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DIRECT OBSERVATION OF SAFETY BELT USE IN MINNESOTA: FALL 2003

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Consultant's Report

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INTRODUCTION

The safety belt is the single most effective in-vehicle device for reducing injury severity from a motor vehicle crash. The National Highway Traffic Safety Administration (NHTSA, 1999) estimates that use of safety belt can reduce the likelihood of a motor vehicle fatality by as much as 50 percent. These safety benefits, unfortunately, are only realized if the safety belt is used. Nationwide, only about 75 percent of front-seat motor-vehicle occupants use safety belts (Glassbrenner, 2002), with back-seat use probably even less frequent (Eby, Kostyniuk, & Vivoda, 2001).

In an effort to raise safety belt use nationwide, NHTSA encourages individual states to focus on this issue by sponsoring innovative programs within states such as the recent "Click-It or Ticket" campaign (NHTSA, 2002a). Minnesota has participated in these (Eby & Vivoda, 2003), and other, programs to increase use of safety belts in the state.

So that Minnesota can track the effectiveness of safety belt promotion efforts, the Minnesota Office of Traffic Safety (OTS) conducts a yearly statewide direct-observation survey of safety belt use. This year, the OTS decided to completely overhaul the sample design and methods used in their direct-observation survey. Toward this end they selected EPIC•MRA and consultants from the University of Michigan Transportation Research Institute to design a statewide direct observation survey following NHTSA guidelines for this type of survey (NHTSA, 1992, 1998c). This report documents the survey design, methods, data analysis, and results.

METHODS

Sample Design

The goal of this sample design was to select observation sites that accurately represent front-outboard vehicle occupants in eligible commercial and noncommercial vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) in Minnesota, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites that can be surveyed efficiently and economically. To achieve this goal, NHTSA guidelines allow states to omit from their sample space the lowest population counties, provided these counties collectively account for 15 percent or less of the state's total population. Therefore, all 87 Minnesota counties were rank ordered by population (US Census Bureau, 2003) and the low population counties were eliminated from the sample space. This step reduced the sample space to 37 counties.

These 37 counties were then separated into four strata. The strata were constructed by obtaining historical belt use rates and vehicle miles of travel (VMT) for each county. Historical belt use rates were determined by examining results from three previous statewide safety belt surveys conducted in Minnesota. Since no historical data were available for 22 of the counties, belt use rates for these counties were estimated using multiple regression based on educational attainment for the other 15 counties ($r^2 = .35$; US Census Bureau, 2003).[1] This factor has been shown previously to correlate positively with belt use. Hennepin County was chosen as a separate stratum because of its disproportionately high VMT. Three other strata were constructed by rank ordering each county by historical belt use rates and then adjusting the stratum boundaries until the total VMT was roughly equal within each stratum. The stratum boundaries were high belt use, medium belt use, low belt use, and Hennepin County. Hennepin County was selected as a separate strata because of the very high VMT in the strata and so that safety belt use VMT within Hennepin County could be calculated separately. Hennepin County VMT was slightly lower than the collective VMTs in the other strata

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1 Educational attainment was defined as the proportion of population in the county over 25 years of age with a bachelor degree.

(94%). Stratum boundaries for the sample space are shown in Table 1.

To achieve the NHTSA required precision of less than 5 percent relative error, the minimum number of observation sites for the survey was determined based on within- and between-county variances from previous belt use surveys and on an estimated 50 vehicles per observation period in the current survey. This number was then increased (N = 240) to get an adequate representation of belt use for each day of the week and for all daylight hours.

Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (60 each). In addition, since an estimated 29 percent of all traffic in Minnesota occurs on limited-access roadways (Federal Highway Administration, 2002), each stratum was further divided into two strata, one of which contained 17 limited access sites (exit ramps) and one that contained 43 roadway intersections. Thus, the sample design had a total of 8 strata.

Table 1: Listing of the Counties Within Each Stratum

Stratum	Counties
High Belt Use **Stratum 1: intersections** **Stratum 5: exit ramps**	Carver, Dakota, Olmsted, Ramsey, Wright
Hennepin **Stratum 2: intersections** **Stratum 6: exit ramps**	Hennepin
Medium Belt Use **Stratum 3: intersections** **Stratum 7: exit ramps**	Beltrami, Blue Earth, Clay, Crow Wing, Freeborn, Goodhue, Kandiyohi, Nicollet, Rice, Scott, Sherburne, St. Louis, Steele, Washington
Low Belt Use **Stratum 4: intersections** **Stratum 8: exit ramps**	Anoka, Becker, Benton, Brown, Carlton, Cass, Chisago, Douglas, Isanti, Itasca, McLeod, Morrison, Mower, Otter Tail, Polk, Stearns, Winona

Within each intersection stratum, observation sites were randomly assigned to a location using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county within the sample space were obtained and a grid pattern was overlaid on the maps. The lines of the grid were separated by 1/4 inch, thus creating grid squares that were about 3/4 of a mile per side. The grid patterns were creating by printing a grid design onto transparencies and uniquely identifying each grid square by two numbers, a horizontal (*x*) coordinate and a vertical (*y*) coordinate. Additional grid transparencies were printed until enough were available to cover all counties within the stratum. Each transparency was numbered to allow for a simpler grid square numbering scheme.

The 43 local intersection sites were chosen by first randomly selecting a transparency number and then a random *x* and a random *y* coordinate within the identified transparency grid sheet. If a single intersection was contained within the square, that intersection was chosen as an observation site. If the square did not fall within the stratum, or there was no intersection within the square, then a new transparency number and *x*, *y* coordinate were randomly selected. If more than one intersection was within the grid square, the grid square was subdivided into four equal sections and a random number between 1 and 4 was selected until one of the intersections was chosen. Thus, each intersection within the stratum had an equal probability of selection.

Once a site was chosen, the following procedure was used to determine the particular street and direction of traffic flow that would be observed. For each intersection, all possible combinations of street and traffic flow were determined. From this set of observer locations, one location was randomly selected with a probability equal to 1/number of locations. For example, if the intersection, was a "+" intersection, as shown in Figure 1, there would then be four possible combinations of street and direction of traffic flow to be observed (observers watched traffic only on the side of the street on which they were standing). In Figure 1, observer location number one indicates that the observer would watch southbound traffic and stand next to Main Street. For observer location number two, the observer would watch eastbound traffic and stand next to Second Street, and so on. In this example, a random number between 1 and 4 would be selected to determine the observer location for this specific site. The probability of selecting an intersection approach is dependent upon the type of intersection. Four-legged intersections like that shown in Figure 1 have four possible observer locations, while three-legged intersections like "T" and "Y" intersections have only three possible observer locations. The effect of this slight difference in probability accounts for .01 percent or less of the standard error in the belt use estimate.

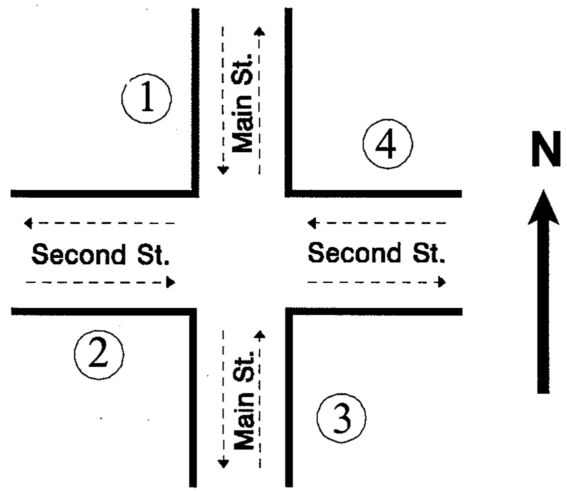

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations .

For each primary intersection site, an alternate site was also selected. The alternate sites were chosen within a five square mile area around the grid square containing the original intersection. This was achieved by randomly picking an *x*, *y* grid coordinate within an alternate site grid transparency consisting of 7 squares horizontally by 7 squares vertically, centered around the primary site. Coordinates were selected until a grid square containing an intersection was found. The observer location at the alternate intersection was determined in the same way as at the primary site.[1]

The 17 freeway exit ramp sites for the exit ramp strata were also selected using a method that allowed equal probability of selection for each exit ramp within the stratum.[2] This was done by enumerating all of the exit ramps within a stratum and randomly

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[1] For those interested in designing a safety belt survey for their county or region, a guidebook and software for selecting and surveying sites for safety belt use is available (Eby, 2000) by contacting UMTRI -SBA, 2901 Baxter Rd., Ann Arbor, MI 48109-2150, or accessing http://www-personal.umich.edu/~eby/sbs.html/.

[2] An exit ramp is defined here as egress from a limited-access freeway, irrespective of the direction of travel. Thus, on a north-south freeway corridor, the north and south bound exit ramps at a particular cross street are considered a single exit ramp location.

selecting, without replacement, 17 numbers between 1 and the number of exit ramps in the stratum. For example, in the low belt use stratum there were a total of 75 exit ramps; therefore a random number between 1 and 75 was generated. This number corresponded to a specific exit ramp within the stratum. To select the next exit ramp, another random number between 1 and 75 was selected with the restriction that no previously selected numbers could be chosen. Once the exit ramps were determined, the observer location for the actual observation was determined by enumerating all possible combinations of direction of traffic flow and sides of the ramp on which to stand. As in the determination of the observer locations at the roadway intersections, the possibilities were then randomly sampled with equal probability. The alternate exit ramp sites were selected by taking the first interchange encountered after randomly selecting a direction of travel along the freeway from the primary site. If this alternate site was outside the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used.

After all sites and standing locations were randomly selected, both intersection and exit ramp sites were visited by a researcher prior to the beginning of data collection to determine their usability. If an intersection site had no traffic control device on the selected direction of travel, but had traffic control on the intersecting street, the researcher randomly picked a new standing location using a coin flip. If an exit ramp site had no traffic control on the selected direction of travel, the researcher randomly picked a travel direction and lane that had such a device.

The day of week and time of day for site observations were quasi-randomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 6:00 pm) had essentially equal probability of selection. The sites were observed using a clustering procedure. That is, sites that were located spatially adjacent to each other were considered to be a cluster. Within each cluster, a shortest route between all of the sites was decided (essentially a loop) and each site was numbered. An observer watched traffic at all sites in the cluster during a single day. The day in which the cluster was to be observed was randomly determined. After taking into consideration the time required to finish all sites before dark, a random starting time for the day was selected. In addition, a random number between one and the number of sites in the cluster was selected. This number determined the site within the cluster where the first observation would take place. The observer then visited sites following a clockwise or counter-clockwise loop. The direction of the loop was determined by the project manager prior to sending the observers into the field. Because of various scheduling limitations (e.g., observer availability, number of hours worked per week) certain days and/or times were selected that could not be observed. When this occurred, a new day and/or time was randomly selected until a usable one was found. The important issue about the randomization is that the day and time assignments for observations at the sites were not correlated with belt use at a site. This quasi-random method is random with respect to this issue.

The observation interval was a constant duration (50 minutes) for each site. However, since all vehicles passing an observer could not be surveyed, a vehicle count of all eligible vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) on the traffic leg under observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total). These counts were used to estimate the number of possible observations so that sites could be weighted by traffic volume.

Table 2 shows descriptive statistics for the 240 observation sites of the statewide survey. As shown in this table, the observations were fairly well distributed over day of week, except few observations were conducted on Monday. Observations were also well distributed by time of day except for the earliest and latest time periods. Note that an observation session was included in the time slot that represented the majority of the observation period. If the observation period was evenly distributed between two time slots, then it was included in the later time slot. This table also shows that the majority of sites observed were the primary sites and that observations were mostly conducted during sunny and cloudy weather conditions, with a smaller percentage conducted during rain.

Table 2. Descriptive Statistics for the 240 Observation Sites							
Day of Week		**Observation Period**		**Site Choice**		**Weather**	
Monday	6.8%	7-9 a.m.	8.9%	Primary	81.3%	Sunny	72.7%
Tuesday	19.5%	9-11 a.m.	25.4%	Alternate	18.7%	Cloudy	26.9%
Wednesday	17.4%	11-1 p.m.	20.8%			Rain	0.4%
Thursday	11.0%	1-3 p.m.	22.4%			Snow	0.0%
Friday	17.8%	3-5 p.m.	19.5%				
Saturday	12.3%	5-7 p.m.	3.0%				
Sunday	15.2%						
TOTALS	100%		100%		100%		100%

Data Collection

Data collection for the study involved direct observation of shoulder belt use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and front-right passengers traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks during daylight hours from August 22 through September 19, 2003. Observations of safety belt use, sex, age, vehicle type, and vehicle purpose (commercial or noncommercial) were conducted when a vehicle came to a stop at a traffic light or a stop sign. Vehicles were included without regard to the state in which the vehicle was registered.

Data Collection Forms

Two forms were used for data collection: a site description form and an observation form. The site description form (see Appendix A) provided descriptive information about the site including the site number, location, site type (freeway exit ramp or intersection), site choice (primary or alternate), observer number, date, day of week, time of day, weather, and a count of eligible vehicles traveling on the proper traffic leg. A place on the form was also furnished for observers to sketch the intersection and to identify observation locations and traffic flow patterns. Finally, a comments section was available for observers to identify landmarks that might be helpful in characterizing the site (e.g., school, shopping mall) and to discuss problems or issues relevant to the site or study.

A second form, the observation form, was used to record safety belt use, passenger information, and vehicle information (see Appendix A). Each observation form was divided into four boxes, with each box having room for the survey of a single vehicle. For each vehicle surveyed, shoulder belt use, sex, and estimated age of the driver as well as vehicle type were recorded on the upper half of the box, while the same information for the front-outboard passenger could be recorded in the lower half of the box if there was a front-outboard passenger present. Children riding in child restraint devices (CRDs) were recorded but not included in any part of the analysis. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered as belted in the analysis. Based upon NHTSA (1998) guidelines, the observer also recorded whether the vehicle was commercial or noncommercial. A commercial vehicle is defined as a vehicle that is used for business purposes and may or may not contain company logos. This classification includes vehicles marked with commercial lettering or logos, or vehicles with ladders or other tools on them. At each site, the observer carried several data collection forms and completed as many as were necessary during the observation period.

Procedures at Each Site

All sites in the sample were visited by one observer for a period of one hour. Upon arriving at a site, the observer determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), the observer proceeded to the alternate site. Otherwise, the observer completed the site description form and then moved to their observation position near the traffic control device. Observers were instructed to observe only the lane immediately adjacent to the curb for safety belt use, regardless of the number of lanes present.

At each site, observers conducted a 5-minute count of all eligible vehicles in the designated traffic leg before beginning safety belt observations. Observations began immediately after completion of the count and continued for 50 minutes. During the observation period, observers recorded data for as many eligible vehicles as they could observe. If traffic flow was heavy, observers were instructed to record data for the first eligible vehicle they saw, and then look up and record data for the next eligible vehicle they saw, continuing this process for the remainder of the observation period. At the end of the observation period, a second 5-minute vehicle count was conducted.

Observer Training

Prior to data collection, members of the Minnesota Department of Public Safety, Office of Traffic Safety (OTS) staff were trained on field data collection procedures. The training of OTS staff included both classroom review of data collection procedures and practice field observations. Field observers were then hired and trained by OTS staff on the proper procedures for data collection. Each observer received a training manual containing detailed information on field procedures for observations, data collection forms, and administrative policies and procedures. A site schedule identifying the location, date, time, and traffic leg to be observed for each site was included in the manual (see Appendix B for a listing of the sites). During data collection, observers were spot checked in the field by a field supervisor to ensure adherence to study protocols.

Data Processing and Estimation Procedures

The site description form and observation form data were entered into an electronic format. The accuracy of the data entry was verified in two ways. First, all data were entered twice and the data sets were compared for consistency. Second, the data from randomly selected sites were reviewed for accuracy by a second party and all site data were checked for inconsistent codes (e.g., the observation end time occurring before the start time). Errors were corrected after consultation with the original data forms.

For each site, computer analysis programs determined the number of observed vehicles, belted and unbelted drivers, and belted and unbelted passengers. Separate counts were made for each independent variable in the survey (i.e., site type, time of day, day of week, weather, sex, age, seating position, and vehicle type). This information was combined with the site information to create a file used for generating study results.

As mentioned earlier, our goal in this safety belt survey was to estimate belt use for the state of Minnesota based on VMT. As also discussed, not all eligible vehicles passing the observer could be included in the survey. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so that an estimate of traffic volume at the site could be derived.

This weighting was done by first adding each of the two 5-minute counts and then multiplying this number by five so that it would represent a 50-minute duration. The resulting number was the estimated number of vehicles passing through the site if all eligible vehicles had been included in the survey during the observation period at that site. The estimated count for each site is divided by the actual number of vehicles observed there to obtain a volume weighting factor for that site. These weights are then applied to the number of actual vehicles of each type observed at each site to yield the weighted N for the total number of drivers and passengers, and total number of belted drivers and passengers for each vehicle type. All analyses reported are based upon the weighted values.

Estimation of Use Rates

The overall safety belt use rate for Minnesota was calculated utilizing the following procedure. The safety belt use rate for each stratum was calculated using the following formula:

$$R_s = \sum \frac{est_i}{obs_i} belted_i \Big/ \sum \frac{est_i}{obs_i} occs_i$$

Where R_s is the use rate for a stratum, i is a site in the stratum, est_i is the estimated number of possible observations had every eligible vehicle been recorded (based on the vehicle counts), obs_i is the actual number of people observed, $belted_i$ is the number of people observed using a safety belt, and $occs_i$ is the number of occupants.

Because the number of intersections among the first four strata and the number of exit ramps among the last four strata differed, the probability of an intersection or exit ramp being randomly selected differed between strata. Therefore, we painstakingly counted all intersections in the first four strata and all exit ramps in the last four strata and used these counts to weight use rates when combining them. The first four strata (intersections) were combined using the following formula:

$$R_i = \frac{\frac{4N_1}{N_{all}}R_1 + \frac{4N_2}{N_{all}}R_2 + \frac{4N_3}{N_{all}}R_3 + \frac{4N_4}{N_{all}}R_4}{\frac{4N_1}{N_{all}} + \frac{4N_2}{N_{all}} + \frac{4N_3}{N_{all}} + \frac{4N_4}{N_{all}}}$$

$$R_i = \frac{N_1R_1 + N_2R_2 + N_3R_3 + N_4R_4}{N_1 + N_2 + N_3 + N_4}$$

where R_i is the combined use rate for the first four strata (intersections), N_1 is the total number of intersections in stratum 1 and so on, and N_{all} is the total number of intersections among all four strata. The use rate for the exit ramp strata (strata 5-8) was calculated using the following formula:

$$R_e = \frac{\frac{4N_5}{N_{all}}R_5 + \frac{4N_6}{N_{all}}R_6 + \frac{4N_7}{N_{all}}R_7 + \frac{4N_8}{N_{all}}R_8}{\frac{4N_5}{N_{all}} + \frac{4N_6}{N_{all}} + \frac{4N_7}{N_{all}} + \frac{4N_8}{N_{all}}}$$

$$R_e = \frac{N_5R_5 + N_6R_6 + N_7R_7 + N_8R_8}{N_5 + N_6 + N_7 + N_8}$$

where R_e is the combined use rate for strata 5-8 (exit ramps), N_5 is the total number of exit ramps in stratum 5 and so on, and N_{all} is the total number of exit ramps among all four strata.

Because only statewide VMT for limited access roadways was available and because only 29 percent of Minnesota travel is on limited access roadways, the statewide safety belt rate was determined weighting R_e and R_i by their VMT using the following equation:

$$R_{MN} = \frac{VMT_i R_i + VMT_e R_e}{VMT_i + VMT_e}$$

Estimation of Variance

The variances for the belt use estimates for each strata were calculated using an equation derived from Cochran's (1977) equation 11.30 from section 11.8:

$$\mathrm{var}_{(ri)} \approx \frac{n}{n-1}\sum_i \left(\frac{g_i}{\Sigma g_k}\right)^2 (r_i - r)^2 + \frac{n}{N}\sum_i \left(\frac{g_i}{\Sigma g_k}\right)^2 \frac{s_i^2}{g_i}$$

where *var(r_i)* equals the variance within a stratum, n is the number of observed intersections, g_i is the weighted number of vehicle occupants at intersection *I*, g_k is the total weighted number of occupants at all sites within the stratum, r_i is the weighted belt use rate at intersection *I*, r is the stratum belt use rate, N is the total number of intersections within a stratum, and $s_i = r_i(1-r_i)$. In the actual calculation of the stratum variances, the second term of this equation was negligible and was dropped in the variance calculations as is common practice.

Again because the number of intersections and exit ramps differed among the strata, when the variances were combined, they were weighted by the number of intersection/exit ramps within each strata. The variances for the first four (intersection) strata were combined using the following formula:

$$\mathrm{var}(Ri) = \left(\frac{N_1}{N_{all}}\right)^2 \mathrm{var}(R_1) + \left(\frac{N_2}{N_{all}}\right)^2 \mathrm{var}(R_2) + \left(\frac{N_3}{N_{all}}\right)^2 \mathrm{var}(R_3) + \left(\frac{N_4}{N_{all}}\right)^2 \mathrm{var}(R_4)$$

The variance for the exit ramp strata were combined using the following formula:

$$\mathrm{var}(\mathrm{Re}) = \left(\frac{N_5}{N_{all}}\right)^2 \mathrm{var}(R_5) + \left(\frac{N_6}{N_{all}}\right)^2 \mathrm{var}(R_6) + \left(\frac{N_7}{N_{all}}\right)^2 \mathrm{var}(R_7) + \left(\frac{N_8}{N_{all}}\right)^2 \mathrm{var}(R_8)$$

The overall variance was determined by weighting the intersection and exit ramp variances relative to the statewide VMT for these types of roadways using the following equation:

$$\mathrm{var}(R) = \frac{(VMT_i)^2 \mathrm{var}(R_i) + (VMT_e)^2 \mathrm{var}(R_e)}{(VMT_i + VMT_e)^2}$$

The 95 percent confidence band was calculated using the formula:

$$95\% ConfidenceBand = R \pm 1.96\sqrt{\mathrm{var}(R)}$$

Finally, the relative error or precision of the estimate was computed using the formula:

$$\mathrm{Re}\,lativeError = \frac{SE}{R}$$

where SE is the standard error. The federal guidelines (NHTSA, 1992, 1998) stipulate that the relative error of the belt use estimate must be under 5 percent.

RESULTS

As discussed previously, the current direct observation survey of safety belt use in Minnesota reports statewide use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks), in addition to reporting use rates for occupants in each vehicle type separately. Following NHTSA (1998c) guidelines, this survey included commercial vehicles. Thus, all rates shown in this report include occupants from both commercial and noncommercial vehicles.

Overall Safety Belt Use

As shown in Figure 2, 79.4 percent ± 1.7 percent of all front-outboard occupants traveling in either passenger cars, sport-utility vehicles, vans/minivans, or pickup trucks in Minnesota between August 22 and September 19, 2003 were restrained with shoulder belts. The "±" value following the use rate indicates a 95 percent confidence band around the percentage. This value should be interpreted to mean that we are 95 percent sure that the actual safety belt use rate falls somewhere between 77.7 percent and 81.0 percent. The relative error for the statewide safety belt use rate was 1.1 percent, well below the 5 percent maximum required by NHTSA.

Minnesota Safety Belt Use

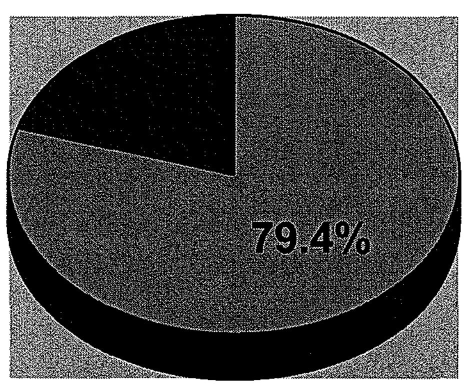

Figure 2. Front-Outboard Shoulder Belt Use in Minnesota (All Vehicle Types and Commercial/Noncommercial Combined).

DISCUSSION

The estimated statewide safety belt use rate for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 79.4 ± 1.6 percent. This rate is higher than the national average of 76 percent estimated from the National Occupant protection Use Survey (NOPUS) conducted by NHTSA (Glassbrenner, 2002). This result shows that Minnesota is doing quite well at getting the majority of its population to use safety belts even with secondary safety belt enforcement.

While the survey found that nearly 80 percent of Minnesota motor vehicle occupants are using safety belts, NHTSA (1997) has set a goal of 90 percent belt use. In order to increase belt use ten more percentage points, Minnesota needs to redouble its efforts. The most effective effort to increase safety belt use statewide would be to change the enforcement provision of Minnesota's safety belt law from secondary to primary enforcement. As discussed in a recent article (Eby, Vivoda, & Fordyce, 2002), nine of the first ten states to make such a change found 8-22 percentage point increases with primary enforcement. In Michigan, the largest increases in use were found for those groups in Minnesota that show the lowest safety belt use: males, young people, and pickup truck occupants. Thus, a particularly effective approach might be to continue to develop and implement programs aimed at increasing belt use among the low belt use demographic populations and part-time users outlined in this report alongside programs that promote safety belt use to all of Minnesota's population, such as primary enforcement.

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APPENDIX A:
Data Collection Forms

SITE DESCRIPTION FORM

SITE # ___ ___ ___
(1 2 3)

SITE LOCATION ______________________________

SITE TYPE	SITE CHOICE	TRAFFIC CONTROL
1☐ Intersection	1☐ Primary	1☐ Traffic Light
2☐ Freeway	2☐ Alternate	2☐ Stop sign
4	5	3☐ None
Exit No. _________		4☐ Other
		6

DATE (month/day): ___ ___/___ ___/2003
(7 8 9 10)

OBSERVER	DAY OF WEEK	WEATHER
1☐ Observer 1	1☐ Monday	1☐ Mostly Sunny
2☐ Observer 2	2☐ Tuesday	2☐ Mostly Cloudy
3☐ Observer 3	3☐ Wednesday	3☐ Rain
4☐ Observer 4	4☐ Thursday	4☐ Snow
5☐ Observer 5	5☐ Friday	13
11	6☐ Saturday	
	7☐ Sunday	
	12	

START TIME: ___ ___:___ ___ (24 hour clock)
(14 15 16 17)

END TIME: ___ ___:___ ___ (24 hour clock)
(18 19 20 21)

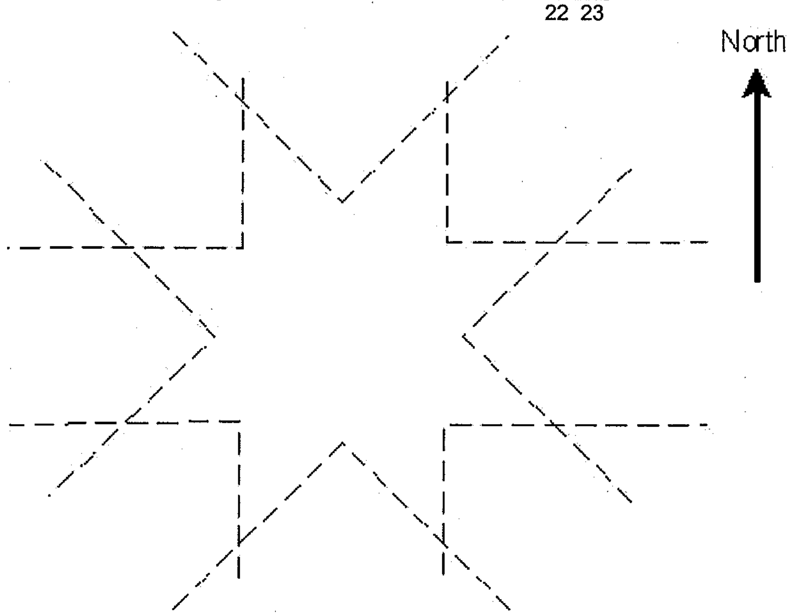
INTERRUPTION (total number of minutes during observation period): ___ ___
(22 23)

MEDIAN: 1G Yes
2G No
24

TRAFFIC COUNT 1: ___ ___ ___
(25 26 27)

TRAFFIC COUNT 2: ___ ___ ___
(28 29 30)

COMMENTS:



SITE # ___ ___ ___
1 2 3

PAGE #

ATTENTION CODING: DUPLICATE COL 1 - 3 FOR ALL VEHICLES

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 6	VEHICLE TYPE 1☐ Car 2☐ Van 3☐ SUV 4☐ Pick-up 7
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 10 2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 10	COMMERCIAL VEHICLE 1☐No 2☐Yes 11

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 6	VEHICLE TYPE 1☐ Car 2☐ Van 3☐ SUV 4☐ Pick-up 7
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 10 2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 10	COMMERCIAL VEHICLE 1☐No 2☐Yes 11

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 6	VEHICLE TYPE 1☐ Car 2☐ Van 3☐ SUV 4☐ Pick-up 7
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 10 2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 10	COMMERCIAL VEHICLE 1☐No 2☐Yes 11

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 6	VEHICLE TYPE 1☐ Car 2☐ Van 3☐ SUV 4☐ Pick-up 7
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 10 2☐ 11 - 15 3☐ 16 - 29 4☐ 30 - 64 5☐ 65+ 10	COMMERCIAL VEHICLE 1☐No 2☐Yes 11

APPENDIX B:
Site Listing

Survey Sites By Number

No.	County	Site Location
001	Dakota	EB 135th St/Co. Rd. 38 & Blaine Ave/County Rout 71/Rich Valley Blvd
002	Olmsted	EB CR 112/County Route 12 & CR 112
003	Carver	EB 150th St/County Route 50 & County Route 41
004	Carver	EB 70th St/County Route 30 & State Route 25/Ash
005	Carver	NB Yancy Ave & State Route 7
006	Carver	SB Little Ave & 102nd St
007	Dakota	EB W 136th St & Nicollet Ave
008	Wright	WB CR 123 & County Route 7/CR 106
009	Olmsted	EB CR 120 & County Route 20
010	Wright	EB CR 118/CR18/50th St. & County Route 35/Main St.
011	Dakota	NB CR 21/Guam Ave & 307th St/CR 90
012	Wright	EB 14th St/CR 112 & State Route 25
013	Dakota	EB 240th St West & Cedar Ave/County Route 23
014	Dakota	NB Johnny Cake Ridge Rd & Coutny Route 32/Cliff Rd
015	Olmsted	SB County Route 3 & County Route 4
016	Olmsted	EB CR 137 & CR 136
017	Dakota	EB 80th St & Concord Blvd/County Route 56
018	Dakota	EB 220th St East & Nicolai/County Route 91
019	Dakota	SB Fairgreen Ave & 280th St West/County Route 86
020	Wright	NB County Route 12 & County Route 37
021	Olmsted	WB County Route 9 & County Route 10
022	Dakota	EB Wescott Rd & Lexington Ave
023	Dakota	NB Hogan Ave/County Route 85 & 220th St East
024	Wright	SB US 12/County Route 16 & Babcock Blvd/County Route 30
025	Wright	EB County Route 38/Harrison St. (Near Oak St/CR 24) & State Route 55/State Route 24
026	Dakota	NB Blaine Ave/CR 79 & 245th St East/County Route 80
027	Olmsted	SB CR 119 & County Route 9
028	Dakota	EB County Route 88/290th Street East & Northfield Blvd/County Route 47
029	Ramsey	NB Hodgson Rd/County Route 49 & Turtle/County Route 3/CR 1
030	Carver	SB Yale Ave/Yancy Ave & County Route 30
031	Olmsted	NB CR 125/Maywood Rd. SW & County Route 25/Salem Rd. SW
032	Olmsted	EB CR 154/85th St. NW & US 52
033	Wright	SB County Route 12 & State Route 55
034	Carver	WB 62nd St & County Route 33
035	Ramsey	EB Minnehaha Ave/State Route 5 & White Bear Ave/County Route 65
036	Olmsted	SB CR 128 & State Route 247/County Route 12
037	Dakota	SB CR 51/County Route 80/Biscayne Ave & 280th St West/County Route 86
038	Olmsted	NB CR 132/County Route 32 & County Route 9
039	Dakota	SB Inga Ave & State Route 50/240th St East
040	Dakota	EB County Route 14/Grand Ave. & Concord St/State Route 156
041	Dakota	NB Goodwin Ave & State Route 55
042	Ramsey	NB Rice St & Maryland Ave
043	Dakota	SB Emery Ave & 190th St East/County Route 62
044	Ramsey	NBP I-35 W & Old Hwy 8/Anoka Cutoff (Exit 26)
045	Ramsey	NBD I-35 E & County Route 23 (Exit 112)
046	Olmsted	WBP I-90 & County Route 10 (Exit 229)
047	Dakota	SBD I-35 & County Route 50/County Route 5(Exit 85)
048	Ramsey	WBP State Route 36 & Hamline Ave
049	Dakota	SBD US-52 & Thompson Ave
050	Ramsey	SBD I-35 E & St. Clair
051	Dakota	WBD I-494 & Robert St (Exit 67)
052	Dakota	NBD I-35 E & State Route 110/Mendota Rd (Exit 101)
053	Olmsted	EBD I-90 & State Route 42 (Exit 224)
054	Ramsey	SBD I-35 E & Randolph Ave
055	Ramsey	EBD State Route 36 & Lexington Ave/County Route 51
056	Ramsey	EBD US-12/US-52/I-94 & S. Cretin Ave
057	Ramsey	NBP County Route 280 & Energy Park Dr
058	Dakota	SBD US-52/Lafayette Frwy & Butler Ave
059	Ramsey	EBP I-694 & US-61/Maplewood Dr (Exit 48)
060	Ramsey	EBD US-12/US-52/I-94 & Lexington Parkway/County Route 51
061	Hennepin	SB Pineview Ave & 129th Ave
062	Hennepin	WB Olson Memorial Hwy/State Rotue 55 & County Route 102/Douglas Drive

063	Hennepin	NB Mohawk Dr & Horseshoe Tr
064	Hennepin	SB County Route 60/Mitchell Rd & State Route 5
065	Hennepin	WB Gleason Lake Rd/County Route 15 & Vicksburg Lane
066	Hennepin	NEB State Route 7 & Chanhassen Rd/State Route 101
067	Hennepin	NB Brown Rd/County Route 146 & Watertown Rd
068	Hennepin	NB Commerce Blvd & West Branch Rd/County Route 151
069	Hennepin	NB Chanhassen Rd/State Route 101 & Minnetonka Blvd/County Route 5
070	Hennepin	SB County Route 44 & Bartlett Blvd/County Route 110
071	Hennepin	SB Tucker Rd & County Route 116/CR 159/Territorial Rd.
072	Hennepin	NEB Old Shakopee Rd/County Route 1 & Penn Ave.
073	Hennepin	NWB County Route 81 & 77th Ave North/County Route 152/Brooklyn Blvd.
074	Hennepin	NB Belchtold Rd & 109th Ave North/County Route 117
075	Hennepin	NB County Route 34/Normandale Blvd & Old Shakopee Rd/County Route 1
076	Hennepin	NB Penn Ave/County Route 2 & Olson Memorial Highway/State Route 55
077	Hennepin	WB Elm Creek Rd & Fernbrooke Ave/County Route 121
078	Hennepin	NB Pioneer Tr/County Route 113 & Woodland Tr/County Route 10
079	Hennepin	WB Rockford Rd/County Route 9 & Medicine Lake Dr/Larch Lane
080	Hennepin	SB Lyndale Ave & West 50th St/County Route 21
081	Hennepin	NB Willow Dr & County Route 24
082	Hennepin	WB 125th Ave North & Zanzibar Lane
083	Hennepin	SB Lyndale Ave & West 82nd St
084	Hennepin	NB Broadway Ave/CR 103/County Route 130 & 85th Ave North/County Route 109
085	Hennepin	NB Mendelssohn Ave & 63rd Ave
086	Hennepin	WB N 121st Ave & Fernbrooke/County Route 121
087	Hennepin	WB Cedar Lake Rd/County Route 16 & Plymouth Rd/County Route 61
088	Hennepin	EB Nike Rd & Main Street/Country Route 92
089	Hennepin	NWB N Nobel Ave & 109th Ave
090	Hennepin	SB Mohawk Dr & State Route 55
091	Hennepin	NB County Route 32 & West 82nd Street
092	Hennepin	WB County Route 109/85th Ave N & Country Route 158/Rice Lake Rd.
093	Hennepin	SB Country Route 101 & County Route 42/Wayzata Blvd.
094	Hennepin	NB University Ave & County Route 23
095	Hennepin	SB Country Route 116/Fletcher Lane & County Route 30/97th Ave N
096	Hennepin	EB County Route 53/66th St. & State Route 77
097	Hennepin	NB Winnetka Ave/County Route 156 & Medicine Lake Rd
098	Hennepin	SB Goose Lake Rd & Elm Creek Rd
099	Hennepin	WB Medicine Lake Rd/26th St. & Medicine Lake Blvd
100	Hennepin	NB Budd Ave & Pagenkoph Rd
101	Hennepin	EB Duck Lake Tr & Eden Prarie Rd/County Route 4
102	Hennepin	NB Eden Prarie Rd/County Route 4 & Excelsior Blvd/County Route 3
103	Hennepin	SEB County Route 152/Osseo Rd. & N. Penn/44th Ave.
104	Hennepin	SBD State Route 77 & County Route 1/Old Shakopee Rd
105	Hennepin	NBD I-35 W & W 82nd St (Exit 8)
106	Hennepin	WBP State Route 62/Crosstown Hwy & Gleason
107	Hennepin	SBD I-494 & County Route 10/Bass Lake Rd (Exit 26)
108	Hennepin	WBP I-94/US-12/US-52 & S 25th Ave.
109	Hennepin	NBP I-35 W & W 35th St/E 35th St
110	Hennepin	WBP I-94/US-52 & County Route 30/Dunkirk Lane (Exit 213)
111	Hennepin	SBD I-35 W & W 66th St/E 66th St
112	Hennepin	NBP US-169 & 36th Ave N
113	Hennepin	EBP I-494 & Townline Rd/US-169
114	Hennepin	N/WBD I-494 & State Route 55/Olson Memorial Hwy
115	Hennepin	WBP State Route 62/Crosstown Hwy & Tracy Ave
116	Hennepin	SBP State Route 100 & Minnetonka Blvd/County Route 5/Vernon
117	Hennepin	SBP State Route 100 & W 50th St/County Route 21/County Route 158
118	Hennepin	EBD State Route 62 & Portland Ave South
119	Hennepin	NBP US-169 & Valley View Rd
120	Hennepin	NBD US-169 & Plymouth Ave/13th Ave N
121	Sherburne	NB County Route 73/127th St./County Route 48 & CR 73/185th Ave.
122	St. Louis	WB State Route 135/County Route 102 & US 53/State Route 169
123	St. Louis	WB CR 791 & County Route 25
124	Rice	SB Culver Ave & 150th Street W/County Route 9
125	Beltrami	SB State Route 72/County Route 36 & County Route 41
126	Washington	NB Manning & 70th St. S
127	Clay	EB State Route 34 & County Route 25
128	Kandiyohi	WB 255th Ave Northeast & County Route 9

129	St. Louis	EB County Route 16/CR 957 & US 53
130	Kandiyohi	EB CR 107/240th Ave. & 40th Street NE
131	Kandiyohi	WB 105 Ave SE & CR 136/165th St SE
132	Blue Earth	WB County Route 29/State Route 30 & State Route 22/State Route 30
133	Freeborn	NB US-69 & County Route 46
134	Clay	EB CR 105 & County Route 13/County Route 73/90th St. N
135	St. Louis	WB State Route 194/Central Entrance & County Route 90/Arlington
136	Steele	SB County Route 3 & State Route 30
137	Blue Earth	WB County Route 13/County Route 38 & US-169
138	Sherburne	SB US 169 & County Route 4
139	Sherburne	EB CR 54/77th St. SE & State Route 25/125th Ave. SE
140	Freeborn	EB CR 115/County Route 23 & County Route 26
141	Blue Earth	WB CR 167 & County Route 39
142	Sherburne	NWB US 10 & County Route 15
143	St. Louis	EB State Route 194 & US 53
144	Freeborn	NB County Route 24/County Route 45/Independence Ave & County Route 31/CR 116/Main St.
145	Goodhue	SB County Route 1 & State Route 60
146	Freeborn	EB County Route 9/CR 78 & US 69
147	Blue Earth	NB County Route 30/CR 107 & County Route 22/CR 108
148	St. Louis	EB County Route 28/Sax Road & County Route 7
149	Nicollet	EB County Route 15/382nd St. & State Route 15
150	Blue Earth	EB Madison Ave/State Route 22 & State Route 22
151	Steele	SB 7th Ave NE & County Route 8/Mineral Springs Rd.
152	Blue Earth	EB County Route 25/CR 138 & County Route 20
153	Blue Earth	NB County Route 14/CR 173 & State Route 83
154	St. Louis	EB County Route 12/Roberg Rd & Lakewood Rd/CR 692
155	Crow Wing	NB County Route 25/CR 144 & State Route 18
156	Kandiyohi	WB 60th Ave SW & County Route 7/135th St.
157	Scott	EB County Route 2/CR 54 & State Route 13/Langford Ave
158	Blue Earth	SB State Route 60 & US 14/State Route 60
159	Goodhue	SB County Route 4 & County Route 10
160	Kandiyohi	SB CR 127/60th St. NE & County Route 26/60th Ave.
161	Clay	EB 90th Ave./County Route 10 & 70th St./County Route 11/State Route 336
162	Nicollet	NB County Route 7/585TH St. & County Route 1/350th St.
163	Scott	EB CR 64/230th St W & State Route 21/Helena Blvd
164	Steele	SBD I-35 & County Route 4 (Exit 32)
165	St. Louis	SBP I-35 & US-53/Piedmont Ave
166	Freeborn	SBP I-35 & County Route 35 (Exit 22)
167	Clay	EBP I-94 & County Route 10 (Exit 15)
168	Washington	N/WBP I-694 & 10th St/County Route 10 (Exit 57)
169	Clay	WBP I-94 & County Route 52 (Exit 2)
170	Rice	SBP I-35 & State Route 60 (Exit 56)
171	Steele	NBD I-35 & County Route 12 (Exit 48)
172	Beltrami	EBP US-2/US-71 & US-71
173	Freeborn	EBD I-90 & State Route 13 (Exit 154)
174	Freeborn	SBD I-35 & State Route 251 (Exit 18)
175	St. Louis	SBP I-35 & S 27th Ave. W (Exit 254)
176	Washington	SBP I-35 & Central Ave. (Exit 252)
177	St. Louis	N/EBD I-35 & 46th Ave
178	Freeborn	NBD I-35 & County Route 46 ? (Exit 11)
179	Washington	NBP US-10/US-61 & 80th St/Grange Blvd
180	St. Louis	N/EBD I-35 & Skyline Pkwy/Boundary Dr. (Exit 249)
181	Morrison	SB CR 264/205th Ave. & County Route 46/183rd St.
182	Douglas	SB County Route 6 & County Route 22
183	McLeod	WB County Route 26/100th St. & State Route 15
184	Morrison	SB County Route 37 & County Route 26/Nature Rd.
185	Polk	NB County Route 63 & US-2
186	Cass	WB County Route 29/CR 107/76th St. & County Route 1
187	Becker	SB Little Toad Lake Rd/County Route 31 & State Route 87
188	Otter Tail	EB County Route 10 & US 59
189	Otter Tail	EB County Route 60/State Route 228 & US 10
190	Cass	WB County Route 34 & State Route 64
191	Brown	EB County Route 22/CR 102 & County Route 13
192	Morrison	SB County Route 6/90th Ave. & County Route 1/State Route 238
193	Mower	WB 115th St. & County Route 14/770th Ave.

194	Stearns	WB CR 146 & State Route 15
195	Cass	EB County Route 43/Twp 4/12th St. & State Route 84/County Route 44
196	Polk	NB County Route 54 & County Route 11
197	Polk	EB CR 213 & CR 213/County Route 48
198	Winona	NEB County Route 44/Huff St. & US 14/US 61
199	Morrison	EB CR 203/County Route 1 & County Route 2
200	Stearns	SB US 71 & State Route 55
201	Douglas	EB State Route 27 & State Route 29
202	Winona	WB County Route 22 extension (unmarked gravel road North of County Route 115) & County Route 37
203	Anoka	SB CR 67 & County Route 22
204	Cass	EB County Route 66/122nd St. & State Route 371
205	Benton	WB County Route 12/Pine Rd. & State Route 25
206	Becker	SB County Route 49/CR 119 & State Route 87
207	Polk	NB County Route 65 & US-75
208	Stearns	WB CR 149 & County Route 48
209	Isanti	SB State Route 47 & County Route 8
210	Otter Tail	EB County Route 6 & County Route 59
211	Stearns	WB Division St/County Route 75 & State Route 15
212	Itasca	EB US 2/4th St. & State Route 38/3rd Ave.
213	McLeod	SB County Route 25/CR 52/5th Ave. S. & US 212
214	Mower	EB County Route 1 & US 218
215	Benton	SB County Route 6 & County Route 4
216	Brown	WB 150th St./CR100 & County Route 2
217	Anoka	SB County Route 5/CR 56 & Northern Blvd/County Route 5
218	Douglas	NB County Route 40 & County Route 82
219	Douglas	WB County Route 10 & County Route 3
220	Winona	NEB County Route 7 & US 14/US 61
221	Stearns	SEB County Route 152 & County Route 10
222	Stearns	WB County Route 75 & County Route 2
223	Isanti	NB County Route 7/CR 57 & State Route 95
224	Carlton	SWBP I-35 & State Route 45 (Exit 239)
225	Anoka	SBP I-35 W & County Route 23/Lake Dr (Exit 36)
226	Stearns	WBD I-94/US-52 & CR 159 (Exit 156)
227	Winona	EBD I-90 & State Route 43 (Exit 249)
228	Stearns	EBP I-94 & State Route 23 (Exit 164)
229	Anoka	EBP US-10 & State Route 65
230	Chisago	SBD I-35 & County Route 10 (Exit152)
231	Mower	WBP I-90 & State Route 56 (Exit 183)
232	Stearns	EBP I-94 & County Route 7 (Exit 171)
233	Winona	WBP I-90 & State Route 76 (Exit 257)
234	Otter Tail	W/NBP I-94 & US-59/County Route 52/County Route 88 (Exit 50)
235	Anoka	WBP US-10/State Route 610 & State Route 47
236	Douglas	EBD I-94 & State Route 79 (Exit 82)
237	Stearns	WBP I-94 & County Route 9 (Exit 153)
238	Stearns	WBD I-94 & County Route 11 (Exit 137)
239	Carlton	EBD I-35 & State Route 61 (Exit 245)
240	Douglas	EBP I-94 & State Route 29 (Exit 103)