EFFECT OF WEIGHT-MILE TAX ON ROAD DAMAGE IN OREGON

Final Report

SPR 313

Oregon Department of Transportation

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by

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16. Abstract

Oregon's weight-mile tax was amended in 1990 to provide for a lower tax rate for trucks weighing more than 80,000 pounds if they added axles. The additional axles within a weight class reduce the amount of road damage. The tax break was largely based on equity considerations, since trucks within a weight class tend to do less road damage if they have more axles; however, the tax reduction also created an economic incentive to add axles and thus reduce road damage. This project attempted to determine if the tax break actually led to an increase in the number of axles within weight classes, which would result in a reduction in the amount of road damage. An analysis of statistical data indicated that there has been a small increase in the number of axles in most weight classes, but it was not possible to determine if this was due to the weight-mile tax. A series of structured interviews supplemented the statistical analysis and indicated that the tax incentive was not a major determinant of truck configuration. One probable reason is that regulatory constraints limit the effectiveness of the tax incentives.

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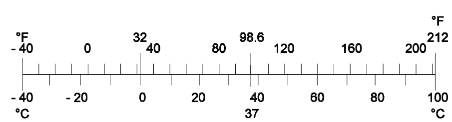
SI* (MODERN METRIC) CONVERSION FACTORS

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	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	Acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

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	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



***** SI is the symbol for the International System of Measurement (4-7-94 jbp)

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EFFECT OF WEIGHT-MILE TAX ON ROAD DAMAGE IN OREGON

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1.0 INTRODUCTION

1.1 BACKGROUND

Most funds for road construction and maintenance are raised by a variety of taxes related to vehicle use. The number and weight of the vehicles that will use a road significantly influence the cost of construction and maintenance. In particular, both the initial construction costs and the need for maintenance are affected by the number and configuration of heavy vehicles using the road.

The federal government and various state governments conduct studies to determine the appropriate allocation of costs among classes of vehicles. These studies find that the fuel taxes and registration fees, which provide a substantial amount of the funds for construction and maintenance, are not levied in proportion to cost responsibility. In particular, they conclude that heavy vehicles typically do not pay their share of the cost, while lighter vehicles tend to be taxed for more than their share. A variety of adjustments have been made at the federal level to try to bring a closer alignment between cost responsibility and taxes; but the most recent study still finds that the heaviest trucks do not pay their share of the cost (*U.S. Department of Transportation 1997b, p. ES-13*). One suggestion for addressing this concern is to adopt a weight-distance tax at the federal level.

A major reason for this cost allocation problem is the nature of road finance relative to the cost structure. Road damage increases much more than proportionately with vehicle weight on a road surface. For example, if Vehicle A weighs 48,000 pounds and Vehicle B weighs 4,000 pounds, the damage done to the road by Vehicle A is far more than 12 times the damage done by Vehicle B. Relative damage is frequently discussed in terms of the Equivalent Standard Axle Loads (ESALs) created by the passage of a vehicle. A standard axle load is defined as 18,000 pounds. Hence, the number of ESALs assigned to a vehicle is a measure of the approximate number of standard axle loads that would have to pass over the road to do as much damage as that vehicle would do on one pass.

While ESALs go up much more than proportionately with vehicle weight, fuel consumption does not vary much with weight. Hence, a heavier truck would be expected to pay slightly higher fuel taxes than a lighter truck but would do much more road damage. Thus, a strong reliance on fuel taxes for apportioning the costs of road maintenance and construction leads to the result that heavier trucks do not pay for their cost responsibility.

In addition to the equity consideration, economic efficiency is more likely to result when vehicles pay the cost that they impose on the road system. If the cost is internalized, then the decision-maker takes that cost into account in determining whether a particular trip is worthwhile and whether the appropriate equipment is used. If the cost is not paid directly by the decision-maker, then it is likely to be ignored; and the resulting decisions may impose costs that exceed their benefits. For example, high fuel taxes encourage conservation of fuel. This creates an incentive to use fewer axles to conserve fuel by minimizing friction; but it increases road damage by increasing the weight per axle. Hence, this form of road financing can create inefficient incentives with respect to road damage. Also, failure to accurately price the use of roads for some heavy vehicles may divert commodities to trucks that could more efficiently be moved by rail or other forms of transportation.

Weight-distance taxes can come much closer to an equitable allocation of cost among users than could a fuel tax. The weight-distance tax also can more accurately reflect the cost imposed on the road system and thus lead to improved efficiency in road usage. Oregon is one of five states that currently levy such a tax. At the federal level, there has been discussion of replacing existing funding sources with a weight-distance tax, but this proposal does not appear likely to be adopted in the near future.

1.2 OREGON'S WEIGHT-DISTANCE TAX

1.2.1 Current Status

The weight-mile tax in Oregon is levied on all trucks weighing more than 26,000 pounds. Trucks subject to the weight-mile tax are exempted from Oregon's diesel fuel tax. Fuel taxes are levied for vehicles weighing up to 26,000 pounds. Trucks subject to the weight-mile tax must declare a maximum operating weight. The declared weight alone determines the tax rate for trucks between 26,001 pounds and 80,000 pounds. For trucks declaring maximum operating weights between 80,001 pounds and 105,500 pounds, the weight and the number of axles determine the tax rate.

Within each weight class over 80,000 pounds, the tax rate declines with more axles. The rate of decline is based on the expected reduction in road damage. The highest single rate is for trucks declaring operating weights up to 98,000 pounds with only five axles. Such trucks are subject to a tax rate of 19.2 cents per mile traveled in the State of Oregon. However, adding a sixth axle with the same declared weight lowers the tax by 17.45% to 15.85 cents per mile. Adding a seventh axle for the same declared weight would lower the tax by an additional 12.93% to 13.8 cents per mile. Taxes are reduced for up to nine axles.

Table 1.1 shows Oregon weight-mile tax rates for vehicles over 80,000 pounds along with the percentage difference in tax rate by number of axles for each weight class. As the number of axles increases from 5 to 9, the tax rate falls between 23% and 36%, depending on the weight class. There is a cost associated with additional axles in direct capital cost and increased tare weight. Based on this cost a break-even Oregon mileage could be estimated. For example, using a 1995 estimate of $3,000 as capital cost and ignoring tare weight, a truck in the 90,001 to 92,000 lb. class would recover all of the capital cost for a sixth axle in less than 13,000 Oregon vehicle-miles. Of course, other factors are important, as will be discussed shortly.

Table 1.1: Tax Rates by Weight and Number of Axles

Declared Weight (pounds)	Oregon Weight-Mile Tax Rates: Rate (mills per mile) by Number of Axles and Percent Difference in Rate from One Less Axle								
	5 axles	% rate change	6 axles	% rate change	7 axles	% rate change	8 axles	% rate change	9 axles	total % change
80,001 to 82,000	141.0	-8.51%	129.0	-6.59%	120.5	-4.98%	114.5	-5.68%	108.0	-23.40%
82,001 to 84,000	145.5	-9.97%	131.0	-6.49%	122.5	-5.31%	116.0	-5.60%	109.5	-24.74%
84,001 to 86,000	150.0	-10.67%	134.0	-7.09%	124.5	-5.62%	117.5	-5.53%	111.0	-26.00%
86,001 to 88,000	155.0	-11.61%	137.0	-7.66%	126.5	-5.53%	119.5	-5.86%	112.5	-27.42%
88,001 to 90,000	161.0	-12.73%	140.5	-8.54%	128.5	-5.45%	121.5	-5.76%	114.5	-28.88%
90,001 to 92,000	168.0	-13.99%	144.5	-9.69%	130.5	-5.36%	123.5	-5.67%	116.5	-30.65%
92,001 to 94,000	175.5	-15.38%	148.5	-10.77%	132.5	-5.28%	125.5	-5.98%	118.0	-32.76%
94,001 to 96,000	183.5	-16.62%	153.0	-11.44%	135.5	-5.90%	127.5	-5.88%	120.0	-34.60%
96,001 to 98,000	192.0	-17.45%	158.5	-12.93%	138.0	-6.16%	129.5	-5.79%	122.0	-36.46%
98,001 to 100,000			164.5	-14.29%	141.0	-6.38%	132.0	-6.06%	124.0	-24.62%
100,001 to 102,000					144.0	-6.25%	135.0	-6.67%	126.0	-12.50%
102,001 to 104,000					147.0	-6.12%	138.0	-6.88%	128.5	-12.59%
104,001 to 105,500					151.0	-6.62%	141.0	-7.09%	131.0	-13.25%

1.2.2 Weight-Mile Tax Structure and Rates

Since its implementation in 1990, Oregon's Weight-Mile tax has changed in both structure and rates. Changes effective in 1992 simplified the tax structure and changed rates. Rates were again changed in 1994 and 1996.

When originally passed in 1989, the tax structure required carriers to report trips for trucks with registered weights over 80,000 pounds on the basis of actual weight for each trip, and to report empty miles separately. This created a rate category for weights 80,000 pounds and below. Effective in 1992, the tax structure was simplified so that all miles for trips at extended weights were reported at the truck's registered weight. This change was also reflected in the tax rates, which were adjusted downward to account for the higher tax rate now levied when operating below registered weight. The final rates for 1992 also reflected a concurrent increase in the weight-mile tax. The rates were again raised effective in 1994 and reduced in 1996.

The change in the tax structure in 1992 has particular implications for the weight and mileage data pre- and post-1992. Eliminating the weight category for 80,000 pounds and below and changing the basis for reporting mileage from actual to registered weight compromised the comparability of data reported before and after the change. The current reporting structure reflects more mileage in each axle-weight group than are actually traveled at that weight.

The tax is levied based on the number of miles driven in Oregon and the declared weight. For trucks operating with extended weight permits (over 80,000 pounds), a maximum operating weight must be declared as well as an 80,000 pound operating weight. For any trip where the weight will be above 80,000 pounds, the tax is levied based on the declared weight. Trucks may declare more than one maximum weight above 80,000 pounds if they add or remove trailers. There must be one declared weight for each configuration. The tax rate has been reduced to reflect the average number of miles driven at reduced weights, but the same tax rate is applicable whether the truck is operating at the declared weight or at any lower weight, including empty, on the trip. Whenever the truck changes configuration, e.g., by adding a trailer, it must report all mileage at the weight declared for that configuration. Hence, a truck may report mileage at different weights above 80,000 pounds on a trip if the configuration is changed during the trip.

If the maximum load on a trip is 80,000 pounds or less, the truck may pay at the 80,000-pound rate. For some truck weights and configurations, the tax on the higher weight would actually be lower than the tax for a weight at 80,000 pounds, since that rate does not reflect the number of axles used. However, if any part of the trip will involve a load greater than 80,000 pounds, the entire trip must be reported at the higher declared weight.

Most trucks must have mileage reported, and the reports may be monthly, quarterly, or annual, depending on the magnitude of travel in Oregon. Mileage must be reported for each truck subject to the weight-mile tax. Several classes of trucks have the option of being taxed on a flat-fee basis. Trucks operating under flat-fees pay a monthly tax based on the average mileage for trucks of that type operating under the flat fee. Hence, the revenue generation is expected to equal what the weight-mile tax would have generated, but under the flat fee the tax will not vary with usage for any particular truck.

1.3 OBJECTIVES OF THE WEIGHT-MILE TAX

The Oregon weight-mile tax promotes two distinct objectives. One is to apportion the cost of road construction and repair in an equitable manner among those who affect the standards needed for construction and cause the need for repair. The second is to discourage the use of heavy axle-loads and thus reduce the wear on the road system. Road damage from truck traffic rises much more than proportionately with the weight on an axle. Oregon's weight-mile tax reflects this increase in road damage by levying higher tax rates on heavier trucks. Oregon is the only state to try to discourage heavy axle loads by offering a tax reduction for trucks with additional axles in weight classes above 80,000 pounds. This project was intended to investigate whether the weight-mile tax has caused a noticeable change in behavior by truckers, leading to reduced road damage. This investigation included examining evidence of the effect of the weight-mile tax on the types of trucks operated in Oregon and on the axle configurations for trucks within a weight class.

At the national level it has been estimated that changing from the current highway financing system to one based more on weight-mile charges would substantially reduce the amount of damage done by trucks carrying the same volume of freight (*Small et al. 1989*). At the extreme, these estimates imply that moving from a weight-mile tax to fuel taxes in Oregon could increase the damage done by trucks carrying the same volume of freight by more than fifty percent relative to current levels. While there is theoretical evidence that the weight-mile tax should reduce road damage, there are several issues that have not been adequately addressed in considering the use of such a tax in one state when neighboring states do not use it. For example, a truck traveling from Los Angeles to Seattle might be configured differently if it had to pay weight-mile taxes on the entire route than it would be if it paid such taxes only on the Oregon segment. Hence, the reduction in road damage due to the weight-mile tax in Oregon would be lower in Oregon than implied by the national estimates; but there could also be some spillover benefits to other states in reduced road damage. This project is a first attempt to address some of these questions and assess the impact that the tax has had on trucker behavior and ultimately on road damage.

The weight-mile tax is a road management device as well as a revenue source. Proposals to replace the weight-mile tax with fuel taxes and registration fees often aim to collect the same amount of revenue that the weight-mile tax would be expected to generate. However, economic analysis suggests that reducing the tax on heavy trucks while increasing the tax on lighter trucks would increase the use of heavy trucks relative to lighter ones. This in turn would increase the road damage and the need for revenue to maintain a given level of service. Further, the Oregon weight-mile tax provides for reduced taxes if loads in the heaviest weight classes are distributed over more axles. This is intended to increase the use of the trucks receiving the tax break and further reduce road damage. A shift away from the weight-mile tax could also remove these incentives and further increase road damage.

This research was exploratory in nature. At the start of the project, identification of viable data sources was a key concern. The report includes a discussion of the types of data that would be needed to more definitively determine the impact of the weight-mile tax.

2.0 RESEARCH DESIGN

2.1 OBJECTIVES

The ultimate objective of this research is to determine if the weight-mile tax leads to changes in truck equipment and usage that results in reduced road damage from the freight carried on Oregon's roads. Direct attempts to examine this objective, however, suffer from a variety of conceptual and data issues. First, there are many factors that influence both the type of truck traffic and the damage that it does. For example, long distance haulers tend to favor larger and heavier vehicles. Savings in driver salaries and operating costs relative to multiple vehicles offset the extra time needed to load and unload such vehicles. States that have substantial amounts of through traffic are then likely to have relatively more heavy-vehicle traffic. The types of commodities typically carried will also influence truck loads, with certain types of commodities carried more economically on larger, heavier trucks while others are better suited economically to smaller and faster vehicles. Hence, direct observation of the types of trucks used in Oregon and changes in the mix over time can provide some information on what the tax may have accomplished; but it can not be considered definitive without some base of comparison to determine what would have happened in the absence of the tax. The information to be provided below is primarily descriptive in nature. For a variety of reasons, appropriate data for the comparisons were not available.

2.2 DATA SOURCES AND LIMITATIONS

The research relied exclusively on data collected by others. A significant part of the project was to identify the best data sources and develop the data required for the estimates. One important finding was that the data currently available did not allow for definitive determination of the impact of the Oregon weight-mile tax.

There are several possible approaches which could be undertaken to isolate the effect of the weight-mile tax. One is to look at the changes that have occurred over time in Oregon since the tax was changed. While changes in the tax are expected to affect behavior, many other factors could also influence this behavior. Hence, changes over time alone would be suggestive, but not definitive. Another approach would be to compare Oregon's changes over time with those in other states or in the nation as a whole. While such comparative information would be helpful in estimating the impact of the weight-mile tax, there are a variety of potential confounding factors that might affect the volume and configuration of truck traffic in Oregon relative to other states. For example, coastal states tend to have less through traffic than interior states; and trucks carrying freight through a state might differ from trucks carrying local freight. Regression analysis that controlled for taxes, commodities, through traffic, and so on, would be the most convincing in terms of isolating the effect of the weight-mile tax.

The available sources of data were analyzed and evaluated to determine the best sources for the comparative information. Generally, the data were not sufficient for our purposes. Most of the analysis was done using the Oregon Highway Use Database, described in detail in Section 5.1.1. The analysis of trends over time within Oregon was completed, but this still suffered from an inability to determine miles traveled outside of Oregon for trucks traveling in Oregon. Comparisons with other states and with the nation were awaiting additional data, particularly data from the 1997 Truck Inventory and Use Survey, described in section 5.1.6. A preliminary regression analysis using data from the Long-Term Pavement Project, described in section 5.1.5, showed some promise but also suffered from inadequate data.

Several types of analysis were investigated in the beginning of the study, but most were not feasible due to data limitations. In this section, some of the objectives are reviewed along with the data issues.

2.2.1 Determinants of Equipment Choice

The most widely cited recent research on the choice of truck type in response to tax differences is reported in the book, Road Work by Kenneth A. Small, Clifford Winston, and Carol A. Evans (*Small et al. 1989*). The book provides estimates of the changes in truck choice that would be found under different tax structures. We had hoped to use the parameter estimates from the study to estimate how the optimal truck type would change for trucks carrying various loads and with varying percentages of their mileage in Oregon. Two problems prevented this type of analysis:

1. The parameter estimates used by Small et al. combined all data for six or more axles into one category; hence, it was not feasible to look at the impact of the tax on choosing more than six axles. These data also related to truck type rather than number of axles, and most of our data sources indicated number of axles rather than truck type. This also made it problematic to estimate various parameters based on truck type used in the analysis.

2. The Oregon data available did not allow us to determine total mileage for a truck. When weight-mile taxes are reported, the form includes mileage in Oregon as well as total mileage, but only the Oregon data are entered into the electronic database. Hence, it was not feasible to determine the total miles traveled, nor was it possible to differentiate between trucks that traveled only in Oregon and those that also traveled interstate.

2.2.2 Oregon versus Other States

It would be useful to compare Oregon with other states regarding the use of trucks in different weight classes and the axle configuration of heavier trucks. Unfortunately, data were not available for such comparisons. The most recent data that might have provided such comparisons were for 1992 (*U.S. Department of Commerce 1994*). This study (Truck Inventory and Use Survey) was also conducted in 1997, but these data were not yet available for analysis. When these data become available, it would be instructive to make such comparisons, as well as determine whether there have been different trends in Oregon than in other states. In particular, comparison with other states that allow extended weights similar to Oregon's would be desirable. When such data become available it should be possible to generate econometric estimates of parameters that help explain these differences based on economic activity, truck tax structures, activity in neighboring states, and so on. More detailed discussion of data sources and issues is presented in Chapter 5.

3.0 ANALYSIS OF WEIGHT-MILE DATA

3.1 OVERVIEW

The primary objective of this project was to determine the effect of the weight-mile tax on the behavior of truck owners. In particular, the project focused on whether the weight-mile tax reduction for additional axles in the over 80,000 pound weight class was associated with an increase in the number of axles per truck in this weight class.

Mileage figures from the Oregon Highway Use Database (HUDB) were sorted to select records of trucks registered over 80,000 pounds. Registered weights were sorted according to weight group, and mileage for each weight group was then aggregated by number of axles. Figures in Appendix A report mileage by number of axles for each weight group. Mileage reported from the HUDB was used to calculate axle-miles (axles*miles for each axle number, summed for each year), ESAL-miles (see appendix B), and ton-miles. The calculation of ton-miles was based on the same assumptions about load factor used in the ESAL calculations (described in detail in Appendix B); trucks were assumed to travel 33% of miles at their empty weight and 67% at full (registered) weight. The net weight per ton-mile was thus 67% of the net full weight, with net full weight defined as registered weight minus tare weight for each configuration. These results form the basis for figures 3.1, 3.2, and 3.3.

Appendix A contains a series of charts showing mileage and ESALs by axle-group within each weight class. The charts show how the distribution of mileage has changed over time. Data is included for the period 1990-1997. The year 1990 marks the change in the tax to account for the number of axles, and data is available only until 1997. A change in reporting requirements and methods to calculate tax liability in 1992 makes the data from 1990 and 1991 not comparable to the later data. However, this data is included in the charts for completeness.

3.2 METHODOLOGY

The distribution of mileage by axle and weight groups presented in this report is based on mileage reported correctly with both weight and number of axles. The analysis showed, however, that a significant portion of mileage for vehicles with registered weights over 80,000 pounds was reported incorrectly without the axle category. The distribution of mileage between axle categories where the number of axles was not reported was estimated for 1991, 1995, and 1997. Including these estimates in the analysis did not significantly alter the proportional distribution of mileage between axle and weight groups. Thus the distribution of incorrectly reported mileage was assumed for the purposes of this report to be the same as that for mileage reported correctly.

In all cases mileage was used as it appeared in the Oregon Highway Use Database. The database included mileage reported in categories where none would be expected, such as mileage by axle category reported at weights of 80,000 pounds or less. This category was eliminated in 1992, but mileage has continued to be reported in this category and is reflected in this report. The mileage in these reports does not include miles reported for single trip permits, including overweight permits. It does include mileage as recorded in the Highway Use Database for vehicles with continuous trip permits allowing continuous overweight operation, which accounts for mileage reported at weights above that allowed with an extended weight permit.

The ESAL data presented in this report is based on ESAL estimates derived for each axle and weight category in the Oregon axle-weight tax table (Methodology is included as Appendix B, "ESAL Estimates: Methodology").

3.3 FINDINGS

These data do indicate a small increase in the number of axles per truck within weight groups over the period 1992-1997. Most weight groups show some shift toward more axles, although the shift is relatively small; and a few weight groups show a shift toward fewer axles. The net effect of these shifts has been a decrease in the number of ESALs per mile. However, the increase in the number of miles in the heaviest weight group leads to an overall effect that shows a much greater net reduction in the number of ESALs per ton. The ESALs per mile are very similar between the weight classes due to the additional axles typically found on the heavier trucks, but the heavier weight classes carry more tons.

Figure 3.1 shows the average number of axles, the average number of ESALs per truck, and the average weight per truck reporting on the axle-weight distance tax. As the graph shows, the reduction in ESALs per truck is accompanied by an increase in the mean weight of trucks. The increase in mean axles per truck is due to the combination of an increase in mileage by the heavier trucks (with more axles) and the increase in the number of axles on average within weight groups.

Detailed data is included in the figures in Appendix A. For example, Figures A.14a and A.14b show that in the 104,000 – 105,500 pound category, there is some slight shift to 8-axle trucks, but no noticeable shift to 9-axle configurations. If the shift were due largely to the tax differential, then the 9-axle configuration should be more popular, since the tax differential between seven and eight axles is the same as the differential between eight and nine axles. In general, where the difference in tax rates is on the order of ten mills per mile, there seems to be little effect on the choice to add an axle. In situations where the tax differential is much larger than this, the impact of the tax differential is confounded by regulatory restrictions.

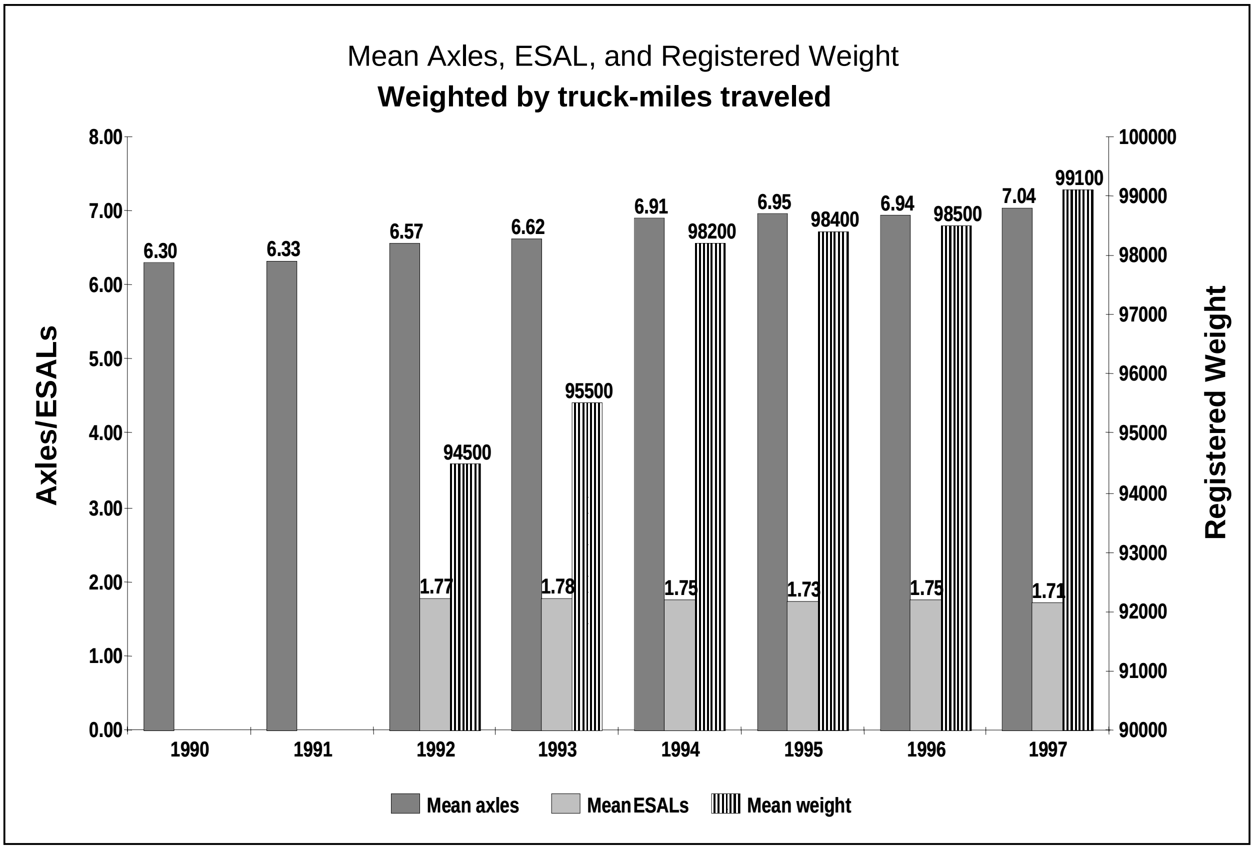

Figure 3.1: Trends in Axles, ESALs, and Registered Weight

Interview results (reported fully in Chapter 4) show that one complication is the weight of the extra axle itself. Where a truck is at a legal weight limit, such as 105,500 pounds, adding an axle actually reduces the net load that can be carried. In many cases, this effect would more than offset the tax savings due to the additional axle. Most truckers report that they add axles to allow going into a higher weight class; but for some weight groups this would not be possible. This may also be a factor for the trucks in the 80,000-pound weight class. While adding a sixth axle would reduce taxes for trucks in this class, they would have to reduce net weight to stay under 80,000 pounds. This could be important for trucks going into California, where 80,000 pounds is the general limit.

Figures 3.2 and 3.3 show the reduction in the number of ESALs per gross ton and per net ton respectively. Over the 1992 - 1997 time period the reduction per gross ton is about 7.5%, while the reduction per net ton is about 8.8%. Of course it can not be concluded that these changes are due solely to the axle-weight distance tax, since there are other factors that may have been changing over time. It is suggestive that the tax has had some impact, although the growth of the highest weight classes is about equally important.

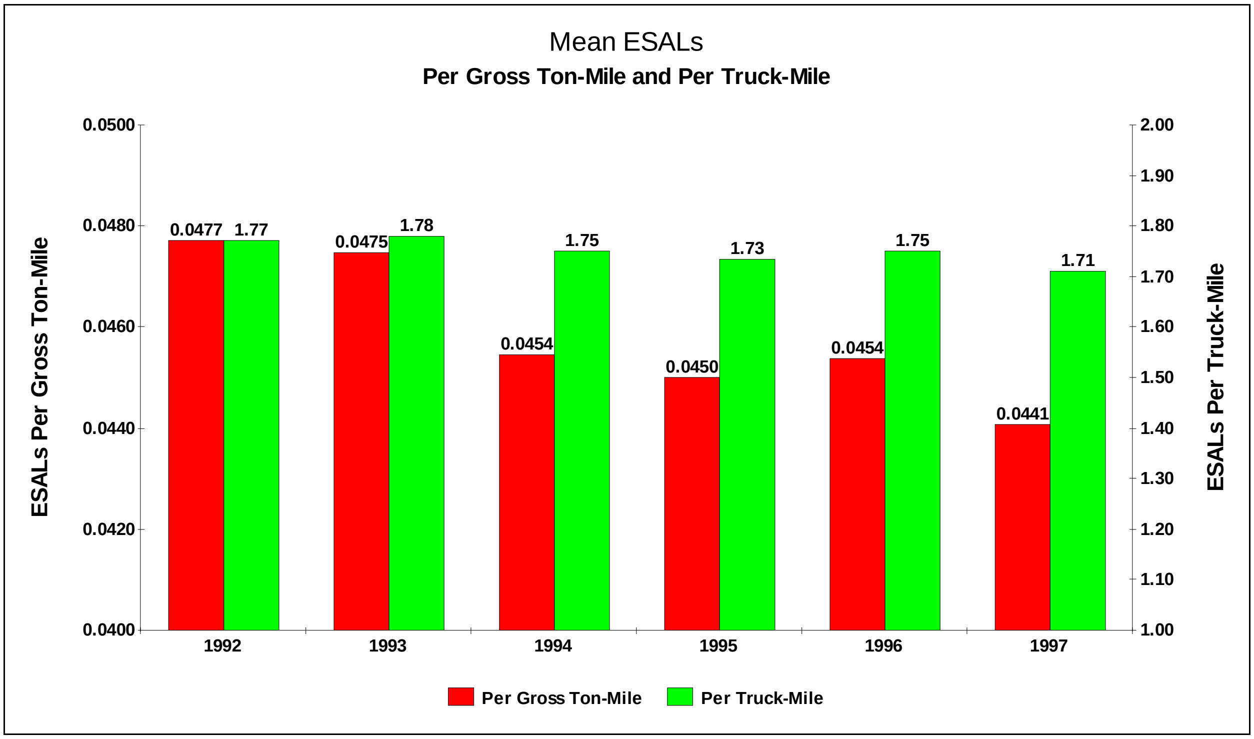

Figure 3.2: ESALs Per Gross Ton-Mile

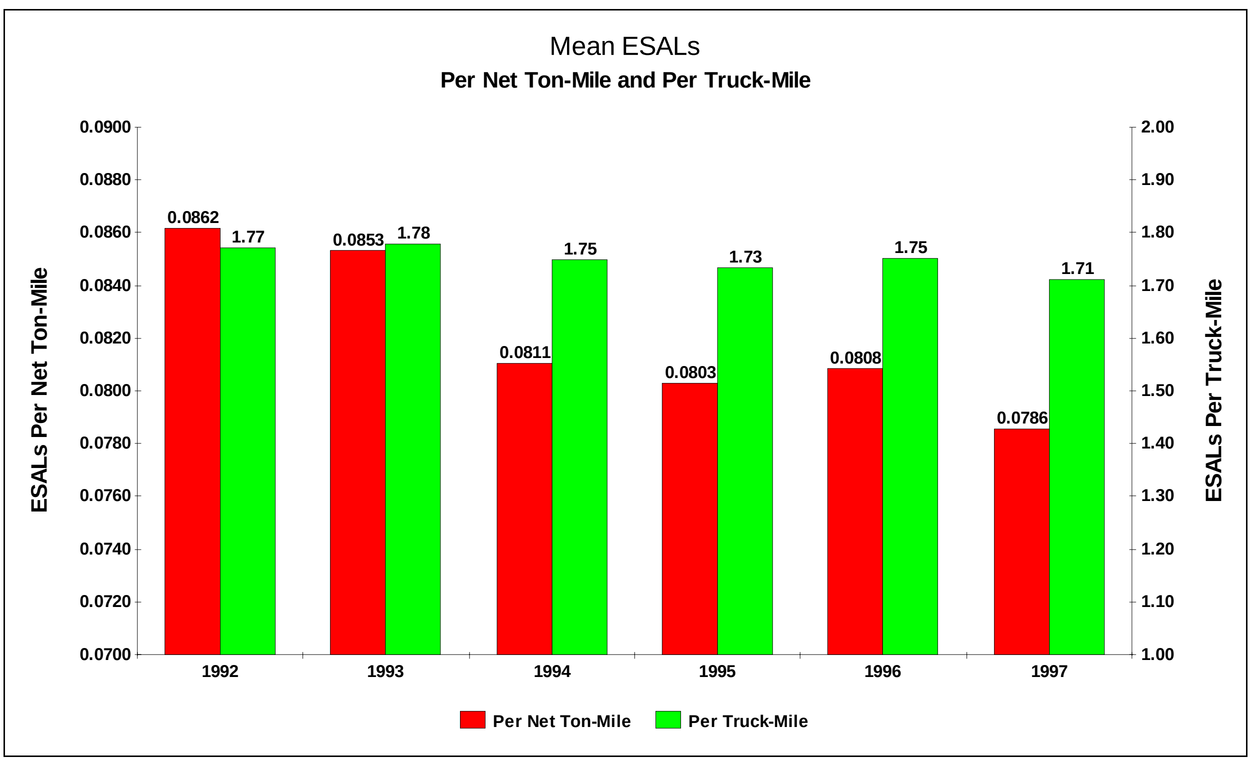

Figure 3.3: ESALs Per Net Ton-Mile

4.0 STRUCTURED INTERVIEWS

Qualitative data was used to supplement the quantitative data used in this study. The qualitative data was obtained from twenty-five structured interviews from a cross-section of trucking firms. The objective was to provide additional insights into the decision-making of firms and thus help interpret the results of the quantitative analyses.

4.1 METHODOLOGY

The procedure for this section of the project was to develop an interview protocol, and to use this as a guide for a series of structured interviews. The structured interview format allowed the person being interviewed substantial discretion in raising issues while maintaining a consistent set of questions to provide information on all areas of interest.

4.1.1 Interview Protocol

The interview protocol was developed collaboratively by the ODOT Technical Advisory Committee (TAC), Bronfman Associates, and the Portland State University research team.

The protocol was designed to gather information that:

- described the characteristics and activities of the firms;
- defined the relative importance of different factors in determining truck configuration to carry various loads;
- identified the impact of the weight-mile tax on decisions of the firm; and
- described attitudes on proposed changes in taxing, registration, or fee policies.

A copy of the protocol is included in Appendix C. Interviews were conducted with several firms prior to developing the questionnaire to identify issues and to expose problems that the interviewer might encounter. Staff developed a draft final protocol, incorporating comments from the TAC. The TAC approved the final protocol. Then interviews were held with three additional firms to determine if the protocol was eliciting the information desired. The information from these interviews was not included in the study.

Persons interviewed were those identified by the firm as having the most knowledge about taxes, their impact on truck configuration, and other factors affecting equipment choice and truck configuration. In most instances, one person was identified as the best person to speak with; however, in two firms it was necessary to speak with two different people. An independent consultant who functioned as record keeper and tax accountant for eight different firms represented one firm.

4.1.2 Selection of Firms

Thousands of trucking firms pay taxes and fees in Oregon. In selecting the twenty-five firms to interview, the research team, with the assistance of the Oregon Department of Transportation, selected a variety of different types of firms that represented different segments of the trucking industry. No effort was made to select a sample that could be used for statistical analysis. The sample of firms chosen included small, medium and large sized firms, firms that travel only in Oregon, firms that travel interstate, private firms, and for hire firms, firms that only haul loads less than 80,000 pounds, firms that haul both, and firms that haul only over 80,000 pounds. In addition, staff attempted to select firms from different sectors of the industry based on the material hauled.

The final group of interviews represented:

- 9 interstate firms,
- 11 regional firms, and
- 5 intrastate firms.

Of these, ten firms were private and fifteen were for hire. The commodities hauled were quite diverse and included heavy equipment, general freight, building materials, wood products, over-dimensional loads, sand and gravel, steel, asphalt, aggregate, logs, cement, wood chips, groceries, baked goods, petroleum products, drilling equipment, theatrical sets, and frozen foods.

Based on weight carried, the group of interviewees represented firms that fell into three categories.

- firms that *never or seldom* carried over 80,000 lbs. (5 firms)
- firms that *almost always* carried loads in excess of 80,000 lbs. (6 firms).
- firms that hauled *both below and above* the 80,000 lbs. level (14 firms)

The interview protocol included specific questions to those who hauled under 80,000 pounds and to those who hauled over. When a firm did both activities, the interviewee was asked to respond to both parts of the questionnaire. The weight of 80,000 pounds was a separating point because the Oregon weight-mile tax rate is levied based solely on declared weight up to 80,000 pounds. For trucks with declared weights above 80,000 pounds, it is also necessary to specify the number of axles that the truck uses. For each weight class above 80,000 pounds, additional axles result in lower tax rates, due to reduced road damage.

The number of axles used by individual firms ranged from three to thirteen. However, most firms routinely used between five and eight axles.

4.1.3 Interviewees

Staff contacted each firm and asked to speak with the individual in the firm who was most familiar with taxes, regulations and other determinants of truck configuration. In most instances, the initial contact (e.g., secretary) was able to identify one person who met these criteria. In two instances, staff needed to speak with two people to obtain some of the detailed information, such as number of miles traveled. All but one of the interviews was conducted by phone. The person selected usually was a direct employee of the firm. In one instance, however, the interviewee was a contract employee.

4.2 FACTORS AFFECTING CONFIGURATION OF TRUCKS

Interviewees in each of the broad categories (under 80,000 pounds and over 80,000 pounds) were asked to indicate the importance of the following factors in determining the configuration of trucks used for hauling:

- Regulations,
- Fuel costs,
- Fuel taxes,
- Safety,
- Weight mile taxes,
- Registration fees,
- Commodity hauled, and
- Customer request.

For each factor, the interviewee was asked to indicate whether the variable was “very important,” “important” or “not important.” After eliciting responses to the entire list of variables, the interviewee was then asked to indicate which of the factors was “most important” and which was “least important.” The interviewer took care to remind the interviewee that the question related explicitly to the configuration of a truck and the number of axles used.

Although the findings are presented in a form that indicates the number of interviewees who responded in a certain way, they are only suggestive of the attitudes and behaviors of all of the firms who pay taxes, fees or are registered in Oregon.

4.2.1 Results for Firms Hauling Under 80,000 Pounds All or Some of the Time

The 19 firms that hauled under 80,000 pounds indicated the following factors as “very important” for determining truck configuration:

- Regulations (13 firms)
- Safety (12 firms),
- Commodity (12 firms)
- Customer request (11 firms)
- Fuel taxes (3 firms)
- Weight-mile tax (2 firms)
- Fuel costs (1 firm)

The interviewees were then asked to indicate which of the above factors was "**most important"** in determining the configuration of their trucks when they were hauling under 80,000 pounds. The factors listed as "most important" were as follows:

- Regulations (5 firms)
- Safety (3 firms)
- Both safety and regulations (4 firms)
- Commodity hauled (4 firms)
- Customer request (4 firms)
- Weight-mile tax (1 firm)

The responses of this group suggest that a variety of factors can determine truck configuration; however, taxes, fees and fuel costs are generally <u>not</u> perceived as the most important factors.

When asked to indicate which factor was "least important," nearly two-thirds (13) of the firms indicated fuel taxes or registration fees were least important; five (5) indicated fuel costs; one (1) indicated customer request; one (1) the weight mile tax, and one (1) the commodity hauled. Thus, as would be expected with firms which haul under 80,000 pounds, the weight-mile tax is of minimal importance in determining truck configuration.

To insure that the perspective of the firms that <u>exclusively</u> haul under 80,000 pounds was not lost, their responses were reviewed separately. This analysis was undertaken to be certain that the weight-mile tax was not affecting their decision <u>not</u> to haul in excess of 80,000 pounds. Nothing in their responses suggested this was the case. Their responses were similar to the whole group.

4.2.2 Results for Firms Hauling Over 80,000 Pounds

The interviewees who indicated that their firms hauled over 80,000 pounds were also asked to indicate the importance of the above factors in determining truck configuration. Their responses were very similar to the under 80,000 pounds group.

The majority of the 22 firms that hauled over 80,000 pounds indicated the following factors as "very important:"

- Regulations (20 firms)
- Safety (14 firms)
- Commodity hauled (13 firms)
- Customer request (13 firms)

When asked to specify which factor was **"most important**" in determining truck configuration, the factors indicated were as follows:

- Regulations (11 firms)
- Safety (3 firms)
- Commodity hauled (5 firms)
- Customer request (3 firms)

Similar to the firms hauling under 80,000 pounds, the interviewees indicated that fuel taxes and registration fees were the least important factors. Thirteen of the twenty-two firms took this position. Other factors mentioned as being least important included fuel costs (5 firms), customer request (1 firm), and weight mile tax (1 firm).

4.3 THE WEIGHT MILE TAX AND TRUCK CONFIGURATION

The structured interview contained additional questions that explored the impact of the weight mile tax on decisions related to truck configuration. First, the trucking firms were asked to indicate if they had significantly increased the number of axles used on their trucks since 1990. Additionally, the firms were asked directly if they added axles because of the weight mile tax.

In reply to the first question, sixteen firms out of the twenty-five interviewed stated that they had not added axles since 1990. Of the remaining firms who did add axles, there were several explanations given, all unrelated to the weight mile tax. One stated that the firm was trying to get productivity gains. Another indicated that they did so because of a change in regulations. A third indicated that the firm began upgrading the stock prior to 1990 to protect their equipment, given the need to carry heavier loads. Another suggested that "customers' demands created a need to carry heavier loads," which in turn required upgrading equipment. None of the firms stated that axles were added explicitly because of the weight mile tax.

4.4 INTERSTATE FIRMS AND THE WEIGHT MILE TAX

Nineteen (19) of the firms interviewed were involved in some interstate commerce. Five (5) of these were regional firms and the rest traveled all over the country. All but one always used the same configuration of truck when travelling in other states. The remaining one usually used the same configuration. Fourteen (14) interviewees stated that the weight mile tax did not affect their routing decisions, and five (5) indicated that the tax affected their decisions minimally. No (0) firms stated that the tax affected their decisions as to what commodity to haul. Fifteen (15) interviewees indicated that the weight mile tax affected their record keeping by making it more difficult, time consuming or "burdensome." This issue appears again when the question was asked as to the disadvantages of the weight mile tax. See below.

4.5 ADVANTAGES OF THE WEIGHT MILE TAX

The interview protocol explored the question of advantage of the weight-mile tax from several perspectives. In the first instance interviewees were asked to indicate what were the advantages of the weight-mile tax. Later they were asked to indicate if a diesel fuel tax or higher registration fees would be more advantageous than the weight-mile tax. Finally, they were asked if Oregon should replace its weight mile tax with a diesel fuel tax and higher registration fees. (At the time of these interviews Oregon had no diesel fuel tax for commercial vehicles weighing over 26,000 pounds.)

The responses to these questions were quite consistent. First, a little over half (14) of the 25 firms clearly indicated that they perceived no advantage to the weight mile tax, while an additional three (3) simply indicated that they did not know of any advantages. The remaining eight (8) indicated that the tax had some advantages. These advantages included the following:

- “Results in safer roads”
- “Doesn’t penalize the short hauler”
- “Know precisely the tax paid for every mile traveled”
- “It’s fair even though it creates high taxes”
- “Helps the roads, helps me as a private citizen with my car”

4.6 FUEL TAX AND HIGHER REGISTRATION FEES VS. WEIGHT-MILE TAX

When asked if a diesel fuel tax and higher registration fees would be more advantageous than the weight-mile tax, a majority of firms (15) responded that they thought such a change would be advantageous. Eight (8) firms indicated that there would be no advantage and two (2) did not know. In response to a direct question asking if the state should replace a weight mile tax with a diesel fuel tax, a little over half (14) of those interviewed said “yes.” Four (4) firms said “no,” another three (3) said it would depend on the proposal, and four (4) did not know.

The appeal of the diesel fuel tax and higher registration fees for most of the interviewees was that such taxes would make record keeping much easier. A few firms indicated that they believed their overall tax bill would go down and that commerce in Oregon would be less restricted.

Of the eight (8) firms that did not want to replace the weight-mile with a diesel fuel tax and higher registration fees, all were relatively small, ran shorter trips, and carried products such as sand and gravel, aggregate, wood chips, or cement. From the perspective of these trucking firms, the weight-mile tax was more equitable than an alternative fuel tax or increased registration fees. These alternatives, they suggested, would penalize them because of the fewer miles that they routinely traveled, or the time they must spend with the engines running but their trucks not moving.

4.7 DISADVANTAGE OF THE WEIGHT MILE TAX

The major disadvantage of the weight mile tax indicated by interviewees had to do with record keeping. A total of eighteen (18) interviewees asserted that the recording keeping required for the weight-mile tax was “burdensome” and was costly to administer. It took up considerable time, required additional staff and, to use the words of one respondent, was “a pain.” Several of these firms suggested that record keeping would be considerably easier if Oregon adopted IFTA standards.

Additional disadvantages mentioned by other interviewees were that “I (sic) don’t always feel roads are being maintained,” and “a tax is a tax.” One firm also noted that the weight-mile tax applies payment on “maximum weight for every mile traveled” and that it gives no credit for the “empty” miles generated in some trips.

Only two (2) respondents indicated that there were no disadvantages to the tax. Both of these were small firms that carried sand and gravel or cement. Finally, two (2) interviewees couldn’t think of a disadvantage.

4.8 INCENTIVES TO ADD AN AXLE

The survey asked several questions which were designed to determine the level of tax break or adjustment in registration fee that would justify adding an additional axle.   Firms generally found these questions not relevant to their decision processes. When asked if they would change the configuration of their trucks if the weight-mile tax were eliminated, the firms were nearly unanimous in responding that nothing would change. Likewise, when asked if the taxes on trucks weighing over 80,000 pounds were reduced would they be more like to use them, they almost all said, “no.” Many indicated that the issue for them regarding vehicle weight was the regulations.

4.9 SUMMARY OF INTERVIEW FINDINGS

The information gathered from these structured interviews strongly suggests that the weight-mile tax has had little impact on the decisions of firms to add axles. Other factors such as regulations, safety, customer requests and commodity appear to be far more important in their decision processes.

On the other hand, many of these firms would like to see the weight-mile tax replaced. Their reasons have to do primarily, it would appear, with their concern over the record keeping requirements and a perception that their tax rate would go down under a different system. Many of the interviewees mentioned the issue of record keeping as a major disadvantage of the weight-mile tax system.

This administrative issue, while important, does not directly address the concerns of this study. Likewise, a number of smaller firms who run shorter hauls suggested that a change in the weight-mile tax to a system of diesel fuel tax and higher registration fees would shift the burden onto them. These are important equity issues, but they are also only of tangential concern to this study. The primary conclusion of the interview analysis is that trucking firms do not perceive the weight-mile tax as an important determinant of equipment purchase or configuration.

5.0 DATA ISSUES

5.1 DATABASE OVERVIEW

Seven databases or data sources were identified for possible use in this study. They were as follows:

- Oregon Motor Carrier Mileage Tax Reports and Highway Use Database
- Oregon DOT Truck Survey Database
- Washington State DOT Freight Truck Origin and Destination Study
- Oregon Special Truck Weight Survey
- Long-Term Pavement Project (LTPP)
- Truck Inventory and Use Survey (TIUS)
- Commodity Flow Survey

Upon investigation, each of these sources proved to be deficient for our purposes. In this section we discuss the proposed use of each data source, problems with data quality or format, and possible solutions to those problems.

5.1.1 Oregon Motor Carrier Mileage Tax Reports and Highway Use Database

All carriers operating within Oregon are required to file Mileage Tax Reports. They are available as hardcopy and as electronic files, and are filed monthly, quarterly or annually depending on the amount of tax owed. The hardcopy reports include truck plate, pass or marker number, declared weight, beginning/ending odometer readings, total miles operated for the reporting period, Oregon miles operated, number of axles, tax rate and total tax. The electronic files do not include odometer readings or total miles operated.

The tax reports are entered into ODOT's Highway Use Database, which includes registration and configuration information on trucks as well as tax and mileage records.

Key Variables

> **Weight:** reports declared weight. The same truck may be operated at several declared weights, depending on carrier information filed with ODOT registration. Mileage is reported for each vehicle at each declared weight for the period.
>
> **Configuration:** Tax report lists number of axles if the declared weight is over 80,000 pounds.
>
> **Mileage:** Hard copy tax record lists total miles and Oregon miles for the reporting period. Mileage outside of Oregon must be computed as a residual.

Tax rates: the rate paid per Oregon mile is included in the tax reports.

Proposed Use

This source of data was the principal source of data for the analysis reported in Section 3.0.

Potential Problems

There is no information on states and/or countries in which the vehicle was operated outside of Oregon. The Highway Use database does not include total miles. Information on total miles would allow for comparison of trucks traveling solely within Oregon and those traveling interstate. It would also allow for analysis of the percentage of the truck miles that are subject to the weight-mile tax and any differences in trends between trucks with many such miles and trucks with few.

5.1.2 ODOT Truck Survey Database

This survey was conducted as part of the commodity flow study recently completed by ODOT. The database contains approximately 16,000 records from surveys conducted during the first half of 1997 (*Oregon Department of Transportation 1998*).

Key Variables

Weight: Actual weight of truck as recorded by weigh station.

Configuration: Includes FHWA vehicle type and trailer classification. Also includes ownership of vehicle and LTL carrier variable.

Mileage: No mileage or distance information is included.

Route: Includes origin and destination zip code, address, and city, and direction of travel. Also includes transportation analysis zone, entry and exit routes from Oregon, where applicable. Actual route and mileage could be estimated through a GIS model or through models developed for use with the Oak Ridge National Highway Network (*see Chin et al 1998, 63-74*).

Commodity: Commodity description (not standardized) is included and is categorized according to the Standard Transportation Commodity Classification (STCC, values 1-43).

Proposed Use, Potential Problems

See discussion in Section 5.1.3.

5.1.3 WSDOT Freight Truck Origin and Destination Study

This Washington State Department of Transportation (WSDOT) database was collected via surveys of drivers at weigh stations between Summer 1993 and Spring 1994 (*Washington State Department of Transportation 1998*).

Key Variables

Weight: The weights of the empty truck and payload weight are reported separately. An additional field indicates whether truck is empty.

Configuration: truck type (5 classes plus other); trailer type (15 classes plus other); number of axles. No information on whether truck is LTL.

Mileage/route: No mileage information is given; detailed route information is listed for each truck (e.g. US101,US12,8,US101,I5,X142,18,X25,I90, to give one example). Origin and destination city and state are given, but zip code is not included.

Commodity: Listed as a string variable only. Commodity is not coded.

Proposed Use

This database and the Oregon Truck Survey database provide for a number of possible comparisons of trucks operating in very similar environments, with the weight-mile tax a primary difference. The data may be stratified to compare configurations for intrastate trips in Oregon vs. those in Washington as well as to compare configurations for interstate trips.

Potential Problems

A major difference in the two surveys is that the Washington survey was conducted at sites throughout the state, while the Oregon survey was confined to 6 locations defined as Ports of Entry (POE). Approximately 40 percent of the total Washington trips were intrastate, while 25 percent were intrastate for Oregon. By comparing the characteristics of the survey locations, data from locations in Washington with similar characteristics could be chosen in order to make a more valid comparison, but the differences in the two surveys would complicate any comparisons.

5.1.4 ODOT Special Truck Weight Survey

The STS is conducted every two years (even years) at a portion of the weigh stations in the state (*Oregon Department of Transportation 1988-1997*). The number of weigh stations has varied from about 6 or 8 sites to 20-25 sites. The survey logs all truck traffic over a 24 to 48 hour period at the site. Surveys are conducted at rural primary and some rural secondary locations. (No interstate and few urban sites have been included.) Electronic records are available back to 1988. The database contains about 30,000 records. This offers an alternative source of time series data and perhaps the only data available that extends back prior to the tax changes in 1990.

Key Variables

Weight: actual weight of truck as loaded/configured

Configuration: standard truck type classification

Route/distance: the 1998 survey includes origin and destination for the first time.

Commodity: includes commodity description as reported by driver; no standard classification.

Potential Problems

The usefulness of this data is limited by the lack of any direct axle count.

5.1.5 Long-Term Pavement Project (LTPP)

The LTPP database contains a great deal of aggregated information on truck traffic as measured at monitoring stations included in the program (*ERES 1997*). The attributes most relevant to this study include mean ESALs per truck and counts of trucks broken down by axle group, weight range, and total number of axles. Each specific axle group (1-4) is reported by weight range (40 weigh ranges, depending on axle group) and total axles for each weight range. Annual volume by vehicle classification is also reported. The only volume estimates available on a consistent basis are annual truck volumes. There are some estimates of total traffic volume, but they are reported inconsistently or not at all for some monitoring stations.

As part of this study the LTPP data was used in a regression analysis of the relationship between state tax structure and choice of vehicle configuration (see Section 5.2). While some of the regression results are suggestive, this data must be supplemented by substantial amounts of additional data regarding factors affecting choice of equipment. Substantial variations exist between states on the sites included in the analysis that make comparisons even more difficult. Further, questions about the reliability of the primary data itself remain to be resolved.

5.1.6 Truck Inventory and Use Survey (TIUS)

The TIUS appears to provide the best source of disaggregated information on truck configuration and activity for the nation (*U.S. Department of Commerce 1994*). The most recent data is for 1992; as of this writing the 1997 data has not yet been released.

Key Variables

Weight: reported as average operating weight.

Configuration: Includes length, truck type and axle arrangement. Axles are reported by category, up to 8 axles or more for triple trailers.

Mileage: annual mileage estimate is included.

Route/operating range: 5 range categories are included, from local to long-range. Information is also reported on percentage of miles traveled outside base-of-operation state.

Commodity: Information is provided on major use and primary products carried.

Proposed Use

Small, Winston, and Evans used this data set for their analysis of the impact of cost on the choice of truck type to carry a given load. This data set is likely to be very useful when the 1997 data is released. It will allow for time trend comparisons between Oregon and other states in the use of trucks in various weight classes and with various configurations.

Potential Problems

Two potential drawbacks to use of the TIUS data are the sample size and the interpretation of state-level estimates. State to state comparisons of trucks operating over 80,000 pounds with various configurations may leave very small samples, especially when broken down by weight group. Moreover, the state-level analysis would necessarily be based on state of domicile for the truck, with no way of estimating the percent of intra- or interstate travel.

5.1.7 Commodity Flow Survey

The US Census Bureau conducts the Commodity Flow Survey (CFS), and the 1997 Survey is being compiled (*U.S. Department of Transportation 1998*). Sample included approximately 12 million shipments. Only aggregate data is released. Data for each shipment include origin, destination, STCC code, weight, value, and mode(s) of transport. Truck shipments are categorized as for-hire, private, or parcel delivery/USPS.

Proposed Use

The CFS may be useful for estimating the types and/or values of commodities being shipped where no other information is available. It has been analyzed for reports which estimate value and ton-miles of shipments for each state (*U.S. Department of Transportation 1997c*), and ton-miles for several commodity groups in various geographic areas (*Chin et al. 1998*).

Potential Problems

The availability of only aggregate data appears to place substantial limits on the uses of the data. This is especially true as the CFS does not report commodity by mode of transport but aggregates across all modes.

5.1.8 Miscellaneous Sources/Information

Other sources of information were suggested during the course of the research. In particular, there is information collected as part of the weigh in motion (WIM) project at the weigh stations. This would be a useful source to determine the change in ESALs over time at the weigh stations, but it has several disadvantages. First, it does not appear that there is any way to determine how representative the information at the weigh stations would be of the distribution of mileage on Oregon's roads. The WIM data does not appear to provide any easy way to determine mileage for the trucks, so we would only have an estimate of the ESALs at specific points rather than the impact on the road system. Second, the distribution of truck types and weights at the weigh stations may differ from the overall distribution within the state. We have no reason to believe that the trend in ESALs at the weigh stations would differ from those throughout the state, but it would require more analysis to determine this with any confidence.

Aside from questions of interpretation, it appears that it would require substantial effort to get the data and put it into useable form. One user indicated that the raw data has substantial errors and should be carefully examined before being used. It is likely that the older data would have even greater problems. In any case, the data sets are large and would be difficult to convert into a useable form. This may be worth pursuing in the future. A significant advantage of WIM data is the availability of a large amount of comparable, disaggregated data from many states.

The 1997 Comprehensive Truck Size and Weight Regulations: Draft, Volume II: Issues and Background provides a summary in Chapter 2 of the Size and Weight regulations at the Federal level and by state (*U.S. Department of Transportation 1997a*).

This source provides estimates of cost of operation at various configurations. For example, the impact of adding an additional axle (i.e., cost of operating tridem vs. tandem axle) is estimated in the FHWA Comprehensive Size and Weight Study (*U.S. Department of Transportation 1995*):

> Additional Axle: The negative capital cost and weight impacts of adding an extra axle on trailers (tandem versus tridem axles) are about $3,000 and about 1,500 pounds of tare weight. [p. 38]

5.2 REGRESSION ANALYSIS

The LTPP data set offered the possibility to run a regression analysis of the determinants of the axle-loads running over a sample of pavements throughout the United States. There were many problems with this data set. The most important problem was that the sample sites were not comparable across states in terms of the function or type of traffic likely to be carried. The sites were chosen to allow for evaluation of pavement performance under a variety of traffic loads and other conditions, not for evaluation of the equipment usage. Nevertheless, the data source was promising because it provided a direct estimate of the ESALs generated by truck traffic and the number of tons represented by those ESALs. Since ESALs per ton shipped are a key determinant of the road damage caused by truck shipments, it seemed worthwhile to examine the possibility to explain some of the variance in ESALs per ton using this data set.

Data was analyzed for the years 1992-1995, the years for which data from Oregon is available. The cases available for analysis were further limited by the completeness of data. Numerous records were missing key data, such as vehicle weights, without which the dependent variable (ESALs per ton) could not be calculated. Details of the variables created and some of the regression results are presented below, but the regression analysis itself is omitted since it is incomplete.

5.2.1 Variables Used

ESALs per ton was the dependent variable. This variable was then regressed on a number of explanatory variables intended to help control for various factors that were considered likely to impact on axle loads. The variables included the maximum weight allowed on a five-axle truck, the maximum weight typically allowed under "normal" circumstances, and several other factors that might affect the dependent variable. The variable of most interest in this study was a dummy variable indicating whether a state had a weight-distance tax or not. For the period covered by the data, six states had such taxes, although they were by no means identical taxes.

The following variable were used in the calculations:

- ESALs per ton: ESALs are from the ANNUAL_ESAL_W4 field of the TRF_MONITOR_BASIC_INFO table in the LTPP main database. Tons are gross tons based on the TRF_MONITOR_AXLE_DISTRIB table. Weights were calculated by summing the product of the number of observations (NUMBER_AXLES) and the mean of the WEIGHT_RANGE_HIGH and WEIGHT_RANGE_LOW fields for each range, divided by 2000. The observations recorded for single axles in the 0-2999 weight range were excluded from weight calculations.

- Functional Classification: This is a classification of the road by functional type, taken from the FUNC_CLASS field of the TRF_BASIC_INFO table.

- Pavement Type: Indicates whether pavement is rigid or flexible; taken from the PAVE_TYPE field of the TRF_BASIC_INFO table.

- Pavement Depth: For rigid pavement; taken from the PAVEMENT_DEPTH field of the TRF_MONITOR_BASIC_INFO table.

- Pavement Structural Number: For flexible pavement; taken from the PAVEMENT_STRUCT_NO field of the TRF_MONITOR_BASIC_INFO table.

- Percent Through: The percentage of ton-miles for each state that represents through shipments (*U.S. Department of Transportation 1997c*).

- Percent In: The percentage of ton-miles for each state that represents intrastate shipments (*U.S. Department of Transportation 1997c*).

- 5-Axle Limit: The highest weight a 5-axle unit can gross before special (other than routine) review and analysis of an individual movement is required (*U.S. Department of Transportation 1997a, pp. II-14 to II-16*).

- Maximum Weight: The highest gross weight any unit with sufficient axles can gross before special (other than routine) review and analysis of an individual movement is required (*U.S. Department of Transportation 1997a, pp. II-14 to II-16*).

- Percent Variable: Total variable motor carrier fees and taxes as a percentage of total motor carrier fees and taxes (*Eklund 1994, Table 2A*).

- Total Taxes: Total Motor Carrier Fees and Taxes at Gross Vehicle Weight of 80,000 pounds and 80,000 miles of (intrastate) travel (*Oregon Department of Transportation 1995, Table 2, p. 5*).

- Weight-Mile: Dummy variable for states with a weight-mile tax (*Oregon Department of Transportation 1996, p. 8*).

5.2.2 Regression Results

The regression results for most variables appeared to be reasonable. For example, higher weight allowances for five-axle trucks resulted in increased ESALs per ton, while higher maximum weights resulted in fewer ESALs per ton. However, these results were not significant at standard levels. The coefficient for the weight-mile states indicated a statistically significant increase in the number of ESALs per ton in such states. Since there is no plausible explanation for why a weight-mile tax should lead to such an increase, the result highlights the problems of limited data.

There are several possibilities that would be worth exploring if more data were available. For example, it is possible that states with a high percentage of heavy axle loads are more likely to adopt weight-mile taxes, or that such states have a preponderance of commodities that generate such axle loads. Completing the analysis would require information on commodities hauled in each state, other factors that are important determinants of the tax rates, and better controls for the effect of non-random site selection on the observed truck traffic. However, in the absence of additional data, this is all speculation. The data set seems worthy of additional analysis, but the findings for this project simply indicate the potential.

5.3 FUTURE PROSPECTS FOR DATA ANALYSIS

The single most important source for follow-up analysis is likely to be the 1997 TIUS data when it is released. This will allow a comparison of trends between Oregon, other states, and the nation, in the number of axles used, ESALs per net ton shipped, and related analysis. In particular, it should allow for a better analysis of how regulatory differences among the states affect truck type and configuration as compared to tax differences.

Within Oregon, addition of the information on total mileage for trucks that travel outside of Oregon would allow for analysis of some of the differences between regulatory restrictions and taxes on behavior of trucks traveling in Oregon. The Oregon Motor Carrier Mileage Reports require that this information be reported; but it is not entered into the Highway Use Database. To be of greatest use, a sample of the data for prior years should be compiled. The data must also be generated so as to get complete annual information from a sample of trucks. This presents some difficulty when based on a sample, since there may be as many as twelve separate monthly reports for each truck. A comparison of trucks traveling exclusively in Oregon with those traveling a large percentage of their miles outside of Oregon would provide some information on the impact of regulatory restrictions on the decisions to add axles, particularly for the 80,000 pound trucks, since higher weight trucks are routinely allowed in Oregon but not in many other states.

The LTPP data also offers an opportunity for additional research. Since the data is not collected for the purpose of representing statewide truck activity, some effort must be made to control for the differences in collection sites across states. Additional information on factors likely to affect truck loads and configuration should also be collected. With the ongoing addition of data, there should be continued improvement in data quality; and this improvement offers the prospect of a more complete national data sample based on observed truck configuration and weight.

6.0 SUMMARY AND CONCLUSIONS

Oregon's weight-mile tax is based on a cost-responsibility approach to road financing. Because trucks require higher standards of road construction and generate substantial road damage, the tax is intended to accurately reflect the costs of the higher road standards and the damage done by trucks traveling on the state's roads. While cost-responsibility is the primary reason for the tax, it is also expected to influence behavior. Higher taxes for trucks that damage the roads more should lead to less usage of such trucks relative to trucks that damage roads less. However, there have been no studies to determine if, in fact, there has been a change in behavior which would lead to reduced road damage. This report presents some evidence that is consistent with the hypothesis that the weight-mile tax does influence behavior in a manner consistent with reduced road damage; however, the data are not complete enough to allow for a definitive conclusion.

Data limitations severely restricted the type of analysis that could be accomplished. The primary data analysis focused on trucks carrying more than 80,000 pounds and the impact of Oregon's tax incentives on the decision to add axles. The data indicate that there has been a slight increase in the number of axles within each weight class, leading to a reduction in the number of ESALs per truck mile. In addition, there has been substantial growth in the mileage reported in the highest weight class, up to 105,500 pounds. Trucks in this weight class typically use seven or eight axles, so they generate only slightly more ESALs per mile than many lighter trucks with fewer axles. Hence, the ESALs per ton shipped tend to decline with more mileage in this weight class. This mileage increase in the highest weight class contributes substantially to the observed decline in ESALs per ton shipped for trucks subject to the axle-weight tax, but it is not possible to determine exactly why this increase is occurring.

The data analysis was supplemented by a series of structured interviews. The interviews indicate that taxes are a relatively unimportant determinant of the type of equipment used. In particular, regulatory and safety considerations are considered much more important than taxes in determining the number of axles used. This is particularly important when a truck is at the legal weight limit and the addition of an axle would reduce the net load that could be carried.

The analysis suggests that the weight-mile tax does have an effect on shipping that leads to a reduction in the amount of road damage, albeit not as large an effect as was anticipated. However, the data are not sufficient for a definitive conclusion; and the interviews suggest that the impact of tax incentives is circumscribed by the importance of regulatory limits and other economic factors that determine truck configuration.

7.0 REFERENCES

Chin et al., Estimating State-Level Truck Activities in America, *Journal of Transportation and Statistics*. 63-74. January. 1998.

Clayton, Alan, Jessie Yeow, et al., Analysis of the Truck Inventory and Use Survey from the Truck Size and Weight Perspective for Trucks with Five-Axles or More, *U.S. Department of Transportation Comprehensive Truck Size and Weight Study Report No. 2*. p. 72, figure 7.5.3.1 and 7.5.3.2. February. 1996.

Eklund, Bill, *Comparison of Total Variable Motor Carrier Fees and Taxes with Total Motor Carrier Fees and Taxes*. Oregon Department of Transportation, Policy and Governmental Relations. February. 1994.

ERES Consultants, Inc., *DataPave 97: Long Term Pavement Performance Database*. US Department of Transportation, Federal Highway Administration. 1997.

Oregon Department of Transportation, *A Comparison of State Motor Carrier Fees and Taxes*. Transportation Development Branch, Policy Section. November. 1995.

Oregon Department of Transportation, *A Five-Year (1990-1994) Comparison of Vehicle Tax Rates in 13 Key States*. Transportation Development Branch, Policy Section. May. 1996.

Oregon Department of Transportation, "Oregon Special Truck Weighings." Database. Policy Section, Transportation Development Division. 1988-1997.

Oregon Department of Transportation, "Oregon Freight Truck Commodity Flows." Database. Transportation Planning Analysis Unit, April. 1998.

Public Utility Commission of Oregon, *Statement of Highway User Tax by Fuel Type*. 1989-1997.

Small, Kenneth A., Clifford Winston, and Carol A. Evans, *Road Work: A New Highway Pricing and Investment Policy*. The Brookings Institution. Washington, DC. 1989.

U.S. Department of Commerce, *1992 Truck Inventory and Use Survey*. Economics and Statistics Administration, Bureau of the Census. U.S. Government Printing Office. 1994.

U.S. Department of Transportation, *Comprehensive Size and Weight Study, Summary Report for Phase I--Synthesis of Truck Size and Weight (TS&W) Studies and Issues*. Federal Highway Administration. March. 1995.

U.S. Department of Transportation, *1997 Comprehensive Truck Size and Weight Study, Draft, Volume II.* Washington DC. June. 1997a.

U.S. Department of Transportation, *1997 Federal Highway Cost Allocation Study.* August. 1997b.

U.S. Department of Transportation, *Truck Movements in America: Shipments From, To, Within, and Through States*. Bureau of Transportation Statistics. May. 1997c.

U.S. Department of Transportation, *1997 Economic Census, Transportation, 1997 Commodity Flow Survey, United States (Preliminary).* Bureau of Transportation Statistics, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1998.

Washington State Department of Transportation and Washington State University, "Washington State Freight Truck Origin and Destination Study." Database. Eastern Washington Intermodal Transportation Study (EWITS), Research Report #21. 1998.

APPENDICES

APPENDIX A

MILEAGE AND ESALS BY WEIGHT GROUP

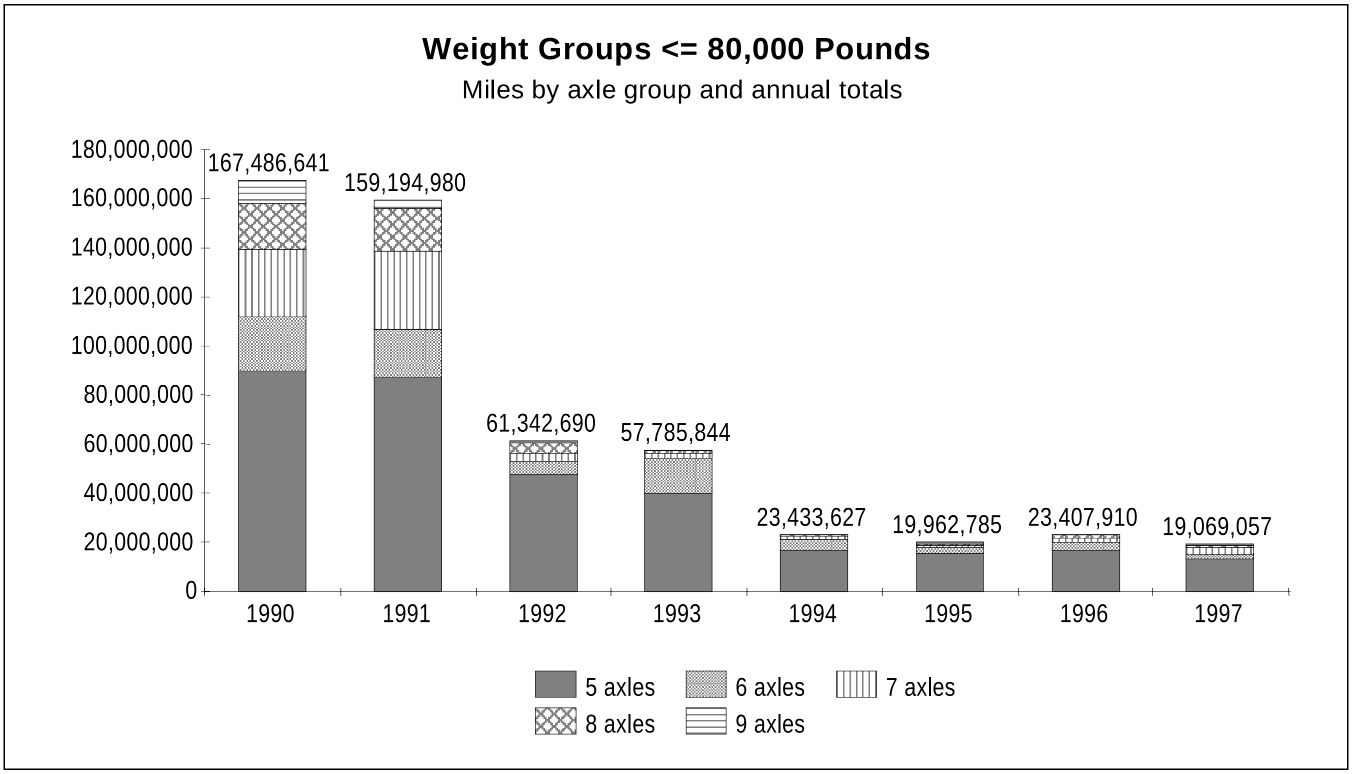

Figure A.1a: Mileage <= 80,000 pounds

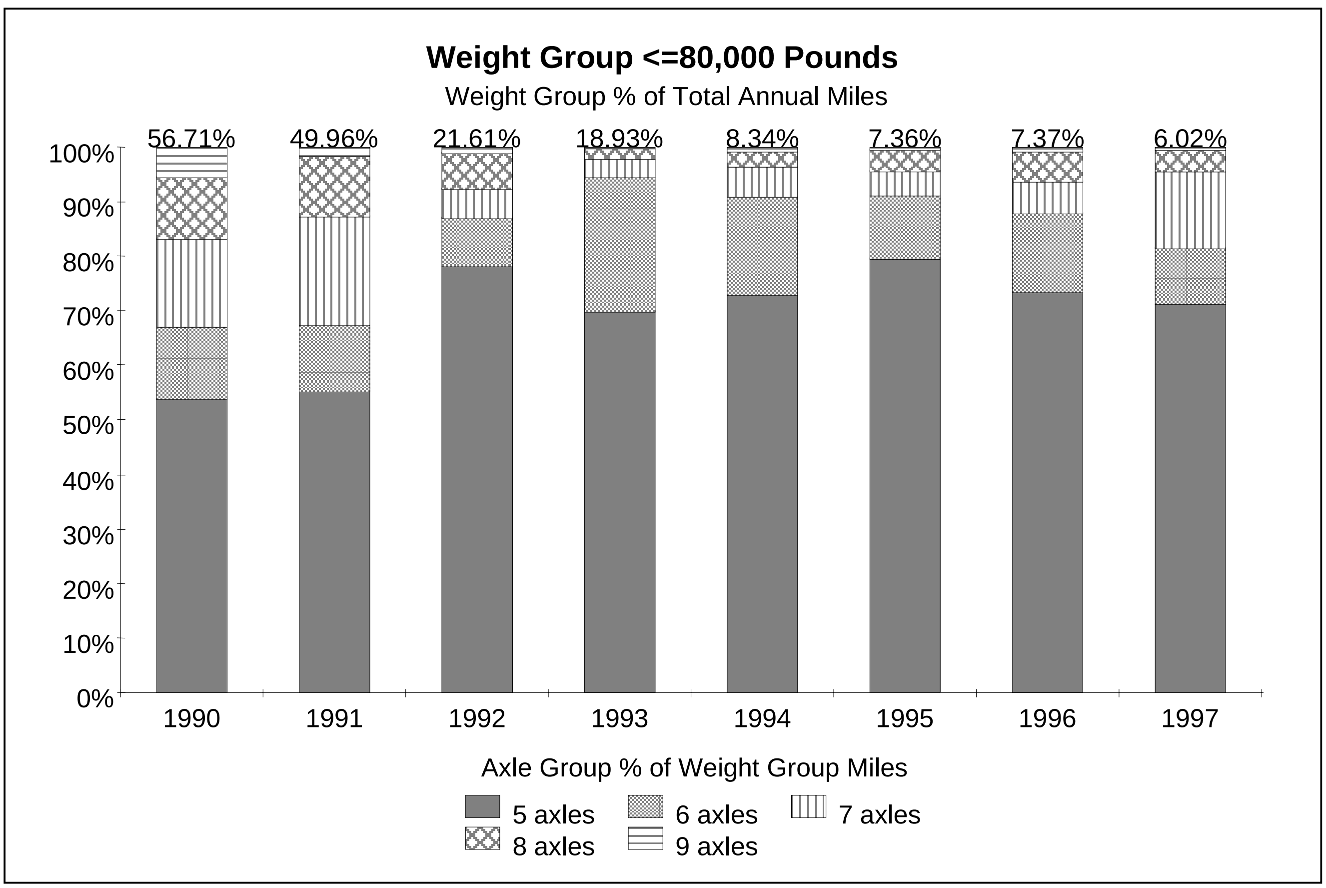

Figure A.1b: Mileage Percentages <= 80,000 pounds

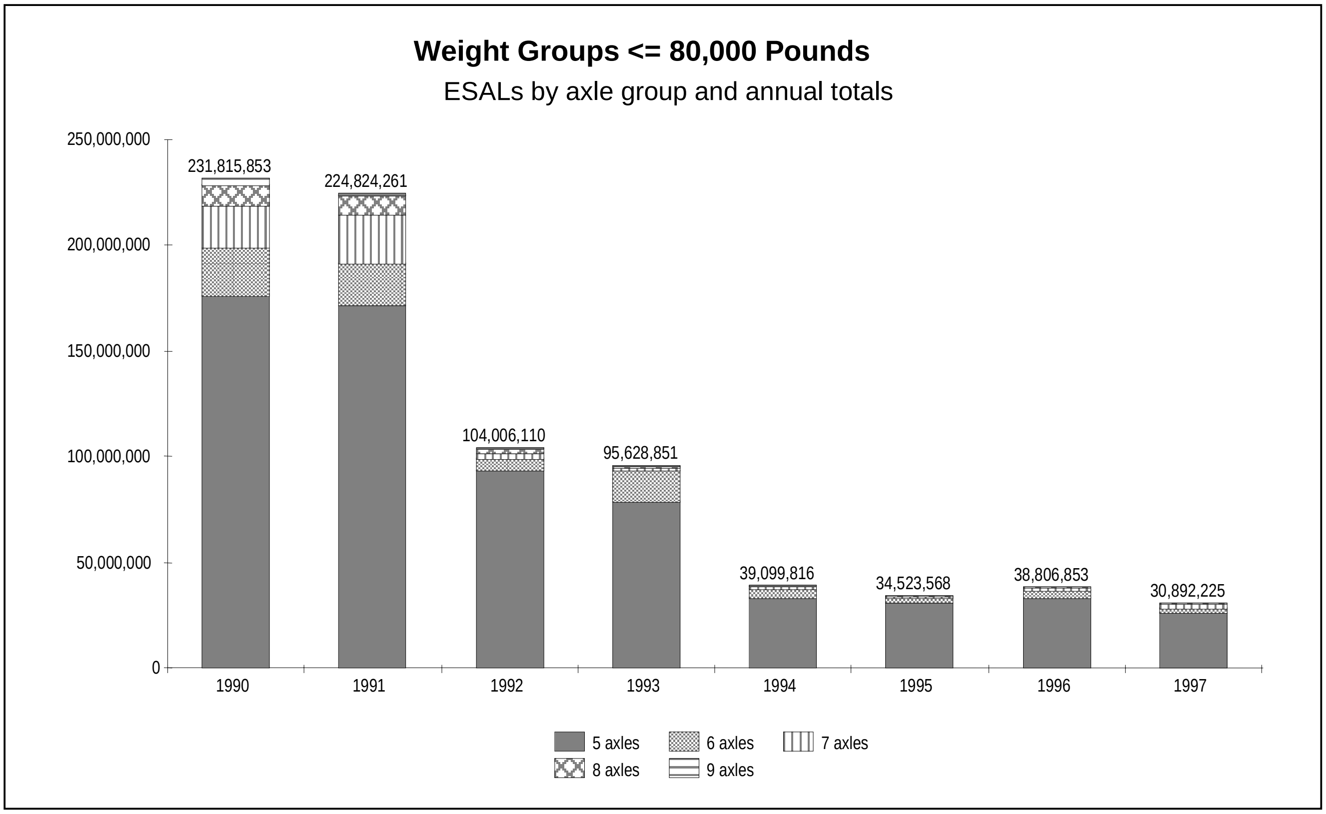

Figure A.1c: ESALs <= 80,000 pounds

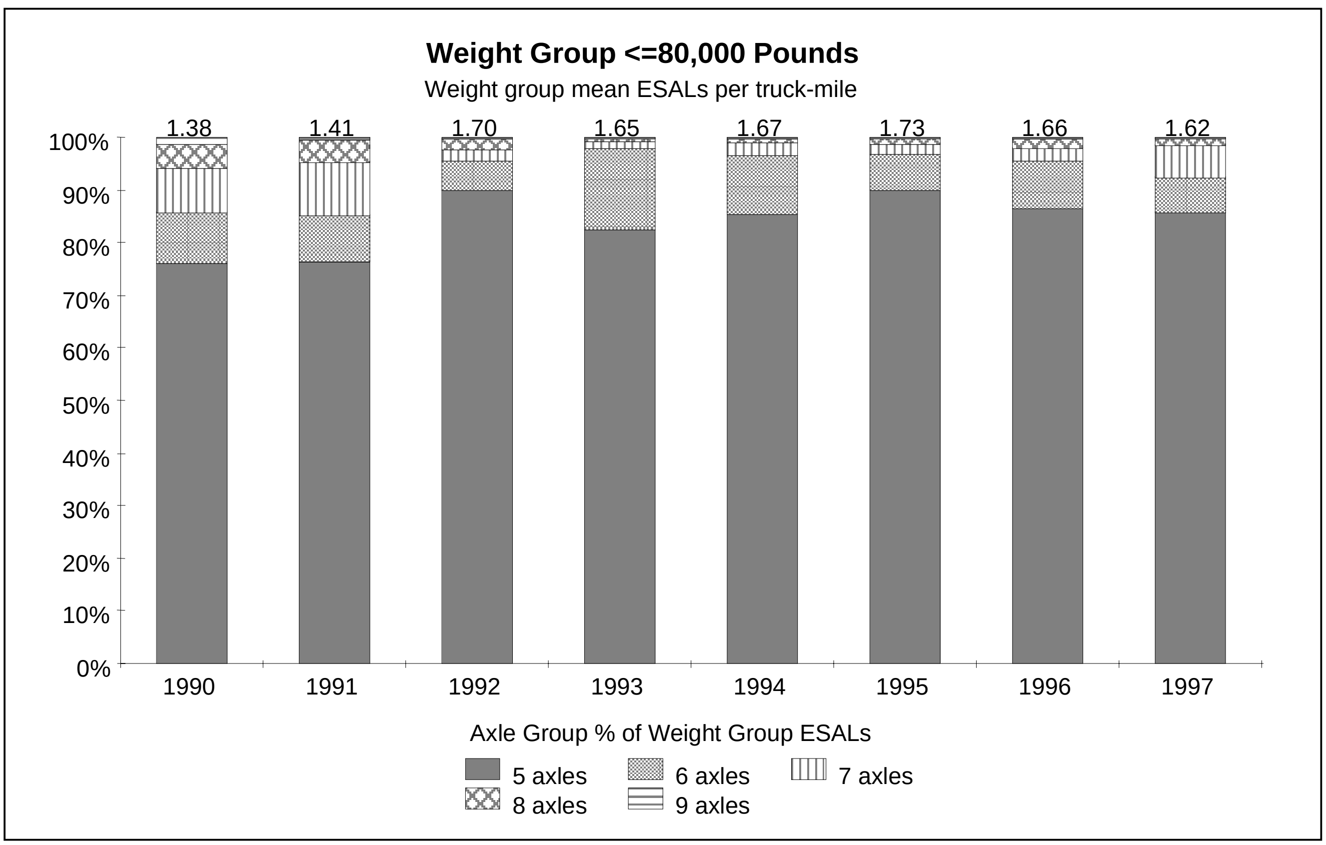

Figure A.1d: ESAL Average and Percentages <= 80,000 pounds

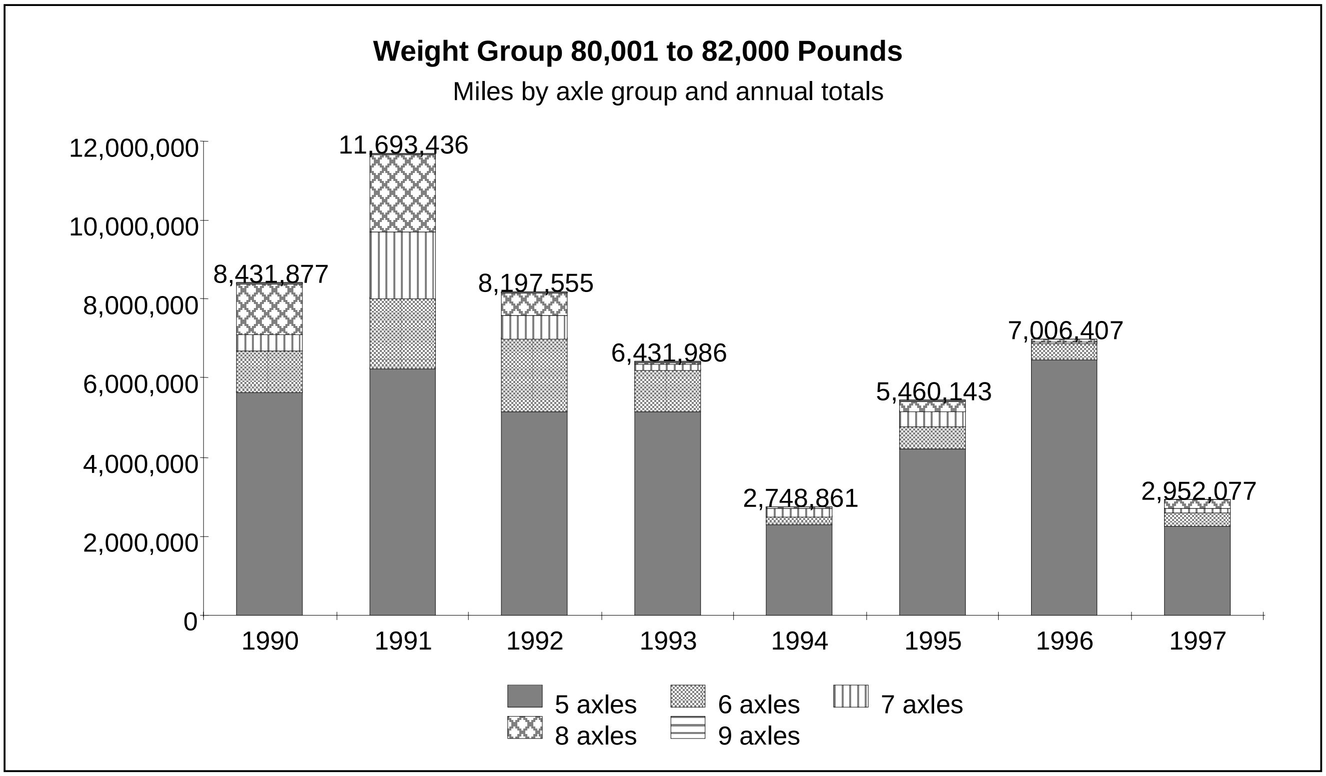

Figure A.2a: Mileage 80,001 to 82,000 pounds

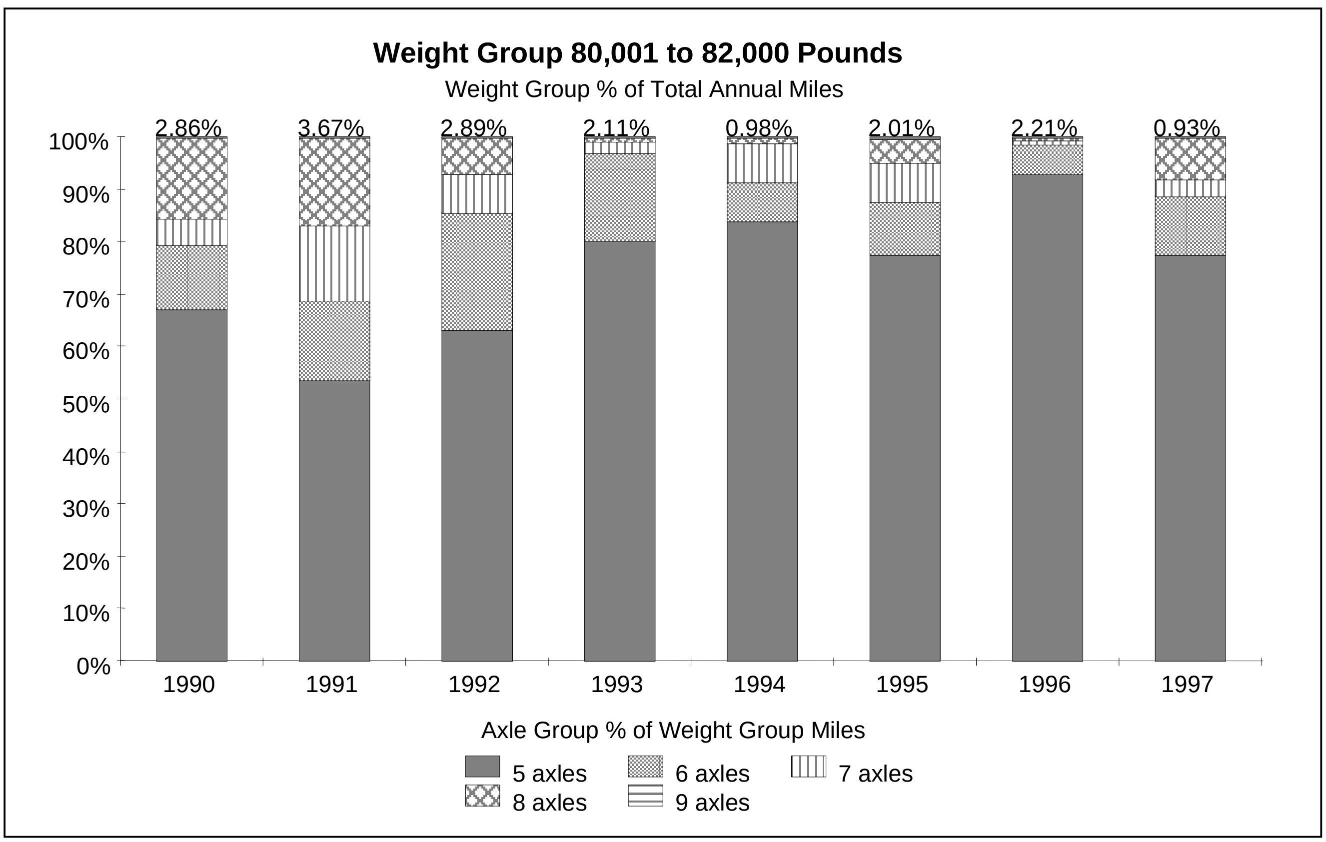

Figure A.2b: Mileage Percentages 80,001 to 82,000 pounds

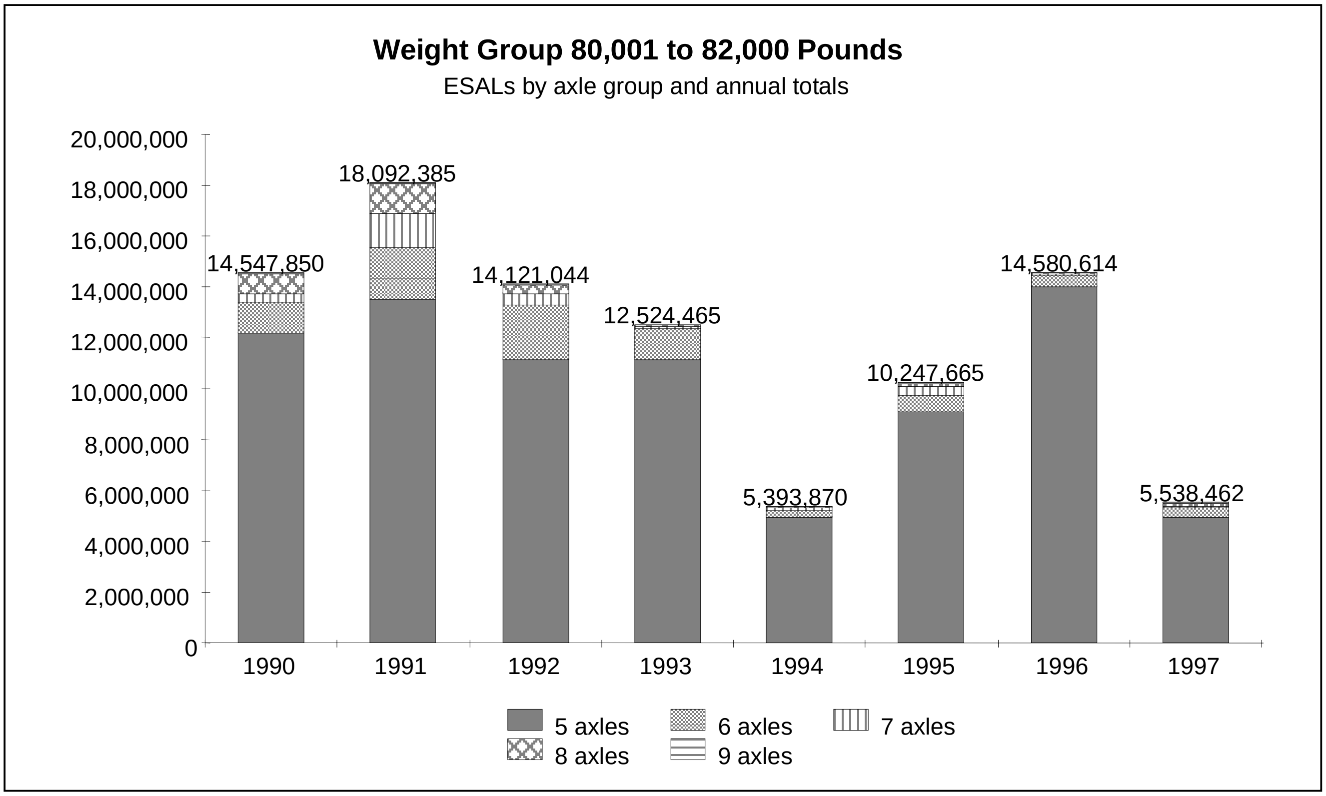

Figure A.2c: ESALs 80,001 to 82,000 pounds

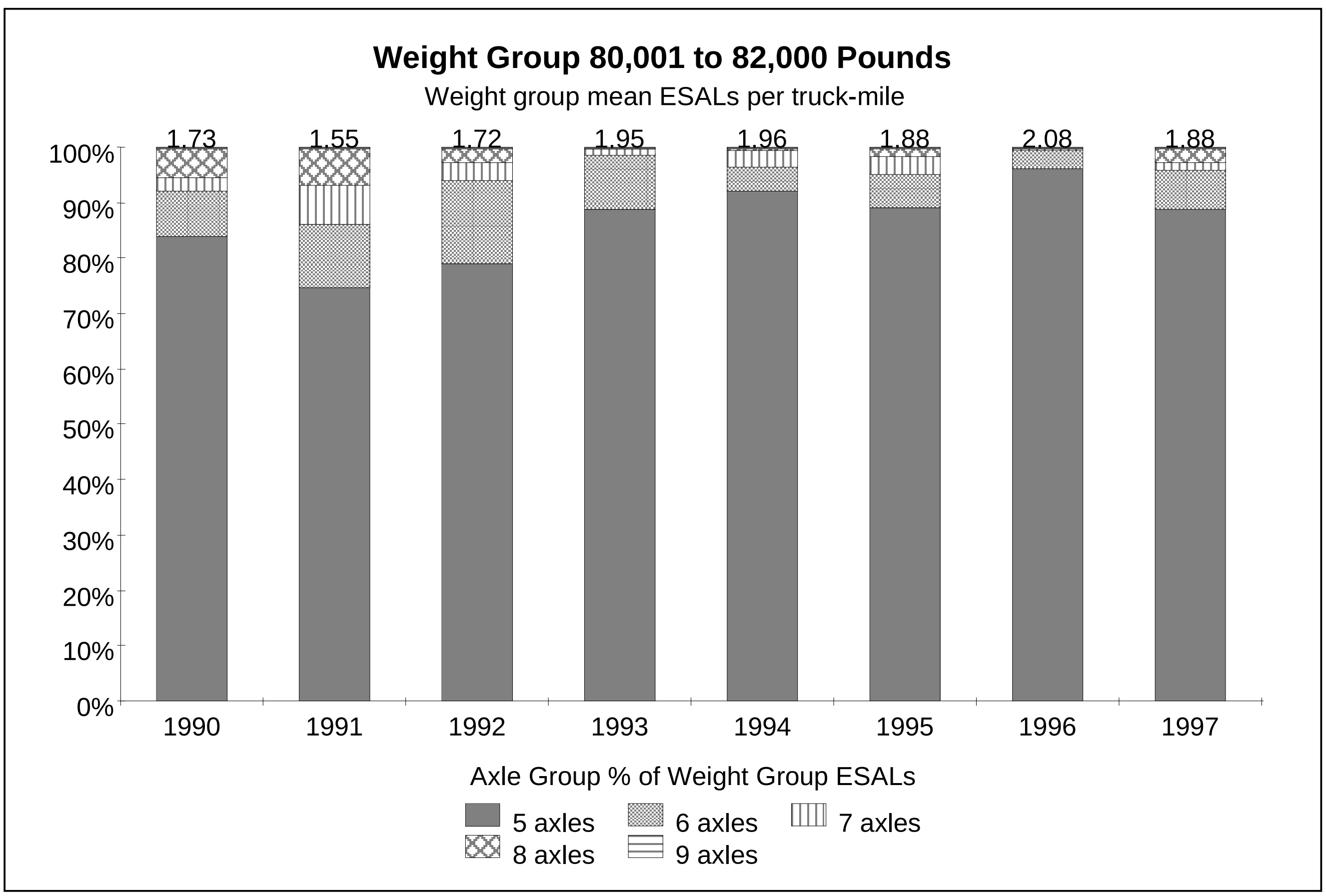

Figure A.2d: ESAL Average and Percentages 80,001 to 82,000 pounds

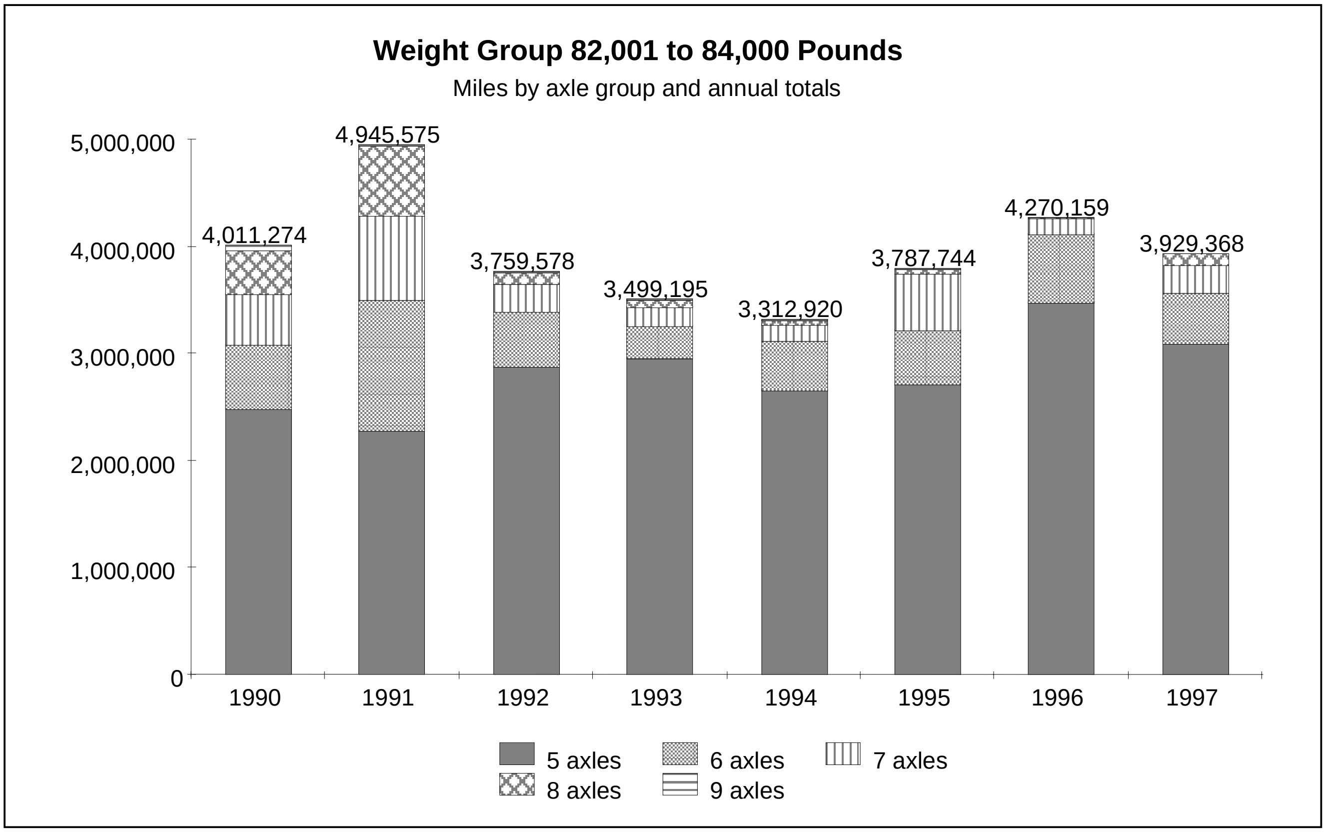

Figure A.3a: Mileage 82,001 to 84,000 pounds

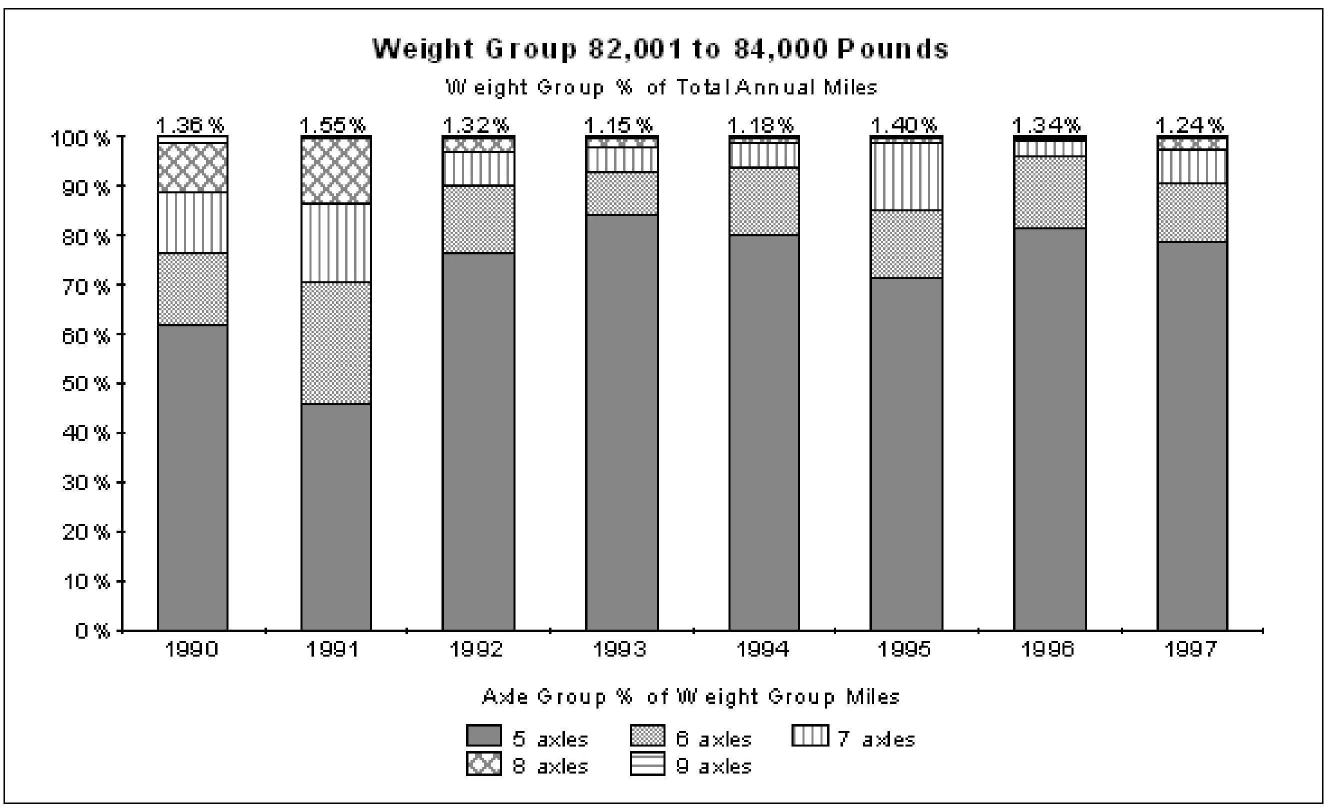

Figure A.3b: Mileage Percentages 82,001 to 84,000 pounds

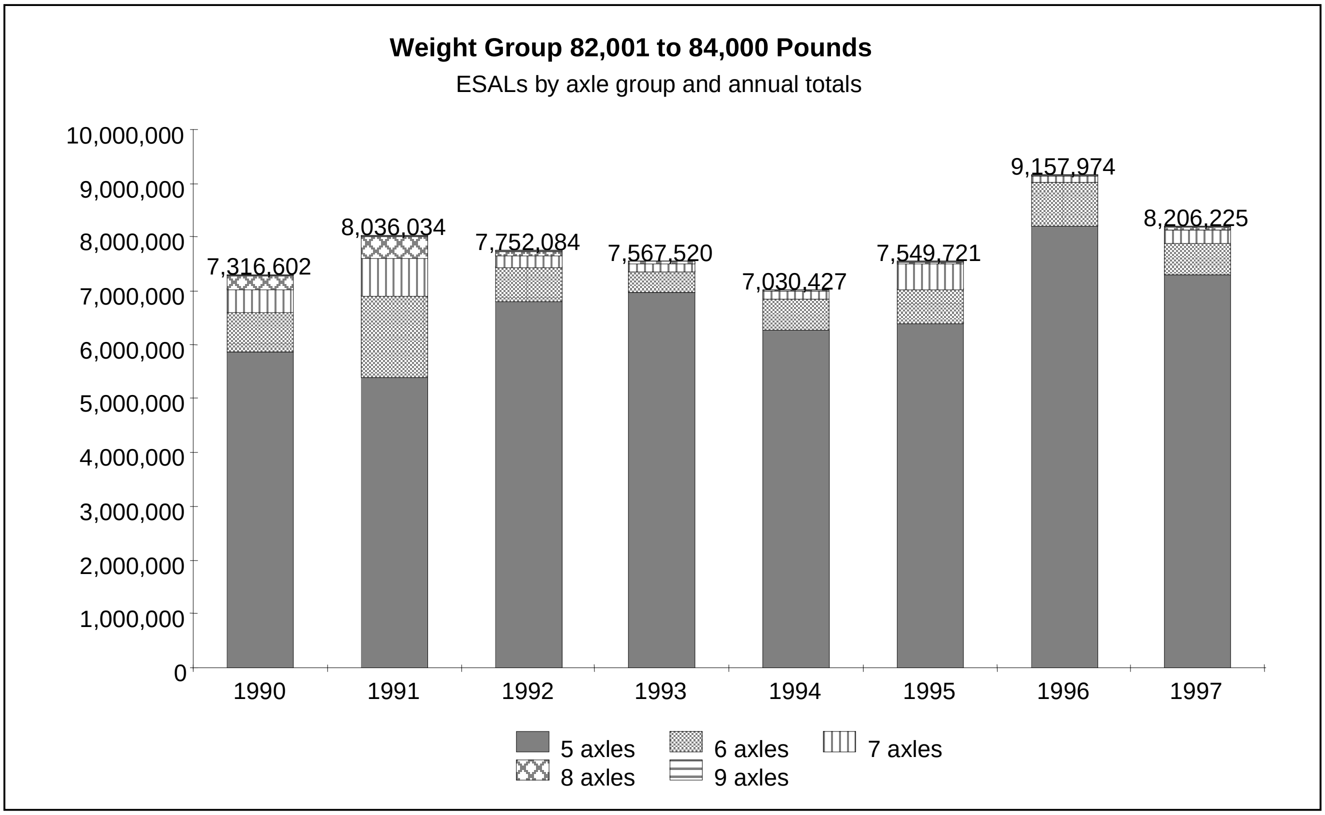

Figure A.3c: ESALs 82,001 to 84,000 pounds

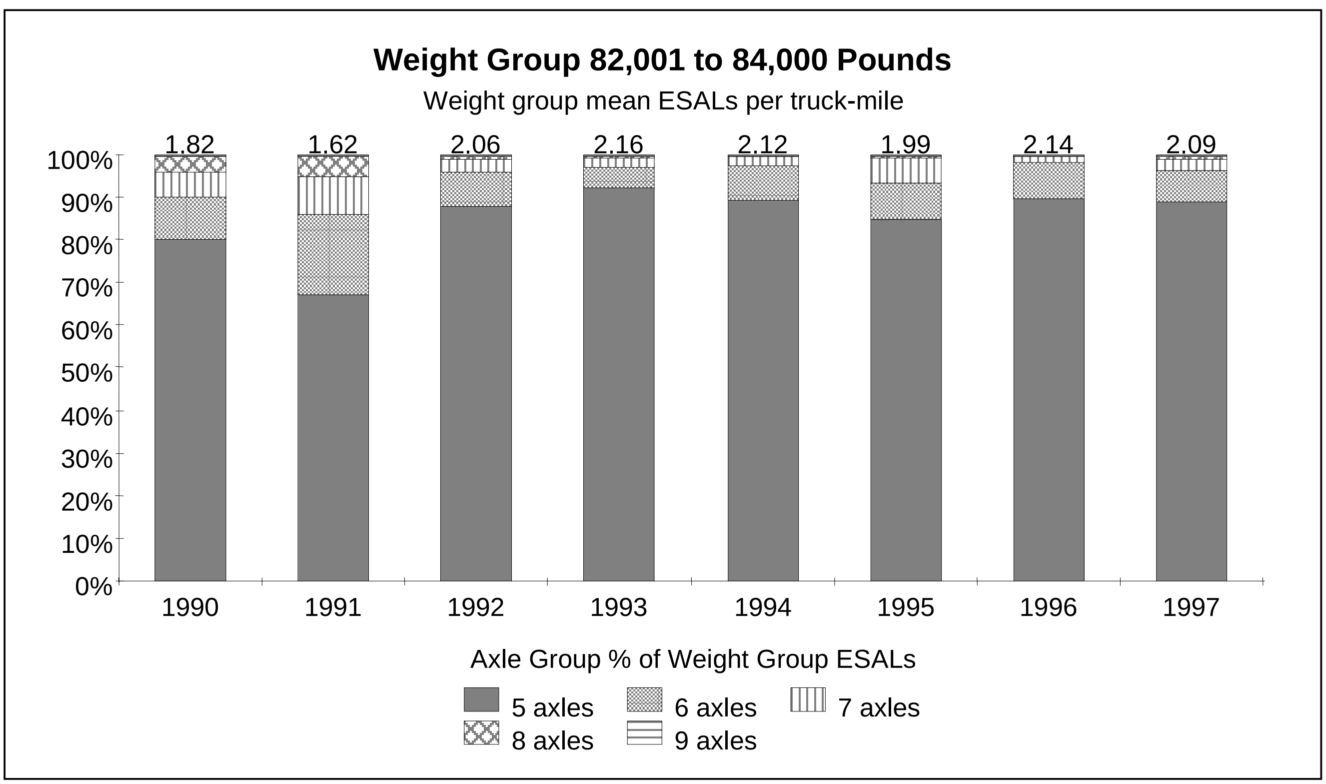

Figure A.3d: ESAL Average and Percentages 82,001 to 84,000 pounds

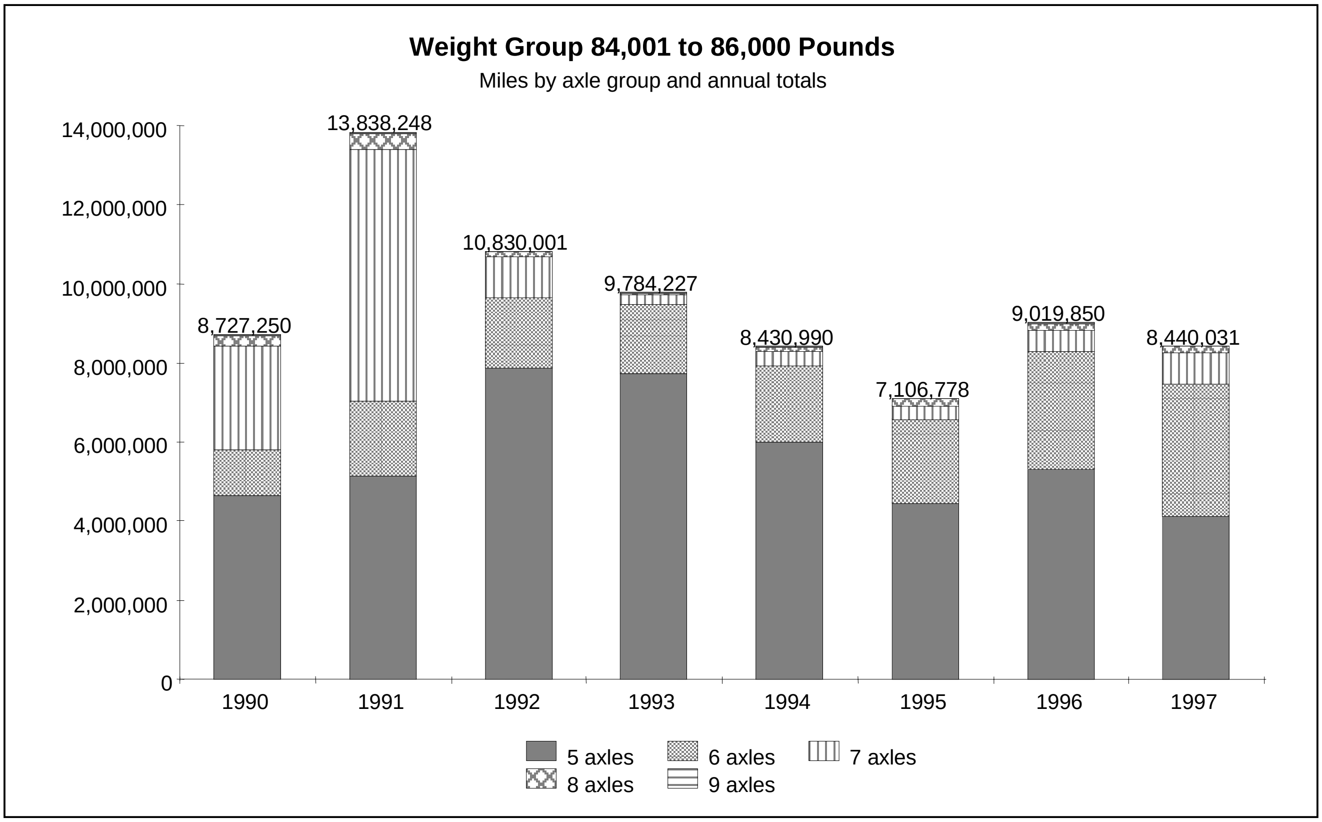

Figure A.4a: Mileage 84,001 to 86,000 pounds

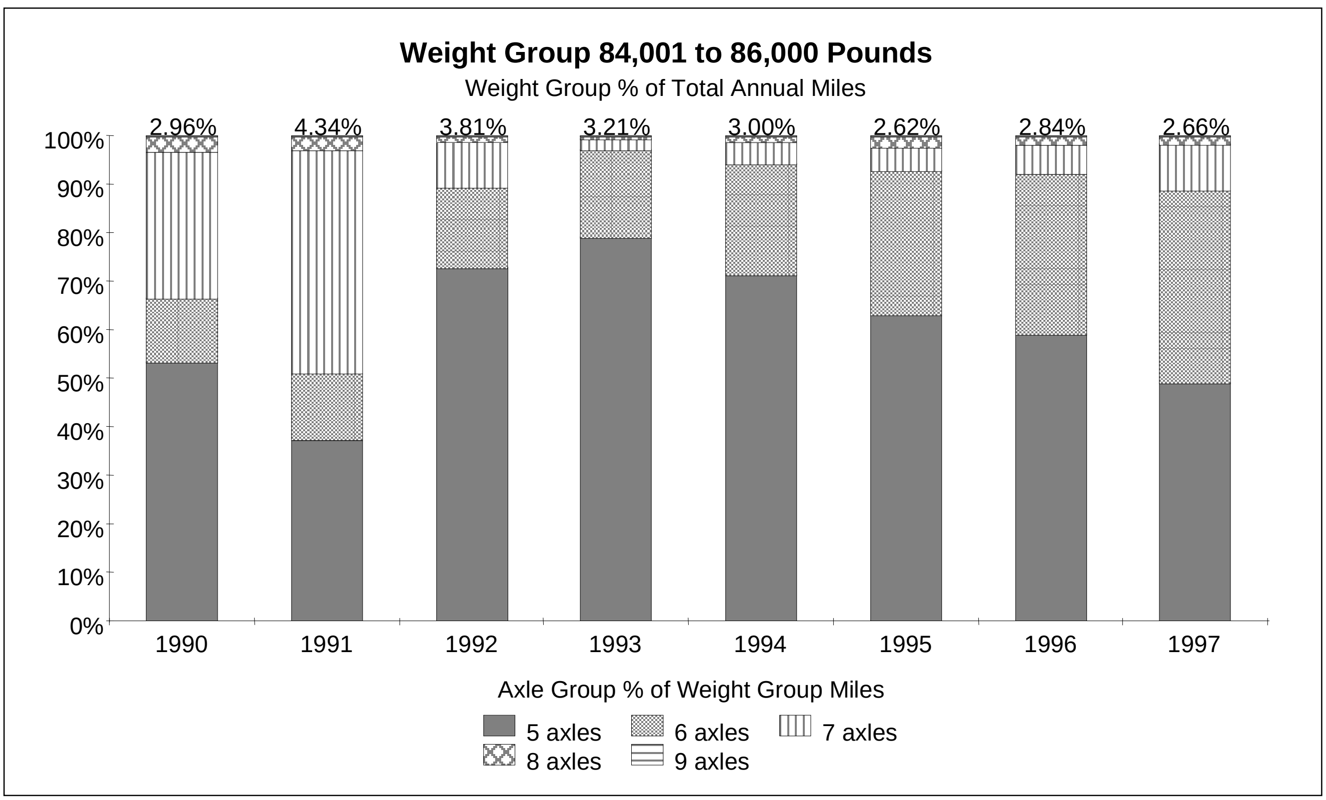

Figure A.4b: Mileage Percentages 84,001 to 86,000 pounds

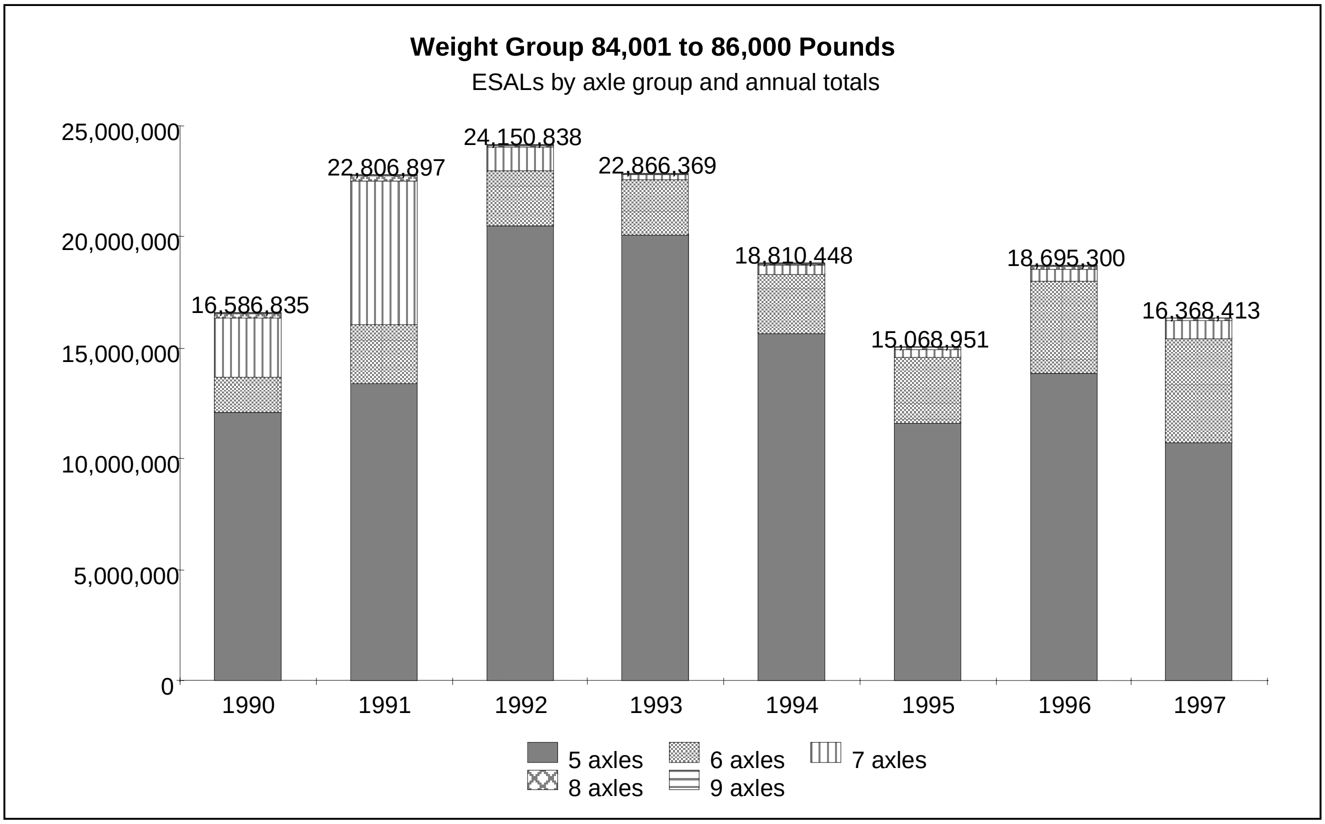

Figure A.4c: ESALs 84,001 to 86,000 pounds

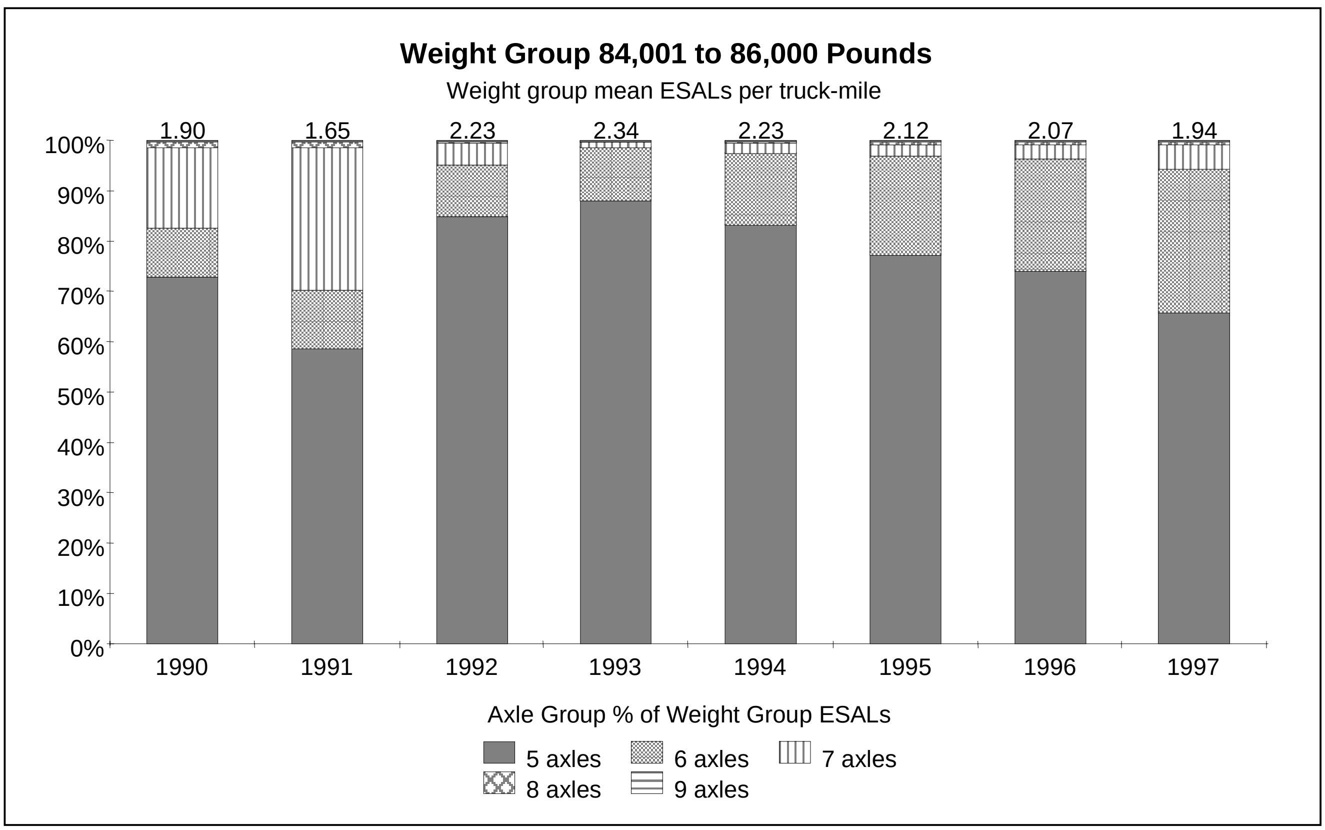

Figure A.4d: ESAL Average and Percentages 84,001 to 86,000 pounds

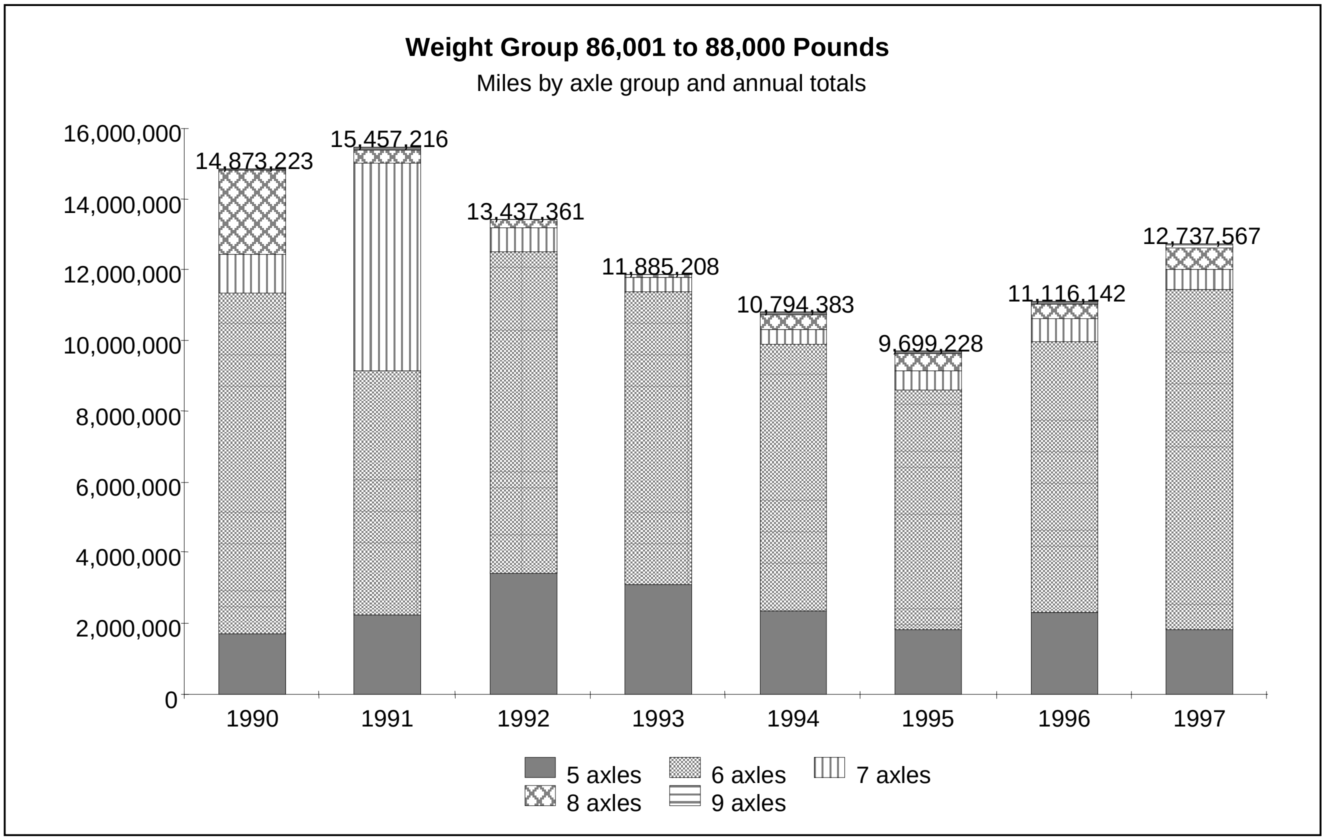

Figure A.5a: Mileage 86,001 to 88,000 pounds

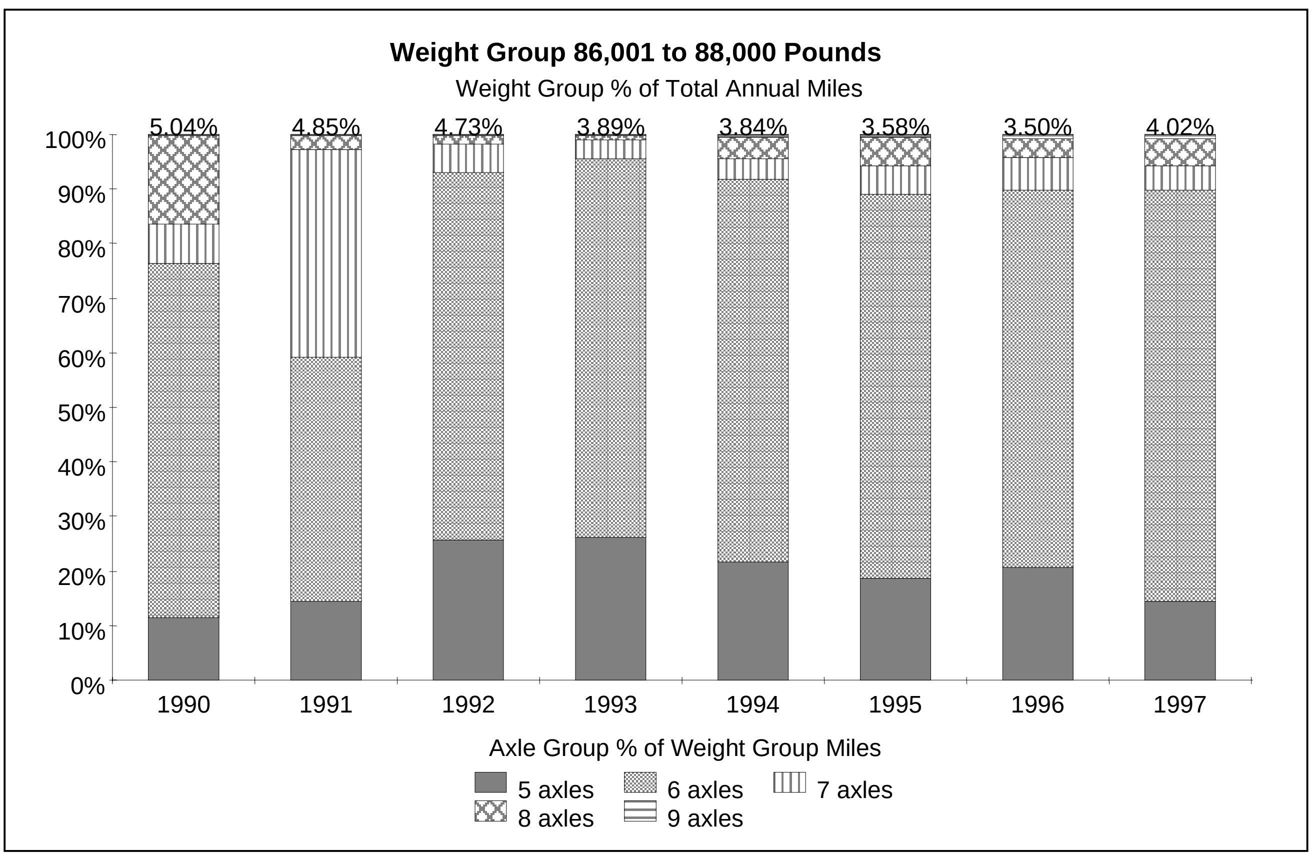

Figure A.5b: Mileage Percentages 86,001 to 88,000 pounds

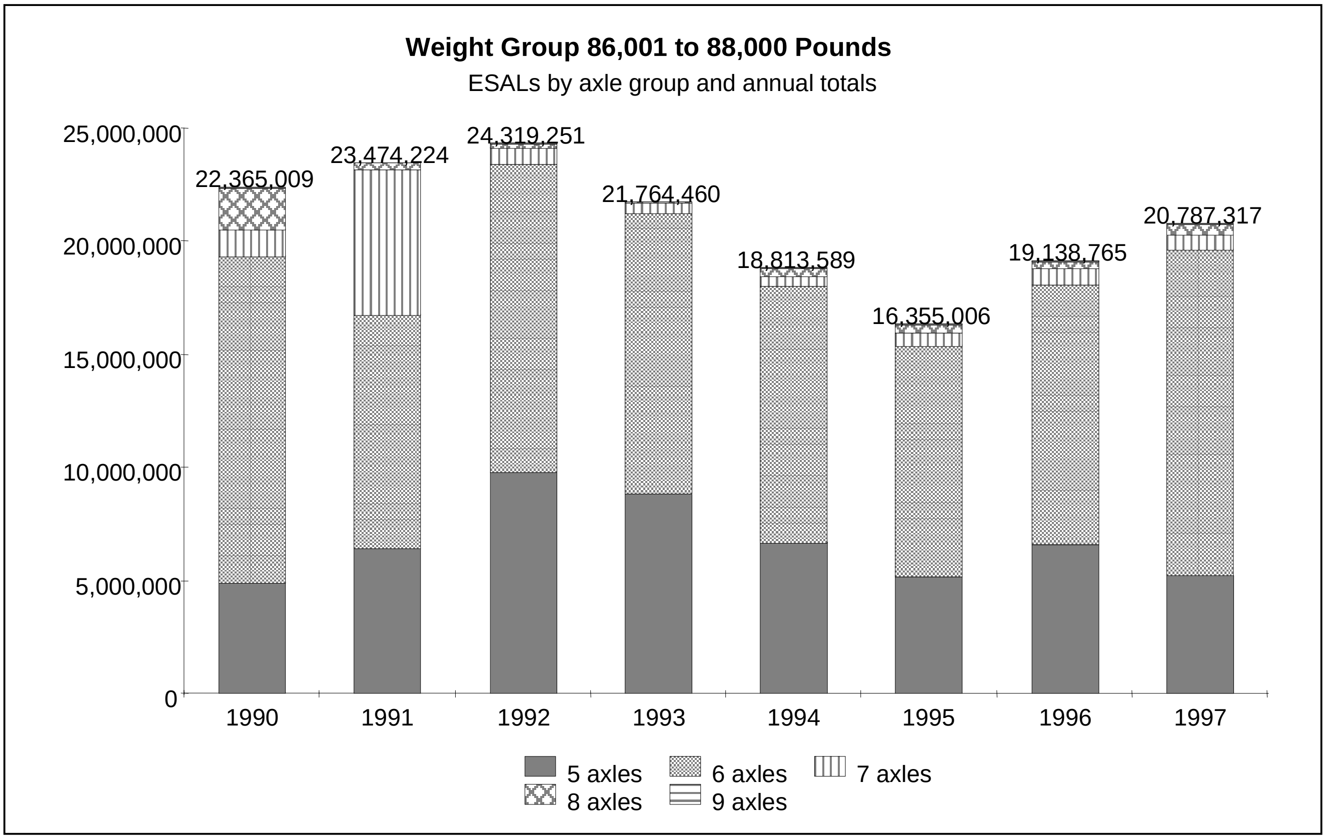

Figure A.5c: ESALs 86,001 to 88,000 pounds

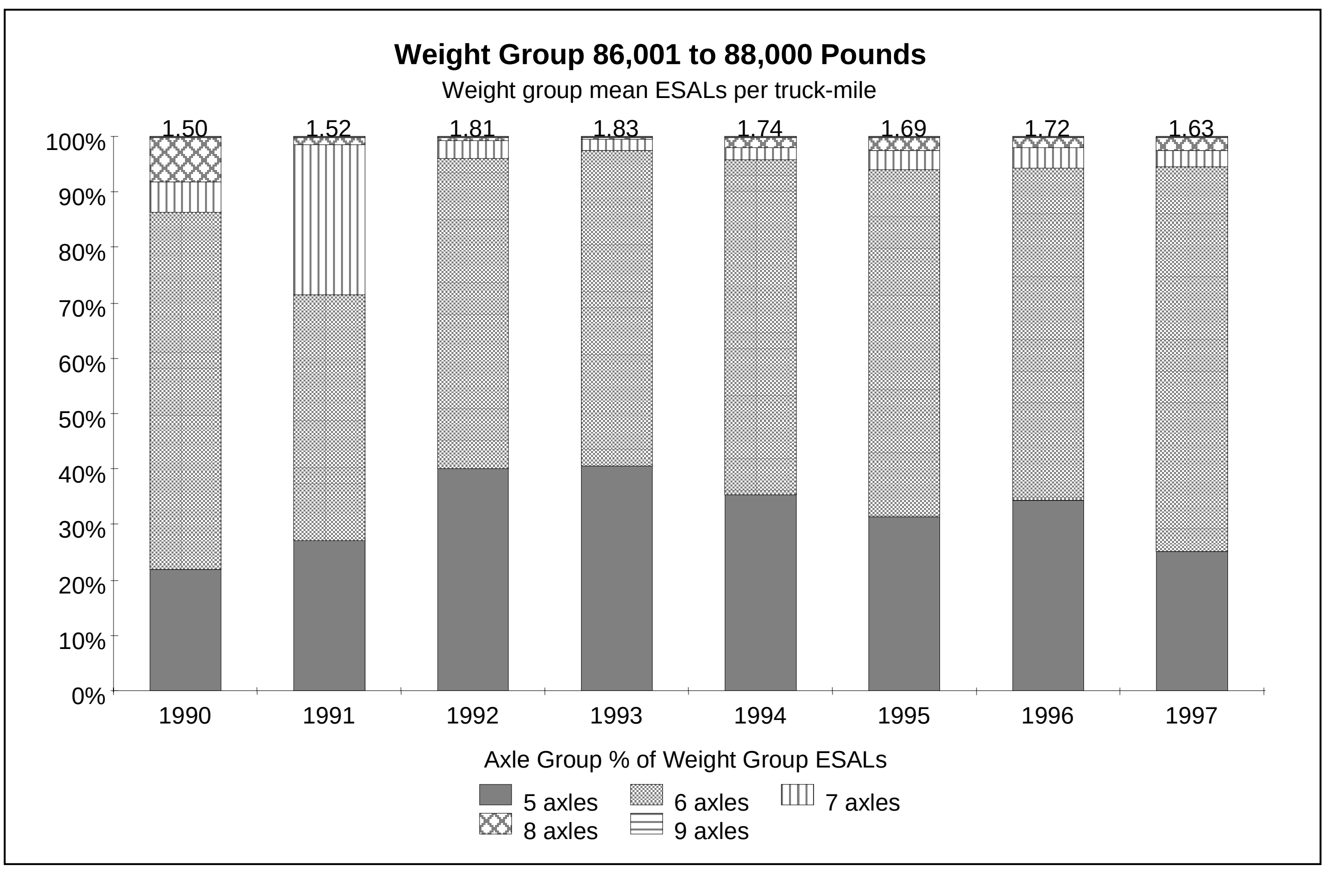

Figure A.5d: ESAL Average and Percentages 86,001 to 88,000 pounds

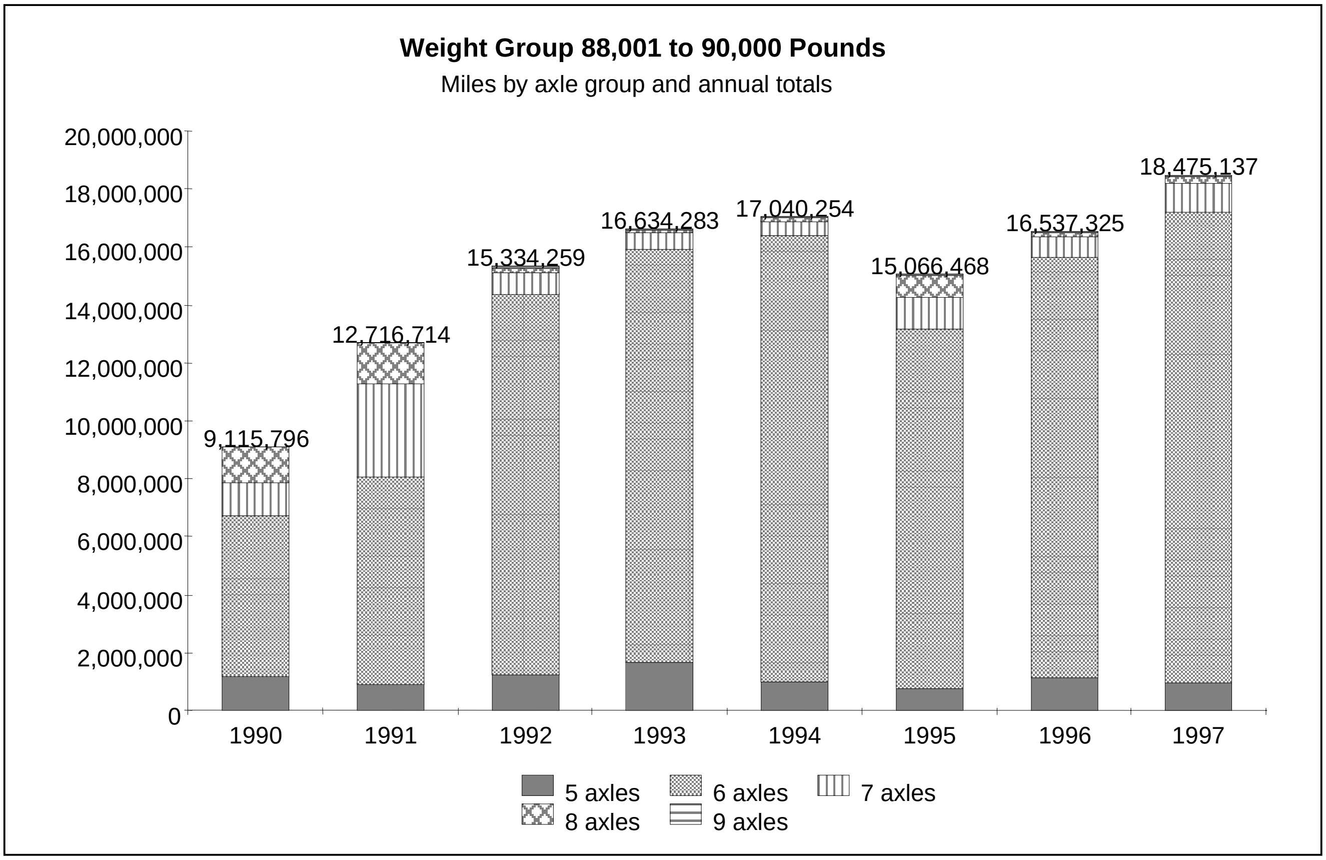

Figure A.6a: Mileage 88,001 to 90,000 pounds

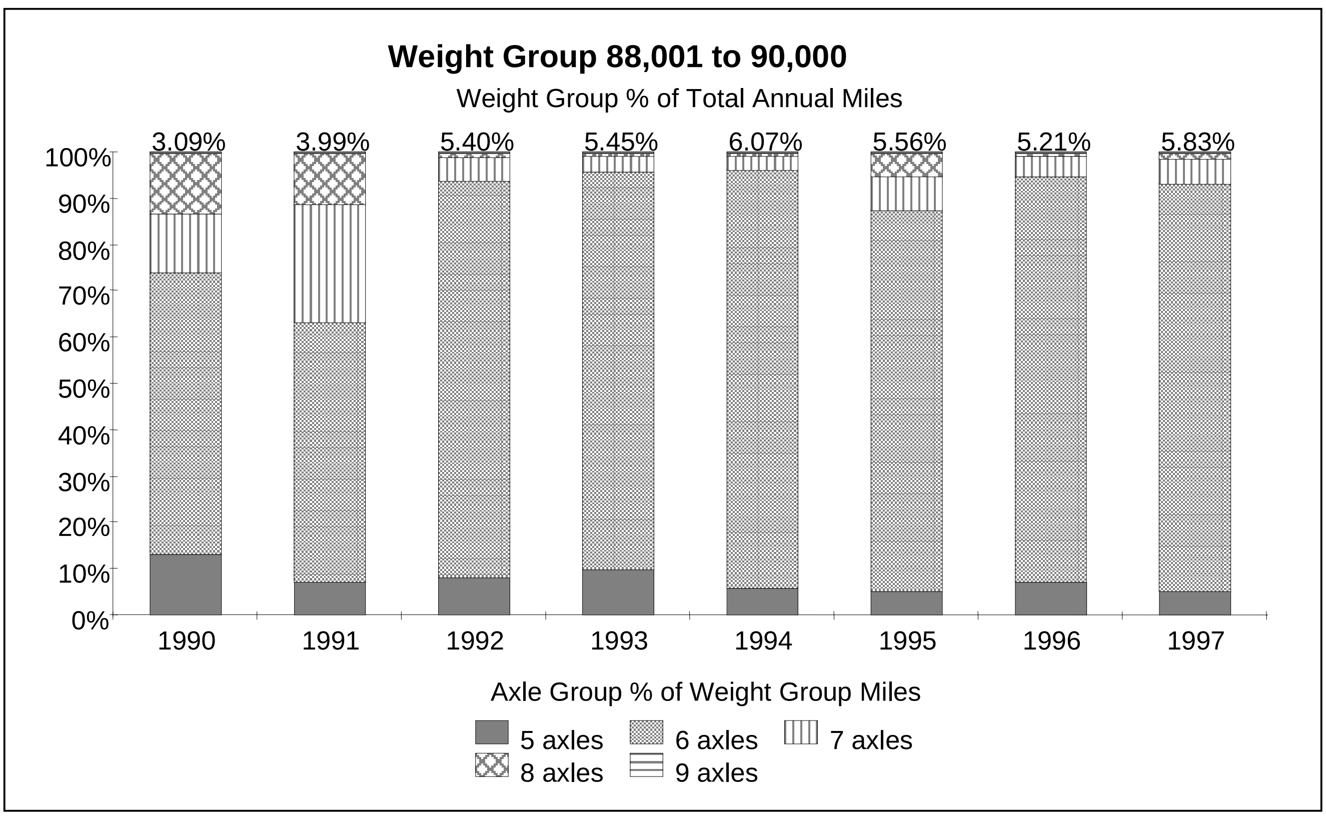

Figure A.6b: Mileage Percentages 88,001 to 90,000 pounds

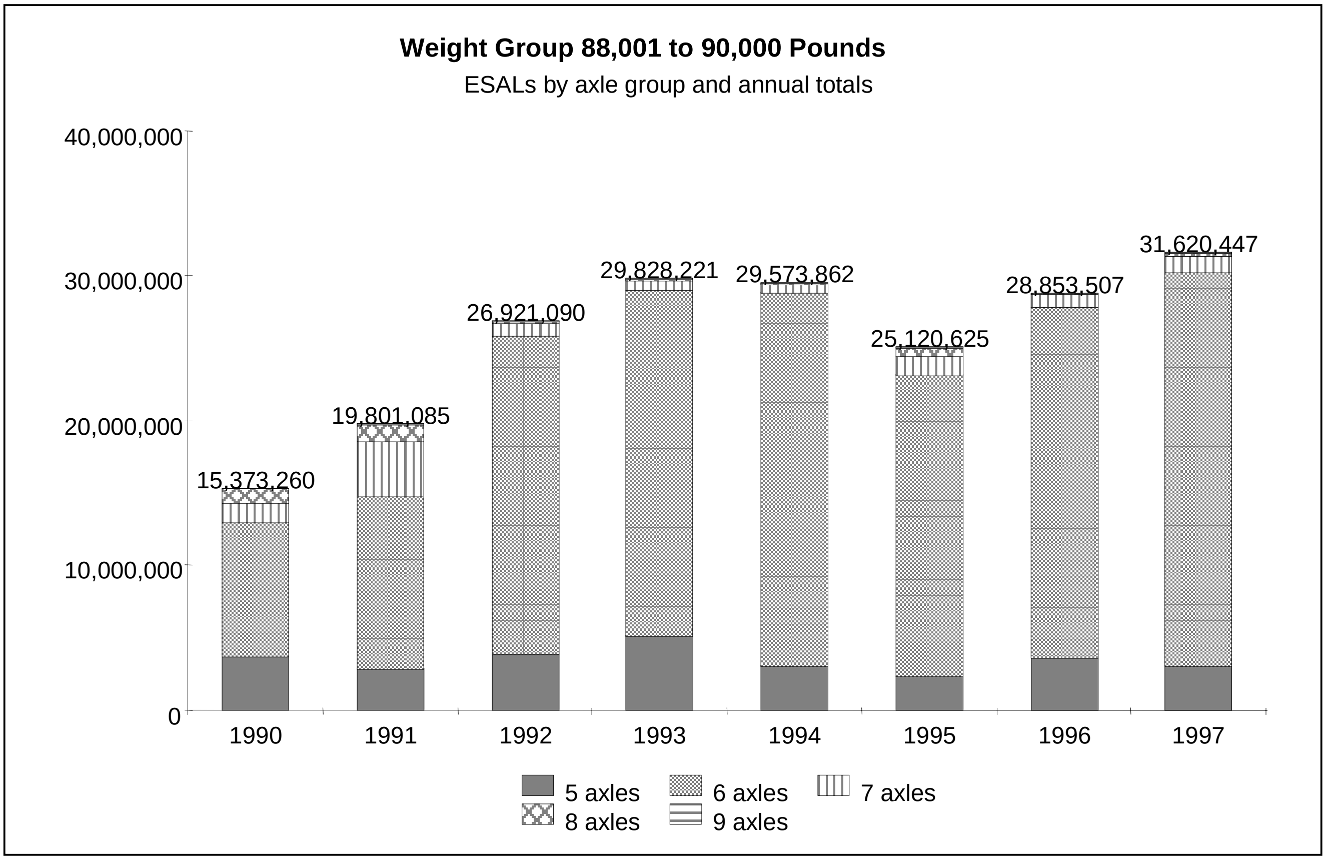

Figure A.6c: ESALs 88,001 to 90,000 pounds

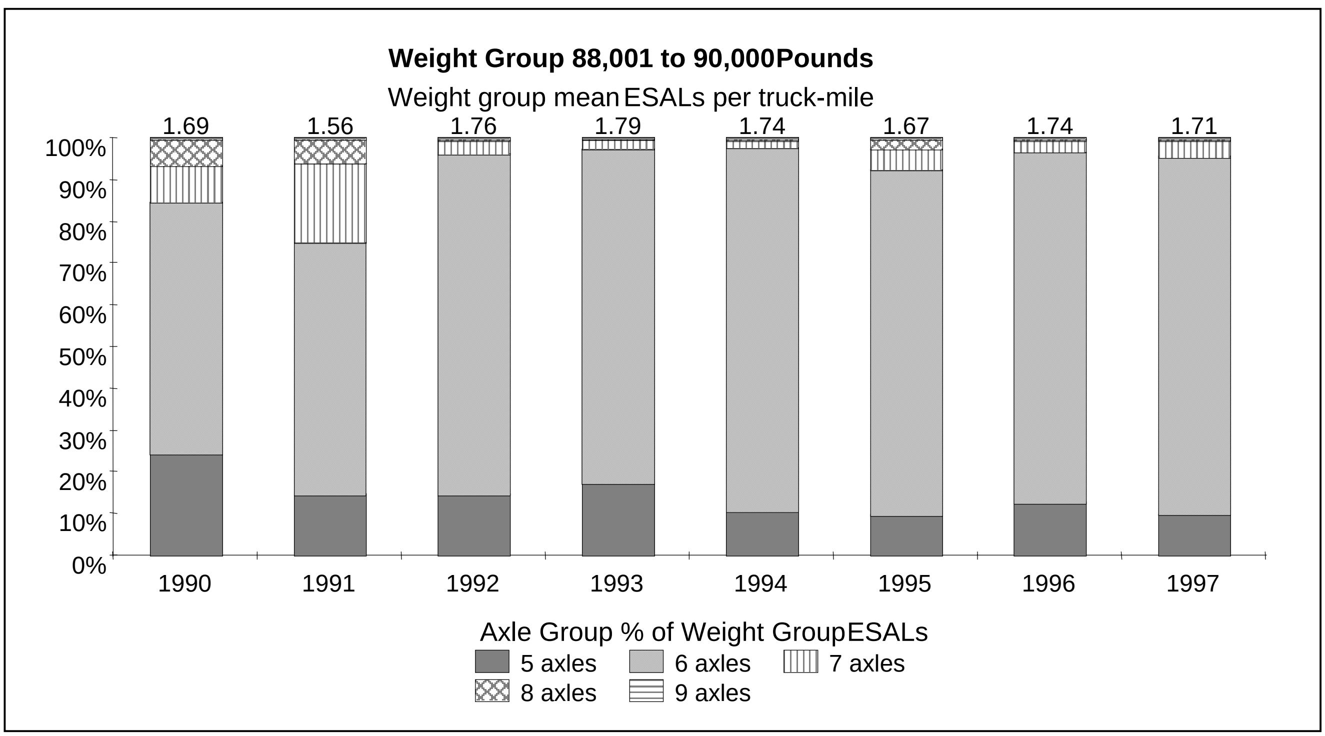

Figure A.6d: ESAL Average and Percentages 88,001 to 90,000 pounds

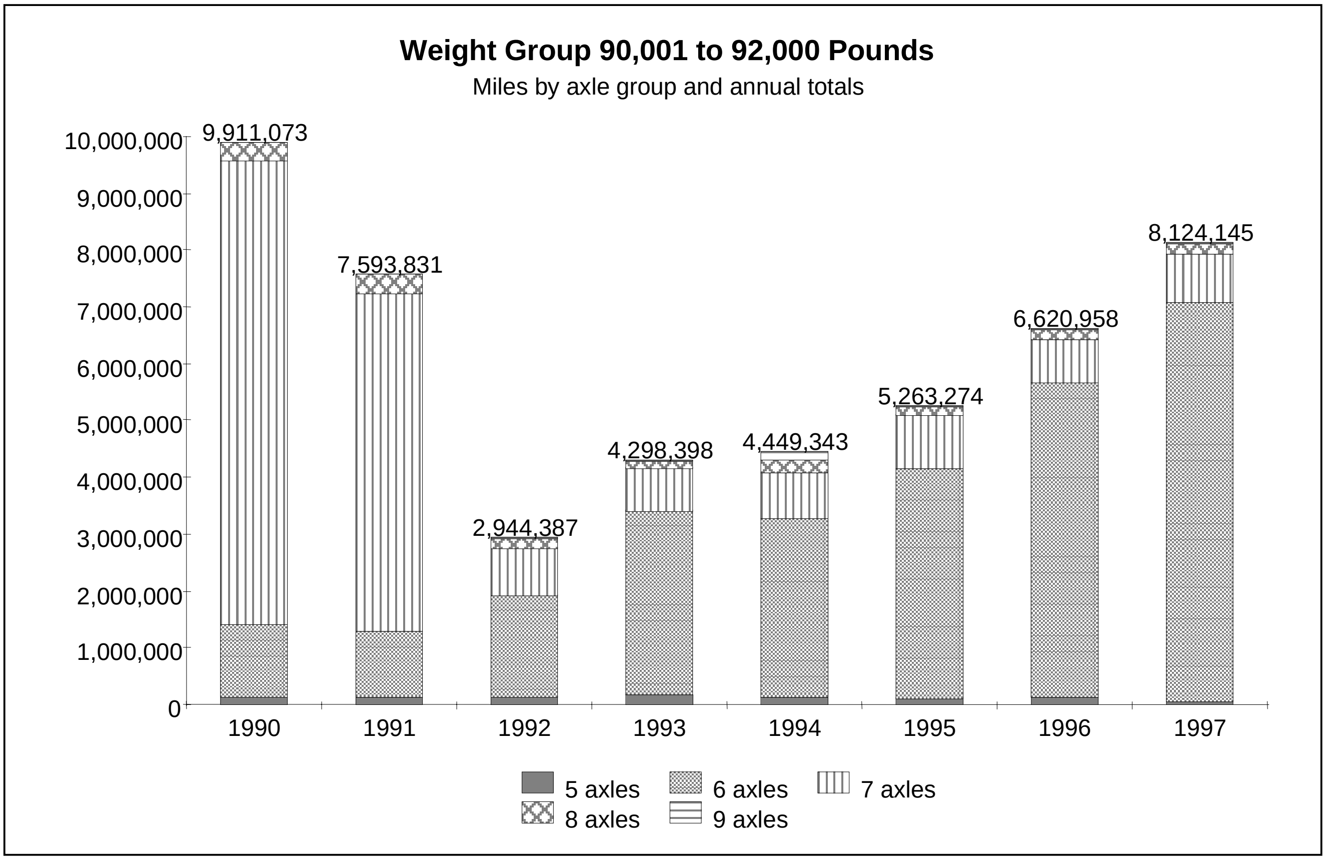

Figure A.7a: Mileage 90,001 to 92,000 pounds

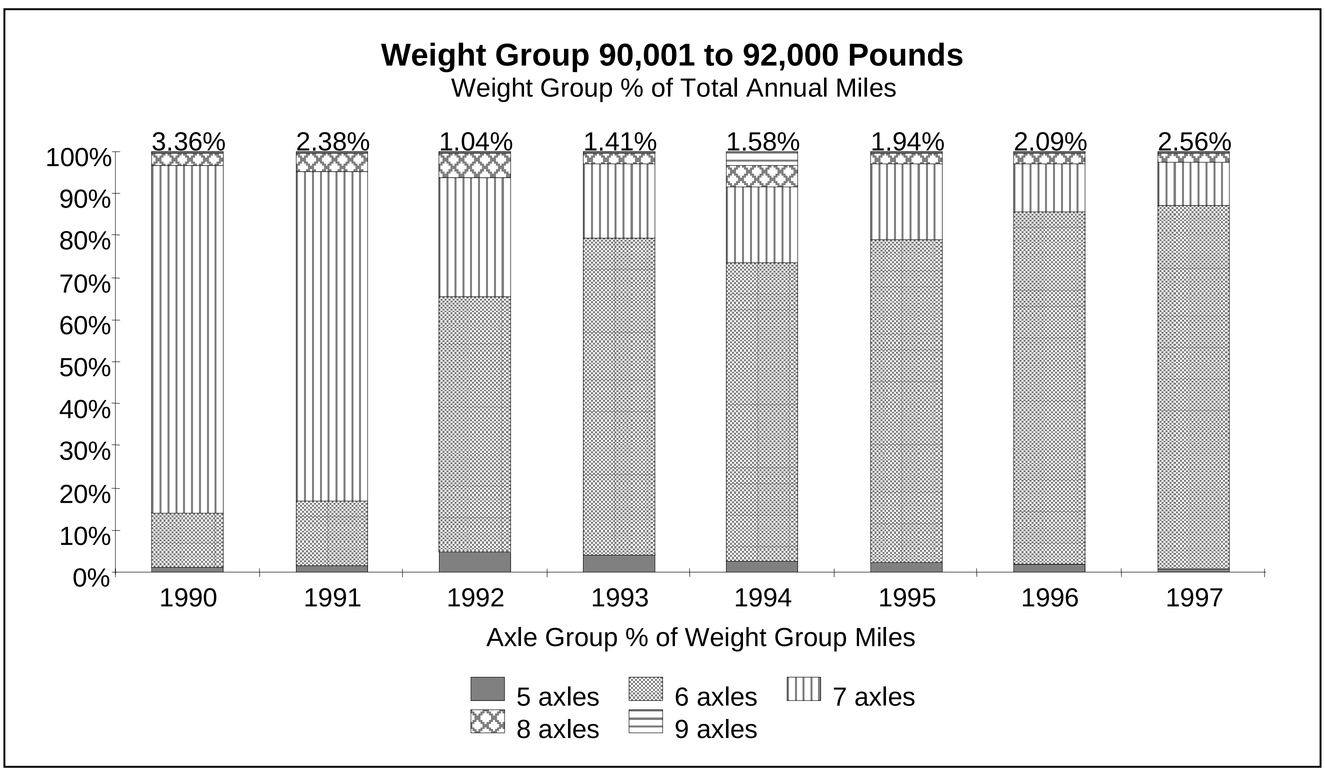

Figure A.7b: Mileage Percentages 90,001 to 92,000 pounds

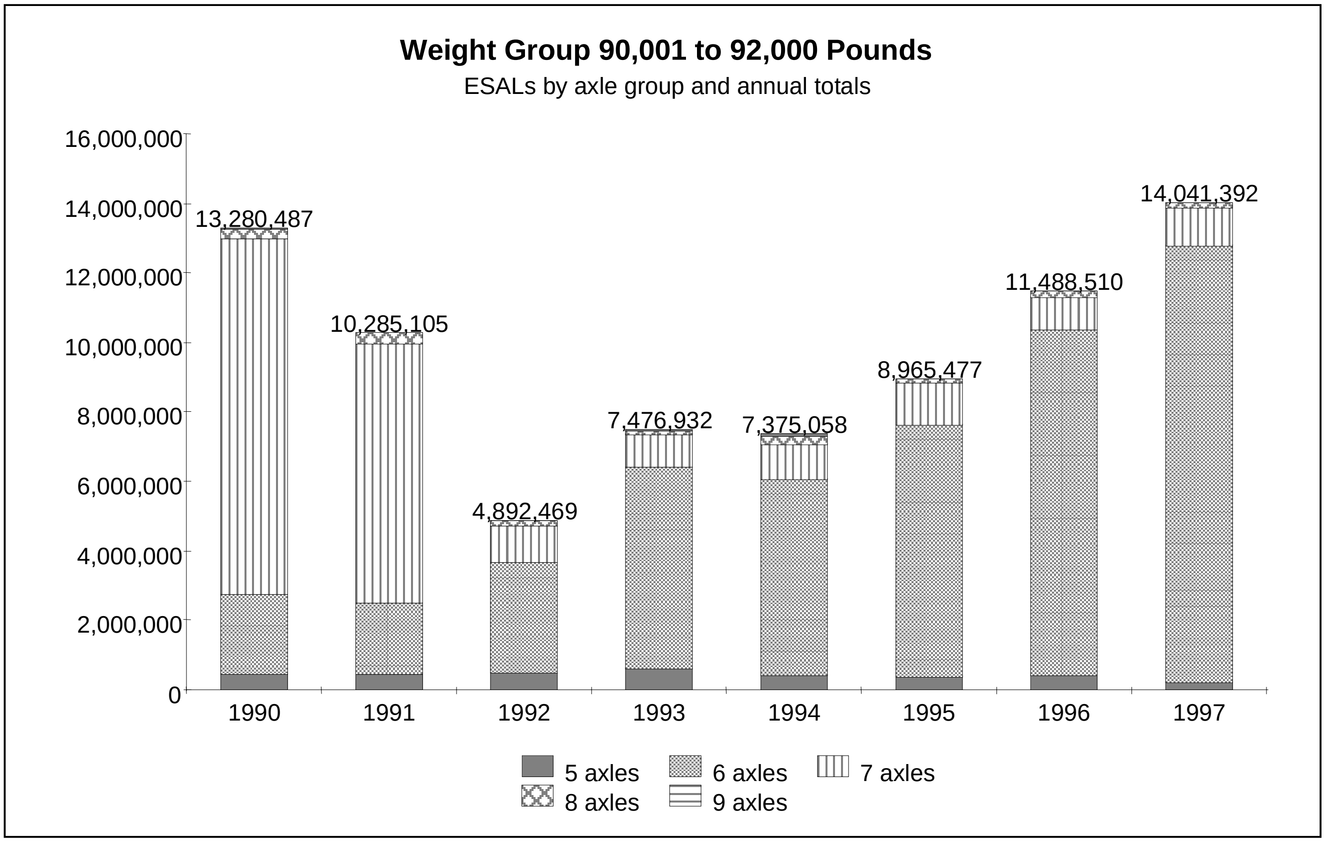

Figure A.7c: ESALs 90,001 to 92,000 pounds

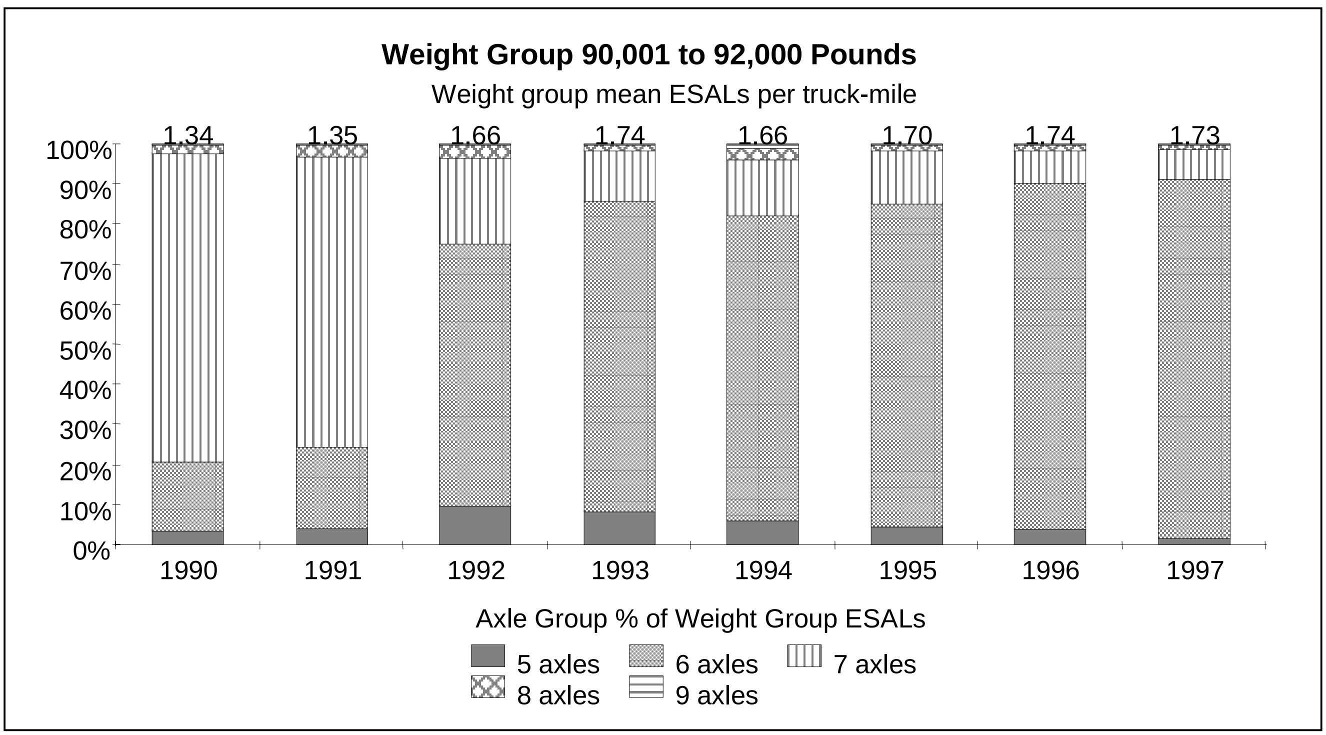

Figure A.7d: ESAL Average and Percentages 90,001 to 92,000 pounds

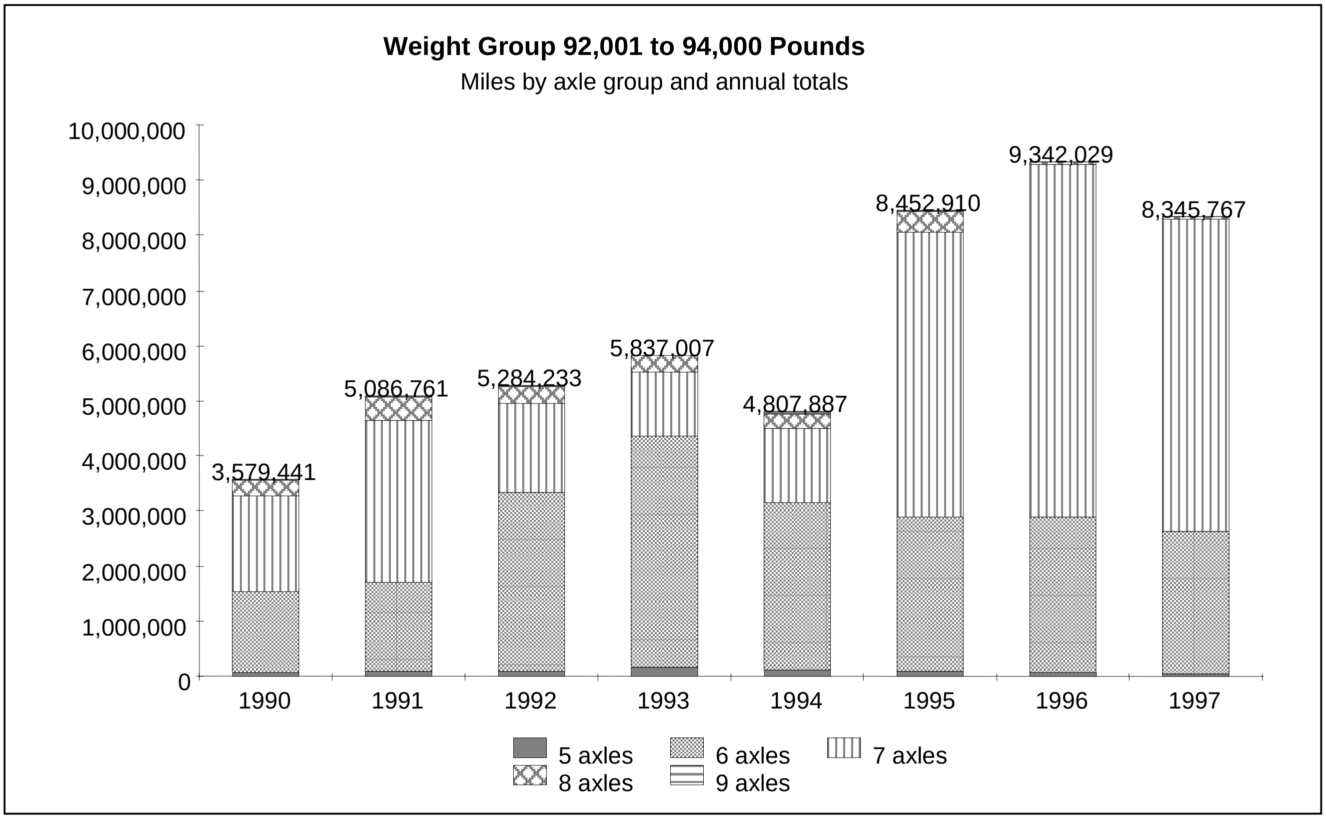

Figure A.8a: Mileage 92,001 to 94,000 pounds

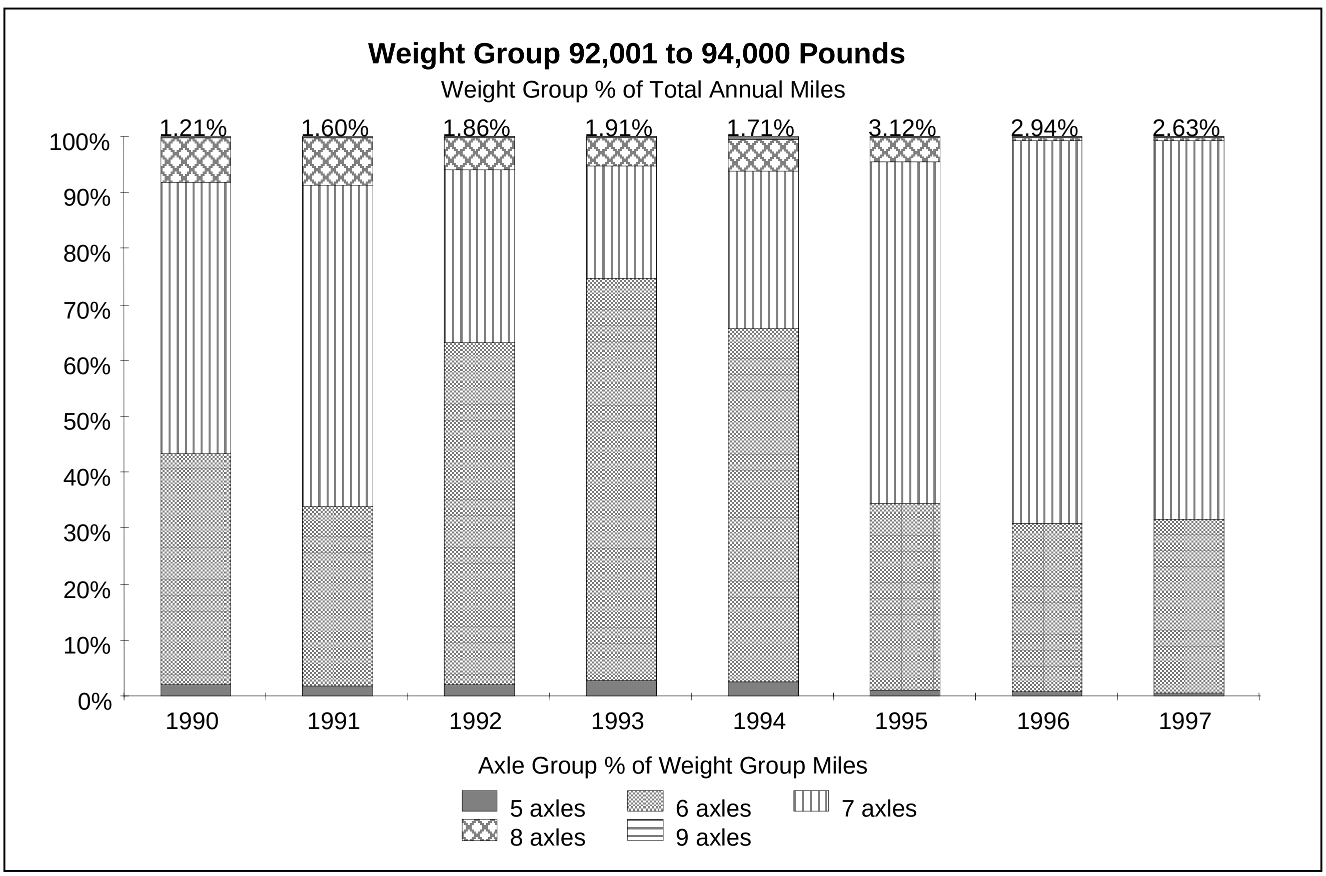

Figure A.8b: Mileage Percentages 92,001 to 94,000 pounds

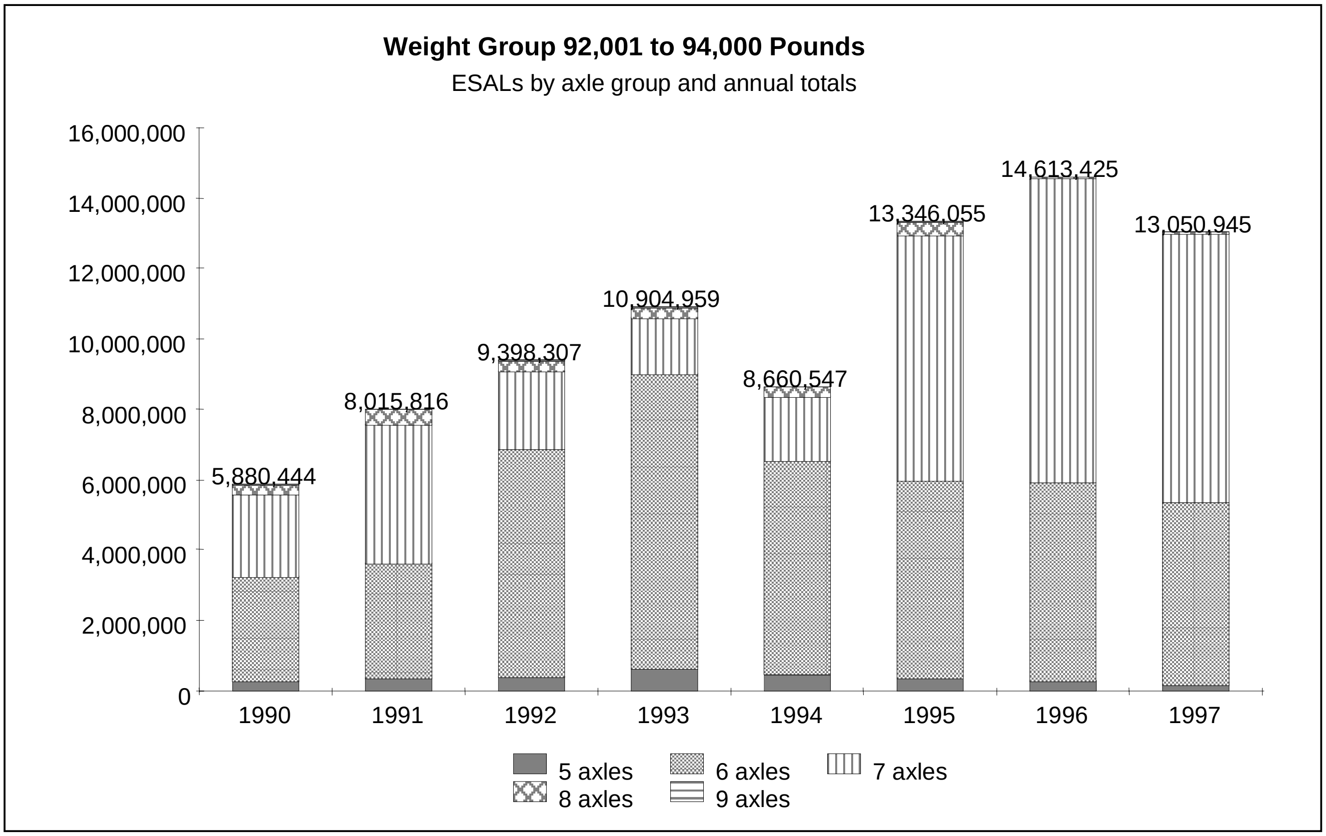

Figure A.8c: ESALs 92,001 to 94,000 pounds

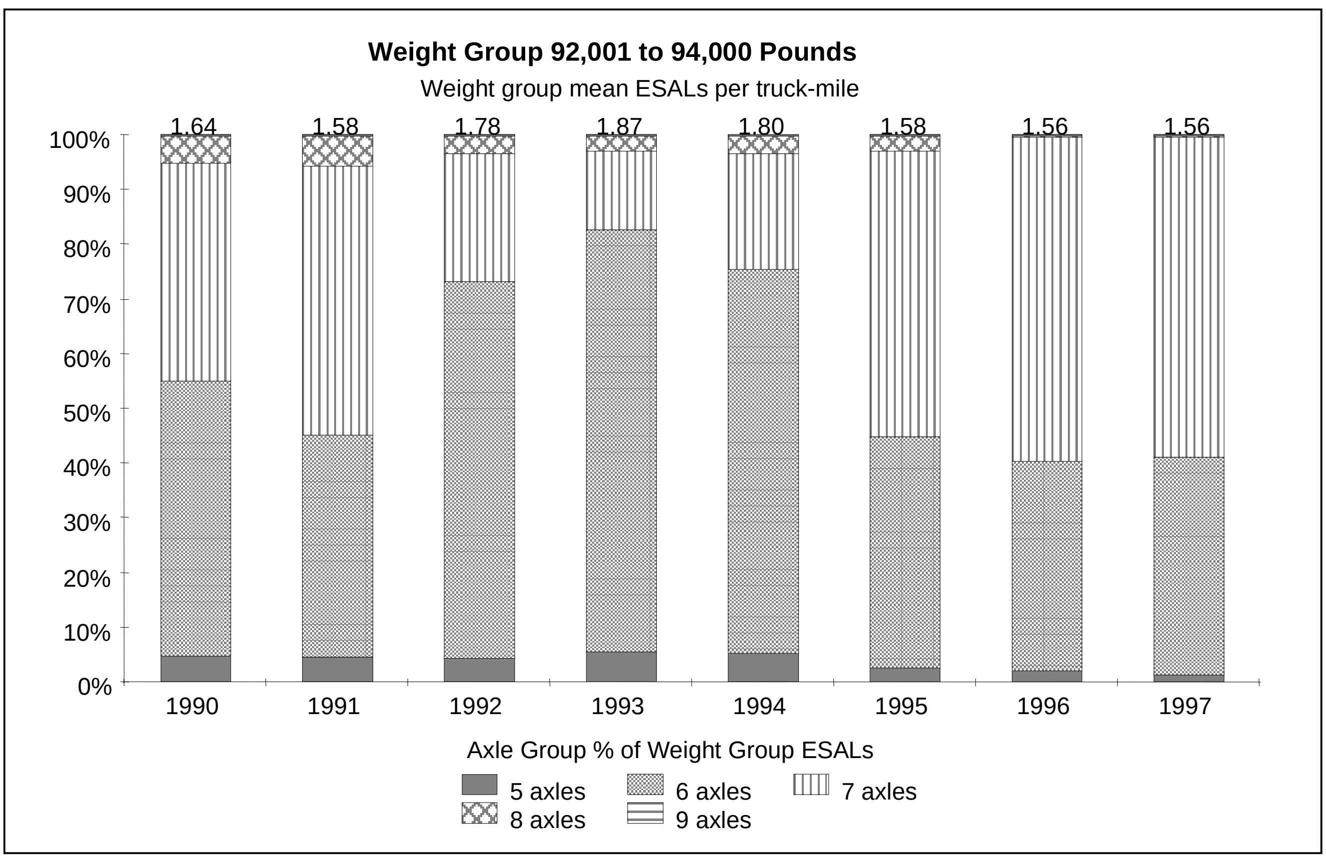

Figure A.8d: ESAL Average and Percentages 92,001 to 94,000 pounds

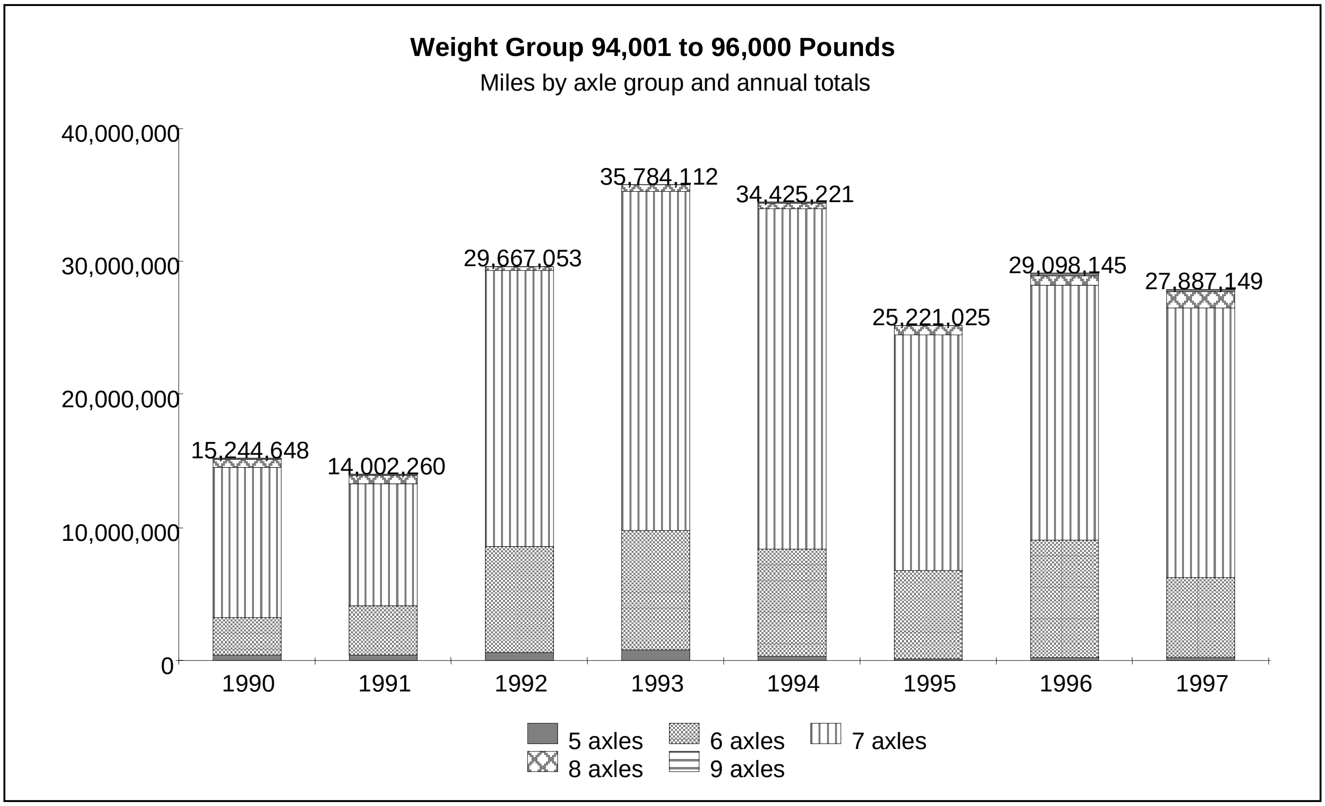

Figure A.9a: Mileage 94,001 to 96,000 pounds

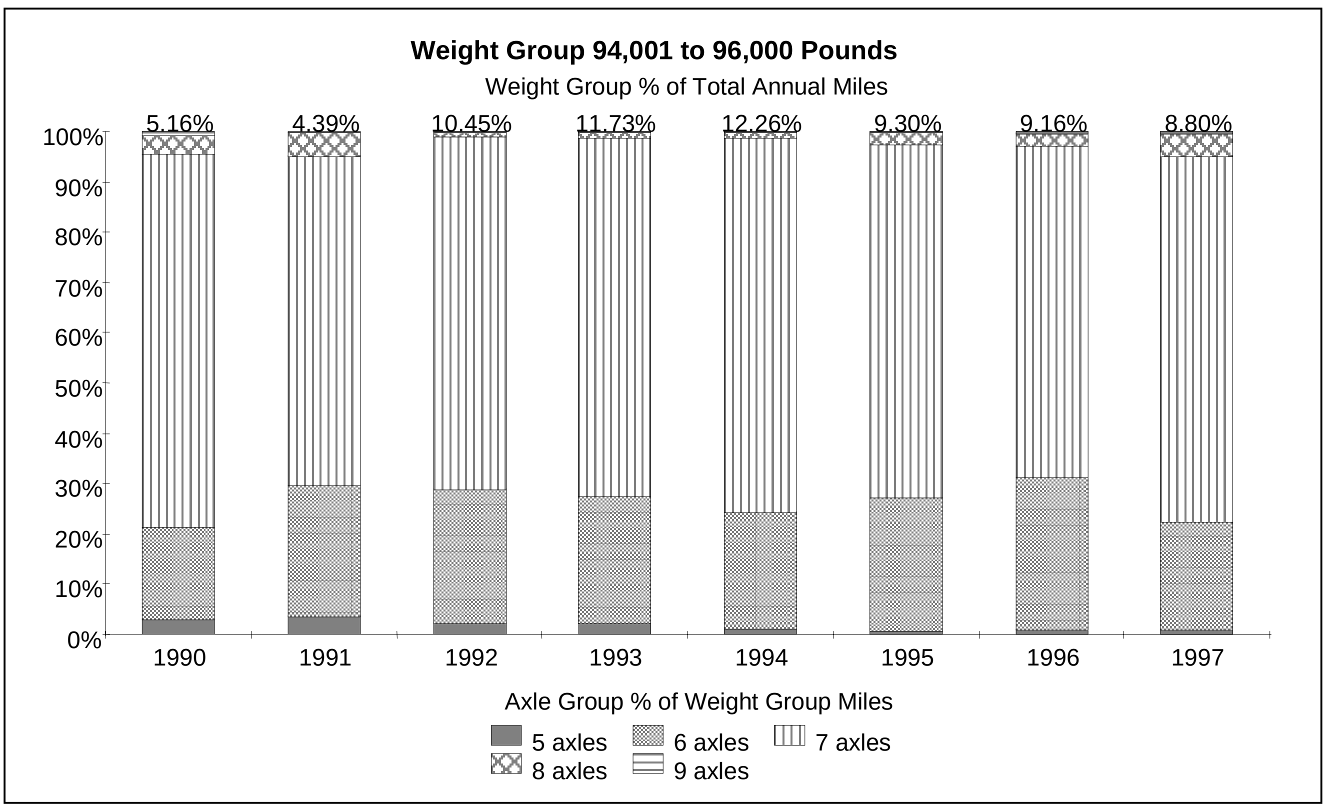

Figure A.9b: Mileage Percentages 94,001 to 96,000 pounds

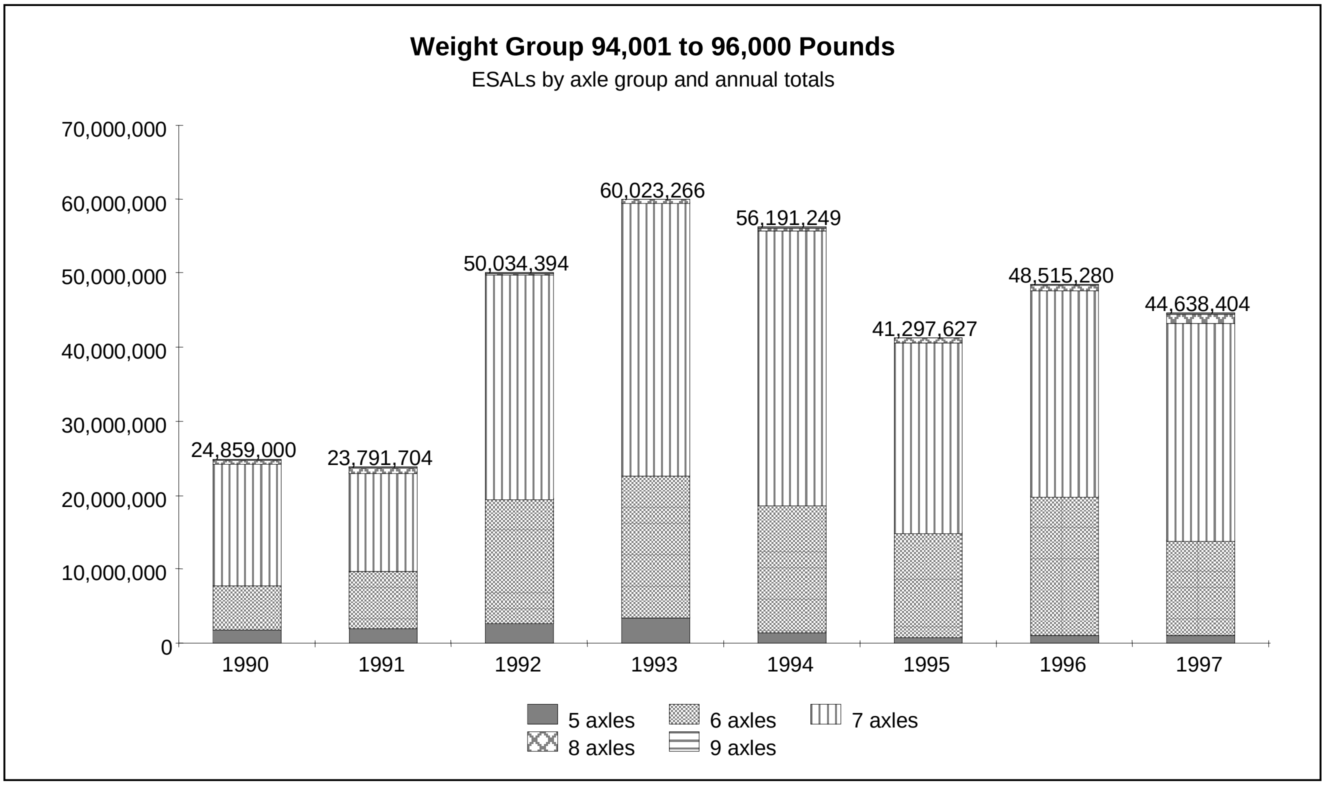

Figure A.9c: ESALs 94,001 to 96,000 pounds

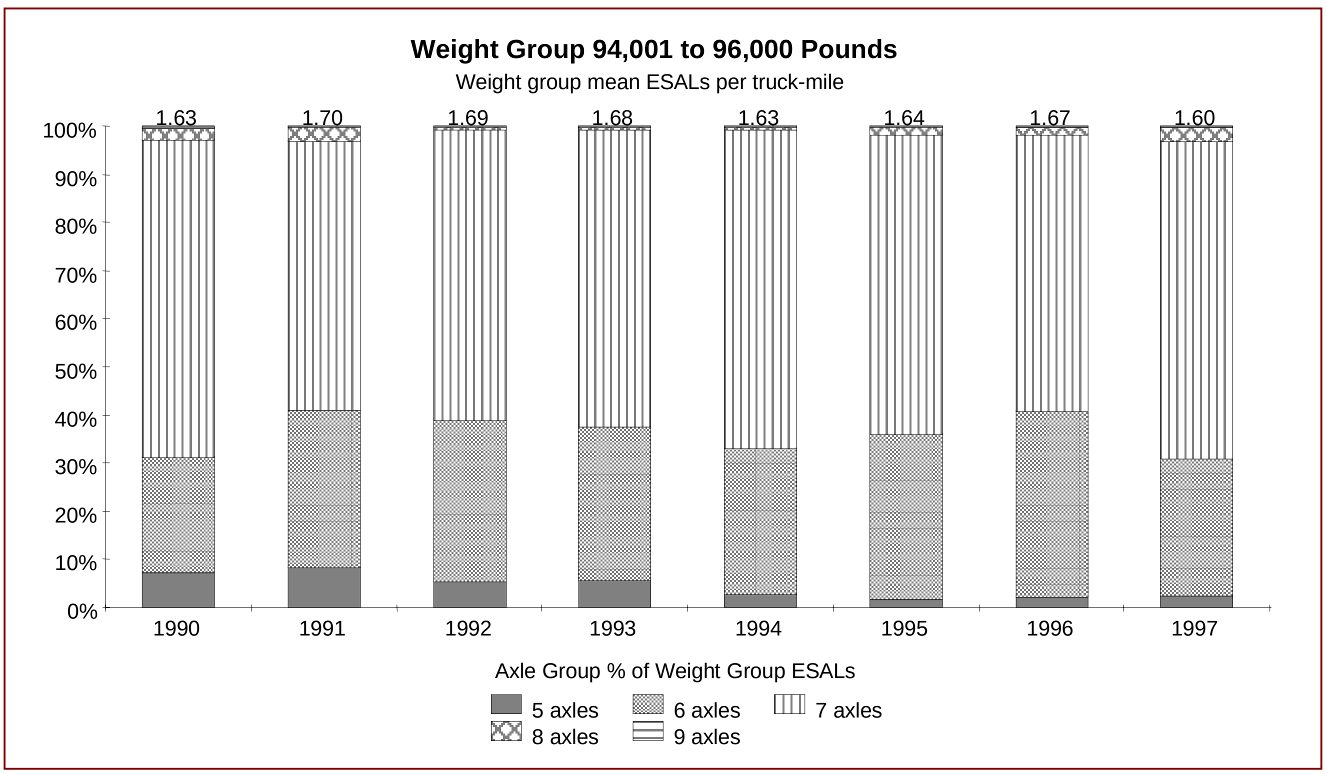

Figure A.9d: ESAL Average and Percentages 94,001 to 96,000 pounds

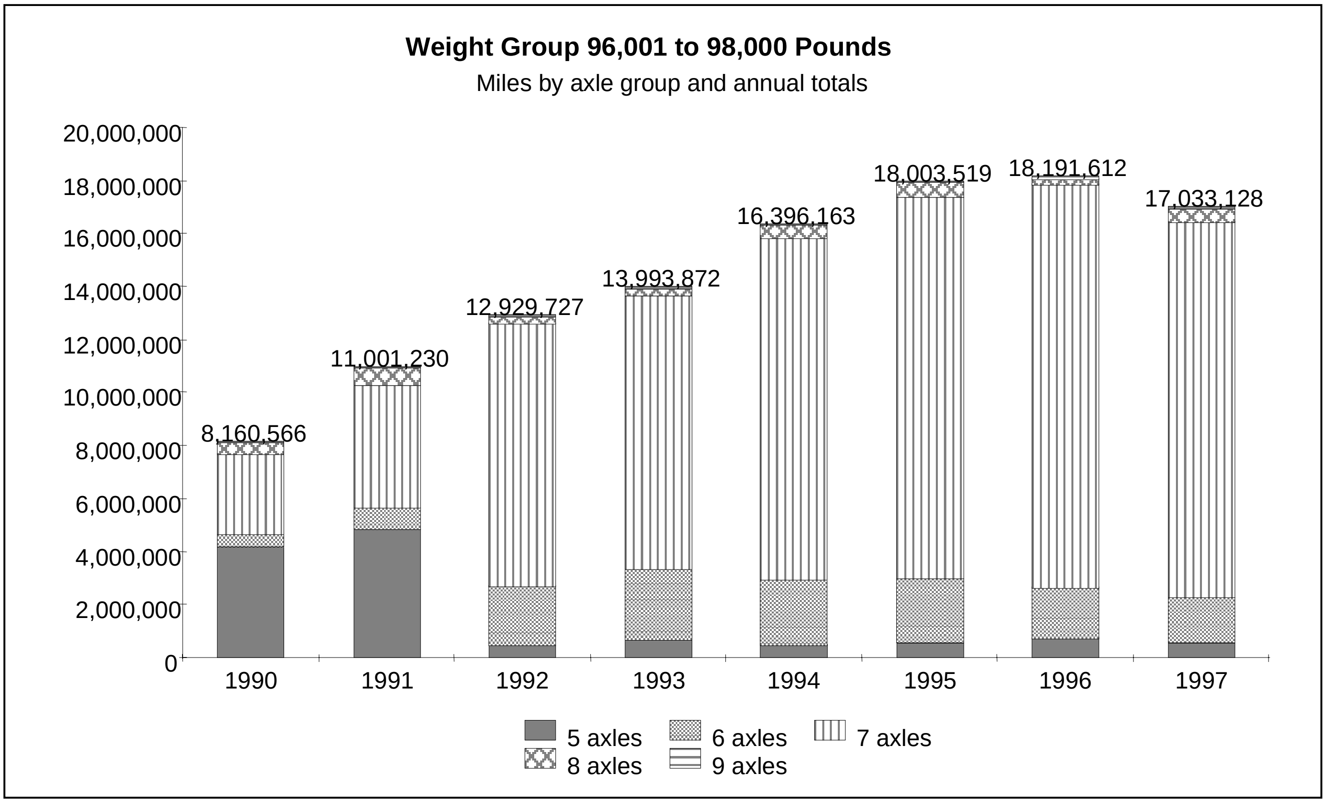

Figure A.10a: Mileage 96,001 to 98,000 pounds

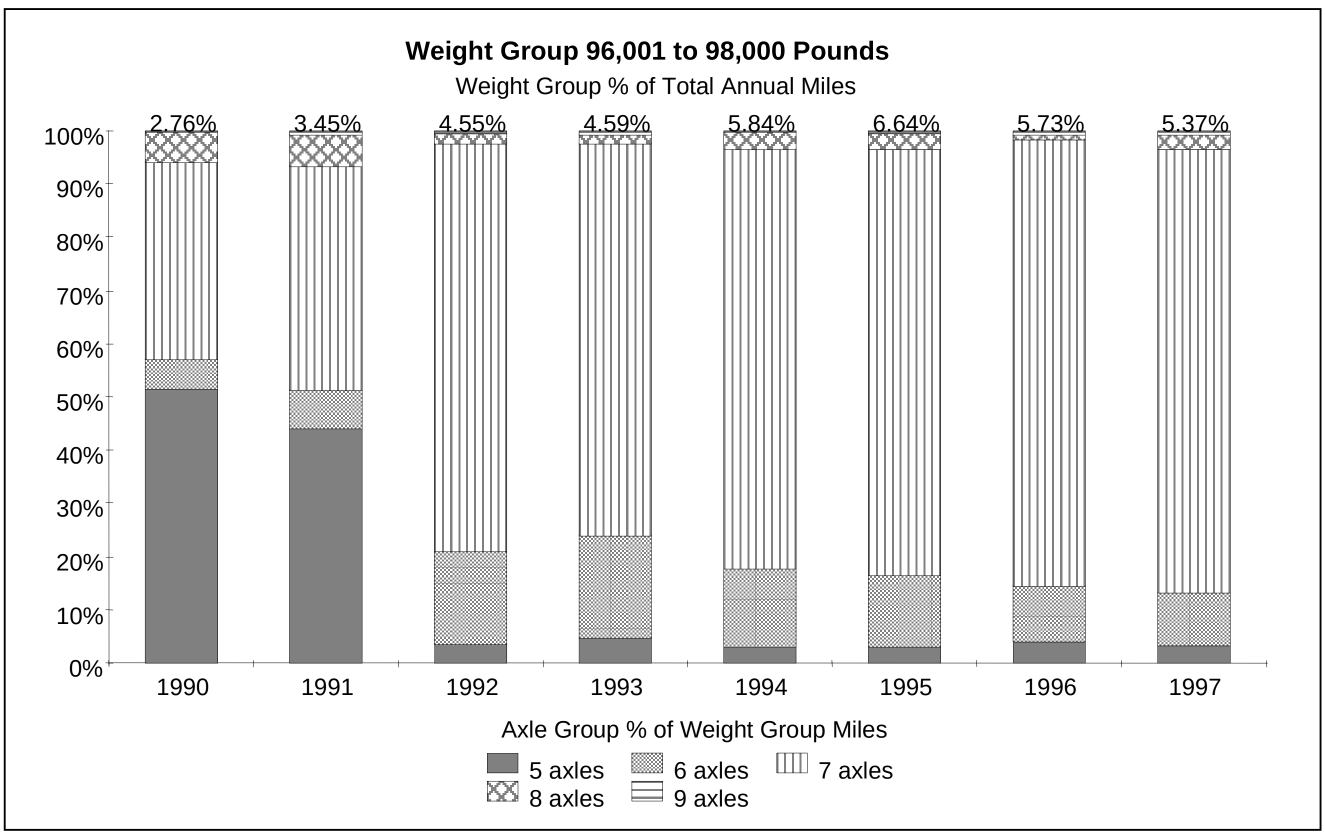

Figure A.10b: Mileage Percentages 96,001 to 98,000 pounds

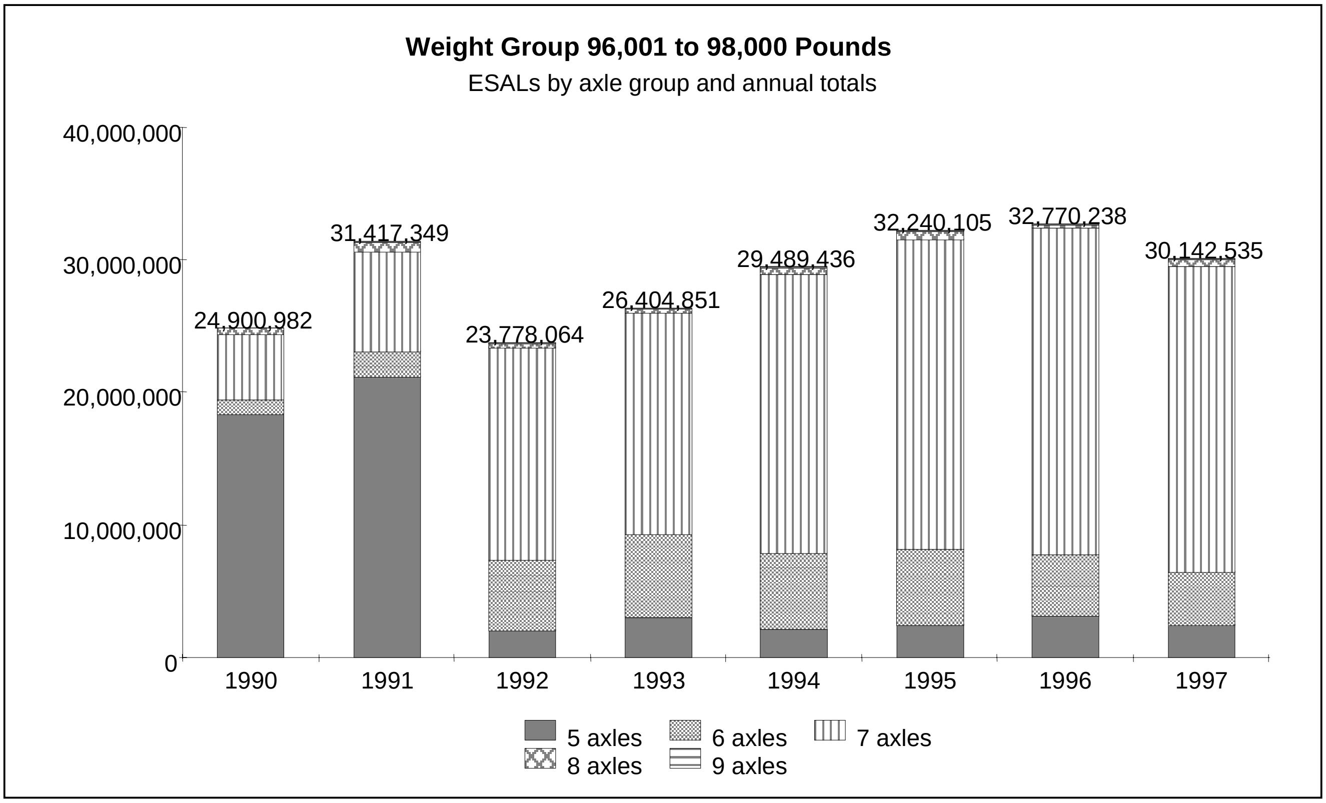

Figure A.10c: ESALs 96,001 to 98,000 pounds

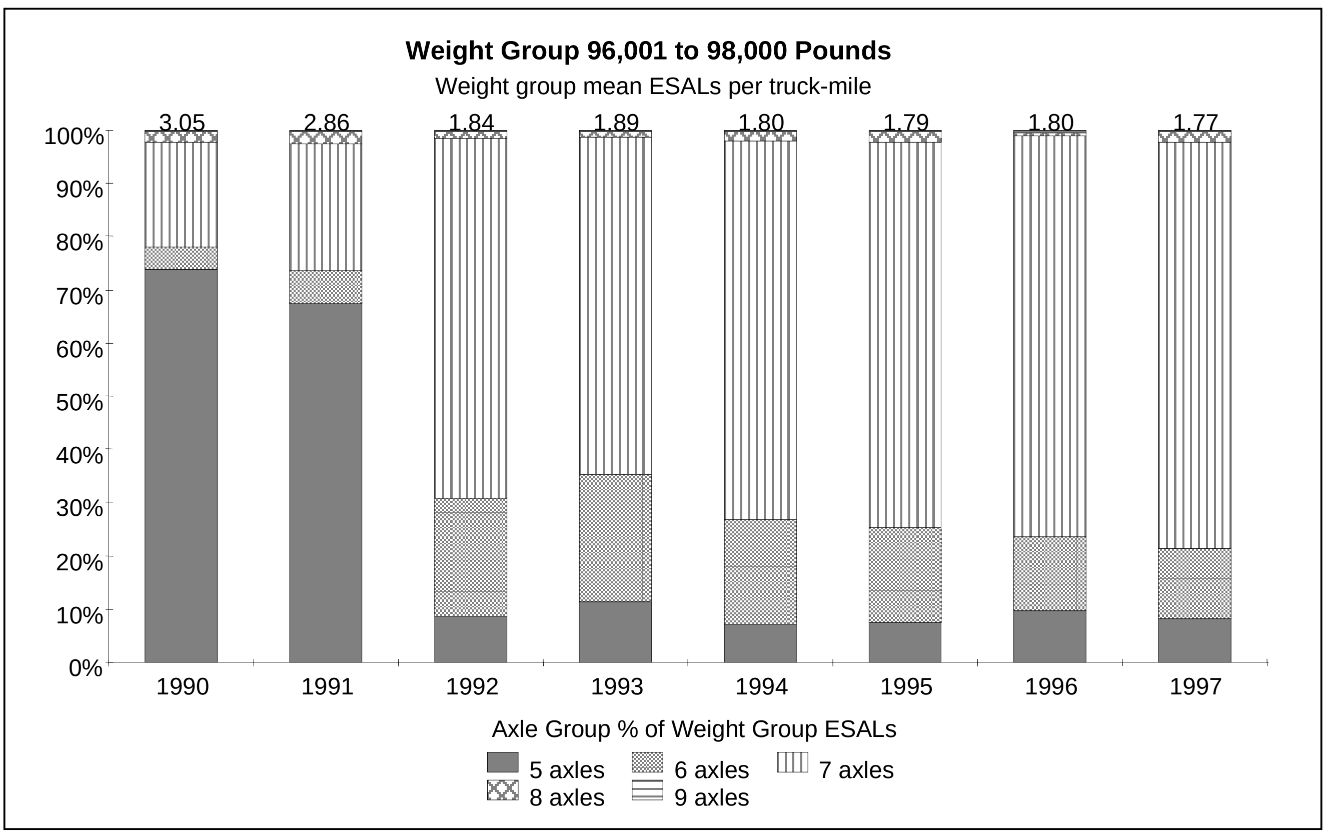

Figure A.10d: ESAL Average and Percentages 96,001 to 98,000 pounds

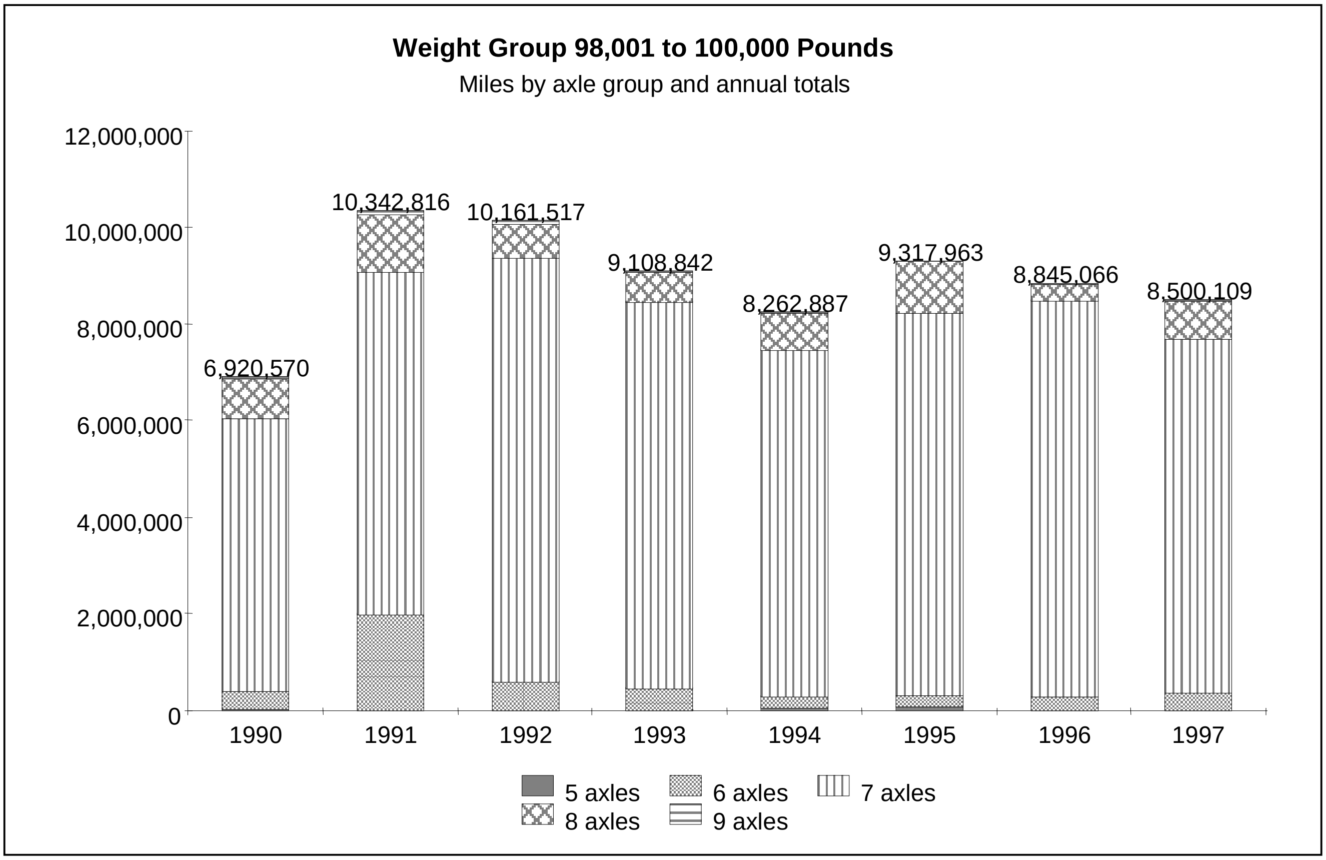

Figure A.11a: Mileage 98,001 to 100,000 pounds

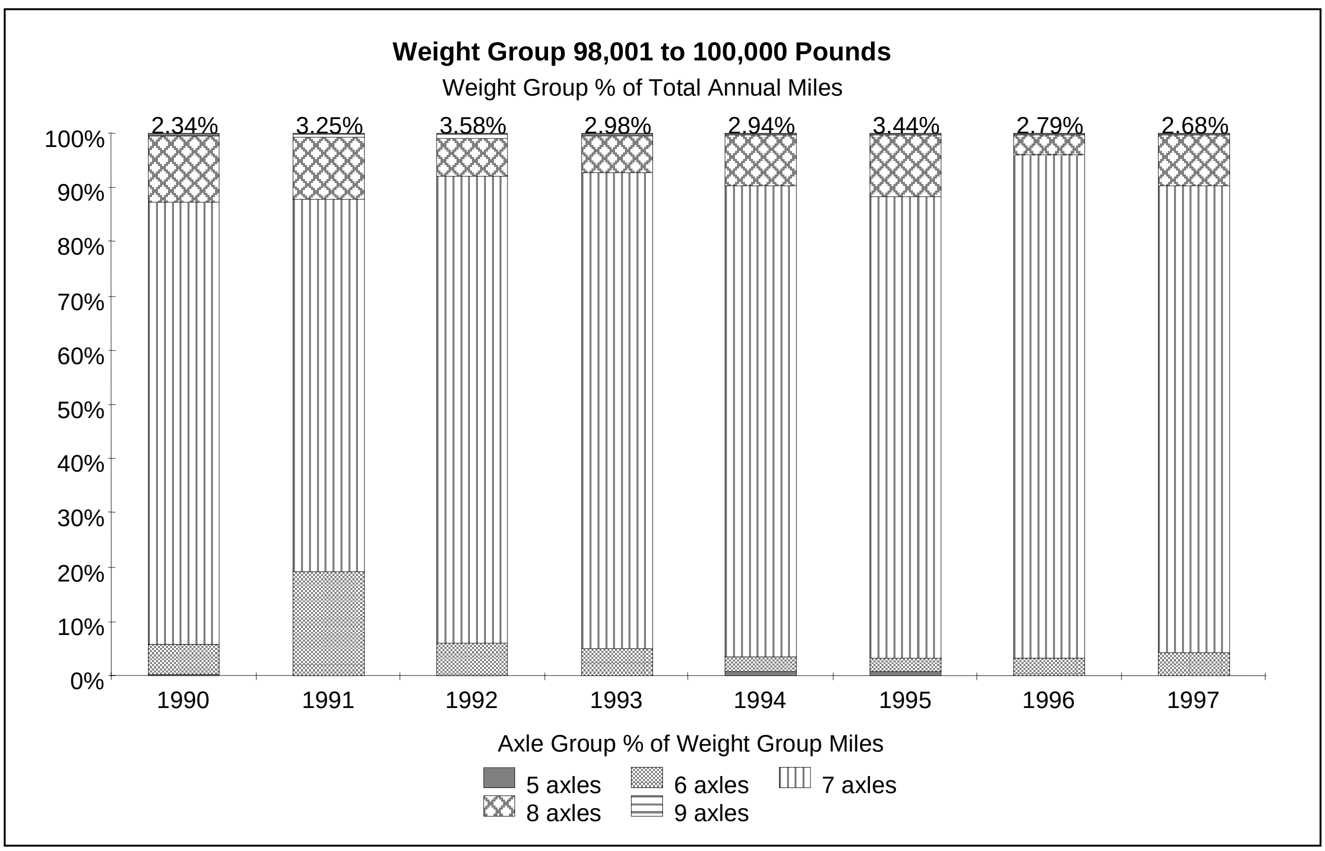

Figure A.11b: Mileage Percentages 98,001 to 100,000 pounds

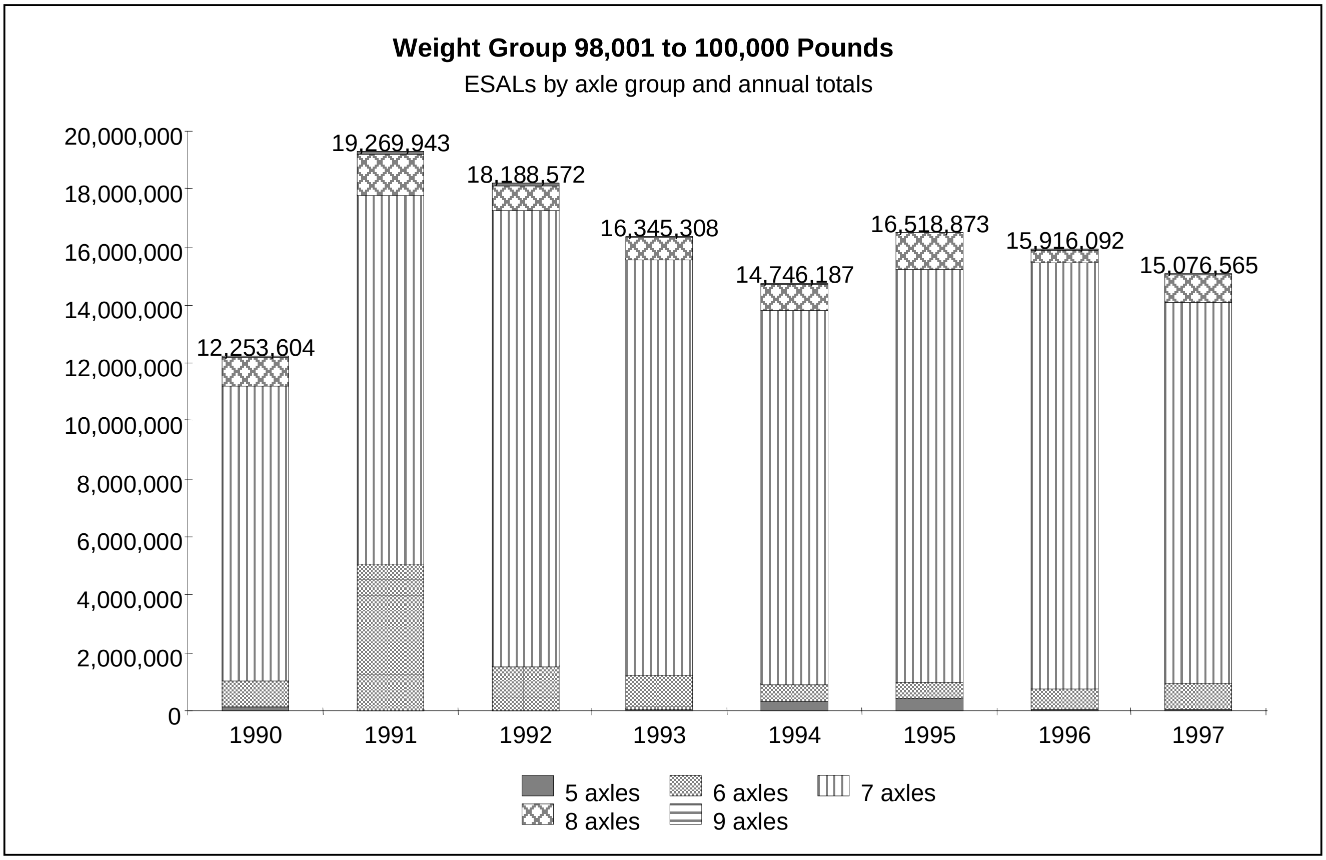

Figure A.11c: ESALs 98,001 to 100,000 pounds

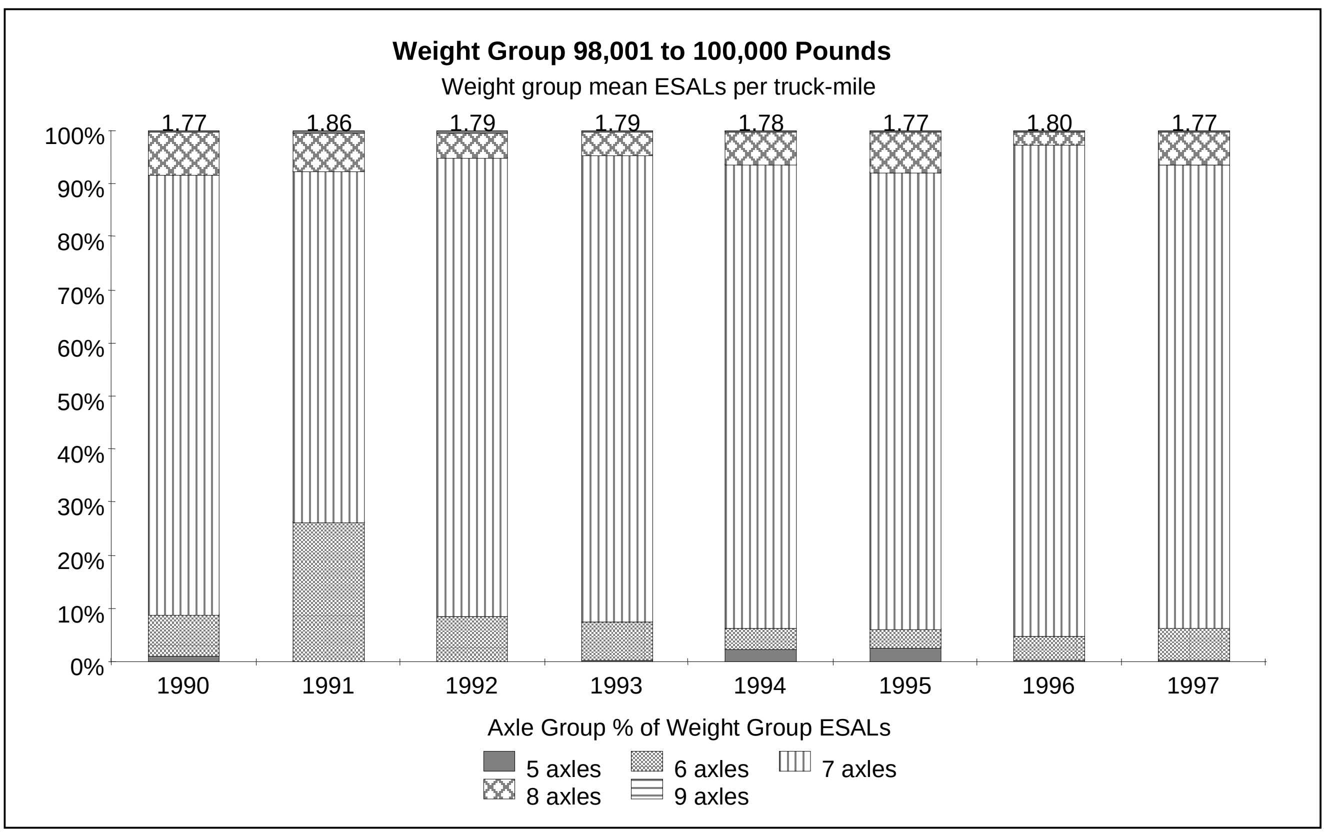

Figure A.11d: ESAL Average and Percentages 98,001 to 100,000 pounds

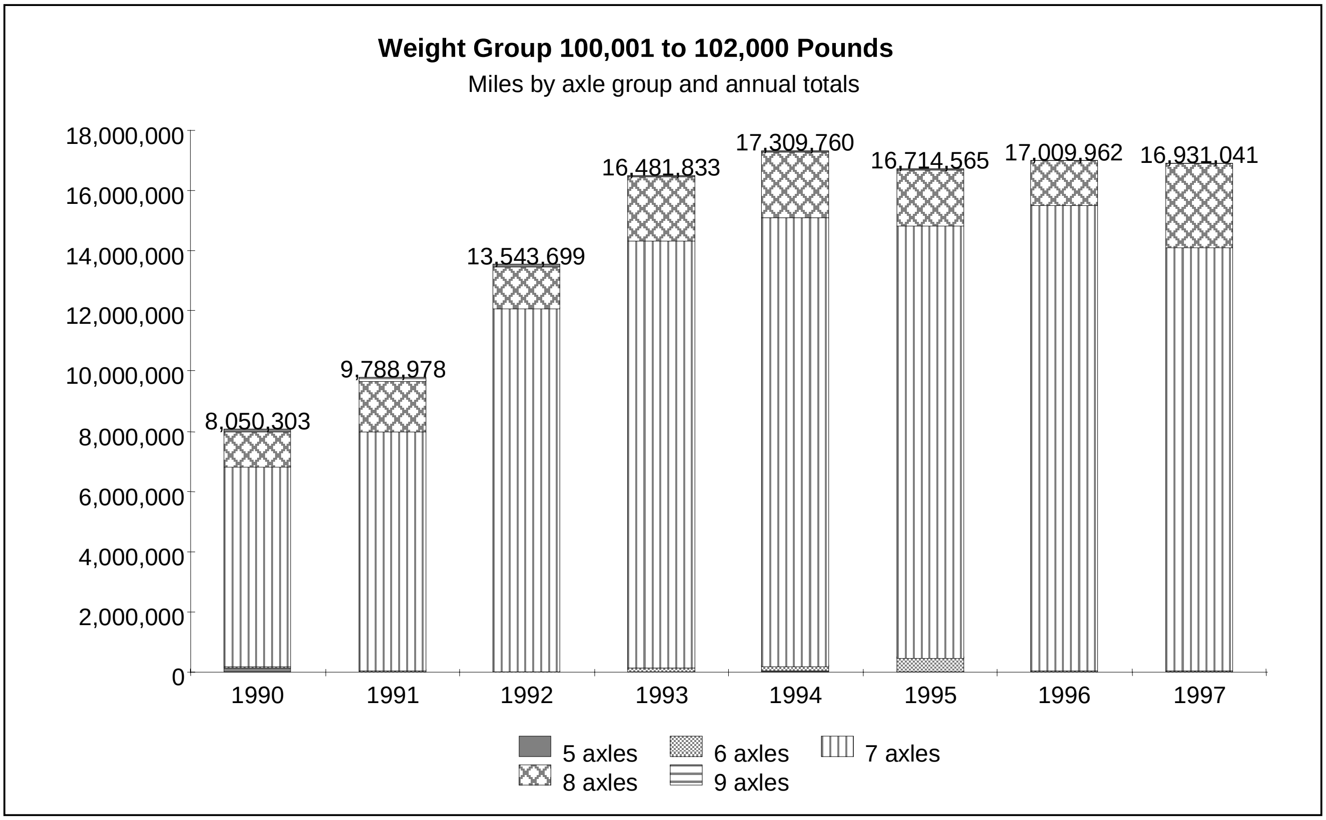

Figure A.12a: Mileage 100,001 to 102,000 pounds

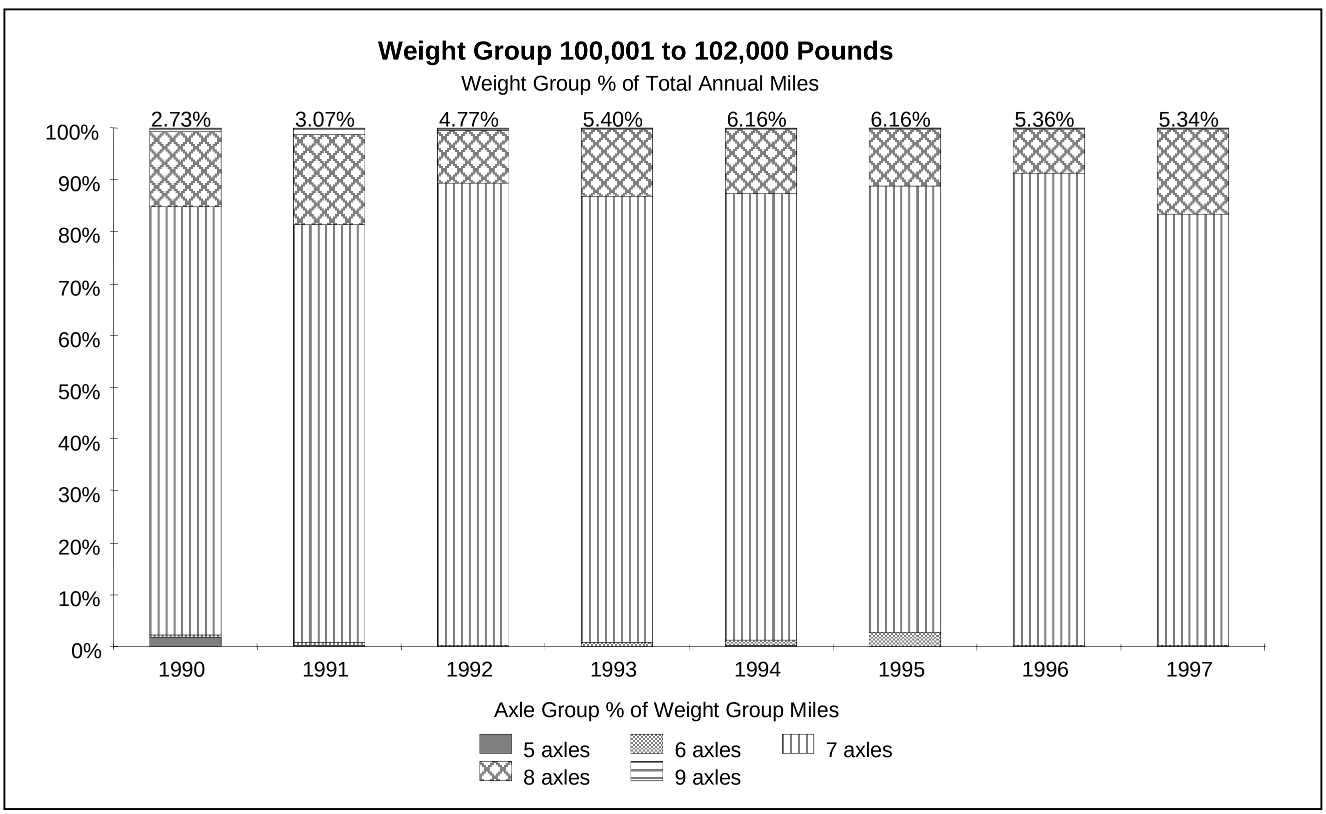

Figure A.12b: Mileage Percentages 100,001 to 102,000 pounds

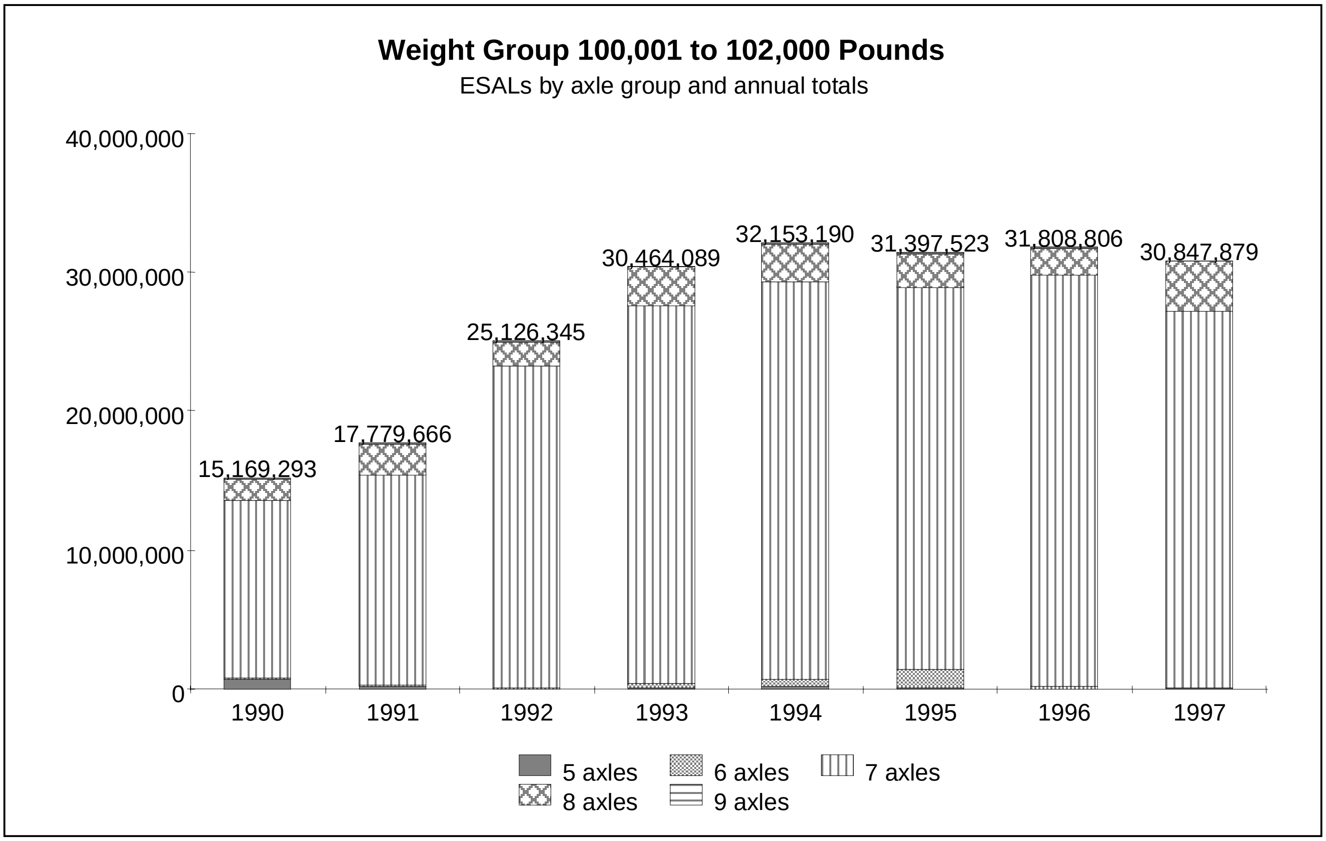

Figure A.12c: ESALs 100,001 to 102,000 pounds

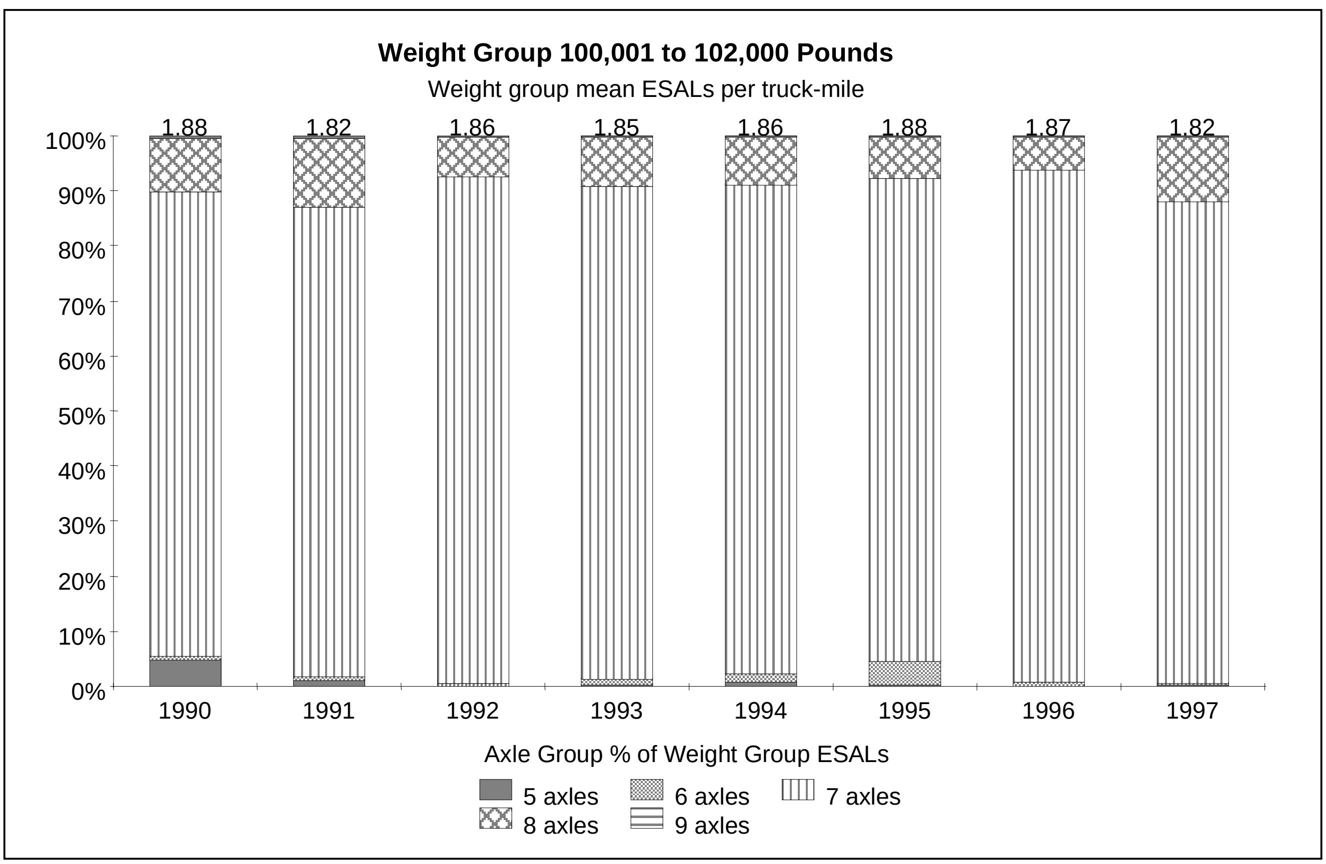

Figure A.12d: ESAL Average and Percentages 100,001 to 102,000 pounds

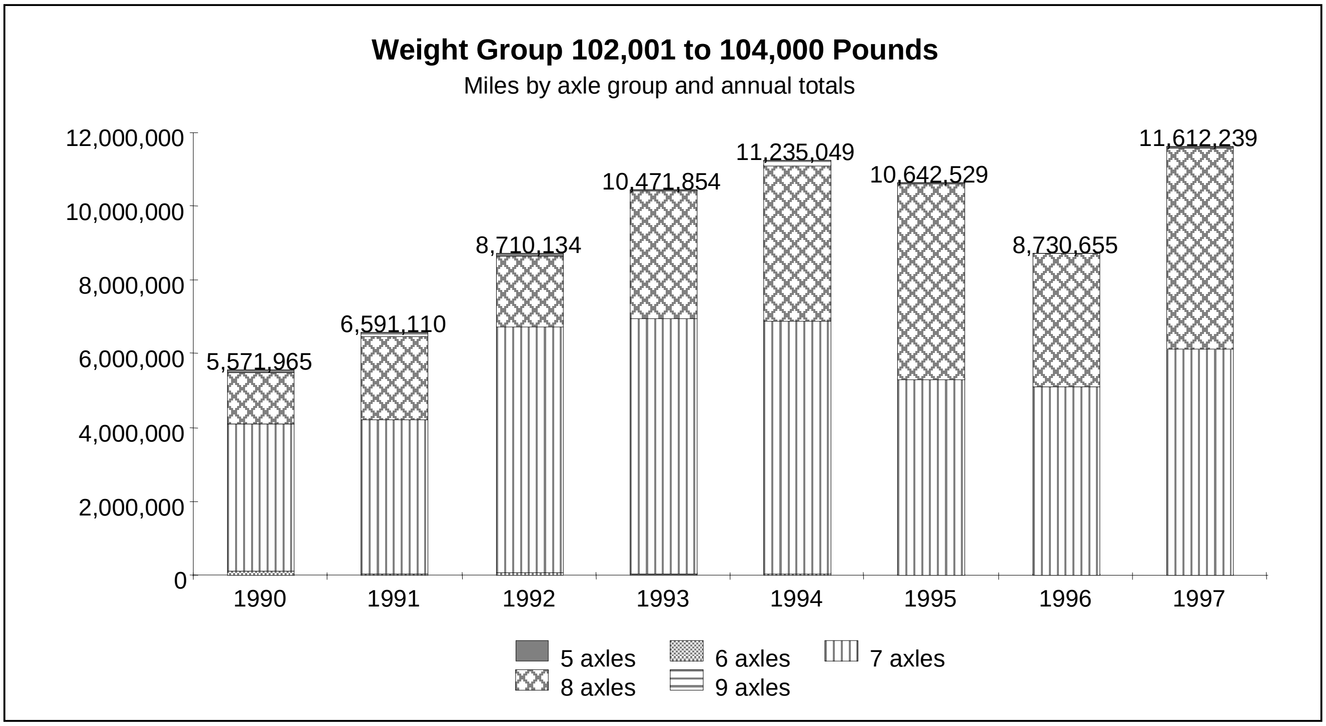

Figure A.13a: Mileage 102,001 to 104,000 pounds

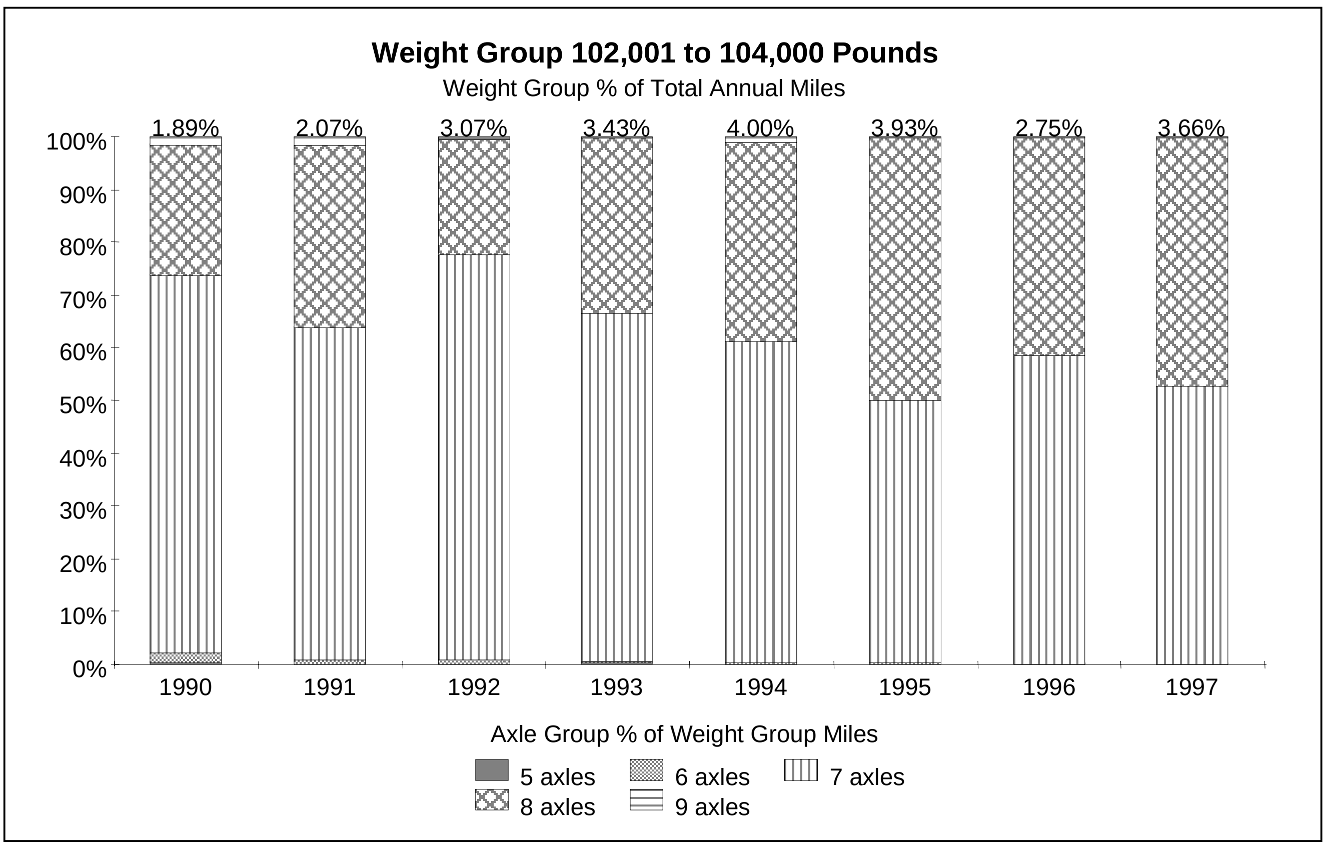

Figure A.13b: Mileage Percentages 102,001 to 104,000 pounds

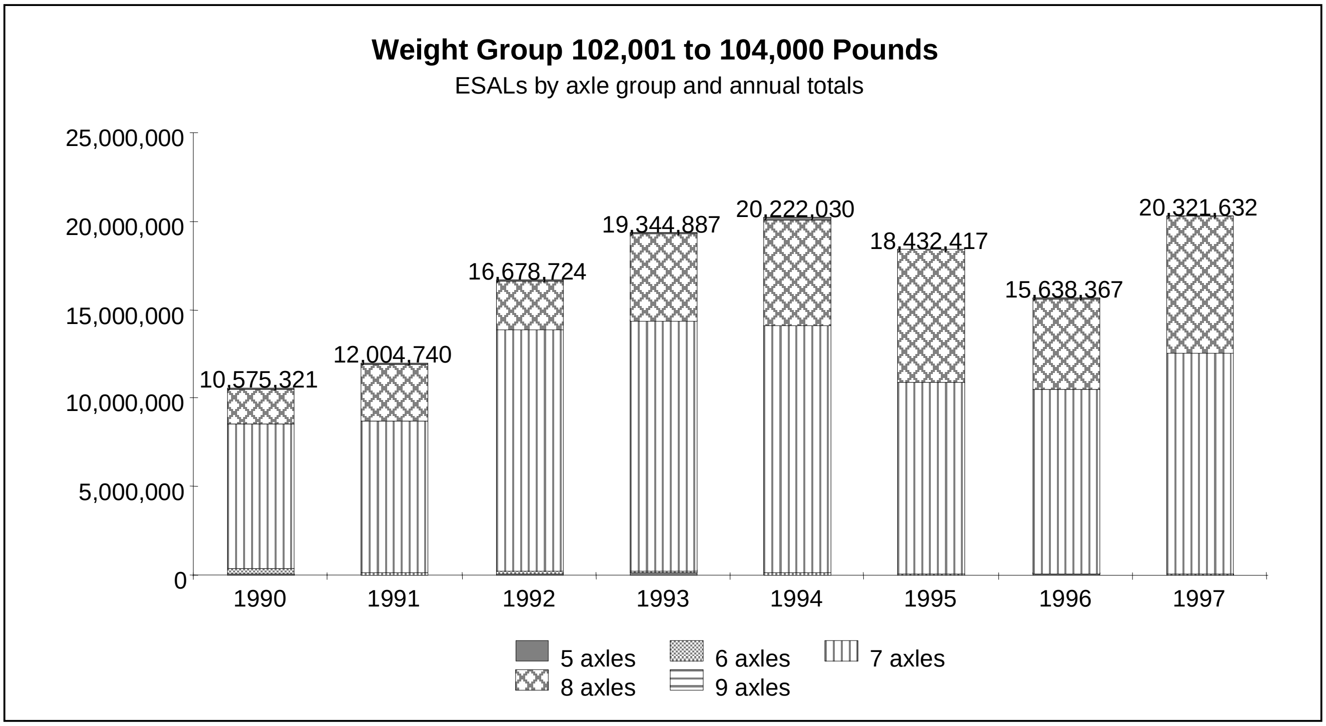

Figure A.13c: ESALs 102,001 to 104,000 pounds

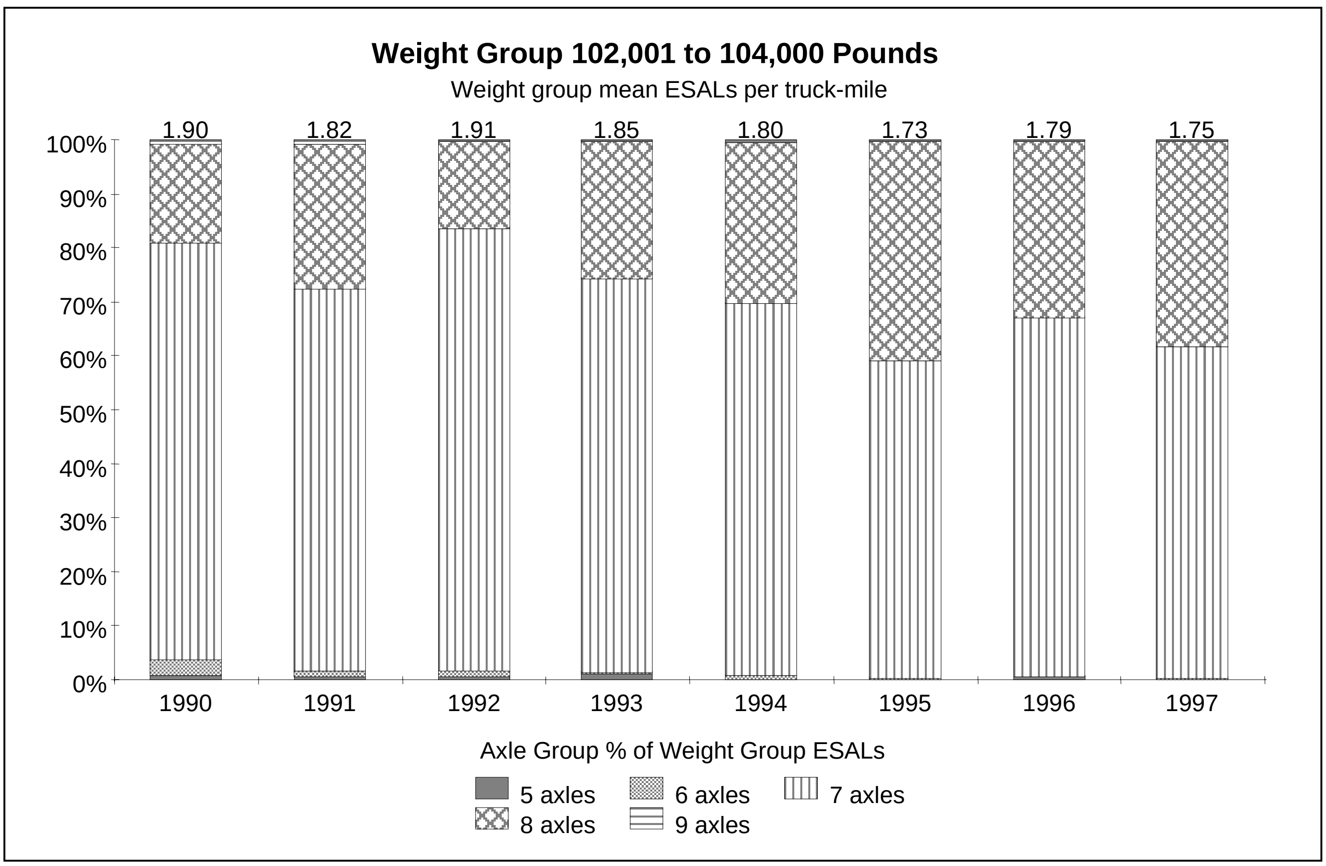

Figure A.13d: ESAL Average and Percentages 102,001 to 104,000 pounds

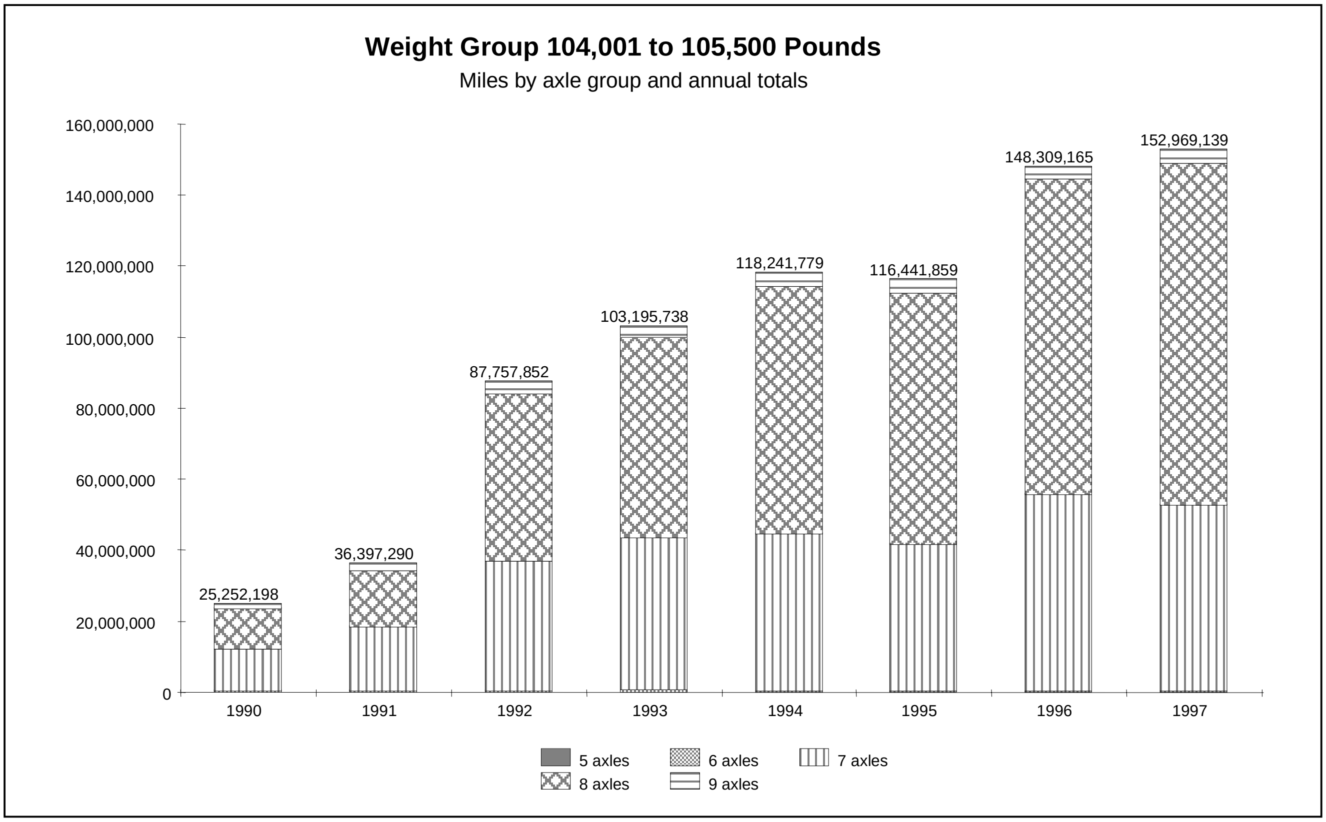

Figure A.14a: Mileage 104,001 to 105,500 pounds

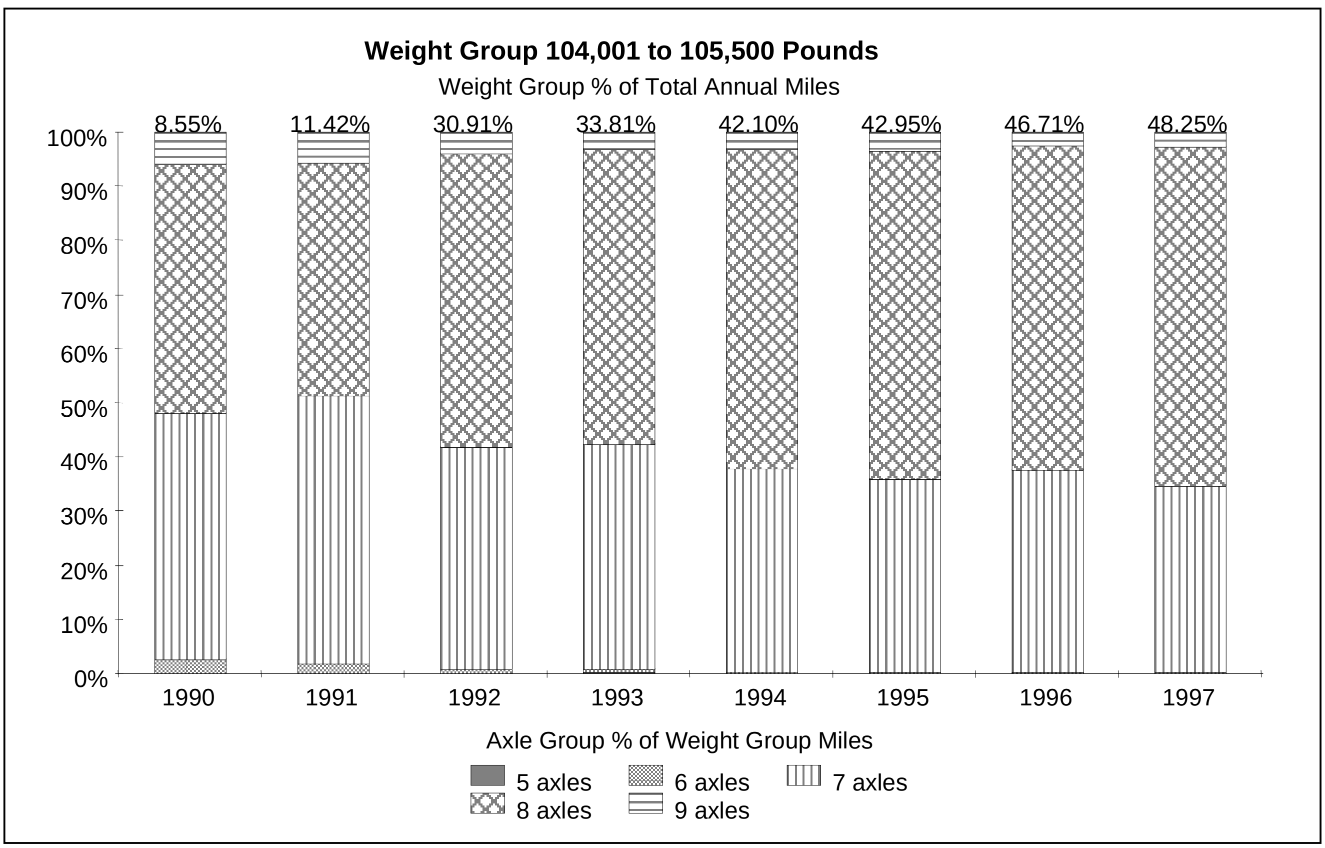

Figure A.14b: Mileage Percentages 104,001 to 105,500 pounds

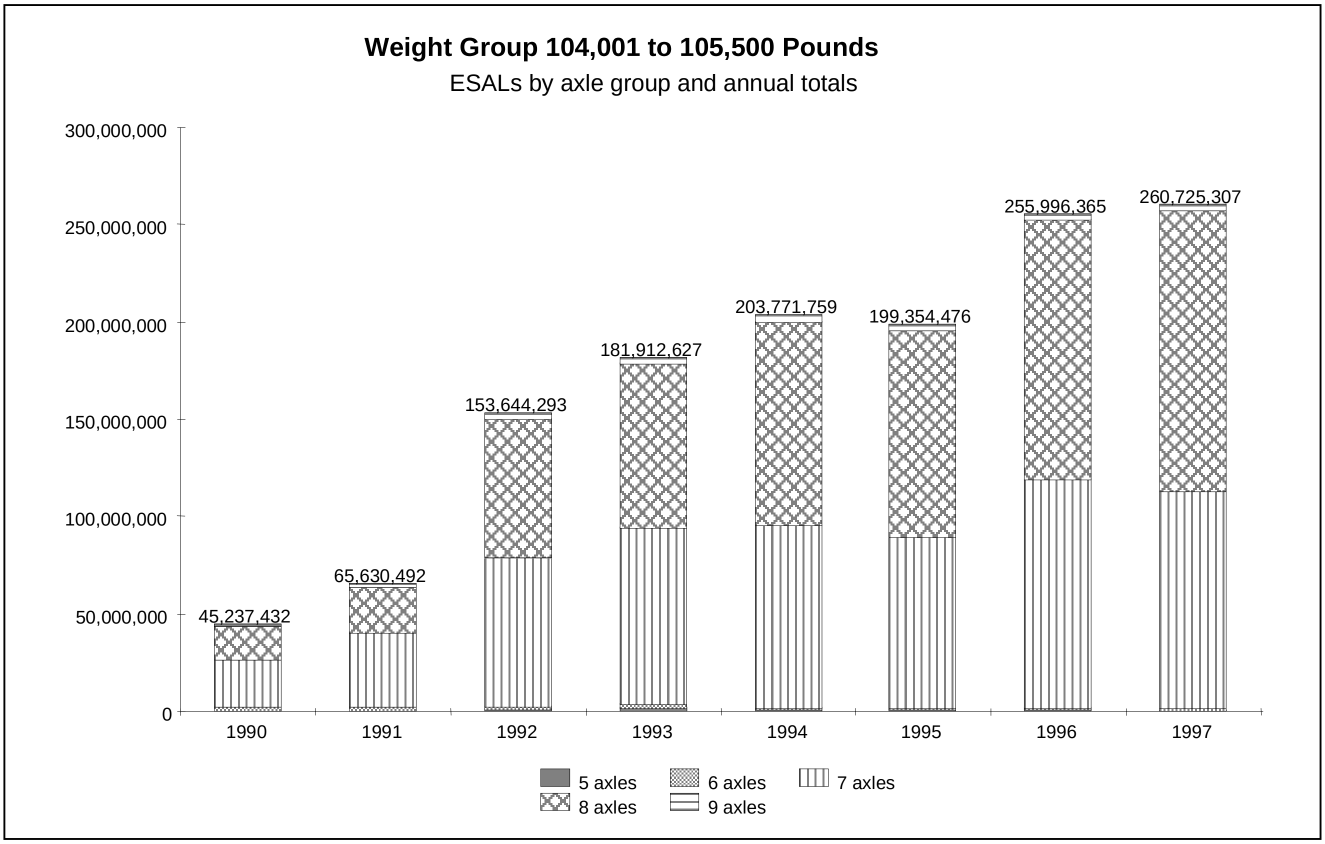

Figure A.14c: ESALs 104,001 to 105,500 pounds

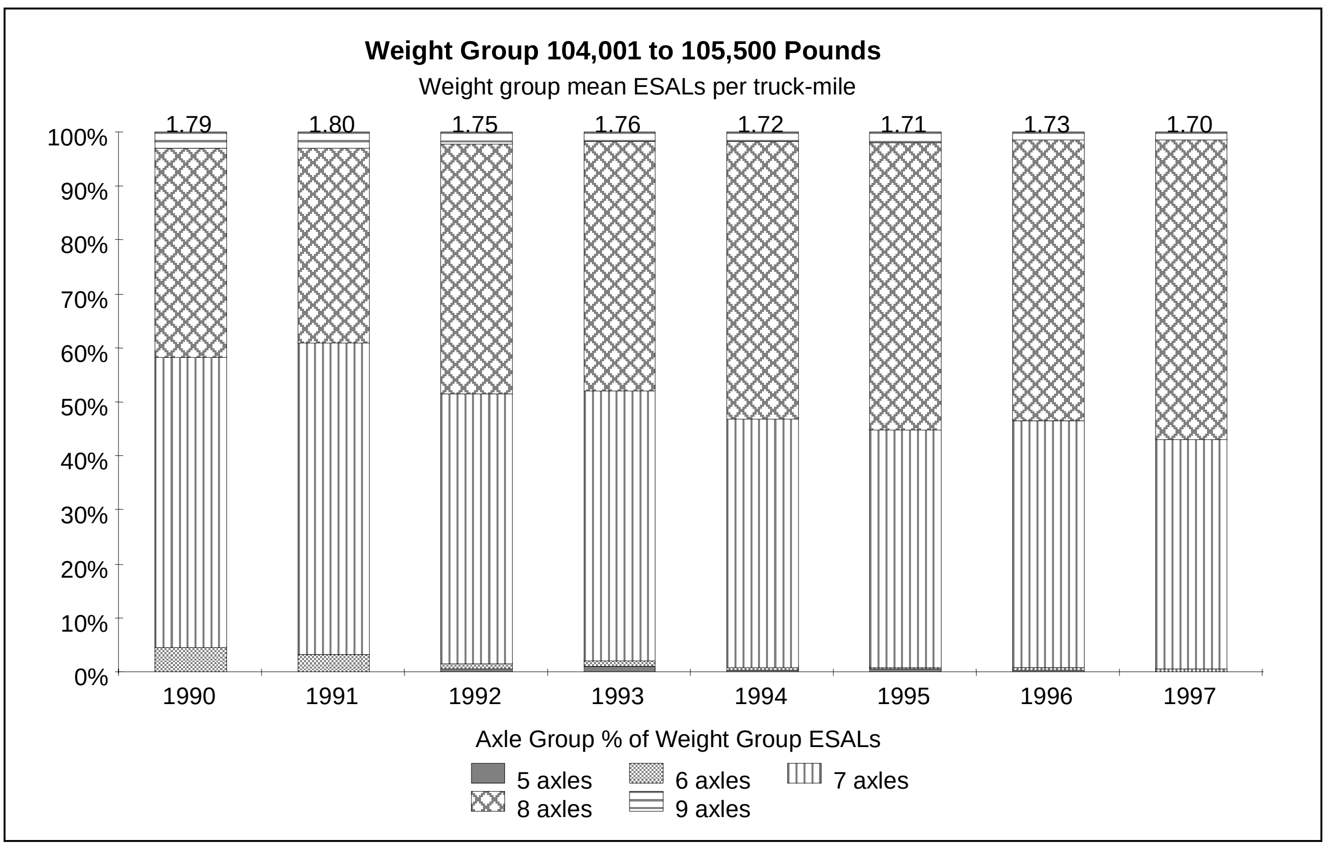

Figure A.14d: ESAL Average and Percentages 104,001 to 105,500 pounds

APPENDIX B

ESAL ESTIMATES: METHODOLOGY

ESAL ESTIMATES: METHODOLOGY

Estimating ESALs requires making assumptions about the characteristics of roads, trucks, and the loads on those trucks. This note on methodology describes the basis for selecting the parameters used in these calculations.

Road Characteristics

ESAL estimates vary with assumptions about the type of pavement (rigid or flexible), the slab thickness (for rigid) or structural number (for flexible), and the deterioration index (p_t). The Oregon Department of Transportation generally uses a p_t of 2.5 and a slab thickness of 9 for rigid pavement and a structural number of 4 for flexible pavement. Based on these design factors, ESAL tables can be used to estimate total ESALs for a vehicle by summing the corresponding ESAL values for the axle load (weight) borne by each axle group (single, tandem, or triple).

In order to generate an overall ESAL estimate for heavy trucks operating on Oregon highways and interstates it is necessary to determine the ratio of miles traveled on rigid to flexible pavements. Separate ratios of flexible to rigid pavement are used for state highways and for interstates as both the ratio of rigid to flexible pavement and the ratio of vehicle miles (for heavy trucks) to road miles is higher for interstates. Using a ratio of 1:19 rigid to flexible for state highways and 1:3 for interstates and a vehicle mile ratio of 2:3 state highway to interstate yields a result of 17:83 vehicle miles on rigid pavement to flexible pavement[i]. Even if the highway to interstate vehicle mile ratio is reversed, the resulting rigid to flexible vehicle mile ratio changes only slightly, to 13:87. Moreover, applying these ratios to ESAL calculations affects the results by only a few percent. Take a 6-axle 3-s3 at 100,000 pounds as an example. The difference should be among the highest found both because ESALs increase logarithmically and because the difference between ESALs for rigid and flexible pavements is absolutely and proportionally greater for multiple-axle groups. The difference in result when each of these ratios is applied is only 3%. The analysis is more sensitive to other parameters as described below, and the small improvement in accuracy that might be obtained from a more accurate estimate of road characteristics and vehicle miles makes refining this estimate a low priority.

Truck Configurations

For each cell in the axle-weight chart there are several possible truck configurations that would correspond to that number of axles and weight. Table B.1 shows the average declared weight as weighted by miles traveled for 1977, which were rounded to obtain the weights used in Table B.2 to calculate ESALs for each configuration with the corresponding number of axles. The ESALs can vary considerably between configurations with the same number of axles, as shown in the 60% difference between a 4-s3 and a 2-s1-2-2.

Table B.1: Declared Weight Weighted By Miles Traveled

1997 average declared weight weighted by miles travelled[1]				
5 axle	6 axle	7 axle	8 axle	9 axle
83118	90386	100690	104693	104127

[1]= (wt*mi)/ mi (for each axle number)

[i] These ratios were provided by John Merriss, ODOT.

Table B.2: ESAL Calculations

Truck Type	Axle Groups (weight and ESALs per group)[1]							Total	Weighted
	drive	1st	2nd	3rd	4th	5th	6th	ESALs	ESALs
3-s2	12	tan 36	tan 35						
ESALs (flexible)	0.213	1.38	1.21					2.803	3.135
ESALs (rigid)	0.176	2.43	2.15					4.756	
2-s1-2	12	18	18	18	17				
ESALs (flexible)	0.213	1	1	1	0.803			4.016	4.007
ESALs (rigid)	0.176	1	1	1	0.786			3.962	
2--3 or 3-2	12	18	18	35 tan					
ESALs (flexible)	0.213	1	1	1.21				3.423	3.577
ESALs (rigid)	0.176	1	1	2.15				4.326	
3-s1-2	12	34 tan	16	14	14				
ESALs (flexible)	0.213	1.11	0.645	0.388	0.388			2.744	2.852
ESALs (rigid)	0.176	1.92	0.604	0.341	0.341			3.382	
2--2-2	12	18	16	16	14	14			
ESALs (flexible)	0.213	1	0.645	0.645	0.388	0.388		3.279	3.243
ESALs (rigid)	0.176	1	0.604	0.604	0.341	0.341		3.066	
2-s1-3	12	18	16	14	30 tan				
ESALs (flexible)	0.213	1	0.645	0.388	0.695			2.941	2.995
ESALs (rigid)	0.176	1	0.604	0.341	1.14			3.261	
4-s2 or 3-s3	12	44 tri	34tan						
ESALs (flexible)	0.213	0.769	1.11					2.092	2.388
ESALs (rigid)	0.176	1.74	1.92					3.836	
2-s1-2-2	12	18	18	14	14	12	12		
ESALs (flexible)	0.213	1	1	0.388	0.388	0.213	0.213	3.415	3.380
ESALs (rigid)	0.176	1	1	0.341	0.341	0.176	0.176	3.21	
3-s2-2	12	tan 30	tan 30	14	14				
ESALs (flexible)	0.213	0.695	0.695	0.388	0.388			2.379	2.508
ESALs (rigid)	0.176	1.14	1.14	0.341	0.341			3.138	
2-2-3 or 3-2-2	12	16	14	14	14	30 tan			
ESALs (flexible)	0.213	0.645	0.388	0.388	0.388	0.695		2.717	2.755
ESALs (rigid)	0.176	0.604	0.341	0.341	0.341	1.14		2.943	
4-s3	12	44 tri	44 tri						
ESALs (flexible)	0.213	0.769	0.769					1.751	2.075
ESALs (rigid)	0.176	1.74	1.74					3.656	
3-s2-3	12	tan 26	tan 26	s 17	tan 24				
ESALs (flexible)	0.213	0.401	0.401	0.803	0.292			2.11	2.202
ESALs (rigid)	0.176	0.622	0.622	0.786	0.444			2.65	
3-s1-2-2	12	tan 26	14	14	14	13	12		
ESALs (flexible)	0.213	0.401	0.388	0.388	0.388	0.292	0.213	2.283	2.277
ESALs (rigid)	0.176	0.622	0.341	0.341	0.341	0.25	0.176	2.247	
3-s2-4	12	tan26	tan 26	tan20	tan20				
ESALs (flexible)	0.213	0.401	0.401	0.141	0.141			1.297	1.388
ESALs (rigid)	0.176	0.622	0.622	0.206	0.206			1.832	
3-s1-2-3	12	tan 24	12	12	12	12	tan20		
ESALs (flexible)	0.213	0.292	0.213	0.213	0.213	0.213	0.141	1.498	1.503
ESALs (rigid)	0.176	0.444	0.176	0.176	0.176	0.176	0.206	1.53	
2-s2-3-2	12	16	20 tan	12	20tan	12	12		
ESALs (flexible)	0.213	0.645	0.141	0.213	0.141	0.213	0.213	1.779	1.769
ESALs (rigid)	0.176	0.604	0.206	0.176	0.206	0.176	0.176	1.72	

[1]ESALs are weighted 83% flexible, 17% rigid.

The difference in ESALs between configurations with the same number of axles complicates a comparison of the difference in ESALs between trucks with different numbers of axles. However, certain configurations are far more common than others. For example, triple trailers are rare, while over 90% of 5-axle trucks are 3-s2s[ii]. For this comparison, one representative configuration was chosen for each axle number. The choice of configurations was based on prevalence within the axle number group and on similarity of configuration between axle number groups. To illustrate, the 3-s2-2, 3-s2-3, and 3-s2-4 are all double trailer configurations differing only in the number of axles in the axle groups on the rear trailer. They could be expected to be the most common configurations in part because they all represent the addition of a trailer to the most common semi-truck type, the 3-s2, and this is borne out by counts from ODOT's special truck weight surveys[iii]. The full list of configurations used in the ESAL comparison is shown in Table B.4, and the loads and ESALs by axle group for each weight and configuration are shown in Table B.5 through B.9.

Load Characteristics

There are two factors related to load that need to be considered in calculating ESALs. The first is distribution of a particular load on a particular truck; that is, how much weight is carried on each axle group. There are legal limits and rules of thumb that make it relatively easy to simulate a representative truckload. A single axle is limited to 20,000 pounds, a tandem to 34,000 pounds (without a non-divisible load permit), a drive axle is limited to about 12,000 pounds before it becomes difficult to steer, and trucks are generally loaded with more weight to the front. Within these parameters there is room to change assumptions about the weights on each particular axle group, but such changes have little effect on overall ESALs.

The second factor involves modeling loads over time, when trucks may operate at numerous weights depending on whether they are empty, full, partially loaded, or full by volume but not weight. Using average registered weight and observed weight from the 1998 ODOT Special Truck Weight Survey, the weighted load factor (LF) for all trucks with 5 axles or more is 79% (load factor is the average operating weight as a percent of declared weight). An ESAL comparison could be based on average operating weights by simply applying the load factor to the declared weight in the axle-weight table and calculating a resulting ESAL. The problem with basing ESAL comparisons on average operating weight is that an average operating weight can be arrived at by any number of combinations of actual operating weights. Because the relationship between ESALs and weight is not linear, a comparison based on average operating weight would almost certainly understate the difference in ESALs between trucks operating at the same average weight, as demonstrated in Table B.3.

[ii] Estimates from the 1998 ODOT Special Truck Weight Survey, data provided by John Merriss.
[iii] Ibid., 1997 and 1998.

Table B.3: ESALs for 79% of declared weight and at 67% full:33% empty

Truck Type (weight)	Axle Groups (weight and ESALs per group) drive	1st	2nd	3rd	4th	Total ESALs	Weighted ESALs	ESALs at 79% LF
3-s2-2 (100)	12	tan 30	tan 30	14	14			
ESALs (flexible)	0.213	0.695	0.695	0.388	0.388	2.379	2.508	
ESALs (rigid)	0.176	1.14	1.14	0.341	0.341	3.138		
67:33 (full:empty)								1.696
3-s2-2 (79)	12	Tan 24	Tan 23	10	10			
ESALs (flexible)	0.213	0.292	0.261	0.102	0.102	0.97	1.038	
ESALs (rigid)	0.176	0.444	0.392	0.082	0.082	1.176		
79% (declared weight)								1.038
3-s2-2 (34)	6	Tan 8	Tan 8	6	6			
ESALs (flexible)	0.013	0.004	0.004	0.013	0.013	0.047	0.046	
ESALs (rigid)	0.01	0.005	0.005	0.01	0.01	0.04		

Table B.3 compares the ESALs for a 7 axle 3-s2-2 with a declared weight of 100,000 pounds at three different weights and at a 79% LF computed by two different methods. The most straightforward method for calculating the ESALs at 79% LF is to simply calculate ESALs at the implied average operating weight of 79,000 pounds. The other method used here is to assume, for the sake of simplicity, that the truck operates at only two weights, the declared weight of 100,000 pounds and an empty weight of 34,000 pounds. An LF of 79% implies the truck is operating about 67% full and 33% empty ((0.67*100+0.33*34)/100=78.2 %). Adding 67% of the ESALs at 100,000 pounds to 33% of ESALs at 34,000 pounds yields the 67:33 ESAL figure. Table B.3 demonstrates that for this configuration and weight with a constant LF of 79%, the ESALs based on a 67:33 ratio are approximately 65% higher than the ESALs based on 79% of operating weight. For this reason, the ESAL comparisons presented in Table B.4 are based on a constant 67:33 full to empty operating weight ratio.

It should be noted that, in making ESAL calculations, it is impossible to hold constant both the LF and the ratio of full to empty operating weights. This analysis assumes that the ratio of miles operated at full capacity to miles operated empty is the same for all trucks, with the result that the implied LF varies as the empty weight is held constant and the declared weight is varied. This is assumed to be more consistent with the way trucks actually operate than the alternative of holding the LF constant.

In order to determine an appropriate full to empty operating ratio, the corresponding declared weights from Table B.2 were used as representative full weights for each axle number group, the weight of an empty 3-s2 was set at 30,000 pounds[iv], and each axle was assumed to add 2,000 pounds to the empty weight.

[iv]Clayton, Alan, Jessie Yeow, et al. Analysis of the Truck Inventory and Use Survey from the Truck Size and Weight Perspective for Trucks with Five-Axles or More: U.S. Department of Transportation Comprehensive Truck Size and Weight Study Report No. 2, February, 1996, p.72, figure 7.5.3.1 and 7.5.3.2. This report analyzes mean tare weights for major 3-s2 types and by geographic region. The 30,000 pound figure is taken as a reasonable estimate based on these analyses.

Using these parameters, a 67:33 full to empty ratio yields a constant LF of 79% (± 1%). The 67:33 ratio used in the ESAL calculations in Table B.4 is thus based on the weighted average LF of 79% and weighted average declared weights by truck type.

Table B.4: ESAL comparison based on the Oregon axle-weight tax table

	Number of Axles and Configuration				
Declared Weight	5	6	7	8	9
(*1000 pounds)	3-s2	3-s3	3-s2-2	3-s2-3	3-s2-4
80	1.951	1.035	0.712	0.541	0.344
82	2.159	1.157	0.784	0.604	0.362
84	2.367	1.249	0.900	0.621	0.385
86	2.603	1.396	1.016	0.684	0.457
88	2.838	1.500	1.089	0.756	0.480
90	3.113	1.673	1.170	0.837	0.528
92	3.389	1.791	1.251	0.918	0.577
94	3.703	2.000	1.350	1.034	0.639
96	4.018	2.130	1.450	1.057	0.702
98	4.374	2.368	1.623	1.095	0.740
100		2.520	1.796	1.195	0.778
102			1.919	1.295	0.826
104			2.041	1.417	0.874
105.5			2.114	1.503	0.920

Table B.4 demonstrates substantial changes in ESALs as the number of axles varies. For example, the decrease in ESALs from 5 to 6 axles is about 46%; 6-7, 27%; 7-8, 30%; and 8-9, 36%. The table also demonstrates that substantial decreases in ESALs can be achieved even if weight increases along with the number of axles, or, conversely, that by adding axles substantially more weight can be carried without increasing ESALs.

The ESAL estimates were also tested for sensitivity to changes in truck configuration. The 105,000 pound weight class was tested as this category accounts for most of the growth in truck miles for trucks registered over 80,000 pounds and for about half of the total miles and ESALs. The analysis tested the sensitivity of the results to a shift of 20% of miles from the base configuration described above to the configuration with the highest ESALs for trucks with 7, 8, and 9axles (trucks with 5 and 6 axles were excluded as they may operate at this weight only with a non-divisible load permit).

As applied to 1997 data, a shift in mileage of 20% would increase ESALs for 7-axle trucks by five percent, 8-axle trucks by one percent and 9-axle trucks by seven percent. Overall, the shift would increase the ESAL estimate by three percent for 1997. Results for other years are similar. Although the ESAL estimates in this case would be slightly understated, the results are not very sensitive to changes in configuration. Use of the simplifying assumption that all trucks with the same number of axles have the same configuration does not appear to compromise the usefulness of the ESAL estimates in comparing changes over time.

Table B.5: ESAL Calculations for 3-s2

3-s2 weight	pavement	drive	tandem	tandem	total esals	weighted esals
30		6	12	12		
	Flex	0.013	0.213	0.213	0.439	0.42591
	Rigid	0.01	0.176	0.176	0.362	
80		12	34	34		
	flex	0.213	1.11	1.11	2.433	2.70211
	rigid	0.176	1.92	1.92	4.016	
82		12	36	34		
	flex	0.213	1.38	1.11	2.703	3.01291
	rigid	0.176	2.43	1.92	4.526	
84		12	36	36		
	flex	0.213	1.38	1.38	2.973	3.32371
	rigid	0.176	2.43	2.43	5.036	
86		12	38	36		
	flex	0.213	1.68	1.38	3.273	3.67471
	rigid	0.176	3.03	2.43	5.636	
88		12	38	38		
	flex	0.213	1.68	1.68	3.573	4.02571
	rigid	0.176	3.03	3.03	6.236	
90		12	40	38		
	flex	0.213	2.03	1.68	3.923	4.43691
	rigid	0.176	3.74	3.03	6.946	
92		12	40	40		
	flex	0.213	2.03	2.03	4.273	4.84811
	rigid	0.176	3.74	3.74	7.656	
94		12	42	40		
	flex	0.213	2.43	2.03	4.673	5.31781
	rigid	0.176	4.55	3.74	8.466	
96		12	42	42		
	flex	0.213	2.43	2.43	5.073	5.78751
	rigid	0.176	4.55	4.55	9.276	
98		12	44	42		
	flex	0.213	2.88	2.43	5.523	6.31911
	rigid	0.176	5.48	4.55	10.206	

Table B.6: ESAL Calculations for 3-s3

3-s3 weight	pavement	Drive	tandem	triple	total esals	weighted esals
32		6	12	14		
	flex	0.013	0.213	0.008	0.226	0.2192
	rigid	0.01	0.176	0.017	0.186	
80		12	28	40		
	flex	0.213	0.534	0.533	1.28	1.43572
	rigid	0.176	0.85	1.17	2.196	
82		12	30	40		
	flex	0.213	0.695	0.533	1.441	1.61865
	rigid	0.176	1.14	1.17	2.486	
84		12	30	42		
	flex	0.213	0.695	0.644	1.552	1.75668
	rigid	0.176	1.14	1.44	2.756	
86		12	32	42		
	flex	0.213	0.887	0.644	1.744	1.97554
	rigid	0.176	1.49	1.44	3.106	
88		12	32	44		
	flex	0.213	0.887	0.769	1.869	2.13029
	rigid	0.176	1.49	1.74	3.406	
90		12	34	44		
	flex	0.213	1.11	0.769	2.092	2.38848
	rigid	0.176	1.92	1.74	3.836	
92		12	34	46		
	flex	0.213	1.11	0.911	2.234	2.56584
	rigid	0.176	1.92	2.09	4.186	
94		12	36	46		
	flex	0.213	1.38	0.911	2.504	2.87664
	rigid	0.176	2.43	2.09	4.696	
96		12	36	48		
	flex	0.213	1.38	1.069	2.662	3.07578
	rigid	0.176	2.43	2.49	5.096	
98		12	38	48		
	flex	0.213	1.68	1.069	2.962	3.42678
	rigid	0.176	3.03	2.49	5.696	
100		12	38	50		
	flex	0.213	1.68	1.25	3.143	3.65351
	rigid	0.176	3.03	2.94	6.146	

Table B.7: ESAL Calculations for 3-s2-2

3-s2-2								
weight	pavement	drive	tandem	tandem	single	single	total esals	weighted esals
34		6	8	8	6	6		
	flex	0.013	0.004	0.004	0.013	0.013	0.047	0.04581
	rigid	0.01	0.005	0.005	0.01	0.01	0.04	
80		10	24	24	12	10		
	flex	0.102	0.292	0.292	0.213	0.102	1.001	1.03959
	rigid	0.082	0.444	0.444	0.176	0.082	1.228	
82		10	24	24	12	12		
	flex	0.102	0.292	0.292	0.213	0.213	1.112	1.1477
	rigid	0.082	0.444	0.444	0.176	0.176	1.322	
84		10	24	24	14	12		
	flex	0.102	0.292	0.292	0.388	0.213	1.287	1.321
	rigid	0.082	0.444	0.444	0.341	0.176	1.487	
86		10	24	24	14	14		
	flex	0.102	0.292	0.292	0.388	0.388	1.462	1.4943
	rigid	0.082	0.444	0.444	0.341	0.341	1.652	
88		12	24	24	14	14		
	flex	0.213	0.292	0.292	0.388	0.388	1.573	1.60241
	rigid	0.176	0.444	0.444	0.341	0.341	1.746	
90		12	26	24	14	14		
	flex	0.213	0.401	0.292	0.388	0.388	1.682	1.72314
	rigid	0.176	0.622	0.444	0.341	0.341	1.924	
92		12	26	26	14	14		
	flex	0.213	0.401	0.401	0.388	0.388	1.791	1.84387
	rigid	0.176	0.622	0.622	0.341	0.341	2.102	
94		12	28	26	14	14		
	flex	0.213	0.534	0.401	0.388	0.388	1.924	1.99302
	rigid	0.176	0.85	0.622	0.341	0.341	2.33	
96		12	28	28	14	14		
	flex	0.213	0.534	0.534	0.388	0.388	2.057	2.14217
	rigid	0.176	0.85	0.85	0.341	0.341	2.558	
98		12	28	28	16	14		
	flex	0.213	0.534	0.534	0.645	0.388	2.314	2.40019
	rigid	0.176	0.85	0.85	0.604	0.341	2.821	
100		12	28	28	16	16		
	flex	0.213	0.534	0.534	0.645	0.645	2.571	2.65821
	rigid	0.176	0.85	0.85	0.604	0.604	3.084	
102		12	30	28	16	16		
	flex	0.213	0.695	0.534	0.645	0.645	2.732	2.84114
	rigid	0.176	1.14	0.85	0.604	0.604	3.374	
104		12	30	30	16	16		
	flex	0.213	0.695	0.695	0.645	0.645	2.893	3.02407
	rigid	0.176	1.14	1.14	0.604	0.604	3.664	
105.5		12	32	30	16	15.5		
	flex	0.213	0.887	0.695	0.645	0.538	2.978	3.13321
	rigid	0.176	1.49	1.14	0.604	0.481	3.891	

Table B.8: ESAL Calculations for 3-s2-3

3-s2-3								
weight	pavement	drive	tandem	tandem	single	tandem	total esals	weighted esals
36		6	8	8	6	8		
	flex	0.013	0.004	0.004	0.013	0.004	0.038	0.03749
	rigid	0.01	0.005	0.005	0.01	0.005	0.035	
80		10	22	22	12	14		
	flex	0.102	0.207	0.207	0.213	0.033	0.762	0.7892
	rigid	0.082	0.308	0.308	0.176	0.048	0.922	
82		10	24	22	12	14		
	flex	0.102	0.292	0.207	0.213	0.033	0.847	0.88287
	rigid	0.082	0.444	0.308	0.176	0.048	1.058	
84		10	24	22	12	16		
	flex	0.102	0.292	0.207	0.213	0.057	0.871	0.90857
	rigid	0.082	0.444	0.308	0.176	0.082	1.092	
86		10	24	24	12	16		
	flex	0.102	0.292	0.292	0.213	0.057	0.956	1.00224
	rigid	0.082	0.444	0.444	0.176	0.082	1.228	
88		12	24	24	12	16		
	flex	0.213	0.292	0.292	0.213	0.057	1.067	1.11035
	rigid	0.176	0.444	0.444	0.176	0.082	1.322	
90		12	26	24	12	16		
	flex	0.213	0.401	0.292	0.213	0.057	1.176	1.23108
	rigid	0.176	0.622	0.444	0.176	0.082	1.5	
92		12	26	26	12	16		
	flex	0.213	0.401	0.401	0.213	0.057	1.285	1.35181
	rigid	0.176	0.622	0.622	0.176	0.082	1.678	
94		12	26	26	14	16		
	flex	0.213	0.401	0.401	0.388	0.057	1.46	1.52511
	rigid	0.176	0.622	0.622	0.341	0.082	1.843	
96		12	26	26	14	18		
	flex	0.213	0.401	0.401	0.388	0.092	1.495	1.55943
	rigid	0.176	0.622	0.622	0.341	0.113	1.874	
98		12	26	26	14	20		
	flex	0.213	0.401	0.401	0.388	0.141	1.544	1.61591
	rigid	0.176	0.622	0.622	0.341	0.206	1.967	
100		12	28	26	14	20		
	flex	0.213	0.534	0.401	0.388	0.141	1.677	1.76506
	rigid	0.176	0.85	0.622	0.341	0.206	2.195	
102		12	28	28	14	20		
	flex	0.213	0.534	0.534	0.388	0.141	1.81	1.91421
	rigid	0.176	0.85	0.85	0.341	0.206	2.423	
104		12	30	28	14	20		
	flex	0.213	0.695	0.534	0.388	0.141	1.971	2.09714
	rigid	0.176	1.14	0.85	0.341	0.206	2.713	
105.5		12	30	29.5	14	20		
	flex	0.213	0.695	0.646	0.388	0.141	2.083	2.2241
	rigid	0.176	1.14	1.05	0.341	0.206	2.913	

Table B.9: ESAL Calculations for 3-s2-4

3-s2-4								
weight	pavement	drive	tandem	tandem	tandem	tandem	total esals	weighted esals
38		6	8	8	8	8		
	flex	0.013	0.004	0.004	0.004	0.004	0.029	0.02917
	rigid	0.01	0.005	0.005	0.005	0.005	0.03	
80		10	20	20	16	14		
	flex	0.102	0.141	0.141	0.057	0.033	0.474	0.4995
	rigid	0.082	0.206	0.206	0.082	0.048	0.624	
82		10	20	20	16	16		
	flex	0.102	0.141	0.141	0.057	0.057	0.498	0.5252
	rigid	0.082	0.206	0.206	0.082	0.082	0.658	
84		10	20	20	18	16		
	flex	0.102	0.141	0.141	0.092	0.057	0.533	0.55952
	rigid	0.082	0.206	0.206	0.113	0.082	0.689	
86		12	20	20	18	16		
	flex	0.213	0.141	0.141	0.092	0.057	0.644	0.66763
	rigid	0.176	0.206	0.206	0.113	0.082	0.783	
88		12	20	20	18	18		
	flex	0.213	0.141	0.141	0.092	0.092	0.679	0.70195
	rigid	0.176	0.206	0.206	0.113	0.113	0.814	
90		12	22	20	18	18		
	flex	0.213	0.207	0.141	0.092	0.092	0.745	0.77407
	rigid	0.176	0.308	0.206	0.113	0.113	0.916	
92		12	22	22	18	18		
	flex	0.213	0.207	0.207	0.092	0.092	0.811	0.84619
	rigid	0.176	0.308	0.308	0.113	0.113	1.018	
94		12	24	22	18	18		
	flex	0.213	0.292	0.207	0.092	0.092	0.896	0.93986
	rigid	0.176	0.444	0.308	0.113	0.113	1.154	
96		12	24	24	18	18		
	flex	0.213	0.292	0.292	0.092	0.092	0.981	1.03353
	rigid	0.176	0.444	0.444	0.113	0.113	1.29	
98		12	24	24	20	18		
	flex	0.213	0.292	0.292	0.141	0.092	1.03	1.09001
	rigid	0.176	0.444	0.444	0.206	0.113	1.383	
100		12	24	24	20	20		
	flex	0.213	0.292	0.292	0.141	0.141	1.079	1.14649
	rigid	0.176	0.444	0.444	0.206	0.206	1.476	
102		12	24	24	22	20		
	flex	0.213	0.292	0.292	0.207	0.141	1.145	1.21861
	rigid	0.176	0.444	0.444	0.308	0.206	1.578	
104		12	24	24	22	22		
	flex	0.213	0.292	0.292	0.207	0.207	1.211	1.29073
	rigid	0.176	0.444	0.444	0.308	0.308	1.68	
105.5		12	24	24	24	21.5		
	flex	0.213	0.292	0.292	0.292	0.18	1.269	1.35893
	rigid	0.176	0.444	0.444	0.444	0.29	1.798	

APPENDIX C

INTERVIEW PROTOCOL AND SELECTED COMMENTS

INTERVIEW PROTOCOL

Firm: ____

Phone: _______________________

Address: ____

Initial Contact Person: ____________________________

Interviewee: ___________________________________

Date of Interview: _______________

My name is Lois Bronfman. I am working as a consultant for the Oregon Department of Transportation and Portland State University on a project designed to investigate the effect of taxes and regulation on the decisions that trucking firms make regarding truck configuration and usage. This part of the study focuses on obtaining qualitative information about your firm's response to these taxes and regulations. I am interested in speaking with someone who can describe and discuss how decisions are made by the firm when choosing the types of trucks to purchase and the choice of trucks for use on specific trips. This person should be familiar with the tax and regulatory structure. Are you the appropriate person with whom to speak?

Before we continue, let me discuss the issue of confidentiality. Your firm was selected from a list of trucking firms registered with the Oregon Department of Transportation. We have tried to identify a cross section of firms (e.g., small, large, intrastate carriers and interstate carriers) to interview. Your name or your firm's name will not be used in reporting our findings. We may indicate the general type of firm from which the perspective came. The interview data will be used to help analysts interpret quantitative data that describe the hauling activities of all firms in the State. You will be sent a copy of the report based on these interviews.

1. Briefly describe the business activity of your firm.

Probe for specifics:

2. Is your firm a Private Firm________ For Hire___________ Other ________

a. What do you primarily haul? _________________

b. How many trucks do you own? _____________

c. How many are registered in Oregon? __________

d. How many actually run in Oregon? _____________

e. Estimate the total number of miles traveled annually. _______
(in all states)

f. Estimate average number of miles traveled per truck. ________

g. What proportion of the travel miles are in Oregon? _______

h. Of the miles traveled in Oregon, what proportion are traveled on Interstates ________________On other roads____________

If travel in states other than Oregon, in how many different states do you travel? _________

3. What types of trucks (configurations) do you use? (Detailed list is for the interviewer's reference)

___Van truck, single axle (32,500 lbs. avg.)

___Flat Bed, Dual Axle (46,500 lbs. avg.)

___Van truck, Dual Axle (46,500 lbs. avg.)

___Single-Axle Tractor and Trailer (52,000 lbs. Max)

____Single-Axle Tractor and Single-Axle Doubles (90,000 lbs. Max w/permit)

____Single-Axle Tractor and Triple Trailers (105,500 lbs. Max. w/Permit)

____Tandem-Axle Tractor, Single Axle Trailer (66,000 lbs. Max.)

____Tandem-Axle Tractor and Trailer (80,000 lbs. Max.)

____Tandem-Axle Tractor and Single Axle Doubles (96,000 lbs. with Permit)

____Tandem-Axle Tractor, Tandem Axle Semi, Full Trailer (105,500 lbs. Max with permit)

____Dump Truck

____Single Axle Dump Truck, Dual Axle Flatbed Trailer

____Tandem Axle Dump Truck and Pup Trailer (80,000 lbs. Max.)

____Tandem-Axle Truck, Single-Axle Pull Trailer (Mule Train) (86,000 lbs. with permit)

_____Tandem-Axle Tractor, Tandem-Axle Pull Trailer (80,000 lbs. max)

_____Tow truck

_____Utility truck

_____Mobile Home Hauler- "Trailer Toter"

4. Do you haul loads in excess of 80,000 lbs.? _________ Frequently _____
Sometimes _____
Seldom ________
Never _________

a. If yes, why? ___________________

b. If no, why not? ___________________

FOR FIRMS WHO DO NOT HAUL IN EXCESS OF 80,000 LBS.

5. What configuration of tractor/trailers do you use? ________

6. Which of the following factors are important for determining the configuration of your truck(s)? Answer in terms of "Very important", "Important," "Not Important."

	Very Important	Important	Not Important	Don't Know
Regulations on weight limits				
Fuel Costs				
Fuel Taxes				
Safety				
Weight Mile Taxes				
Registration Fees				
Commodity Hauled				
Customer Request				
Other				

7. Of the above, which factor is most important? _____________

Explain____

Which is least important? _______________Explain_________

8. Has your firm significantly increased the number of axles used on its trucks since 1990?
Yes _____ No _____
If yes, why? ____
If no, why not? ____

Probe: Did you add additional axles because of the weight-mile tax?

FOR FIRMS HAULING IN EXCESS OF 80,000 LBS.

9. Approximately how many miles annually do you travel in Oregon carrying loads in excess of 80,000 lbs.? ________

10. When you haul in excess of 80,000 lbs. in Oregon, what configuration of tractor/trailers do you use to carry the heavier load? ___________

11. When you haul over 80,000 lbs. which of the following factors are important for determining the configuration of your trucks? Indicate "Very Important," "Important," "Not Important."

	Very Important	Important	Not Important	Don't Know
Regulations on weight limits				
Fuel Costs				
Fuel Taxes				
Safety				
Weight Mile Taxes				
Registration Fees				
Commodity				
Customer Request				
Other				

12. Of the above, which factor is most important? _____________
Explain____

Which is least important? _______________Explain__________________

13. Has your firm significantly increased the number of axles used on its trucks since 1990?
Yes _____ No _____
If yes, why? ____
If no, why not? ____

(Probe: have you added extra axles because the weight-mile-tax?)

14. Do you haul in excess of 80,000 lbs. outside of Oregon? Yes _________ No______

15. Do you use the same configuration of truck when you haul in excess of 80,000 lbs. outside of Oregon? Yes _______ No ____________.   If no, why not? _________

16. Are any of your trucks eligible for flat fee. Yes. _________ No_______

If yes, do you ever switch between flat fee and weight mile? Yes _____No____
If yes, why do you switch? _______________

17. When hauling over 80,000 lbs. which type of permit do you use?

“Extended Weight” permit ______
“Continuous Trip” permit ______
“Single Trip (Heavy Haul)” permit ______

Why? _____________

FOR INTERSTATE TRUCKING FIRMS

18. Does the weight-mile tax in Oregon affect your routing decisions in any way?

If Yes, How ____________________?

19. How does the weight-mile tax affect your record keeping and reporting activities?

20. Does the weight-mile tax affect your decisions about what to haul? __________

GENERAL POLICY QUESTIONS

21. Recognizing that some form of taxation is necessary, what are the advantages of a “Weight-mile” tax from the perspective of your firm? ________________________

Disadvantages? ____

22. Virtually all states use diesel fuel taxes, registration and permit fees.   Five states use weight-distance taxes. In four of those states, the weight-distance taxes are in addition to fuel taxes. Oregon is the only state without a diesel fuel tax.

Would there be an advantage to your firm to have a diesel fuel tax and higher registration fees instead of a weight-mile tax?   Yes. _____   No. _____

If yes, why? ____

If no, why not? ____

23. Should Oregon replace its weight-mile tax with a diesel fuel tax and higher registration fees?
Yes. ______ No ______

If yes, would this change have any affect on your decisions to carry loads over 80,000 lbs.?

Explain answer. ____

24. Under a system of higher registration/permit fees, how much would your firm have to save to justify additional axles when purchasing new equipment?

Probe if interviewee finds difficult to answer: How much does it cost to add an additional axle? ________________What would be the increase in operating expenses with more axles?______________________________

Probe: If still having trouble, ask if a reduction of $40 to $50 per year in registration fees would be likely to induce them to add an axle.

25. If the taxes on trucks weighing over 80,000 lbs. were reduced, would you be more likely to use them?

THANK YOU FOR YOUR TIME AND COOPERATION.

SELECTED COMMENTS FROM INTERVIEWS

[Do you haul in excess of 80,000 lbs.?] "Yes, (we want) to maximize the bridge law formula and maximize payload."

– Moderate sized, for hire, regional trucking firm

–

"Weight mile tax has nothing really to do with (configuration); it's what we're moving. We add axles on to accommodate the excess weight. It's more of a safety factor. It's a lot safer to haul heavy loads on nine axles than on five. You can stop."

– Large, for hire, interstate firm that frequently carries in excess of 80,000 lbs.

–

"Can't make capital decisions based on policy change in weight-mile."

– Large, for hire, interstate trucking firm

"It's the bridge formula that determines axle configurations…and commodities."

– Moderately large, for hire trucking firm that carries primarily in excess of 80.000 lbs.

"It (the weight-mile tax) is the fair way to go; everyone pays their fair share."

– Small, private firm that carries both over and under 80,000 lbs.

"We will add another axle if we can - conscious of it, you bet! If we can haul with 8 axles, we'll do it; but only if equipment is available and legal. We ignore the tax. The customer is most important."

– Large, private, interstate firm that routinely carries over 80,000 lbs.

"The current proposal put out by the trucking industry is a combination of higher registration fees and diesel fuel tax. Registration fees are too high. Pushes the cost to the little guy. Terribly self serving and selfish."

– Moderately large, private firm that hauls over 80,000 lbs. in Oregon only

"I would like to eliminate (the weight-mile tax) because of record keeping, but not go overboard. Let's base it on those who run the most miles. (The system) …needs to be based on mileage per year."

– Private, for hire, regional trucking firm that routinely carries over 80,000 lbs.

"(Higher registration fees) would be a disadvantage to us because we drive so few miles."

– Smaller, private firm that operates exclusively in Oregon and carries less than 80,000 lbs.

"Oregon is the highest tax state in the country; …(in addition) there are the costs of tracking and reporting Oregon miles…; (we) hire an additional person to keep track of weight miles."

– Large, for hire, interstate firm that carries above and below 80,000 lbs.

"I'd love to put another axle on, but I can't because of California's regulations."

– Large, for hire, interstate firm carries over and below 80.000 lbs.

"Generally (the weight-mile tax) doesn't come into my mind; …cost savings is minimal when adding axles."

– Large, for hire, regional trucking firm

"If Oregon eliminated the weight-mile tax, we would still go with the same configuration."

– Moderate sized, private, regional trucking firm that routinely carries over 80,000 lbs.

"If the weight-mile tax were eliminated and replaced by diesel taxes and higher fees, (we) wouldn't buy more axles. Regulations don't make it worth the effort. Need to change the regulations."

– Logging firm that works primarily in Oregon

"What drives configuration is what we are hauling. We try to break it down to keep under 80,000 lbs. We don't look at state regulations as driving force in business decisions."

– Very large, for hire, interstate trucking firm that hauls all kinds of products

"Go to IFTA standard; do everything to lessen paper work; make it easier."

– Moderate sized, for hire, interstate firm that carries both over and under 80,000 lbs.