An Assessment of the Safety Performance of Farm Vehicles Subject to Exemptions Under MAP-21

U.S. Department of Transportation
Federal Motor Carrier Safety Administration

May 2016

FOREWORD

In July 2012, President Obama signed into law the Moving Ahead for Progress in the 21st Century Act (MAP-21). MAP-21 provides Federal funding for transportation-related projects and programs and for Federal agencies within the U.S. Department of Transportation (USDOT). Section 32934 of the Act provides exemptions from specific requirements of chapters 311, 313, and 315 of title 49, United States Code for commercial motor vehicles (CMVs) engaged in farming operations. Farm vehicles subject to these exemptions are referred to, both in MAP-21 and in this report, as "covered farm vehicles."

MAP-21 requires that the Secretary of Transportation conduct a "Safety Study" of covered farm vehicles. This report presents the methodology and findings from an analysis conducted by the Federal Motor Carrier Safety Administration's (FMCSA's) Office of Analysis, Research, and Technology, with support from the Office of Field Operations, in response to the requirement in MAP-21 that a safety study of covered farm vehicles be performed. The analysis includes a determination of the best way to identify covered farm carriers and their vehicles in the databases maintained by FMCSA; estimates for the number of covered farm carriers, covered farm vehicles, and drivers of covered farm vehicles; estimates of driver and vehicle out-of-service (OOS) rates, based on inspections of covered farm vehicles and their drivers; estimates of crash rates for covered farm carriers; and an assessment of regulations in each State which are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.

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16. Abstract

This report presents the methodology and findings from an analysis conducted by the Federal Motor Carrier Safety Administration's (FMCSA's) Office of Analysis, Research, and Technology, with support from the Office of Field Operations, in response to the requirement in the Moving Ahead for Progress in the 21st Century Act (MAP-21) that a safety study of covered farm vehicles be performed.

The analysis includes:

- **A determination of the best way to identify covered farm carriers and their vehicles in the databases maintained by FMCSA.**
- **Estimates for the number of covered farm carriers, covered farm vehicles, and drivers of covered farm vehicles.**
- **Estimates of driver and vehicle out-of-service (OOS) rates, based on inspections of covered farm vehicles and their drivers.**
- **Estimates of crash rates for covered farm carriers.**
- **An assessment of regulations in each State which are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.**

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SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions to SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		Length		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		Area		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	Acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		Volume (volumes greater than 1,000L shall be shown in m^3)		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		Mass		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or “metric ton”)	Mg (or “t”)
		Temperature (exact degrees)		
°F	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	°C
		Illumination		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		Force and Pressure or Stress		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

Approximate Conversions from SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		Length		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		Area		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
Ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		Volume		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		Mass		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or “t”)	megagrams (or “metric ton”)	1.103	short tons (2,000 lb)	T
		Temperature (exact degrees)		
°C	Celsius	1.8c+32	Fahrenheit	°F
		Illumination		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		Force and Pressure or Stress		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003, Section 508-accessible version September 2009

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym	Definition
CDL	commercial driver's license
CMV	commercial motor vehicle
FARS	Fatality Analysis Reporting System
FMCSA	Federal Motor Carrier Safety Administration
GVWR	gross vehicle weight rating
HM	hazardous materials
HOS	hours-of-service
MAP-21	Moving Ahead for Progress in the 21st Century Act
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
NHTSA	National Highway Traffic Safety Administration
OOS	out-of-service
USDOT	U.S. Department of Transportation
VMT	vehicle miles traveled

EXECUTIVE SUMMARY

On July 6, 2012, the President signed into law the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. 112–141). MAP-21 provides Federal funding for transportation-related projects and programs and for Federal agencies within the U.S. Department of Transportation (USDOT). Section 32934 of the Act provides exemptions from specific requirements of chapters 311, 313, and 315 of title 49, United States Code for commercial motor vehicles (CMVs) engaged in farming operations. These exemptions pertain to:

- Commercial driver's license (CDL) requirements (49 CFR Part 383).
- Drug and alcohol testing requirements (49 CFR Part 382).
- Physical qualifications requirements (49 CFR Part 391, Subpart E).
- Hours-of-service (HOS) requirements (49 CFR Part 395).
- Vehicle inspection, repair, and maintenance requirements (49 CFR Part 396).

Farm vehicles subject to these exemptions are referred to, both in MAP-21 and in this report, as "covered farm vehicles." A covered farm vehicle is defined in the Act as a vehicle that:

- Is operated by a farm or ranch owner or operator, or an employee or family member of a farm or ranch owner or operator.
- Transports agricultural commodities, livestock, machinery, or supplies to or from a farm or ranch.
- Is not used in for-hire operations.
- Does not transport hazardous materials (HM) that require a placard.
- Is equipped with a special "farm" license plate or other designation issued by the State in which the vehicle is registered that allows law enforcement officials to identify it as a farm vehicle.
- Has a gross vehicle weight rating (GVWR) or gross vehicle weight, whichever is greater, of 26,001 pounds or less, or greater than 26,001 pounds and travels either within the State it is registered or within 150 air miles of the farm or ranch the vehicle is servicing.

SAFETY STUDY

MAP-21 also requires that the Secretary of Transportation conduct a "Safety Study" of covered farm vehicles. The Act requires that the analysis address the following subject areas:

- The number of covered farm vehicles in operation and the number of drivers operating them.
- The number of crashes involving covered farm vehicles.

- The number of occupants and non-occupants injured in crashes involving covered farm vehicles.
- The number of fatalities of occupants and non-occupants killed in crashes involving covered farm vehicles.
- Crash investigations and accident reconstruction investigations of all fatalities in crashes involving covered farm vehicles.
- Overall operating mileage of covered farm vehicles.
- The number of covered farm vehicles operating in neighboring States.
- A listing of State regulations issued and maintained in each State that are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.

SCOPE OF THIS REPORT

This report presents the methodology and findings from an analysis conducted by the Federal Motor Carrier Safety Administration's (FMCSA's) Office of Analysis, Research, and Technology, with support from the Office of Field Operations, in response to the requirement in MAP-21 that a safety study of covered farm vehicles be performed. The analysis includes:

- A determination of the best way to identify covered farm carriers and their vehicles in the databases maintained by FMCSA.
- Estimates for the number of covered farm carriers, covered farm vehicles, and drivers of covered farm vehicles.
- Estimates of driver and vehicle out-of-service (OOS) rates, based on inspections of covered farm vehicles and their drivers.
- Estimates of crash rates for covered farm carriers.
- An assessment of regulations in each State which are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.

No data are available on crash investigations and accident reconstruction investigations for crashes involving covered farm vehicles. As a result, FMCSA cannot address that particular requirement of MAP-21. In addition, information is not available that would allow the Agency to determine the total number of crashes involving covered farm vehicles, or the total number of fatalities and injuries in covered farm vehicle crashes for both occupants and non-occupants of these vehicles, as required by MAP-21. In lieu of addressing these requirements, this study estimates crash rates for motor carriers operating covered farm vehicles, as well as the level of severity of crashes involving these vehicles, based on a subset of carriers that can be reliably identified as farming operations in FMCSA's Motor Carrier Management Information System (MCMIS). The percentage of crashes involving injuries and fatalities for these carriers is compared to similar statistics for all truck crashes associated with private carriers domiciled in the same States. This approach allows one to determine whether crashes involving covered farm

vehicles are more likely to result in injuries and fatalities than crashes involving trucks from other types of carriers.

Table 1 summarizes the MAP-21 requirements for this study, findings, and the extent to which available data permitted the subject areas to be addressed.

Table 1. Summary of study findings related to MAP-21 subject area requirements.

Subject Area	Findings
Number of covered farm vehicles and drivers operating them.	Analysis revealed an estimated 99,820 covered farm vehicles and 74,865 drivers of covered farm vehicles in the United States (based on national estimates derived from a limited sample of 8 States).
Number of covered farm vehicle crashes.	The number of covered farm vehicle crashes could not be estimated from existing data. However, crash rates were examined. Crash rates for covered farm carriers are slightly higher than crash rates for all private carriers in these same States (based on a sample of 19 States).
Number of occupants and non-occupants injured in crashes involving covered farm vehicles.	As the number of occupants and non-occupants injured in crashes involving covered farm vehicles could not be estimated from existing data, the crash severity in farm vehicle crashes was assessed. Data suggest that crashes involving covered farm vehicles are no more likely to result in an injury or fatality than crashes involving CMVs from other types of private carriers (based on a sample of 19 States).
Number of fatalities of occupants and non-occupants in crashes involving covered farm vehicles.	As the number of fatalities of occupants and non-occupants in crashes involving covered farm vehicles could not be estimated with existing data, the crash severity in farm vehicle crashes was assessed. Data suggest that crashes involving covered farm vehicles are no more likely to result in an injury or fatality than crashes involving CMVs from other types of private carriers (based on a sample of 19 States).
Analysis of covered farm vehicle crash investigations.	Data not available.
Overall operating mileage of covered farm vehicles.	Covered farm carriers identified in a sample of eight States where such identification could be made had an average annual vehicle miles traveled (VMT) of 37,962 miles per year. Based on this figure, the estimated national VMT for covered farm vehicles is 947 million miles per year (based on a limited sample of 8 States).
Number of covered farm vehicles operating in neighboring States.	Approximately 78 percent of covered farm carriers in the eight key States operate at least one covered farm vehicle across State lines. Applying this percentage to the estimated number of total covered farm vehicles gives a figure of approximately 79,000 total covered farm vehicles crossing State lines. These estimates are based on a limited sample of eight States, which did not include several large-sized States. Therefore, results may be biased towards the characteristics of smaller States.
Listing of State regulations identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.	Most States have issued exemptions similar to those required by the Act, or are in the process of modifying existing regulations. Some States, however, still have regulations that are at variance with the MAP-21 covered farm vehicle exemptions.

METHODOLOGY

FMCSA developed a methodology to identify motor carriers in MCMIS with a high probability of having covered farm vehicles, as defined by MAP-21. The methodology utilizes motor carrier cargo and vehicle weight information contained in MCMIS, as well as information on license tag number configurations associated with farm license plates in various States, to identify such carriers. Nevertheless, many nonfarm entities, such as farm cooperatives and businesses specializing in various agricultural services were still captured by the farm carrier identification algorithms used in the study. To the extent possible, this latter group of nonfarm carriers was removed from the final data analysis file by evaluating the names of the businesses initially captured and removing (either manually, or by computer logic) those whose names seemed inconsistent with farming operations.

The exemptions for covered farm vehicles outlined in MAP-21 apply both to vehicles engaged in interstate and intrastate operations, although these vehicles must have farm license plates or something similar. However, because not all States have special license tag configurations for their farm license plates and not all States require 100 percent of their intrastate carriers to register with FMCSA, a census of all carriers operating covered farm vehicles could not be developed in this study.

Hence, this study produced estimates of the number of covered farm vehicles and carriers, their OOS rates, and their crash rates, by focusing on a sample of eight States that both require intrastate carriers to register with FMCSA and obtain a USDOT number, and also have special license tag configurations for farm vehicles that can be identified in roadside inspection data contained in MCMIS. These sample data were supplemented by data from all 19 States whose farm license plate configurations can be recognized in MCMIS (but do not necessarily require all intrastate motor carriers to obtain USDOT numbers).

In order for a CMV to qualify for the farming exemptions granted under MAP-21, it must not only have a special farm license plate, but must also meet various requirements concerning vehicle weight and travel distance. However, if a CMV has farm license plates, inspectors at the roadside may simply assume that the vehicle is subject to the farming exemptions granted by Section 32934, due to the inspector's inability to determine whether a given vehicle meets these other requirements (see the MAP-21 definition of a farm vehicle, above). Thus, this study also produced additional safety statistics for all carriers in MCMIS identified as having farm license plates (based on all 19 States whose special farm license tag configurations can be identified in roadside inspection data contained in MCMIS).

CONCLUSION

This study estimates that roughly 100,000 vehicles and 75,000 drivers are impacted nationally by the MAP-21 exemptions for covered farm vehicles and their drivers. Covered farm carriers identified in the 8 key States had an average vehicle miles traveled (VMT) of 37,962 miles per year. Based on this figure, the estimated national VMT for covered farm vehicles is 947 million miles per year. These estimates, however, are based in large part on motor carrier information

from only eight States whose data were extrapolated to the national level. The limited number of States available to use in this extrapolation may impact the accuracy of these estimates.

Based on MCMIS data from these same eight States, approximately 78 percent of covered farm carriers operate at least one covered farm vehicle across State lines. Applying this percentage to the estimated number of total covered farm vehicles gives a figure of approximately 79,000 total covered farm vehicles crossing State lines. The reader must be cautioned, however, that this estimate is based on data from only eight States, and these States do not include large-sized agricultural States, such as California or Texas. For this reason, the estimate may have an upward bias.

Driver and vehicle OOS rates for covered farm vehicles domiciled in the eight key States were higher than similar rates for all private carriers prior to enactment of MAP-21 (6.8 percent versus 5.4 percent for drivers; 29.0 percent versus 24.2 percent for vehicles). The difference in the OOS rates between covered farm carriers and all private carriers in the eight key States is statistically significant in the case of the vehicle OOS rate (at the 95-percent level of confidence), but is not in the case of the driver OOS rate. Results for covered farm vehicles, based on inspections from all 19 States where farm license tag numbers can be identified in MCMIS, are similar.

The violation rates for inadequate or no record of duty status and no medical certificate were higher in the period immediately prior to enactment of MAP-21 for both drivers of covered farm vehicles and for drivers of all vehicles with farm license plates, when compared to drivers of all private carriers. These differences are, for the most part, statistically significant.

Crash rates in 2011 and 2012, expressed both in terms of crashes per 100 power units and crashes per million VMT, were generally slightly higher for carriers identified by the study as covered farm carriers (i.e., carriers identified as having covered farm vehicles) than for all private carriers based on data from the eight key States requiring all intrastate carriers to obtain USDOT numbers, as well as data from all 19 States whose farm license plates can be recognized in MCMIS inspection and crash data. This same relationship also holds for all carriers with farm-plated vehicles. When comparing “per power unit” crash rates of all carriers with farm-plated vehicles to crash rates for all private carriers in these 2 years, all carriers with farm-plated vehicles have crash rates that are approximately 45–55 percent higher, and these differences are statistically significant.

The data do not suggest that crashes involving covered farm vehicles are more likely to result in an injury or fatality than crashes involving CMVs from other types of private carriers. However, the percentage of all private carrier fatality-related crashes involving covered farm carriers is marginally higher than the percentage of covered farm carriers in the general private carrier population.

States have until March 14, 2016—3 years following publication of FMCSA’s March 16, 2013 Final Rule concerning covered farm vehicles—to make their motor vehicle regulations conform with the new Federal regulations pertaining to covered farm vehicles, as outlined under MAP-21. Most States have already issued exemptions similar to those stipulated under the Act, or are in the process of modifying existing current regulations. Some States, however, still have regulations that are at variance with the MAP-21 covered farm vehicle exemptions. That is, these

States currently have existing laws similar to those Federal regulations from which covered farm vehicles have been made exempt, and these State laws still apply to covered farm vehicles (as defined under MAP-21) or to a subset of these vehicles.

1. INTRODUCTION

On July 6, 2012, the President signed into law the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. 112–141). MAP-21 authorized transportation-related projects and programs and funding for Federal agencies within the U.S. Department of Transportation (USDOT). Section 32934 of the Act provides exemptions from specific requirements of chapters 311, 313, and 315 of title 49, United States Code for commercial motor vehicles (CMVs) engaged in farming operations. These exemptions pertain to the following:

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- Physical qualifications requirements (49 CFR Part 291, Subpart E).
- Hours-of-service (HOS) requirements (49 CFR Part 395).
- Vehicle inspection and maintenance requirements (49 CFR Part 396).

Farm vehicles subject to these exemptions are referred to, both in MAP-21 and in this report, as "covered farm vehicles." A covered farm vehicle is defined in the Act as a vehicle that:

- Is operated by a farm or ranch owner or operator, or an employee or family member of a farm or ranch owner or operator.
- Transports agricultural commodities, livestock, machinery, or supplies to or from a farm or ranch.
- Is not used in for-hire operations.
- Does not transport hazardous materials (HM) that require a placard.
- Is equipped with a special "farm" license plate or other designation issued by the State in which the vehicle is registered that allows law enforcement officials to identify it as a farm vehicle.
- Has a gross vehicle weight rating (GVWR) or gross vehicle weight, whichever is greater, of 26,001 pounds or less, or greater than 26,001 pounds and travels either within the State it is registered or within 150 air miles of the farm or ranch the vehicle is servicing.

1.1 SAFETY STUDY

MAP-21 also requires that the Secretary of Transportation conduct a "Safety Study" of covered farm vehicles. The Act requires that the analysis address the following subject areas:

- The number of covered farm vehicles in operation and the number drivers operating them.
- The number of crashes involving covered farm vehicles.

- The number of occupants and non-occupants injured in crashes involving covered farm vehicles.
- The number of fatalities of occupants and non-occupants killed in crashes involving covered farm vehicles.
- Crash investigations and accident reconstruction investigations of all fatalities in crashes involving covered farm vehicles.
- Overall operating mileage of covered farm vehicles.
- The number of covered farm vehicles operating in neighboring States.
- A listing of State regulations issued and maintained in each State that are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.

No data are available on crash investigations and accident reconstruction investigations for crashes involving covered farm vehicles. As a result, the Federal Motor Carrier Safety Administration (FMCSA) cannot address that particular requirement of MAP-21. In addition, information is not available that would allow the Agency to determine the total number of crashes involving covered farm vehicles, or the total number of fatalities and injuries in covered farm vehicle crashes for both occupants and non-occupants of these vehicles, as required by MAP-21 (the only database that links fatalities and injuries to occupants of particular vehicles is the National Highway Traffic Safety Administration's [NHTSA's] Fatality Analysis and Reporting System [FARS] and it only captures fatality-related crashes; moreover, based on the methodology used in this study to identify covered farm vehicles, the Agency would only be able to identify a subset of the covered farm vehicle crashes in FARS – specifically, those involving trucks with USDOT numbers and having license plates from particular States).

In lieu of addressing these particular requirements, this study estimates crash rates for motor carriers operating covered farm vehicles, as well as the level of severity of crashes involving these vehicles, based on a subset of carriers that can be reliably identified in FMCSA's Motor Carrier Management Information System (MCMIS) as farming operations. The percentage of crashes involving injuries and fatalities for these carriers is compared to similar statistics for all truck crashes associated with private carriers domiciled in the same States. This approach allows one to determine whether crashes involving covered farm vehicles are more likely to result in injuries and fatalities than crashes involving trucks from other types of carriers.

1.2 DEFINITION OF TERMS

MAP-21 uses the term "covered farm vehicles" when referring to vehicles eligible for exemptions under Section 32934 of the Act. This report also uses the term "covered farm vehicles" in the same manner. In addition, this report uses the term "farm carrier" when referring to a motor carrier that has at least one covered farm vehicle. The term "farm" is not defined in the Act. As a result, this study uses a definition for farms that is consistent with Agency precedent. This is discussed in more detail in the Methodology section of this report.

1.3 SCOPE OF THIS REPORT

This report presents the methodology and findings of an analysis conducted by the FMCSA's Office of Analysis, Research, and Technology, with support from the Office of Field Operations, in response to the requirement in MAP-21 that a safety study of covered farm vehicles be performed. The analysis includes:

- A determination of the best way to identify covered farm carriers and their vehicles in the databases maintained by FMCSA.
- Estimates for the number of covered farm carriers, covered farm vehicles, and drivers of covered farm vehicles.
- Estimates of driver and vehicle out-of-service (OOS) rates, based on inspections of covered farm vehicles and their drivers.
- Estimates of crash rates for covered farm carriers.
- An assessment of regulations in each State that are identical to the Federal regulations subject to exemption under MAP-21 for covered farm vehicles.

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2. METHODOLOGY FOR IDENTIFYING FARM CARRIERS AND THEIR VEHICLES

To perform the analyses required for this study, FMCSA created a database of motor carriers likely to have vehicles subject to the farm exemptions granted under MAP-21. This section describes the methodology used to identify such carriers in FMCSA's inspection and crash databases (to the extent that they can be identified), as well as the assumptions used.

This section also describes the methodology used to estimate the total number of such carriers operating in the United States, as well as the total number of vehicles and drivers associated with them. Because a full enumeration of such carriers is not feasible, these parameters can only be estimated using extrapolation procedures. Finally, this section describes the metrics used to assess the safety performance of these carriers and the procedures used to generate estimates for these metrics.

2.1 DEFINITION OF A FARM

Identifying vehicles covered under Section 32834 of MAP-21 requires a working definition of a farm. Because a farm is not defined in MAP-21, this study uses a definition historically used by the Agency: In order for a business to qualify as a farm, it must engage in animal husbandry or cultivate a crop. However, businesses engaged in animal husbandry or crop cultivation and whose operations extend to the preparation and packaging of their products are not considered farms. Likewise, a business that harvests something from the land that is not cultivated is also not considered a farm. Thus under this definition, a Christmas tree farm would qualify as a farm because the trees are cultivated on an annual basis, but a logging operation that cuts uncultivated trees occurring in a natural state would not. A poultry farm would be considered a farm, as long as the same business does not prepare and package meat from the poultry.

Businesses that receive special farm license plates for all or a portion of their vehicles may or may not meet this definition of a farm, let alone meet the definition for having farm vehicles, as outlined under MAP-21. For example, farms whose operations include the selling of packaged frozen vegetables or packaged meats may have farm-plated vehicles, but would not be considered by the Agency to be farming operations eligible for MAP-21 exemptions. Moreover, nonfarm entities, such as landscaping businesses, produce vendors and markets, grain elevator companies, farm service companies, farm equipment vendors, and a host of other types of operations tangentially related to farming may be issued farm plates by State motor vehicle agencies (see discussion in Section 3). To the extent possible, such companies were eliminated from the initial list of carriers identified by FMCSA as having a covered farm vehicle through automated data screening processes, as well as through manual data cleaning (see below).

2.2 IDENTIFYING "COVERED FARM VEHICLES" AND THEIR ASSOCIATED CARRIERS

MAP-21 requires that farm vehicles have farm license plates in order to be covered by the Act (these vehicles are referred to as "covered farm vehicles" in the Act). Not all farm-plated

vehicles, however, meet the MAP-21 requirements for covered farm vehicles or are associated with what FMCSA would consider a farm (see above). For example, a farm-plated vehicle may be over 26,001 pounds and traveling beyond 150 air miles of the farm it is servicing. Alternatively, the farm-plated vehicle may be associated with a business that provides services to farms but is not itself a farm as defined by FMCSA, such as a farm cooperative, a grain elevator company, or a food wholesaler. Thus, while the Agency considers it necessary for a covered farm vehicle to have a farm license plate, this condition alone is not sufficient for identifying and differentiating covered farm vehicles. Due to this shortcoming, FMCSA used a two-pronged approach to identify covered farm vehicles and their associated carriers in its databases.

First, the Agency used its internal database—MCMIS—to identify carriers that appear to be engaged in farm-related activities, based on the various cargo classification categories checked off by the carrier on its Form MCS-150 (this form is filled out by the carrier when it applies for a USDOT number and must be updated every 2 years), and on the characteristics of its drivers and vehicles documented on this same form (number of straight trucks, number of tractors and trailers, number of intrastate drivers, number of interstate drivers operating within 100 air miles[1], etc.). Next, roadside inspection data (also housed in MCMIS) were examined to identify inspected vehicles with farm license plates and their associated carriers. By combining both pieces of information, FMCSA was able to identify motor carriers with a high likelihood of operating covered farm vehicles by virtue of having both the appropriate cargo classifications listed on their Form MCS-150 and having had roadside inspections performed on farm-plated vehicles.

Note, however, that it is not possible to develop a comprehensive list of all carriers in all States likely to be operating covered farm vehicles for the following reasons:

- Farm plate tag number configurations that can be used to identify farm-plated vehicles in the MCMIS inspection file are only available for a subset of States (19 States); in the remaining States, although the license plate may have the word “farm” stenciled on it, there is no unique characteristic about the tag number that allows it to be identified as a farm plate when it is recorded in a roadside inspection report or police accident report. Based on this reason alone, it is not possible to enumerate all carriers likely to have covered farm vehicles in all 50 States (using MCMIS data).
- Some farm-plated vehicles, despite having USDOT numbers, may not have been involved in a crash and may not receive roadside inspections on a regular basis. As a result, these vehicles may not show up in FMCSA’s MCMIS roadside inspection or crash databases. For the carriers associated with these vehicles, it cannot be determined whether they operate vehicles with farm plates.
- Other farm-plated vehicles may belong to intrastate carriers not required to obtain a USDOT number for their vehicles. Although such vehicles might appear in the MCMIS roadside inspection and crash databases (if and when they get inspected or a crash

[1] The Form MCS-150 provides information on the number of interstate and intrastate drivers operating within and beyond 100 air miles of the carrier’s domiciled location, rather than within and beyond 150 air miles, as outlined in Section 32934 of MAP-21. The Form MCS-150 also does not provide information on the weight of the motor carrier’s vehicles and, instead, provides information on the number of straight trucks, truck tractors, and truck trailers. It is reasonable to assume, however, that most straight trucks are less than 26,001 pounds and that tractor trailers are greater than 26,000 pounds. These issues are discussed in more detail later in this same section of the report.

occurs), MCMIS would have no information on the cargo they transport or the interstate and intrastate travel characteristics of the carrier. As a result, MCMIS cannot help corroborate whether such vehicles are indeed covered farm vehicles.

Due to these facts, the best list that can be generated is a comprehensive list of carriers most likely to have covered farm vehicles in those States where all intrastate carriers are required to obtain a USDOT number[2] and where farm license plates can be identified from license tag numbers.

The above-mentioned considerations have several implications for the current study. First, the total number of crashes involving covered farm vehicles is not determinable, since the crashed vehicle's license plate can only be identified as a farm plate in the MCMIS crash file or in the National Highway Traffic Safety Administration's (NHTSA's) Fatality Analysis Reporting System (FARS) when the plate is from one of the 19 States that have special tag configurations for farm vehicles. Moreover, even when such a crash can be identified by FMCSA as one involving a farm-plated vehicle, if the vehicle is not associated with a carrier having a USDOT number, it cannot be confirmed whether the farm-plated vehicle is likely to be a covered farm vehicle, based on FMCSA's Form MCS-150 information on cargo and interstate/intrastate travel. Despite the fact that the total number of crashes involving covered farm vehicles cannot be determined, crash rates for carriers with covered farm vehicles (i.e., crashes per power unit) can still be estimated, based on a sample consisting of those carriers in the MCMIS and FARS databases that can be identified as having covered farm vehicles.

The second implication of not being able to generate a comprehensive listing of all carriers with covered farm vehicles is that estimates of the total number of such carriers and their vehicles must necessarily be based on the subset of States that both issue special license plate tag number configurations for farm plates and that require intrastate carriers to obtain a USDOT number. Statistical extrapolation procedures must then be used to estimate the total number of covered farm carriers and vehicles operating in the United States based on this sample of States. To the extent, however, that some covered farm vehicles may never get inspected and never get into a crash, these estimates could have a downward bias and underestimate the actual number of covered farm vehicles and carriers.

2.3 STATES THAT CAN BE USED FOR DATA ANALYSIS

2.3.1 Key Eight States

Nineteen States have special tag number configurations for farm vehicles that can be used to identify such vehicles in the Agency's inspection and crash files. These States are Alabama, Alaska, Arizona, Delaware, Illinois, Indiana, Maryland, Michigan, Minnesota, Mississippi, New Jersey, New York, North Dakota, Oklahoma, Oregon, Pennsylvania, Virginia, West Virginia, and Wisconsin. Of these 19 States whose farm license plate tag configurations can be identified in the MCMIS inspection and crash data, only 8 of them require all their intrastate carriers to obtain USDOT numbers. As a result, out of these 19 States, Form MCS-150 MCMIS registration

[2] Some States require some carriers, but not all, to obtain USDOT numbers. In such States, the requirement is often that only carriers with vehicles over 26,000 pounds must obtain a USDOT number.

information is available for all State motor carriers in only 8 of them. These States are Alabama, Alaska, Indiana, Michigan, Minnesota, New York, Oregon, and West Virginia. Due to this fact, data from these eight States are best suited for evaluating the safety performance of covered farm vehicles. National estimates of carriers and vehicles eligible for the covered farm vehicle exemptions can also be produced from these same States by extrapolating results from these States to the national level. Estimates based on data from other States could produce biased results, as a result of not including all intrastate carriers with covered farm vehicles.

2.3.2 Remainder of 19 States

Exemptions granted to covered farm vehicles under MAP-21 might conceivably extend to other farm-plated vehicles not covered under the Act. Such a scenario could happen if inspectors at the roadside do not have the ability to identify those vehicles that are covered and those that are not. For example, it may not be realistic to assume that an inspector would necessarily refuse to grant MAP-21 exemptions to a vehicle belonging to a grain elevator company or farm cooperative (companies that are not true farms), given that it has farm plates. In other cases, the inspector may not have enough information about the business to make a proper determination. Lastly, inspectors may not be able to determine whether the driver of a vehicle over 26,000 pounds is within 150 air-miles of the farm it is servicing (as required for such vehicles to be eligible for these MAP-21 exemptions). Thus, in the most extreme case, MAP-21 exemptions for covered farm vehicles might end up being granted at the roadside to all vehicles with farm plates. For this reason, this study also produces motor carrier safety performance statistics for all carriers that have vehicles with farm plates identifiable in MCMIS (in addition to statistics for carriers with vehicles believed to operate covered farm vehicles). For estimates based on all vehicles with farm plates, data from all 19 States (referenced above) are used.

2.4 COUNTING A MOTOR CARRIER'S COVERED FARM VEHICLES

At any given point in time, any farm-plated vehicle operated by an entity meeting FMCSA's definition of a farm might be a covered farm vehicle under MAP-21. This stems from the fact that the Act defines covered farm vehicles on a trip-by-trip basis. Where possible, however, FMCSA used the Form MCS-150 information housed in MCMIS to determine the predominant travel patterns of the motor carrier's vehicles and to classify the motor carrier accordingly. If it did not appear likely that any of the motor carrier's vehicles had predominant travel patterns consistent with the requirements of MAP-21 for covered farm vehicles, then the carrier was not considered a covered farm carrier. For example, if the motor carrier's Form MCS-150 information indicated that it only had tractor trailers (as opposed to straight trucks) and only drivers engaged in interstate operations beyond 100 air miles, then its vehicles were not considered covered farm vehicles.

Once a motor carrier has been identified as potentially having covered farm vehicles, the data sources do not indicate how many of its vehicles may fall into this category. For instance, consider a motor carrier whose Form MCS-150 indicates that it has four tractor trailers, three drivers operating interstate beyond 100 air miles, and three drivers that operate intrastate within 100 air miles. Based on this information, any number of the four vehicles may operate interstate or intrastate. In addition, some vehicles may operate as covered farm vehicles on one day, but on another day may travel too far to be covered under MAP-21. Due to these considerations,

FMCSA has considered all vehicles belonging to the carrier to be covered farm vehicles, once it has been determined from roadside inspection, crash, and Form MCS-150 data that the carrier is likely to have at least one such vehicle.

2.5 DESCRIPTION OF ALGORITHMS USED TO IDENTIFY COVERED FARM CARRIERS AND VEHICLES

The MCMIS database system contains information on CMV roadside inspections and crashes (including license plate information), interventions performed on motor carriers by the Agency's enforcement office, such as compliance reviews, as well as background information on all motor carriers with USDOT numbers (USDOT numbers are required of all motor carriers engaged in interstate operations, and of all motor carriers engaged in intrastate operations involving the transport of HM requiring a placard). As mentioned, above, FMCSA used a two-pronged approach to identify carriers potentially having covered farm vehicles, one based on motor carrier background information in MCMIS (taken from Form MCS-150), and the other based on license plate information collected during roadside inspections or recorded on police accident reports:

- **MCMIS Form MCS-150 Farm Identification Algorithm:** Identification of carriers with potential covered farm vehicles, based on MCMIS Form MCS-150 information, indicating both cargo classifications indicative of farming operations, as well as intrastate and interstate driver information consistent with the MAP-21 requirements.
- **Farm Plate Identification Algorithm:** Identification of carriers in the MCMIS roadside inspection and crash files with vehicles having special farm license plates.

These two algorithms are discussed in greater detail below. Carriers captured by both algorithms were considered to have a high probability of being subject to MAP-21 exemptions.

The two algorithms for identifying motor carriers operating covered farm vehicles yield two different populations groups that partially, but not completely, overlap with each other. The relationship between these two populations is depicted in Table 2.

Table 2. Schematic breakout of potential carriers identified by farm carrier identification algorithms and eligibility for MAP-21 farm exemptions.

MCMIS Form MCS 150 Farm Identification Algorithm:	Farm Plate Identification Algorithm:	
	Farm Tags Identified in Inspection or Crash Data	**Farm Tags Not Identified in Inspection and Crash Data**
Identified as Farm Carriers from Form MCS-150	Cell A: All carriers in this cell should be subject to MAP-21 farm exemptions.	Cell B: Some carriers in this cell may be subject to MAP-21 if they have farm-plated vehicles that have never been inspected by FMCSA.
Not Identified as Farm Carriers from Form MCS-150	Cell C: Some carriers in this cell may be subject to MAP-21 if they are intrastate carriers not required to have a USDOT number or their Form MCS-150 data are incomplete or inaccurate.	Cell D: Some carriers in this cell may be subject to MAP-21 if they are intrastate carriers with no USDOT number or incomplete Form MCS-150 data and have farm-plated vehicles that have never been inspected at the roadside.

In this schematic diagram, carriers identified as covered farm carriers by both MCMIS Form MCS-150 information and license plate tag number configurations belong to Cell A. These carriers have the highest likelihood of being eligible for the MAP-21 exemptions. By focusing much of the analysis for this study on the eight key States that have identifiable tag number configurations for farm license plates and that require intrastate carriers to obtain a USDOT number, the bias resulting from not capturing those MAP-21-eligible farm carriers falling into cells "B," "C," and "D," above, is minimized. However, even when limiting the analysis to these States, a small number of MAP-21-eligible carriers may not be captured as a result of having incomplete Form MCS-150 data or having farm-plated vehicles that never get inspected at the roadside (or that are never involved in crashes).

Carriers in Cell B appear to be engaged in farm-related operations, based on Form MCS-150 data, but do not have any inspections recorded in MCMIS for farm-plated vehicles. It is possible that some of these carriers may have farm-plated vehicles that were never inspected and never involved in crashes and thus do not show up in the Agency's MCMIS inspection database. Although such vehicles may be eligible for exemptions granted by MAP-21 for covered farm vehicles, the Agency will never be able to identify this group of carriers.

The two algorithms used to identify carriers likely to have covered farm vehicles are discussed in more detail below.

2.6 ALGORITHM 1: IDENTIFYING FARMING OPERATIONS BASED ON MCMIS FORM MCS-150 DATA

The MCMIS Census File contains summary information on carriers that have filed for USDOT numbers. This algorithm classified a carrier as likely to have a covered farm vehicle if it met all of the following five criteria:

- Carrier has recent activity in MCMIS (defined as having had any of the following activities in the last 3 years: an inspection, a crash, a company review or audit by

FMCSA, a Motor Carrier Identification Report update, vehicle registration activity, a Unified Carrier Registration System payment, or has current operating authority in FMCSA's Licensing and Insurance database).

- Carrier is a private carrier (operational class equals "C").
- The cargo transported by the carrier includes at least one of the following five categories, and the cargo transported by the carrier does not include mobile homes (Category H), meat (Category R), or beverages (Category X):
  - Fresh produce (i.e., Cargo Category J on Form MCS-150).
  - Livestock (Category O).
  - Grain, feed, or hay (Category P).
  - Farm supplies (Category AA).
  - Cargo Category "Other," if it states "Farm" or "Poultry."

    If farm supplies are indicated and it is the only one of the above mentioned categories indicated, then the carrier must have the words, "farm," "ranch," "orchard," "dairy," "nursery," "greenhouse," or "acres" in its legal or "doing business as" (DBA) name.
- The MCS Form-150 indicates that the carrier only operates "straight trucks," or the carrier has truck tractors and the company is engaged only in intrastate, non-HM operations, or the carrier has truck tractors, is engaged in interstate operations, and all vehicles travel within 100 air miles.
- The carrier does not have any of the following words or partial words embedded in either its legal or DBA name: "cooperative," "co-op," "landscap," "lawn," "produce" (unless embedded in the word, producers), "market," "food," "store," "deliver," "creamery," "grain," "seed," "fertilizer," "elevator," "wholesal," "retail," "rent," "sales," "service," "assoc," "assn," "products," "supply," "supplies," "constr," "contrac," "equipm," "excavat," "builders," "building," "apartmen," "property," "homes," "home," "develop," "distribu," "transport," "hauling," "trucking," "trucks," "garage," "salvage," "cars," "auto," "repair," "hardware," "plumbing," "electric," "concrete," "masonry," "manufact," "furniture," "carpentr," "cabinet," "logging," "lumber," "iron," "metal," "concrete," "maintena," "manage," "mgmt," "realty," "realtors," or "real est."

2.6.1 Exclusion of Carriers Indicating Particular Cargo Categories

As indicated, above, carriers indicating mobile homes, meat, and beverages (MCS-150 categories H, R, and X) were automatically treated as nonfarm entities. In the case of a carrier transporting meat, one can reasonably assume that such carriers are slaughtering their livestock (or do not deal with actual livestock at all) and thus do not meet FMCSA's definition of a farm. The analysis further assumes that carriers transporting beverages are either processing and packaging their own agricultural products, or are delivering or packaging someone else's agricultural products, and therefore do not meet FMCSA's farm definition.

Intuitively, one might also assume that motor carriers indicating that they transport "general freight" (MCMIS Form MCS-150 Category A) or "household goods" (Form MCS-150 Category

B) would not be farming operations and should be summarily excluded from the data file. It turns out, however, that many carriers in MCMIS that appear to be bona fide farming operations (based on Google searches) have one of these two cargo categories checked on their MCS-150 form (one must assume that such carriers either inadvertently check the wrong cargo classification boxes on the Form MCS-150, or they do not fully understand the meaning of these cargo categories).

2.6.2 Identifying Carriers with Vehicles Weighing More Than 26,000 Pounds

MAP-21 exemptions for covered farm vehicles do not extend to vehicles weighing more than 26,001 pounds that are engaged in interstate operations that involve travel outside of a 150-mile radius from the farm the vehicle is servicing. Thus, it is important that Algorithm A exclude such carriers to the extent possible. Algorithm A identifies vehicles less than 26,000 pounds based on the number of straight trucks listed on the Form MCS-150 and identifies vehicles more than 26,000 pounds based on the number of truck tractors listed on the form. This assumes that all straight trucks have gross vehicle weights of 26,000 pounds or less. Obviously, there may be some carriers with straight trucks that weigh more than 26,000 pounds. Hence, it is possible that the fourth step of this algorithm (see steps 1-5, above) may capture some carriers that do not qualify to be covered farm carriers. It is expected, however, that the total number of vehicles misidentified by the entire algorithm is small, given that the conditions of the first three steps must also be met.

2.6.3 Carriers with Interstate Vehicles Weighing More Than 26,000 Pounds and Operating Within 150 Air Miles

Map-21 stipulates that vehicles weighing more than 26,000 pounds may operate within 150 air miles of the farm being serviced when operating interstate and still be covered under the legislation. However, because MCMIS only has information on company vehicles traveling within 100 air miles and vehicles traveling beyond 100 air miles (rather than within and beyond 150 air miles), a 100 air-mile criterion had to be used here. In other words, if a carrier only listed truck tractors traveling more than 100 miles interstate on its Form MCS-150, it was excluded from the target population. As a result of this, it is possible that some motor carriers with covered farm vehicles operating beyond 100 air miles, but within 150 air miles, were not captured by this algorithm.

2.6.4 Further Data Cleaning for Carriers Captured by MCMIS Form MCS-150 Farm Identification Algorithm

To help identify and remove additional ineligible carriers captured by the MCMIS Farm Identification Algorithm, those carriers captured by the algorithm with more than 30 trucks were examined in detail, often using Internet search procedures. Many of these companies had their own Web sites, which often allowed for a quick determination of their eligibility under MAP-21. For the most part, this exercise was restricted to the key 19 States where farm plates can be identified in MCMIS. As a result of this exercise, many large poultry operations (producing packaged chicken for grocery stores, such as Purdue), food delivery and frozen food operations, truck hauling operations, and various other nonfarm entities (including Monsanto) were identified and removed from the list of carriers initially identified by the algorithm.

2.7 ALGORITHM 2: IDENTIFYING FARMING OPERATIONS, BASED ON FARM-PLATED VEHICLES FOUND IN MCMIS ROADSIDE INSPECTION AND CRASH FILES

Although all States issue special farm license plates for certain vehicles engaged in farming operations, many States merely stencil the word "FARM" onto the plate, or use a special decal to identify the plate as a farm plate, rather than use a special tag number configuration. Farm vehicles whose farm license plates do not have special tag number configurations cannot be identified in the MCMIS roadside inspection and crash databases based on the vehicle's tag number. As mentioned previously, FMCSA was able to identify 19 States that do use special tag number configurations for farm vehicle license plates. The special tag number configurations for each of these States are provided in Appendix A.

Using roadside inspection data from these 19 States and 10 years of roadside inspection and police accident report data, FMCSA identified roadside inspections and crashes involving vehicles with farm license plates from the above-mentioned States. For those identified vehicles with USDOT numbers, a cross check was then performed against the MCMIS Census File to identify the motor carrier associated with the vehicle. The motor carrier was then captured by the "farm plate" identification algorithm if MCMIS showed any recent activity on the part of the carrier.

Roadside inspections and crashes involving farm-plated vehicles without USDOT numbers (e.g., intrastate carriers not required to have USDOT numbers) could not be matched to the MCMIS Census File, and a different approach had to be used to identify the motor carriers associated with them. All inspection and crash reports for such vehicles showing the same address information were assumed to belong to the same carrier, and the carrier's name was then taken from the most recent inspection or police accident report found. If one of these inspections or crashes occurred within the last 3 years, the motor carrier was then deemed to have recent activity and was captured by the "farm plate" algorithm.[3]

Carriers initially captured by the "farm plate" algorithm and listed in MCMIS as "for-hire" operations or as having more than 500 power units or 500 total drivers were also deleted from the final dataset used in the analysis. Based on examination of the names of these carriers, the vast majority of them appeared not to be involved in farming operations. Many of these carriers may have been captured by the algorithm as a result of license plate tag numbers being recorded incorrectly at the roadside. Several hundred carriers were removed from the final dataset because of the size restriction, including Coca Cola, Ryder Trucks, Penske, North American Van Lines, Bridgestone Tire, FedEx, Tyson Foods, CR England, JB Hunt, New Bern Transport, Schneider National, Swift Transportation, and Conway Freight. A handful of other carriers that were captured by the algorithm and had fewer than 500 power units and drivers (including Sunoco, Honeywell, Bridgestone Tire, and Daimler Trucks) were also removed from the dataset because it was clear that they, too, were not farming operations, and it seemed unlikely that their vehicles would actually have farm plates.

[3] Note that it was not necessary to require motor carriers with USDOT numbers to have had an inspection in the last 3 years to ensure recent activity because such carriers could later be checked for recent activity in MCMIS using a broader range of checks; as a result, any carrier from 1 of these 19 States with a USDOT number that was found to have an inspection or crash involving a farm-plated vehicle in the last 10 years was captured by this algorithm.

2.8 ANALYSIS APPROACH

This report presents estimates of the number of carriers and vehicles subject to farm vehicle exemptions under MAP-21 and assesses the safety performance of these same carriers and vehicles using calendar year inspection and crash data for 2011 and 2012 and partial calendar year data for 2013. The specific metrics estimated and procedures used to generate these estimates are discussed below.

2.8.1 National Estimates of the Vehicle and Carrier Population Impacted by MAP-21

National estimates for the number of carriers, vehicles, and drivers covered under MAP-21 can be derived from the eight States where both farm license plate tag number formats are identifiable in the MCMIS inspection data, and where all interstate and intrastate carriers (including those only operating vehicles less than 26,001 pounds) are required to obtain USDOT numbers. These estimates can be produced in the following manner:

- For the eight States that both have special license plate tag configurations for farm vehicles and also require intrastate carriers to obtain USDOT numbers, estimate the percentage of the carriers identified by the Form MCS-150 farm detection algorithm (Algorithm 1) that have covered farm vehicles. This percentage can be approximated by examining those carriers captured by the algorithm that were also inspected at the roadside within the last 3 years. Using this subset of carriers and determining what fraction of them were captured by the farm plate algorithm (i.e., that had inspections performed on farm-plated vehicles) gives a reasonable estimate of the percentage of carriers with covered farm vehicles captured by the Form MCS-150 algorithm (see Figure 1).

$$\mathbf{P}_{\text{mcs, farm, 8states}}$$

Figure 1. Variable. Percentage of carriers in the eight key States with covered farm vehicles, as captured by the Form MCS-150 algorithm.

- Estimate the total number of carriers captured by the Form MCS-150 algorithm that are covered farm carriers (i.e., have covered farm vehicles) in these same eight States (see Figure 2):

$$\mathbf{Carriers}_{\text{farm, 8states}} = \mathbf{P}_{\text{mcs, farm, 8states}} \times (\mathbf{No.\ Carriers\ in\ 8\ States\ Captured\ by\ Form\ MCS\text{-}150\ Algorithm})$$

Figure 2. Formula. Total number of carriers in the eight key States that have covered farm vehicles, as captured by the Form MCS-150 algorithm.

- Estimate the percentage of carriers in the United States that are covered farm carriers by determining the percentage of covered farm carriers in these eight States. This can be accomplished by dividing the estimate of the total number of covered farm carriers captured by the Form MCS-150 algorithm by the total number of motor carriers in these eight States (see Figure 3):

$$\mathbf{P}_{farm,U.S.} = \mathbf{Carriers}_{farm,8states} / \mathbf{Total\ Carriers}_{8States}$$

Figure 3. Formula. Percentage of carriers in the United States that are covered farm carriers.

- Estimate the total number of U.S. carriers, including both intrastate and interstate carriers. Because MCMIS does not contain data on all intrastate carriers in all States, this parameter must be estimated. The calculations required for estimating the total number of U.S. carriers are presented in Appendix B.
- Estimate total U.S. farm carriers (see Figure 4):

$$\mathbf{Total\ Carriers}_{farm,U.S.} = \mathbf{P}_{farm,8states} \times \mathbf{Total\ Carriers}_{U.S.}$$

Figure 4. Formula. Total U.S. farm carriers.

- Calculate the average number of vehicles per carrier (**Ave Veh** $_{farm,\ 8\ states}$) for the farm carriers identified in these eight States (i.e. carriers identified by both the MCS-150 algorithm and the farm plate algorithm) and use this number to estimate total covered farm vehicles (see Figure 5):

$$\mathbf{Total\ Covered\ Farm\ Vehicles}_{U.S.} = \mathbf{Ave\ Veh}_{farm,\ 8\ states} \times \mathbf{Total\ Carriers}_{farm,\ U.S.}$$

Figure 5. Formula. Total covered farm vehicles in the United States, using the average number of vehicles per carrier for the farm carriers identified in the eight key States and total farm carriers in the United States.

- Estimate the total number of drivers operating covered farm vehicles (**Ave Drv** $_{farm,\ 8\ states}$) by calculating the average number of drivers per carrier for the farm carriers identified in these eight States (i.e. carriers identified by both the MCS-150 algorithm and the farm plate algorithm) and use this number to estimate total covered farm vehicle drivers (see Figure 6):

$$\mathbf{Total\ Covered\ Farm\ Drivers}_{U.S.} = \mathbf{Ave\ Drv}_{farm,\ 8\ states} \times \mathbf{Total\ Carriers}_{farm,\ U.S.}$$

Figure 6. Formula. Total covered farm vehicle drivers in the United States, using the average number of drivers per carrier for the farm carriers identified in the eight key States and total farm carriers in the United States.

- To estimate the total number of covered farm vehicles in operation that cross State lines using MCMIS data, determine the percentage of carriers captured by both algorithms in the key eight States that are involved in interstate operations. Classify a carrier as being engaged in interstate operations if it meets any of the following conditions:
  - The carrier's Form MCS-150 data indicates it has "interstate" drivers.
  - The carrier has had at least one vehicle inspected where the inspector indicated that the carrier was an interstate carrier on the inspection report.
  - The carrier has had at least one inspection in a State different from the State represented by the vehicle's license plate.

- The percentage of covered farm carriers in the eight States that meet at least one of these conditions can be used to estimate the percentage of total covered farm vehicles crossing State lines. Applying this percentage to the national estimate for the total number of covered farm vehicles gives an estimate of the total number of covered farm vehicles crossing State lines.

2.8.2 Safety Metrics

This study used various safety metrics to assess the relative safety fitness of covered farm vehicles, as well as other farm vehicles not necessarily subject to exemptions under MAP-21. These metrics include driver and vehicle OOS rates, crash rates, and other statistics that measure the extent to which these vehicles are overrepresented or underrepresented in CMV crashes. Analyses were performed using four population groups:

- **Group 1.** Carriers captured by both farm vehicle identification algorithms that are domiciled in one of the key eight States requiring all carriers (including intrastate carriers operating vehicles that weigh less than 26,000 pounds) to obtain USDOT numbers. This is the smallest population grouping used in the analysis, but also the most representative, since the relative number of interstate and intrastate carriers in this group should be consistent with their proportions in the population.
- **Group 2.** Carriers captured by both farm vehicle identification algorithms that are domiciled in one of the 19 States whose farm license plates can be recognized in MCMIS. This population grouping contains many more carriers than Group1, allowing confirmation of findings found from Group 1 carriers when the Group 1 sample size is small. One shortcoming of this group, however, is that it may not be representative in terms of its mix of interstate and intrastate carriers, since some covered farm carriers in some of these States may never have obtained a USDOT number and thus would not be captured by this group (since the Form MCS-150 identification algorithm would have no information for such carriers).
- **Group 3.** This group includes all carriers with farm-plated vehicles identified by the farm plate identification algorithm. This population grouping includes more than carriers with covered farm vehicles, since many carriers with farm-plated vehicles may not meet all of the requirements for MAP-21 exemptions, or may not meet FMCSA's definition of a farm. Nevertheless, this population grouping is important to analyze because many inspectors at the roadside may not have the ability to distinguish between those farm-plated vehicles eligible for MAP-21 farm exemptions and those that are not, and consequently may decide to grant MAP-21 farming exemptions to all vehicles with farm plates.
- **Group 4.** This group includes all private carriers with recent activity domiciled in 1 of the key 8 States, or, depending on the particular analysis, domiciled in 1 of the 19 States whose farm license plates can be identified in MCMIS. This group of carriers is used strictly as a comparison group in the analysis.

2.8.3 Out-of-Service Rates

This study evaluates the safety performance of covered farm vehicles and their associated carriers by examining roadside inspection OOS rates and crash rates. OOS and violation rates were calculated using data from 2012 and 2013. MAP-21 became law on October 1, 2012. OOS rates were calculated for covered farm vehicles for the 9-month period immediately prior to the enactment of the law (January 1–September 30, 2012), and for the 9-month period immediately after the enactment of the law (October 1, 2012–June 30, 2013). This allows for the measurement of potential changes in inspection OOS rates as a result of the law, as well as changes in the number of inspections performed on covered farm vehicles. However, it must be noted that any change in OOS rates subsequent to the enactment of the law does not necessarily reflect an actual change in motor carrier or driver behavior, since the enactment of MAP-21 itself redefines what constitutes a driver and vehicle violation for covered farm vehicles.

2.8.4 Crash Statistics

Because crashes involving covered farm vehicles can only be conclusively identified in cases where the vehicle has a farm plate from 1 of the 19 States discussed above and where the carrier associated with the vehicle has a USDOT number allowing for confirmation of travel distances and cargo transported, the total number of such crashes in any given year, as well as the total number of resulting injuries and fatalities, cannot be readily tabulated. Extrapolation techniques for estimating such totals are also problematic, since crashes are rare events. Hence, this study focuses on estimating crash rates for carriers with covered farm vehicles—instead of total crashes involving such vehicles—using crash data from those carriers from the key eight States. These rates are calculated both in terms of crashes per 100 power units and crashes per million vehicle miles traveled (VMT). Crash rates for all private carriers with farm-plated vehicles (based on carriers domiciled in 1 of the 19 States where the farm tag numbers can be identified in MCMIS) are also estimated. For purposes of comparison, these rates are compared to crash rates for all private carriers with recent activity domiciled in 1 of the key 8 States, and crash rates for all private carriers with recent activity domiciled in 1 of the 19 States where farm license plates can be recognized in MCMIS.

For the carrier's crash data to be used in the "per power unit" crash rate calculations, the analysis used the following business rules to ensure data quality:

- The carrier's power unit count in MCMIS had to be non-missing.
- The ratio of its power unit count to driver count had to be less than or equal to five.

In addition, for the carrier's crash data to be used in the "per VMT" crash rate calculations:

- The carrier's VMT had to have been updated in MCMIS during calendar years 2011 and 2012 for the 2011 and 2012 crash rate estimates, respectively.
- The carrier's total reported VMT divided by its total reported power units had to be no greater than 150,000 miles per power unit.

MAP-21 also requires that the total number of fatalities and injuries in farm vehicle crashes be calculated for occupants of farm vehicles and for non-occupants. However, the only database

that provides this kind of information is FARS, which is maintained by NHTSA. This fact—combined with the inability to identify all covered farm vehicle crashes—makes it unfeasible to fulfill this particular requirement of the study. In lieu of these statistics, this study focuses on assessing the level of severity of crashes involving farm vehicles, based on the subset of crashes in MCMIS associated with carriers identified by both farm carrier algorithms. The fraction of these crashes that involve injuries and fatalities can be compared to similar statistics for all trucks associated with private carriers domiciled in these same States. This approach allows one to determine whether crashes involving covered farm vehicles are more likely to result in injuries and fatalities than all crashes involving trucks from private carriers.

3. FINDINGS

3.1 DATABASE CHARACTERISTICS

Based on the 19 States whose farm vehicle license plates can be recognized in MCMIS inspection and crash data (and after cleaning the data for anomalies, such as for-hire carriers with farm-plated vehicles), a little over 12,000 carriers were identified by the farm plate algorithm as having at least one vehicle with a farm license plate, as well as a roadside inspection or crash within the last 3 years. Of these carriers, 8,121 have a USDOT number. Examining these 8,121 carriers with USDOT numbers and at least one farm-plated vehicle is useful, since they all have Form MCS-150 information on file with FMCSA, which can then be used to measure the extent to which carriers with farm-plated vehicles conform, generally speaking, to the Agency's notion of a farming operation or to other requirements of MAP-21.

Table 3 shows the percentage of these carriers that meet the various criteria used by the Form MCS-150 algorithm for identifying farm carriers. When these criteria are considered individually, the table indicates that the vast majority of carriers with farm-plated vehicles appear to meet the various requirements for being considered a farming operation or for being subject to MAP-21 farm exemptions. However, when all of the criteria are considered collectively, only slightly more than half of these carriers meet all of the criteria used by the Form MCS-150 algorithm to identify carriers subject to MAP-21 farm exemptions.

Table 3. Percentage of carriers with farm-plated vehicles and USDOT numbers that meet criteria used in the MCMIS Form MCS-150 Farm Identification Algorithm.*

Condition Met	All Private Carriers Identified by Farm Plate Algorithm with USDOT Numbers (8,121 carriers)
Private Carrier (FMCSA and MAP-21 Requirement)	94%†
Allowable Cargo (FMCSA Requirement)	76%
Vehicle Travel Restrictions (MAP-21 Requirement)	82%
Legal and DBA Name Consistent with Farming Operation	83%
All Conditions of Form MCS-150 Farm Identification Algorithm Met	56%

*Based on carriers with recent activity whose farm-plated vehicles were identified from inspection or crash data.

†The remaining 6 percent of the carriers had missing "Operation Classification" information on the Form MCS-150.

A significant number of carriers with farm-plated vehicles (44 percent) do not meet one or more of the requirements of the Form MCS-150 algorithm for identifying farm carriers from MCMIS. To the extent that this occurs, some carriers may be incorrectly identified as having farm plates by the algorithm. These results suggest that a large number of carriers with farm-plated vehicles in all likelihood do not conform to either the requirements of MAP-21 or to the Agency's notion of what constitutes a farming operation.

Conversely, not all carriers identified by the Form MCS-150 farm detection algorithm appear to have vehicles with farm plates. Examining carriers captured by the Form MCS-150 algorithm from the key eight States (where both farm plates can be identified in the data and where all intrastate carriers must obtain a USDOT number), and focusing on those that have had a crash or

inspection in the last 3 years, only 38 percent were captured by the farm plate identification algorithm. Since having a farm license plate is required to be eligible for MAP-21 farm exemptions, the data suggest that many businesses engaged in farm-related activities may not be eligible for MAP-21 farm exemptions.

3.2 ESTIMATED NUMBER OF COVERED FARM CARRIERS, VEHICLES, AND DRIVERS

As outlined in the Methodology section of this report, national estimates for the number of covered farm carriers, covered farm vehicles, and covered farm drivers can be generated by:

- Producing similar estimates for those key eight States that have both recognizable tag number configurations for farm vehicles and that require all intrastate and interstate carriers to obtain USDOT numbers.
- Extrapolating these results to the national level.

Table 4 presents results based on this approach. Results for all interim calculations (i.e., the seven steps presented in the Methodology section) that are required to generate these estimates are presented in Appendix C.

Table 4. Estimates of the number of covered farm carriers, vehicles, and drivers.

Estimated Number of Carriers with Covered Farm Vehicles	24,955
Estimated Number of Covered Farm Vehicles	99,820
Estimated Number of Drivers of Covered Farm Vehicles	74,865
Estimated Average Number of Drivers per Covered Farm Carrier	3
Estimated Average Number of Trucks per Covered Farm Carrier	4

Covered farm carriers identified in the key 8 States had an average VMT of 37,962 miles per year. MCMIS VMT data for covered farm carriers from these particular States should include both intrastate and interstate carriers, since these States require all intrastate and interstate carriers to obtain USDOT numbers (and therefore to submit Form MCS-150 information, including VMT). Based on this figure, the estimated national VMT for covered farm vehicles is 947 million miles per year.

Based on MCMIS data from these same eight States, approximately 78 percent of covered farm carriers operate at least one covered farm vehicle across State lines. Applying this percentage to the estimated number of total covered farm vehicles gives a figure of approximately 79,000 total covered farm vehicles crossing State lines. The reader must be cautioned, however, that this estimate is based on data from only eight States, and these States do not include large-sized agricultural States, such as California or Texas. For this reason, the estimate may have an upward bias.

4. DRIVER AND VEHICLE OUT-OF-SERVICE AND OTHER ROADSIDE VIOLATION RATES

Table 5 presents driver and vehicle OOS rates for both covered farm vehicles and for all vehicles with farm plates. Both vehicle categories are considered, as roadside inspectors may incorrectly classify some vehicles as covered farm vehicles simply because they have a farm license plate. Thus, both vehicle categories may be impacted by MAP-21. Note that Table 5 compares covered farm carrier OOS rates for the 9-month period immediately prior to the enactment of MAP-21 to the 9-month period immediately after its enactment.[4]

Table 5. Driver and vehicle OOS rates for covered farm vehicles and vehicles with farm plates, for the 9-month periods immediately prior to and after the enactment of MAP-21.[§]

Vehicles/Carriers	Driver OOS Rate			Vehicle OOS Rate		
	Before MAP-21 %, (# of inspections)	**After MAP-21** %, (# of inspections)	**Percent Change in Rate**	**Before MAP-21** %, (# of inspections)	**After MAP-21** %, (# of inspections)	**Percent Change in Rate**
Covered Farm Vehicles Key Eight States[*]	6.8% (833)	5.0% (733)	-26% (-12%)	29.0%[**] (628)	14.1% (501)	-51% (-20%)
19 States[†]	6.6% (1,809)	5.1% (1,449)	-22% (-20%)	29.0%[**] (1,343)	15.9% (1,012)	-45% (-25%)
Vehicles with Farm Plates 19 States[‡]	7.1% (7,156)	6.7% (6,042)	-6% (-16%)	30.7%[**] (5,455)	21.0% (4,476)	-32% (-18%)
All Private Carriers Key Eight States	5.4% (67,964)	5.7% (57,802)	6% (-15%)	24.2% (53,521)	23.4% (44,908)	-3% (-16%)
19 States	4.9% (163,565)	5.1% (147,032)	4% (-10%)	21.0% (130,065)	20.2% (115,947)	-4% (-11%)

[*]Based on vehicles belonging to carriers identified by both farm identification algorithms and domiciled in one of the following eight States: AL, AK, IN, MI, MN, NY, OR, WV.

[†]Based on vehicles belonging to carriers identified by both farm identification algorithms and domiciled in one of the following 19 States: AL, AK, AZ, DE, IL, IN, MD, MI, MN, MS, NJ, NY, ND, OK, OR, PA, VA, WV, WI.

[‡]Based on inspected vehicles with farm plates from one of the following States: AL, AK, AZ, DE, IL, IN, MD, MI, MN, MS, NJ, NY, ND, OK, OR, PA, VA, WV, WI, excluding carriers listed in MCMIS as "for-hire," and carriers with more than 500 power units.

[§]Source: FMCSA, MCMIS, data snapshot as of September 27, 2013.

[**]Indicates that the difference between estimate and number for all private carriers in State grouping is statistically significant at the 95-percent level of confidence.

For the covered farm vehicles, OOS rate estimates are based on vehicles belonging to carriers that have been identified by both farm identification algorithms. The OOS rate estimates for all

[4] Although the primary purpose of this report is to assess the overall safety fitness of vehicles and drivers subject to MAP-21 farm exemptions, and not to assess MAP-21's impact upon safety for the entities it exempts (for which there is only limited data), the latter exercise is still useful, to the extent that it can be done, and comparing crash rates in the pre-MAP-21 period to the post-MAP-21 period provides some notion of the extent of this impact.

farm-plated vehicles are based on all inspected vehicles with farm plates where such plates can be identified in MCMIS. Since the MAP-21 exemptions have a direct effect on what particular violations may be cited for covered farm vehicles, the table presents driver and vehicle OOS rates both for the 9-month period immediately prior to enactment of MAP-21 (October 1, 2012), and for the 9-month period immediately following enactment of MAP-21.

Table 5 indicates that the driver and vehicle OOS rates for covered farm vehicles domiciled in the key eight States were higher than similar rates for all private carriers prior to enactment of MAP-21 (6.8 percent versus 5.4 percent for drivers; 29.0 percent versus 24.2 percent for vehicles). The difference in the OOS rates between covered farm carriers and all private carriers in the eight key states is statistically significant in the case of the vehicle OOS rate (at the 0.05 level), but is not in the case of the driver OOS rate (note that the lack of statistical significance in the difference in the driver OOS rate between covered farm vehicles and all private vehicles is in all likelihood due to the small sample size of driver inspections available to evaluate). Using inspection data from all 19 States where farm license tag numbers can be identified in MCMIS gives similar results for the covered farm vehicle OOS rates, although more pronounced. In this instance, the vehicle OOS rate for covered farm vehicles is 38 percent higher than the vehicle OOS rate for all private carriers (as opposed to 20 percent higher, as was the case in the key 8 States).

After enactment of MAP-21, both the driver and vehicle OOS rates for covered farm vehicles in the key eight States dropped. The largest drop occurred in the vehicle OOS rate, which decreased by 51 percent (29.0 percent OOS to 14.1 percent OOS), while the driver OOS rate dropped by 26 percent (6.8 percent OOS to 5.0 percent OOS). Presumably these changes in both the vehicle and driver OOS rates occurred, at least in part, because covered farm vehicles became subject to fewer regulations subsequent to MAP-21. Table 5 also shows that the population of all private carriers experienced only slight changes in vehicle and driver OOS rates after enactment of MAP-21.

In addition to covered farm vehicles, all farm-plated vehicles showed a decrease in OOS rates as well after enactment of MAP-21, although less pronounced. That these decreases in OOS rates occurred for both covered farm vehicles and for all farm-plated vehicles (although less dramatically), suggests that roadside inspectors may not always be able to determine which vehicles are eligible for MAP-21 farming exemptions and which are not.

Not only did OOS rates for covered farm vehicles and farm-plated vehicles drop after enactment of MAP-21, but total inspections performed on these vehicles dropped, as well. Although Table 5 indicates that total inspections dropped for all private carriers during the first 9 months after enactment of MAP-21 (presumably, due to seasonal variation in roadside inspection activity), the percentage decrease was more pronounced for covered farm vehicles and farm-plated vehicles, particularly in the case of vehicle inspections. For example, for vehicles with license plates from 1 of the 19 States whose farm license plates can be recognized in the MCMIS inspection data, total vehicle inspections on covered farm vehicles dropped by 25 percent, whereas total vehicle inspections on all private carriers during this same period dropped by only 11 percent.

As mentioned above, the drop in OOS rates for covered farm vehicles after the enactment of MAP-21 does not necessarily mean that the condition and characteristics of these vehicles and

their drivers necessarily improved, since much or all of this drop may be attributable to these vehicles and drivers being subject to fewer Federal regulations in the post-MAP-21 time period. Thus, in terms of assessing the safety performance of covered farm vehicles and drivers, the pre-MAP-21 OOS rates may be more relevant.

4.1.1 Hours-of-Service and Medical Certification Violation Rates

MAP-21 exempts covered farm vehicles from the inspection, repair, and maintenance requirements outlined in Section 396 of the Federal Motor Carrier Safety Regulations (FMSCRs). It also exempts drivers of these vehicles from the HOS requirements of Part 395 and requirements pertaining to medical certificates in Part 391. In terms of the inspection, repair, and maintenance requirements of Section 396, these regulations are, for the most part, either paperwork-related, or duplicative of other regulations in Part 393 from which covered farm vehicles are not exempted. Two exceptions to this are Part 396.5, relating to oil and lubrication, and Part 396.9, relating to operating a vehicle placed OOS; however, these two subparts represent a very small percentage of all OOS violations issued under Part 396. For the reasons outlined above, the Agency does not believe that the MAP-21exemptions granted to covered farm vehicles pertaining to Part 396 will have a significant impact upon motor carrier safety.

However, MAP-21 covered farm vehicle exemptions pertaining to HOS and medical certification could potentially have a larger impact on motor carrier safety. Consequently, the Agency also examined the extent to which drivers of covered farm vehicles violated HOS and medical certification requirements during the 9-month period immediately prior to the enactment of MAP-21. Table 6 presents these findings. During this 9-month period, the rates for violations pertaining to inadequate or no record of duty status were higher for covered farm vehicles (and for all vehicles with farm plates) when compared to all private carriers. These differences are statistically significant in the case of covered farm vehicles in the 8 key States and in the case of all vehicles with farm plates in the 19 States where such plates can be identified.

Table 6. Driver-related violation rates pertaining to HOS and medical qualifications for covered farm vehicles and vehicles with farm plates, for the 9-month period prior to the enactment of MAP-21.[§]

Vehicles/Carriers	Violations Per 100 Inspections (Number of Inspections)			
	Exceeding Maximum HOS	No/Inadequate Record of Duty Status	Physically Unqualified Driver	No Medical Certification
Covered Farm Vehicles Key Eight States[*]	1.0 (833)	10.3** (833)	0.5 (833)	14.5** (833)
19 States[†]	1.5 (1,809)	7.9 (1,809)	0.3 (1,809)	13.7** (1,809)
Vehicles with Farm Plates 19 States[‡]	2.1 (7,156)	9.7** (7,156)	0.3 (7,156)	14.4** (7,156)
All Private Carriers Key Eight States	1.7 (67,964)	7.5 (67,964)	0.3 (67,964)	9.5 (67,964)
19 States	1.5 (163,565)	6.5 (163,565)	0.4 (163,565)	8.9 (163,565)

[*]Based on vehicles belonging to carriers identified by both farm identification algorithms and domiciled in one of the following eight States: AL, AK, IN, MI, MN, NY, OR, WV.

[†]Based on vehicles belonging to carriers identified by both farm identification algorithms and domiciled in one of the following 19 States: AL, AK, AZ, DE, IL, IN, MD, MI, MN, MS, NJ, NY, ND, OK, OR, PA, VA, WV, WI.

[‡]Based on inspected vehicles with farm plates from one of the following States: AL, AK, AZ, DE, IL, IN, MD, MI, MN, MS, NJ, NY, ND, OK, OR, PA, VA, WV, WI, excluding carriers listed in MCMIS as "for-hire," and carriers with more than 500 power units.

[§]Source: FMCSA, MCMIS, data snapshot as of September 27, 2013.

[**]Indicates that the difference between estimate and number for all private carriers in State grouping is statistically significant at the 95-percent level of confidence.

Although differences in HOS violation rates between drivers from all private carriers and drivers of covered farm vehicles or vehicles with farm plates cannot be shown to be statistically significant, Table 6 shows that the HOS violation rate for all vehicles with farm plates is 40 percent higher than the HOS violation rate for all private carriers (2.1 violations per 100 inspections versus 1.5 for all private carriers). Had the sample size (i.e., the number of inspections available for evaluation) been larger, this difference most likely would have been statistically significant.

In addition to having more violations pertaining to record of duty status, drivers of both covered farm vehicles and all vehicles with farm plates show violation rates that are approximately 50 percent higher for "no medical certificate" than for drivers from all private carriers in these same States during this period. Table 6 indicates that this violation rate was approximately 14 percent for both covered farm vehicles and all vehicles with farm plates, compared to approximately 9 percent for all private carriers. Table 6 also indicates that only a very small number of inspections on either covered farm vehicles or any farm-plated vehicle were associated with violations for the driver actually being physically unqualified (less than 1 percent of inspections).

4.2 CRASH ANALYSIS

Crash statistics for covered farm vehicles and for all carriers with farm-plated vehicles for calendar years 2011 and 2012 are presented in Table 7. For the calendar year data, crash rates are presented both in terms of crashes per 100 power units and crashes per million VMT. As shown in Table 7, for crash rates based on VMT, the number of carriers available for the analysis is small when compared to the number of carriers available for determining crash rates based on power units. This disparity stems from this study's requirement that a carrier's VMT data in MCMIS must pass various data quality edit checks in order to be used in the analysis.

Table 7. Crash rates for covered farm vehicles and vehicles with farm plates[‡] in 2011 and 2012.

Vehicles/Carriers	2011				2012			
	Carriers in "Crashes per Power Unit" Calculations	Carriers in "Crashes per VMT" Calculations	Crashes per 100 Power Units	Crashes per Million VMT	Carriers in "Crashes per Power Unit" Calculations	Carriers in "Crashes per VMT" Calculations	Crashes per 100 Power Units	Crashes per Million VMT
Covered Farm Vehicles Key Eight States:	1,905	282	0.9	1.5**	1,853	221	1.1	0.7
19 States:	4,175	630	1.2	0.9	4,077	524	1.2	0.8
All Vehicles with Farm Plates and USDOT Numbers in 19 States[†]	7,881	1,117	1.3**	0.6	7,722	1,075	1.4**	0.9
All Private Carriers[§] Key Eight States:	60,544[°]	60,544[°]	0.9	0.6	63,378[°]	63,378[°]	0.9	0.6
19 States:	110,638[°]	110,638[°]	1.1	0.7	117,581[°]	117,581[°]	1.0	0.7

[*]Based on vehicles belonging to carriers identified by both farm identification algorithms and domiciled in one of the following eight States: AL, AK, IN, MI, MN, NY, OR, WV.

[†]Based on inspected vehicles with farm plates from one of the following States: AL, AK, AZ, DE, IL, IN, MD, MI, MN, MS, NJ, NY, ND, OK, OR, PA, VA, WV, WI, excluding carriers listed in MCMIS as "for-hire," and carriers with more than 500 power units.

[‡]Source: FMCSA, MCMIS, data snapshot as of September 27, 2013.

[§]For quality control purposes, only carriers whose MCMIS data indicated no more than 150,000 VMT per power unit and no more than five power units per driver were included.

[°]For this group, all carriers were required to meet both data quality edit checks (pertaining to carrier VMT and total power units) in all calculations; consequently the number of carriers used in the "per power unit" and the "per VMT" calculations is the same.

**Indicates that the difference between estimate and number for all private carriers in State grouping is statistically significant at the 95-percent level of confidence.

Table 7 suggests that, generally speaking, crash rates for covered farm carriers—both in the key 8 States that require all interstate and intrastate carriers to obtain USDOT numbers and in all 19 States whose farm license plates can be recognized in MCMIS—are slightly higher than crash rates for all private carriers in these same States. This relationship holds for crash rates expressed both in terms of crashes per power unit and crashes per VMT. However, differences between the crash rates of covered farm carriers and all private carriers are not statistically significant, with

the exception of the high crash rate in 2011 for covered farm carriers in the key eight States, when expressed in terms of crashes per million VMT. This anomaly is discussed below.

In 2011, the crash rate for covered farm carriers in the key eight States, expressed in terms of crashes per million VMT, is more than double the crash rate for all private carriers in these same States (1.5 crashes per million VMT versus 0.6 crashes per million VMT). This anomaly may be a direct result of the small sample size of only 282 covered farm carriers with usable VMT data. Five of these carriers had less than 10,000 VMT, as well as one crash, thus inflating the estimated crash rate for covered farm vehicles in these eight States for this year. In 2012, none of these five carriers were involved in a crash, and the 2012 crash rate based on VMT dropped to 0.7 crashes per million VMT.

For all carriers with farm-plated vehicles, the crash rate estimates, when expressed in terms of crashes per 100 power units, are higher than the crash rates for covered farm vehicles and for all private carriers in both 2011 and 2012. When expressed in terms of crashes per VMT, however, the crash rates for these same carriers show a less distinct pattern, being higher than the other population groups in 2012, but lower in 2011. Nonetheless, when considering crash rates expressed in terms of crashes per power unit, all carriers with farm-plated vehicles have a crash rate that is approximately 45–55 percent higher than the "per power unit" crash rate of all private carriers in both 2011 and 2012, and this difference is statistically significant.

4.2.1 Crash Severity Assessment

The next two tables address whether crashes involving covered farm vehicles are more likely to result in injuries or fatalities, and whether or not covered farm vehicles are overrepresented in injury- and fatality-related motor vehicle crashes. Specifically, Table 8 shows the fraction of covered farm vehicle crashes involving injuries and fatalities and compares these results to similar statistics from all CMV crashes involving private motor carriers. The table indicates that in 2011, 41 percent of covered farm vehicle crashes involving carriers with plates from the key eight States resulted in an injury, and 5 percent resulted in a fatality. The data for all covered farm carriers from all 19 States whose farm license plates can be recognized in MCMIS show similar results. These results are similar to results obtained for all private carriers in these same States. Although the percentage of crashes involving a fatality is slightly higher for carriers with covered farm vehicles than for all private carriers, these differences shown in Table 7 are not statistically significant at the 95-percent level. The data suggest that crashes involving covered farm vehicles cannot be shown to be more likely to result in an injury or fatality than crashes involving CMVs from other types of private carriers.

Table 8. Percentage of covered farm vehicle crashes involving injuries and fatalities.[†]

Vehicles/Carriers	2011			2012		
	Crashes Evaluated	Percent of Crashes Involving Injury	Percent of Crashes Involving Fatality	Crashes Identified	Percent of Crashes Involving Injury	Percent of Crashes Involving Fatality
Covered Farm Vehicles* Key Eight States	64	41%	5%	78	36%	4%
19 States	169	41%	4%	176	43%	4%
All Private Carriers Key Eight States	3,424	43%	3%	3,425	39%	4%
19 States	8,379	40%	3%	7,972	39%	4%

[*]Based on vehicles belonging to carriers identified by both farm identification algorithms.

[†]Source: FMCSA, MCMIS, data snapshot as of September 27, 2013.

In 2012, the percentage of crashes that resulted in an injury, based on carriers domiciled in the key eight States, was slightly lower for carriers with covered farm vehicles than for all private carriers in these same States (36 percent versus 39 percent). This same percentage, when based on all covered farm carriers identified in all 19 States where farm plates can be identified, was slightly higher for carriers with covered farm vehicles than for all private carriers in these same States (43 percent versus 39 percent). Neither of these percentage differences is statistically significant.

In the case of fatalities, the relative number of crashes involving a fatality is identical for both population groups in 2012, both for the key 8 States and for all 19 States whose farm license plate configurations can be identified in MCMIS. The 2012 crash data, taken as a whole, confirm the results from the 2011 data and suggest that crashes involving covered farm vehicles are no more likely to result in an injury or fatality than crashes involving other types of CMVs operated by private carriers.

While Table 8 considers the likelihood of an injury or fatality occurring once a covered farm vehicle crash occurs, Table 9 addresses the question of whether carriers with covered farm vehicles are overrepresented in injury- and fatality-related crashes, based on the number of such vehicles in the population. Table 9 shows that the number of injury- and fatality-related crashes involving covered farm carriers is roughly proportional to the number of these carriers in the population.

Table 9. Representation of covered farm vehicles in injury- and fatality-related motor vehicle crashes.

Covered Farm Carriers	Total Carriers Evaluated	Percent of Private Carrier Power Units	Percent of All Private Carrier Crashes	Percent of All Private Carrier Injury Crashes	Percent of All Private Carrier Fatal Crashes
2011 Key Eight States	1,831	1.7%	1.9%	1.8%	3.1%
19 States	4,039	1.7%	2.0%	2.0%	3.1%
2012 Key Eight States	1,853	1.8%	2.2%	2.1%	2.3%
19 States	4,077	1.8%	2.2%	2.5%	3.1%

In both 2011 and 2012, the percentage of all private carrier injury-related crashes involving covered farm carriers was roughly equivalent to the percentage of all private carriers in the population that are covered farm carriers. In the case of fatal crashes, the percentage of all private carrier fatality-related crashes involving covered farm carriers was marginally higher than the percentage of covered farm carriers in the general private carrier population. In the case of the fatality-related crashes, however, this slight disparity may be attributable to the fact that fatal crashes are relatively rare events and the number of carriers being evaluated is very small. For example, the covered farm carriers from all 19 States where farm plates can be identified in MCMIS had only 8 and 7 fatality-related crashes in 2011 and 2012, respectively.

5. ASSESSMENT OF STATE LAWS AT VARIANCE WITH MAP-21

States have until March 14, 2016, under the Motor Carrier Safety Assistance Program (MCSAP) to make their motor vehicle regulations compatible with the MAP-21 Federal regulations pertaining to covered farm vehicles. Most States have already issued exemptions similar to those required by the Act, or are in the process of modifying existing regulations. Some States, however, still have regulations that are at variance with the MAP-21 exemptions. That is, these States currently have laws similar to the Federal regulations from which covered farm vehicles are now exempt; these State laws still apply to covered farm vehicles or to a subset of these vehicles.

The State of Florida, for example, plans to continue to subject covered farm vehicles to some repair and maintenance requirements (analogous to 49 CFR 396.6 and 396.3(a)(1)), CDL licensing requirements (for drivers employed solely as drivers), and drug and alcohol testing requirements for drivers of farm vehicles still required to have a CDL. The State of Nebraska does not consider articulated trucks carrying hazardous materials to be covered farm vehicles, which is consistent with MAP-21, but it appears to allow straight trucks carrying hazardous materials to receive the exemption. The State of Idaho currently grants CDL exemptions only for farm vehicles that are specifically engaged in "farm to market" operations. Once all States adopt their covered farm vehicles laws, FMCSA will work with any States whose laws appear to be at variance with MAP-21, with the goal of ensuring compliance.

Appendix D provides information on the current status of each State's efforts to conform its laws to MAP-21 in terms of exemptions granted to farm vehicles.

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6. SUMMARY

This study estimates that roughly 100,000 vehicles and 75,000 drivers are impacted by nationally MAP-21's exemptions for covered farm vehicles and their drivers. Covered farm carriers identified in the key 8 States had an average annual VMT of 37,962 miles per year. Based on this figure, the estimated national VMT for covered farm vehicles is 947 million miles per year. These estimates, however, are based in large part on motor carrier information from only eight States, whose data were extrapolated to the national level. The limited number of States available to use in this extrapolation may impact the accuracy of these estimates.

Based on MCMIS data from these same eight States, approximately 78 percent of covered farm carriers operate at least one covered farm vehicle across State lines. Applying this percentage to the estimated number of total covered farm vehicles gives a figure of approximately 79,000 total covered farm vehicles crossing State lines. The reader must be cautioned, however, that this estimate is based on data from only eight States, which do not include large-sized agricultural States, such as California or Texas. For this reason, the estimate may have an upward bias.

Driver and vehicle OOS rates for covered farm vehicles domiciled in the eight key States were higher than similar rates for all private carriers prior to the enactment of MAP-21 (6.8 percent versus 5.4 percent for drivers; 29.0 percent versus 24.2 percent for vehicles). The difference in the OOS rates between covered farm carriers and all private carriers in the eight key States is statistically significant in the case of the vehicle OOS rate (at the 95-percent level of confidence), but is not statistically significant in the case of the driver OOS rate. Results for covered farm vehicles are similar, based on inspections from all 19 States where farm license tag numbers can be identified in MCMIS.

The violation rates for failure to prepare a record of duty status (RODS) or for inadequate RODS and for lack of a valid medical certificate were higher in the period immediately prior to the enactment of MAP-21 for both drivers of covered farm vehicles and for drivers of all vehicles with farm license plates when compared to drivers of all private carriers. These differences are, for the most part, statistically significant.

After the enactment of MAP-21, both driver and vehicle OOS rates for covered farm vehicles appear to have dropped, based on a sample of motor carriers deemed likely to operate covered farm vehicles. Vehicle OOS rates dropped by approximately half for these vehicles, and driver OOS rates dropped by 20–25 percent. Presumably, these changes in both the vehicle and driver OOS rates are attributable, at least in part, to the fact that covered farm vehicles became subject to fewer regulations subsequent to the enactment of MAP-21.

Crash rates in 2011 and 2012, expressed both in terms of crashes per 100 power units and crashes per million VMT, were generally slightly higher for carriers identified by the study as covered farm carriers than for all private carriers, based on data from the 8 key States that require all intrastate carriers to obtain USDOT numbers, as well as data from all 19 States whose farm license plates can be recognized in MCMIS inspection and crash data. This same relationship holds for all carriers with farm-plated vehicles. When comparing "per power unit" crash rates of all carriers with farm-plated vehicles to crash rates for all private carriers in these 2 years, all

carriers with farm-plated vehicles have crash rates that are approximately 45–55 percent higher, and these differences are statistically significant.

The data do not suggest that crashes involving covered farm vehicles are more likely to result in an injury or fatality than crashes involving CMVs from other types of private carriers. However, the percentage of all private carrier fatality-related crashes involving covered farm carriers is marginally higher than the percentage of covered farm carriers in the general private carrier population.

States have until March 14, 2016, under MCSAP to make their motor vehicle regulations compatible with the new Federal regulations pertaining to covered farm vehicles as outlined under MAP-21. Most States have already issued exemptions similar to those stipulated under the Act, or are in the process of modifying existing current regulations. In some cases, however, States still have regulations that are at variance with the MAP-21 covered farm vehicle exemptions. Once all States adopt their covered farm vehicles laws, FMCSA will work with any States whose laws appear to be at variance with MAP-21, with the goal of ensuring compliance.

APPENDIX A: STATES WITH SPECIAL LICENSE PLATE TAG CONFIGURATIONS FOR FARM VEHICLES

For the following 19 States, farm license plates can be identified in roadside inspection and police accident reports based on the license tag configurations shown below:

1. If License Plate State = AL and (positions 2&3 or positions 3&4 of the tag# equal F1, or F2, or F3, or F4).
2. If License Plate State = AK and (the last 2 positions are FA, preceded by numerals only).
3. If License Plate State = AZ and (the first two positions are FV, followed by numerals).
4. If License Plate State = DE and (the first two positions are FT, followed by numerals only).
5. If License Plate State = IL and (the last two positions = VF, VG, VH, VJ, VK, VL, VP, VR, VT, VV, VX, or VZ, preceded by numerals) or (the last 3 positions are TVF, TVG, VTH, TVJ, TVK, TVL, TVP, TVR, TVT, TVV, TVX, or TVZ, preceded by numeric).
6. If License Plate State = IN and (the first position is F, positions two through four are numeric, and the remaining positions are letters).
7. If License Plate State = MD and (the first five positions are numeric, followed by FT or TR).
8. If License Plate State = MI and [(the fourth position is F and all other positions are numeric) or (the first position is A or B, the second position is any letter, and the remaining positions are numeric)].
9. If License Plate State = MN and the first position is T.
10. If License Plate State = MS and (the first position is F, followed by numerals only).
11. If License Plate State = NJ and (first position is F, followed by numerals only) or (the first two positions are FA, followed by numerals only) or (the first position is F, the second position is a letter, the third and fourth positions are numeric, and fifth position is a letter) or (the first position = X, the second position = Y or Z, the third position = A, B, C, or D, the fourth and fifth positions = numeric, and the fifth position = a letter) or (the first two positions = TR, positions three through six are numeric) or (the first two positions are TR, the third position is A–M, positions four through six are numeric) or (the first two positions are TS, the third position is A–F, positions four through six are numeric) or (the first four positions are numeric, the fifth position = T, the sixth position = any letter) or (the first two positions are TA, and positions three through six are numeric).
12. If License Plate State = NY and (positions one through five are numeric, and positions six through seven = FR).

13. If License Plate State = ND and (the first position = F, and the second and third positions are letters, followed by three numerals).
14. If License Plate State = OK and (the first two positions are letters, the third position = F, and the remaining positions are numeric only) or (the first three positions are numeric, the fourth and fifth positions are letters, and the sixth position = F).
15. If License Plate State = OR and (the first position is F, followed by numerals).
16. If License Plate State = PA and (the first two positions are FM, positions three through six are numeric, and the seventh position is a letter).
17. If License Plate State = VA and (the first position is F, followed by numerals only).
18. If License Plate State = WV and (the first position is X, followed by numerals only).
19. If License Plate State = WI and (the first two positions are HF, followed by numerals only) or (the last position = F, preceded by numerals only).

APPENDIX B: ESTIMATING TOTAL U.S. CARRIERS

The calculations used to estimate the total number of motor carriers, vehicles, and drivers impacted by MAP-21 employs an estimate for the total number of U.S. motor carriers, using data from MCMIS (December 2012 snapshot). To estimate the total number of U.S. carriers, the following steps were used:

- States were first grouped into those that require all motor carrier carriers to acquire USDOT numbers and those that do not. It was determined that 17 States required all motor carriers to obtain USDOT numbers, and for these 17 States, the interstate and intrastate (representing carriers that engaged only in intrastate operations) carrier counts were as follows:

$$\textbf{Total Intrastate Carriers}_{17states} = \textbf{163,640}$$

$$\textbf{Total Interstate Carriers}_{17states} = \textbf{169,704}$$

Based on these counts, it was estimated that intrastate carrier counts in the U.S. represent 96 percent of the interstate carrier counts.

- For the States that do not require all intrastate carriers to obtain USDOT numbers, the total number of interstate motor carriers in MCMIS was 318,338.
- Based on steps 1 and 2 above, the total number of U.S. motor carriers can be estimated to be:

  Total U.S. Carriers = 333,344 + 318,338 + (0.9642671956 x 318,338) = 958,645

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APPENDIX C: INTERMEDIATE CALCULATIONS USED TO PRODUCE NATIONAL ESTIMATES OF COVERED FARM CARRIERS, VEHICLES, AND DRIVERS

This appendix presents the intermediate calculations used to produce national estimates for the number of covered farm carriers, vehicles, and drivers. These calculations involve seven steps which are described in Section 2 of the report and are repeated, below. The results of the calculations are also shown for each step.

- For the eight States that both have special license plate tag configurations for farm vehicles and also require intrastate carriers to obtain USDOT numbers, estimate the percentage of the carriers identified by the Form MCS-150 farm detection algorithm (Algorithm 1) that have covered farm vehicles. This percentage can be approximated by examining those carriers captured by the algorithm that were also inspected at the roadside within the last 3 years. Using this subset of carriers and determining what fraction of them were captured by the farm plate algorithm (i.e., that had inspections performed on farm-plated vehicles) gives a reasonable estimate of the percentage of carriers with covered farm vehicles captured by the Form MCS-150 algorithm (see Figure 7). The result of this calculation is **38.48 percent**.

$$\mathbf{P}_{\text{mcs, farm, 8states}}$$

Figure 7. Variable. Percentage of carriers in the eight key States with covered farm vehicles, as captured by the Form MCS-150 algorithm.

- Estimate the total number of carriers captured by the Form MCS-150 algorithm that are covered farm carriers (i.e., have covered farm vehicles) in these same eight States (see Figure 8). When applied, this becomes: **.3848 x 11,583**.

$$\mathbf{Carriers}_{\text{farm, 8states}} = \mathbf{P}_{\text{mcs, farm, 8states}} \times (\mathbf{No.\ Carriers\ in\ 8\ States\ Captured\ by\ Form\ MCS\text{-}150\ Algorithm})$$

Figure 8. Formula. Total number of carriers in the eight key States that have covered farm vehicles, as captured by the Form MCS-150 algorithm.

- Estimate the percentage of carriers in the United States that are covered farm carriers by determining the percentage of covered farm carriers in these eight States. This can be accomplished by dividing the estimate of the total number of covered farm carriers captured by the Form MCS-150 algorithm by the total number of motor carriers in these eight States (see Figure 9). The result of this calculation is: **2.65 percent**.

$$\mathbf{P}_{\text{farm,U.S.}} = \mathbf{Carriers}_{\text{farm,8states}} / \mathbf{Total\ Carriers}_{\text{8States}}$$

Figure 9. Formula. Percentage of carriers in the United States that are covered farm carriers.

- Estimate the total number of U.S. carriers, including both intrastate and interstate carriers. Because MCMIS does not contain data on all intrastate carriers in all States, this parameter must be estimated. The calculations required for estimating the total number of U.S. carriers are presented in Appendix B. The result of this calculation is: **958,645**.
- Estimate total U.S. farm carriers (see Figure 10). The result of this calculation is: **25,445**.

$$\textbf{Total Carriers}_{\text{farm,U.S.}} = \textbf{P}_{\text{farm,8states}} \times \textbf{Total Carriers}_{\text{U.S.}}$$

Figure 10. Formula. Total U.S. farm carriers.

- Calculate the average number of vehicles per carrier (**Ave Veh** $_{\text{farm, 8 states}}$) for the farm carriers identified in these eight States (i.e. carriers identified by both the MCS-150 algorithm and the farm plate algorithm) and use this number to estimate total covered farm vehicles (see Figure 11). When calculated using these instructions, the average number of vehicles per carrier is four. This number multiplied by the total U.S. farm carriers (25,445) produces a total of **101,780 total covered farm vehicles**.

$$\textbf{Total Covered Farm Vehicles}_{\text{U.S.}} = \textbf{Ave Veh}_{\text{farm, 8 states}} \times \textbf{Total Carriers}_{\text{farm, U.S.}}$$

Figure 11. Formula. Total covered farm vehicles in the United States, using the average number of vehicles per carrier for the farm carriers identified in the eight key States and total farm carriers in the United States.

- Estimate the total number of drivers operating covered farm vehicles (**Ave Drv** $_{\text{farm, 8 states}}$) by calculating the average number of drivers per carrier for the farm carriers identified in these eight States (i.e. carriers identified by both the MCS-150 algorithm and the farm plate algorithm) and use this number to estimate total covered farm vehicle drivers (see Figure 12). When calculated using these instructions, the total number of drivers operating covered farm vehicles per carrier is three. This number multiplied by the total U.S. farm carriers (25,445) produces a total of **76,335 total covered farm drivers**.

$$\textbf{Total Covered Farm Drivers}_{\text{U.S.}} = \textbf{Ave Drv}_{\text{farm, 8 states}} \times \textbf{Total Carriers}_{\text{farm, U.S.}}$$

Figure 12. Formula. Total covered farm drivers in the United States, using the average number of drivers per carrier for the farm carriers identified in the eight key States and total farm carriers in the United States.

APPENDIX D: PROGRESS OF STATES AND TERRITORIES IN MAKING THEIR LAWS COMPATIBLE WITH MAP-21 EXEMPTIONS FOR FARM VEHICLES

Table 10 presents information on the current status of efforts in States and territories to make their laws compatible with MAP-21 in terms of exemptions granted to farm vehicles. The information was obtained from individuals representing these States and territories at a meeting of the Commercial Vehicle Safety Alliance (CVSA) during the spring of 2014.

Table 10. Progress of states and territories in making their laws compatible with MAP-21 farm vehicle exemptions.

State	Current Status	State	Current Status
Alabama	Completed	Montana	Completed
Alaska	In progress	Nebraska	Completed
American Samoa	In progress	Nevada	In progress
Arizona	In progress	New Hampshire	Completed
Arkansas	Completed	New Jersey	Completed
California	In progress	New Mexico	In progress
Colorado	Completed	New York	In progress
Connecticut	Completed	North Carolina	In progress
Delaware	In progress	North Dakota	Completed
District of Columbia	Completed	Northern Marianas	In progress
Florida	In progress	Ohio	In progress
Georgia	Completed	Oklahoma	Completed
Guam	In progress	Oregon	Completed
Hawaii	In progress	Pennsylvania	Completed
Idaho	In progress	Puerto Rico	In progress
Illinois	In progress	Rhode Island	Completed
Indiana	Completed	South Carolina	Completed
Iowa	In progress	South Dakota	Completed
Kansas	Completed	Tennessee	Completed
Kentucky	Completed	Texas	In progress
Louisiana	Completed	Utah	Completed
Maine	Completed	Vermont	Completed
Maryland	Completed	Virgin Islands	In progress
Massachusetts	Completed	Virginia	Completed
Michigan	Completed	Washington	Completed
Minnesota	In progress	West Virginia	Completed
Mississippi	Completed	Wisconsin	In progress
Missouri	Completed	Wyoming	Completed

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