge is assessed on each traffic violation – Douglas County Ordinance 999-002 (Douglas County Sheriff 2012). If a driver is cited for three traffic violations on a citation, the assessment totals $30 with a surcharge of $10 applied for each violation. All surcharges collected are dispersed to local programs that provide services to crime victims. If one of the violations is speeding, an additional surcharge applies. The state of Colorado collects a $12 surcharge for each speeding citation. These funds are dedicated to the Colorado Traumatic Brain injury fund (U.S. Department of Health and Human Services 2006). In Texas, the Driver Responsibility Program is governed by the Texas Transportation Code, Chapter 708. An annual surcharge of $100 is

assessed for three years following offenses such as impaired driving, driving under an invalid license, and driving without insurance. The Trauma Center and Texas General Revenue Funds receive 99% of the funds collected, 1% is provided to the Transportation Department for Program Administration. Another example of the driver responsibility assessment is found in New York where anyone convicted of an alcohol or drug related traffic offense must pay $250 for three years (New York Department of Motor Vehicles 2012).

Operational solutions may also be discussed. Given the 40% of drivers were willing to substantially increase the distance driven to avoid trucks, passenger- or truck-only routes or one-way traffic may be useful in certain situations or during selected time intervals. Public education and awareness regarding this type of change would be crucial. In additional to operational interventions, increased use of roadway safety enhancements such as clear zone, intersection lighting, edge lines, and rumble stripes could also be considered. The ability of counties to pool needs in contracting as a group or joining into a state services contract may accelerate these types of investments.

Finally, the ability of counties to share best practices and supplement efforts to manage heavy trucks in order to maintain roads in good condition may contribute to longer-term road safety. Road degradations, both paved and gravel, is widespread. While enforcement efforts are led by the state, several counties have begun their own efforts. Sharing best practices and standards related to these efforts may be useful for those already engaged and for counties or locales that are considering similar strategies.

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APPENDIX A. SURVEY INSTRUMENT

2012 Oil County Traffic Safety Survey

Individual Responses Kept Confidential.

1. How safe do you feel driving in your area compared to five years ago?
   ☐ Much Safer ☐ Somewhat Safer ☐ Same ☐ Less Safe ☐ Much Less Safe

2. Would you pay for a messaging system to alert drivers of heavy traffic or incidents to help drivers? ☐ Yes ☐ No

3. Have you had to brake suddenly or swerve to avoid a crash in the past 3 months? ☐ Yes ☐ No

4. Do you think more law enforcement visibility would reduce crashes? ☐ Yes ☐ No

5. How often do you meet/pass large trucks while driving?
   ☐ Daily ☐ Few Times per Week ☐ Few Times per Month ☐ Less than Once per Month ☐ Never

6. How safe do you feel when…
   passing large trucks? ☐ Very Safe ☐ Somewhat Safe ☐ Neutral ☐ Unsafe ☐ Very Unsafe
   being passed by large trucks? ☐ Very Safe ☐ Somewhat Safe ☐ Neutral ☐ Unsafe ☐ Very Unsafe

7. For a trip that typically takes you 20 minutes, how much longer would you drive to travel a route with…
   fewer large oil trucks? ☐ 5 minutes ☐ 10 minutes ☐ 20+ minutes ☐ I would not change my travel time
   better signage and surface conditions? ☐ 5 minutes ☐ 10 minutes ☐ 20+ minutes ☐ I would not change my travel time

8. How often do you use your seat belt
   while traveling in town? ☐ Always ☐ Nearly Always ☐ Sometimes ☐ Rarely ☐ Never
   when in a vehicle traveling over 30 mph? ☐ Always ☐ Nearly Always ☐ Sometimes ☐ Rarely ☐ Never

9. On a road with a speed limit of 65 mph, how often do you driver faster than 70 mph?
   ☐ Always ☐ Nearly Always ☐ Sometimes ☐ Rarely ☐ Never

10. The North Dakota Department of Transportation began a safety program called "Progress Zone" with industry partners. It uses advertisements and billboards to promote better driving. The ads are bright yellow and have short messages on them. Have you seen ads like this one? ☐ Yes ☐ No

11. Did you change your driving behavior after seeing "Progress Zone" ads? ☐ Yes ☐ No ☐ Did Not See Ads

12. Have you recently read, seen, or heard traffic safety ads relating to:

Passing with caution	☐ Yes	☐ No	If yes, where?	☐ TV	☐ Radio	☐ Print	☐ Billboard	☐ Other
Slowing down	☐ Yes	☐ No	If yes, where?	☐ TV	☐ Radio	☐ Print	☐ Billboard	☐ Other
Buckling up	☐ Yes	☐ No	If yes, where?	☐ TV	☐ Radio	☐ Print	☐ Billboard	☐ Other
Sharing the road	☐ Yes	☐ No	If yes, where?	☐ TV	☐ Radio	☐ Print	☐ Billboard	☐ Other

13. How do you rank the following issues as priorities for traffic safety? (1=most important and 4 being least important).

	Rank
Signage related to Traffic Rules	_____
Law Enforcement Presence	_____
Driver Awareness	_____
Truck/Passenger Car Interaction	_____

14. What type of road do you most often drive? ☐ Interstate/Divided Highway ☐ Two-Lane State Highways ☐ Rural/Gravel

15. How long have you lived at your current residence? _____Years

16. Your age: ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65-74 ☐ 75 or Older

17. Your Gender: ☐ Male ☐ Female

18. Your Zip Code: _____

ıclude any comments on the back of the survey.

Thank you for Participating!

APPENDIX B. MISSING RESPONSES

Q#	Question	Total Responses	Missing Responses
	Perceptions of Safety		
Q1	Safety Compared to 5 Years Ago	772	7
Q2	Pay for Message System	724	55
Q3	Sudden Brake/Swerve	771	8
Q4	Law Enforcement Visibility	750	29
	Passenger Vehicle/Large Truck Interaction		
Q5	Meet/Pass Large Trucks	776	3
Q6a	Safety Passing Large Trucks	768	11
Q6b	Safety Being Passed by Large Trucks	759	20
Q7a	Longer Route with Fewer Trucks	737	42
Q7b	Longer Route with Better Conditions	725	54
	Behavior		
Q8a	Seat Belt Use in Town	773	6
Q8b	Seat Belt Use Driving Over 30 MPH	764	15
Q9	Speed in 65 MPH Zone	776	3
	ProgressZone: Moving Forward Safely		
Q10	*ProgressZone: Moving Forward Safely* Exposure	768	11
Q11	*ProgressZone: Moving Forward Safely* Influence	760	19
Q12a	RSH Passing with Caution	714	65
Q12b	RSH Slowing Down	723	56
Q12c	RSH Buckling Up	752	27
Q12d	RSH Sharing the Road	706	73
	Driving Priorities		
Q13a	Signage of Traffic Rules	757	22
Q13b	Law Enforcement Presence	759	20
Q13c	Driver Awareness	758	21
Q13d	Truck/Passenger Car Interaction	756	23

Total n=779