Regional Freight Study Technical Report – Roanoke Valley Area Metropolitan Planning Organization (RVAMPO) and Roanoke Valley-Alleghany Regional Commission (RVARC).

Freight Trip Generation for the Roanoke Valley – Technical Report

Fiscal Year – 2012 – Final 11-15-2012

ACKNOWLEDGEMENTS

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Purpose:

The regional freight study has two separate, but interrelated purposes. The first purpose is to estimate the relationship between number of employees in a business and the value, volume and weight of outbound and inbound freight in the Roanoke Metropolitan Planning Organization (RVAMPO) Study Area Boundary 2035. The second purpose is to apply the empirical results, found by pursuing the first purpose, to the RVAMPO Transportation Analysis Zone (TAZ) structure, and to discuss the applied results with regards to other regional transportation planning factors such as:

- Environmental Justice -which incorporates impacts on low-income and minority populations;
- Public Transportation;
- Non-motorized Transportation;
- Transportation Safety; and,
- Regional Air Quality

The reason that freight transportation is discussed in relation to these other planning factors, is that freight transportation has an interrelation with passenger transportation, employment dynamics and economic development implications. Freight vehicles that use the public right-of-way also intermingle with passenger vehicles in the same transportation infrastructure. Finally, federal guidance encourages metropolitan planning organizations and rural planning agencies to address transportation planning with a multi-modal lens while incorporating larger community and economic dynamics.

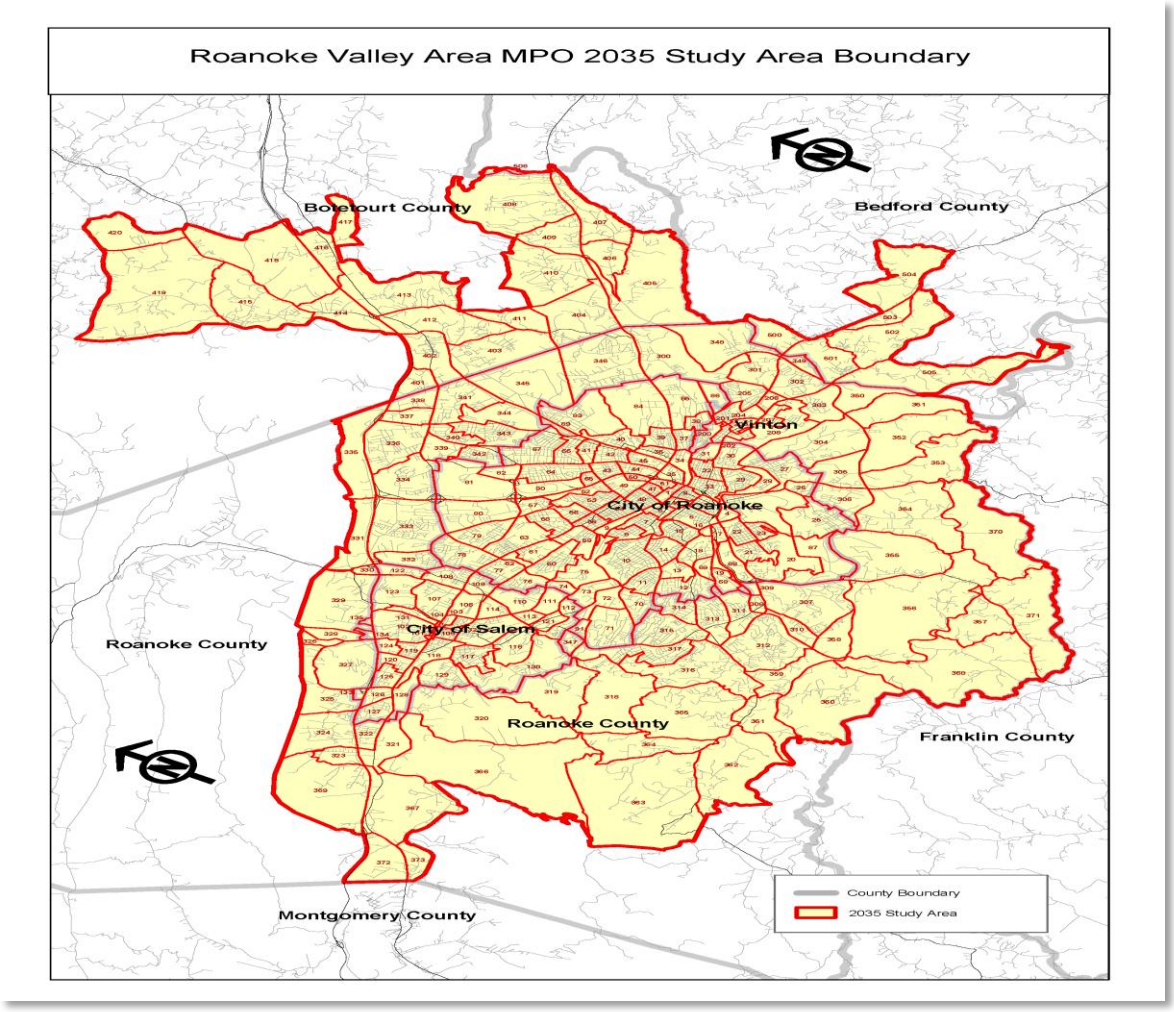
Motivation:

According to federal law, every urban area with a population of 50,000 or greater in the United States is required to form a Metropolitan Planning Organization (MPO) and develop, maintain and update a regional Constrained Long-Range Transportation Plan (CLRTP). Typically CLRTP's are focused on estimating passenger travel demand for a base year and projecting passenger travel demand to a future horizon year typically 20 years or more from the base year. Freight transportation is assessed indirectly in this process through calibration and validation of the computerized 4-step travel demand model. Essentially, traffic counts are taken which indicate the proportion of vehicles with 3 or more axels in a traffic flow, and that proportion is reported as a truck percentage. This truck percentage is then converted into passenger car equivalents using equivalents such as: a vehicle with a certain number of axels is the equivalent of three passenger cars as far as traffic flow is concerned. The passenger car equivalents and then assessed during the "Traffic Assignment Step" (Step 4) of the 4-step travel demand model. This conventional indirect method of factoring in freight transportation is likely to be incomplete given current realities of freight transportation demand such as:

- the increasing popularity of supply chain management and logistics management approaches in manufacturing, light manufacturing, distribution and retail businesses;
- the increasing popularity of retail purchases from the internet which require shipment to the purchaser; and,

- the increasing use of third party fulfillment and logistics providers as businesses "outsource" logistics to market providers while focusing on their "core business."

For the aforementioned reasons, researchers and planners desire to more completely assess and estimate freight transportation demand and to incorporate that demand with the passenger travel demand estimated by the conventional 4-step travel demand model. Fully incorporating freight travel demand estimates into the transportation planning process is a complicated and multi-year research endeavor. This study seeks to complete the first step of the process by investigating and assessing regional specific (RVAMPO) relationships between the number of employees in a business and average freight generated (outbound) and received (inbound) as measured by freight volume, value and average shipment weight. These relationships will then be used with the socioeconomic data that is used in the transportation planning process to generate a "freight generation" profile in the base year for the various Transportation Analysis Zones (TAZs) in the RVAMPO Study Area Boundary (see map below). The scope of this study will end at the regional freight generation profile. Subsequent research will be needed over the years to incorporate the three other travel demand estimation steps (trip distribution, mode choice and traffic assignment) specifically with regards to freight transportation.



The development of a regional freight generation profile will still be useful as a separate "filter" or "lens" to use in the transportation planning process and will be used as additional information to the process. Additionally, the results of this study may be useful to the economic development community. A relationship between employees and freight value could provide useful information to regional economic developers.

Literature Review:

There is some past research on freight trip generation estimates within the United States and abroad. Past research has generally focused on specific industry sectors of interest. There has generally not been research into overall freight per employee or freight per square foot measures that can be applied to an entire MPO at the TAZ level. This research will fill that gap by developing general freight generation estimates and applying them to the RVAMPO TAZ structure where applicable. With this goal in mind, following is a review of the applicable literature.

In 2003 Jones and Sharma presented a paper to the Transportation Research Board Annual Meeting in Washington DC titled "Development of Freight Statewide Trip Forecasting Model for Nebraska" Their research estimated freight trips using and economic input-output model called IMPLAN which is developed and maintained by the University of Minnesota. IMPLAN is tailored to model economic transactions and multiplier effects over a specific geography, in this case Nebraska. An estimate of freight trips were derived from the economic transactions modeled in IMPLAN. In this regard, freight transportation was not surveyed directly; rather it was derived by the economic transactions within Nebraska. Following is a table listing estimated freight tons per employee according to industry code in Adams County:

TABLE 1 Freight trip production table for Adams county

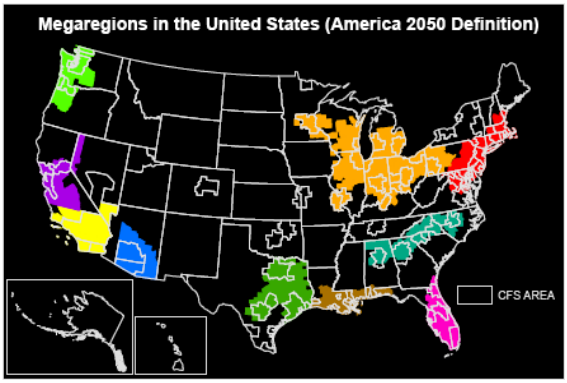
SIC/STCC Code	Employment	Comments	Tons per Employee	Tons shipped	County Total
1	657	SIC Farm count	58.71	38571.3	
13	0	assumed 0	906.34	0.0	
14	0	assumed 0	1202.83	0.0	
19	0	assumed 0	0.84	0.0	
20	765		392.75	300454.9	
22	0	assumed 0	147.57	0.0	
23	10		8.77	87.7	
24	41		127.80	5239.9	
25	10		38.94	389.4	
26	175		160.41	28071.9	
27	108		11.58	1250.4	
28	60		164.18	9850.6	
29	0	assumed 0	11470.24	0.0	
30	198		28.50	5643.7	
31	10		10.91	109.1	
32	38		112.10	4259.9	
33	79		66.83	5279.4	
34	175		25.82	4519.0	
35	1347		10.19	13725.1	
36	0	assumed 0	7.72	0.0	
37	0	assumed 0	4.02	0.0	
38	375		3.69	1383.6	
39	10		6.78	67.8	Sum
40	10	SIC 5093	277.37	2773.7	421,678

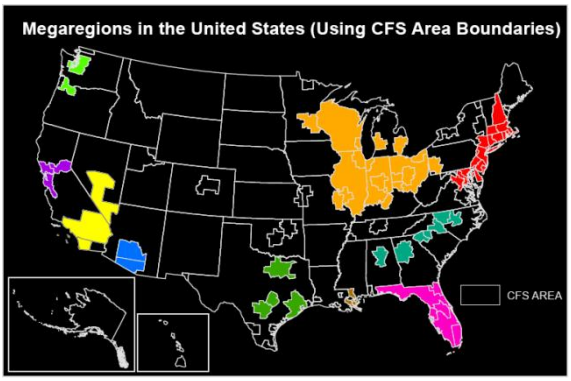
Total annual tons attracted for all counties = 19,819,323
Total annual tons attracted at state level = 19,075,491 **Error = 3.9 %**

(Jones and Sharma, 11)

Another report out of the Transportation and Economic Development Center at George Mason University titled "Mega-regions and Freight: Evidence from Commodity Flow Survey and Freight Analysis Framework" by Dr. Jonathan Gifford et al. specifically deals with the question of whether freight

generation measures such of annual tons per employee are different in so-named Mega Regions than in other outside of Mega Regions. A geographic representation of Mega Regions using two different definitions for North America follows:





(Gifford, Chen, Kelekar, Zebrowski and Zhou, 10)

This report estimates tons per employee and value per ton for general "freight related businesses" both inside and outside of Megaregions using the CFS area boundaries depicted above. The estimates derive from the Commodity Flow Survey and the Freight Analysis Framework. Both are federal level publications of aggregate freight data. A summary of relevant estimates to the RVAMPO study follow:

Mean Value	**Non-Mega-regions**	**Mega-Regions**	**t-value ***
Tons per employee (in '000)	3.38	1.45	5.3727
Value per employee (in millions)	1.76	1.43	3.2269
Ton-miles per employee (in millions)	1.41	0.34	5.4526
Value per ton (Outbound)	1.32	0.74	(5.4341)
Value per ton (Inbound)	1.09	0.80	(4.8618)
Outbound-to-Inbound Value ratio	0.90	1.05	(3.0154)
Outbound-to-Inbound Tonnage ratio	0.90	1.13	2.3024
Note: * - Welch's t-test yielded t-values indicating significant differences between the two groups.			

(Gifford, Chen, Li, Kelekar, Zebrowski and Zhou, 15)

A third study, from the Netherlands titled "Freight trip generation by firms" was prepared by Iding, Meester and Tavasszy for the 42n European Congress of the Regional Science Association in 2002. Iding et al. explicitly acknowledge that

"Road congestion is gradually becoming worse, and while much attention has been given to the role of the private car in this context, the contribution of freight transport by trucks to traffic congestion has received relatively little attention so far…. In order to predict traffic generation by industrial sites, the relation between the different activities on an industrial site and the number of freight trips has to be specified. Information about this relation is scarce however. In the Netherlands and elsewhere, it has hardly been studied yet." (Iding, Meester and Tavasszy, 2)

Iding et al. summarized results from the previous freight trip generation studies in the United States in the following table:

Table 1: Freight trip generation by sector of industry (U.S. studies)

	Per 1000 m² floor area		Per hectare site area of firm		
	BTS	Tadi & Balbach	BTS	Chatterjee et al	Zavattero & Weseman
Production	2.4	3.9 – 6.5	7.6	10.1 – 16.1	8.9
Wholesale	2.4 – 9.9	4.0			
Light industry	16.0	6.5			
Services				43.9	35.2

Source: editing of data from Bureau of Transportation Statistics, Chatterjee et al (1979), Zavattero & Weseman (1993) and Tadi & Balbach (1994)

(Iding, Meester and Tavasszy, 5)

In order to establish up-to-date estimates of freight trip generation relationships, Iding et al. developed a study methodology based on a large sample size and linear regression relationships. The initial sample size of 10,000 firms yielded 1,529 responses or a response rate of 15%. Iding et al. separated industry sectors by industry code and reported results of sectors with more than 10 respondents. They found that

"For most of the sectors a relation between size (measured either by area or by number of employees) and number of freight trips can be proven. The strength of this relation varies considerably, however. In some branches of industry (like wood products, chemicals, glass and pottery) R^2 is rather high. For wholesale activities, the relation is weak but nevertheless significant." (Iding, Meester and Tavasszy, 9)

Iding et al reported the regression coefficients for the various industry sectors in the study. Below is an example of their results for outbound freight by area and number of employees in the Netherlands:

Table 4: Regression analysis: number of trips taking out freight, by sector of industry

SBI-code		Site area of firm (in m^2)				Number of employees			
		N	R^2	c	b	N	R^2	c	b
15	Food & drinks	45	.24	**5.98**	**.04**	47	.24	**6.67**	**.05**
17	Textile	20	.46	**3.53**	**.01**	19	.70	**2.58**	**.03**
19	Leather & leather products	16	.00	3.64	.00	19	.34	**1.25**	**.13**
20	Wood products (excl. furniture)	36	.60	**1.73**	**.02**	36	.39	**2.57**	**.03**
22	Printed matter	38	.04	5.14	.02	38	.73	**2.62**	**.10**
24	Chemicals	36	.52	**5.62**	**.02**	39	.43	**5.47**	**.04**
25	Products of rubber & synthetics	40	.15	**3.54**	**.02**	42	.71	**0.79**	**.13**
26	Glass, pottery etc.	37	.83	**5.51**	**.04**	38	.68	**7.59**	**.12**
28	Metal products	66	.41	**2.71**	**.04**	71	.00	4.83	.00
29	Machinery	46	.02	5.79	.01	46	.00	6.45	.00
33	Medical devices & instruments	19	.01	4.99	.00	19	.14	3.49	.04
34	Cars, trucks, trailers	40	.33	**2.90**	**.03**	42	.40	**3.64**	**.05**
36	Furniture & various commodities	24	.59	**1.68**	**.02**	25	.28	**1.49**	**.08**
45	Construction	254	.14	**6.29**	**.02**	264	.01	6.82	.01
50	Trading & repair of motor vehicles	77	.05	3.03	.03	86	.15	**3.01**	**.10**
51	Wholesale	240	.24	**4.15**	**.08**	257	.02	**7.56**	**.04**
60	Land transport	89	.35	**11.01**	**.09**	90	.49	**7.89**	**.33**
63	Services for transport	16	.72	**12.46**	**.11**	17	.17	15.45	.05

* **Bold**: F sign. ($p < .05$)

((Iding, Meester and Tavasszy, 10)

In summary, the literature review reinforced that freight trip generation rates have not been well studied in the literature. There are three studies of note with partial applicability to the RVAMPO Study Area summarized below:

Study	Data Source/ Approach	Relevance to RVAMPO Study
Development of Freight Statewide Trip Forecasting Model for Nebraska	IMPLAN , an economic assessment package employing an input-output model was used to estimate freight trips based on economic activity	Estimated annual freight weight generated per employee for a variety of industries in Nebraska.
Mega-regions and Freight: Evidence from Commodity Flow Survey and Freight Analysis Framework	Commodity Flow Survey from the Bureau of Transportation Statistics and Freight Analysis Framework from Federal Highway Administration	Estimated annual freight weight generated per employee and annual freight value generated per employee at the "Mega Region" geographic scale.
Freight trip generation by firms (Netherlands)	10,000 firms sampled with 1,529 responses. Data relationships evaluated using linear regression	Corroborates a linear regression approach and provides R^2 values for comparison.

Literature review reinforces the concept that a freight generation study focused on the Roanoke Valley is needed to uncover local freight generation relationships. Results from the existing studies are not general enough to apply directly to the RVAMPO study area as they are.

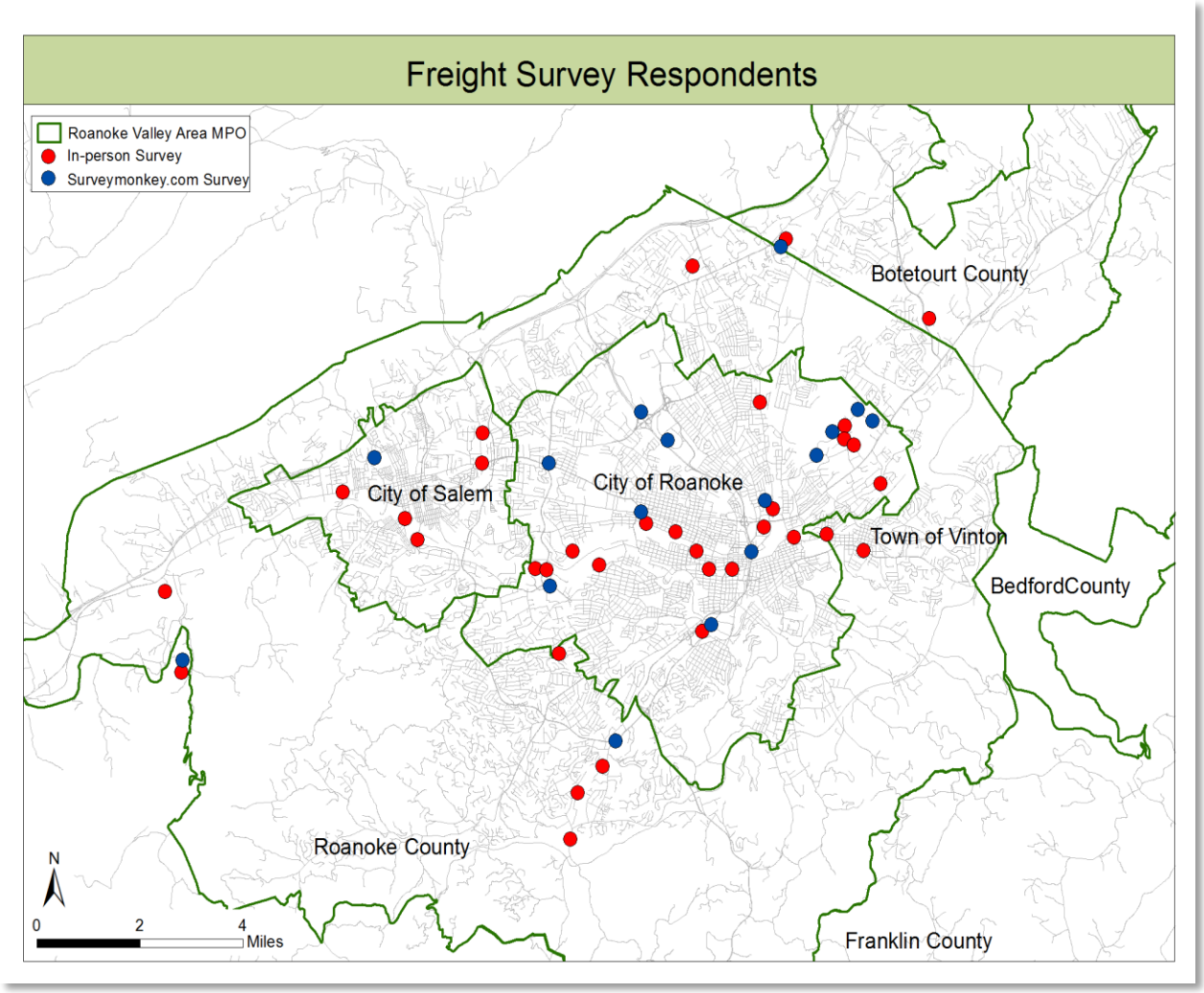
A fourth study is mentioned separately because it had a direct influence on the design and execution of this particular study. ***The Mobile Area Metropolitan Planning Organization Freight Plan – Final Report June 21, 2010*** prepared for the South Alabama Regional Planning Commission by the Center for Management & Economic Research at the University of Alabama in Huntsville was used to develop the survey instrument. Originally the plan was to partner with the Center for Management & Economic Research at the University of Alabama in Huntsville and have them analyze RVAMPO data based on their sophisticated technique using survey results and Freight Analysis Framework (FAF) national level data. Unfortunately, funding did not come through for the Center for Management & Economic Research analysis and RVAMPO staffs were required to develop an alternative in-house data analysis methodology.

Methodology:

The methodology for this study centers around a two page survey instrument that was targeted at businesses that ship or receive inputs or final product on a fairly routine basis. The target was not necessarily transportation, freight or third-party logistics firms; rather it was firms in other areas of business who generate freight in the normal operation of business. The two-page survey instrument, depicted on the following pages, was derived from a similar survey developed for the South Alabama Regional Planning Commission (Mobile Area) by the University of Alabama in Huntsville Center for Management and Economic Research.

The sampling methodology for Phase 1 of data gathering process consisted of sampling businesses in the top 10 freight producing industry classifications in the Roanoke Region on a geographic basis using Geographic Information Systems software. The goal was to get a representative geographic coverage of businesses, and to schedule "freight interviews" with executives at the business to gather information and discuss freight transportation issues. This involved a time consuming process of cold calling the targeted businesses and setting up an appropriate interview time for a planner to visit the business at a later date. In total 29 of the eventual 57 survey responses were obtained in this face-to-face manner. After some time it became clear that the face-to-face method would not produce a sufficient quantity of completed surveys in a reasonable amount of time. In Phase 2 of the data gathering process an electronic version of the two-page survey was created and hosted on SurveyMonkey. The SurveyMonkey link was posted to Facebook Pages and Linkedin Groups for the Roanoke Regional Chamber of Commerce, the Roanoke Partnership, the Roanoke Blacksburg Technology Council and other industry associations and groups. The SurveyMonkey link was distributed in both the City of Roanoke and Roanoke County's economic development e-newsletters. In addition, a planner would attend regional conferences and events such as the Roanoke Career and Lifestyle Fair with small business card sized survey invitations completed with the electronic survey link. The more mass market approach to data gathering in Phase 2 garnered an additional 28 responses for a total of 57 responses from Phases 1 and 2. Since both a geographically diverse targeting method and a mass market method were employed

in data gathering, it is felt that the sample is representative of the general business community in the Roanoke Valley. Due to the nature of the questions which ask about value and revenue, there was a noticeable incidence of partially completed surveys where one or more responses were skipped due to proprietary reasons of the businesses themselves. As such, some measures reported in the analysis portion of this report will have between 20 and 40 data points rather than the full 57.



Freight Transportation Survey
Industry Interview Form - Roanoke MPO
Roanoke Valley-Alleghany Regional Commission

	CONTACT INFORMATION		
A	DATE OF VISIT:	/ /	
B	Company Name:		
C	Street Address:		
D	City/State:		
E	Zip		
F	Phone:		
G	Contact Name:		
H	Contact Title/Position:		
I	Email Address:		
J	Transportation Analysis Zone		
K	SCTG		
L	Commodity		
	BEGIN SURVEY QUESTIONS:		

1 How would you describe the primary business operation/activity at this location?

_____

_____

2 How many employees do you have at this location?

Full-time= _____ **Part-time=** _____ **Total all FT+PT =** _____

3 Do you receive or generate regular shipments to/from this location by:

(circle answer)	Inbound Receipts			Outbound Shipments	
Truck:	Yes	No	**Truck:**	Yes	No
Rail:	Yes	No	**Rail:**	Yes	No
Air:	Yes	No	**Air:**	Yes	No

4 How many deliveries (number of trailers, vehicles, and/or containers) for each mode do you RECEIVE each WEEK?

Truck	Tractor Trailer_____ #		Delivery Van_____ #	
Rail	Container_____ #		Rail Car_____ #	
Air	Container_____ #		Other_____ #	

5 How many shipments (number of trailers, vehicles, and/or containers) for each mode do you GENERATE each WEEK?

Truck	Tractor Trailer_____ #		Delivery Van_____ #	
Rail	Container_____ #		Rail Car_____ #	
Air	Container_____ #		Other_____ #	

6 From where are the INBOUND deliveries coming?

(Specific cities, states, etc.)

_____

Query if no specific answers:			**Approx %**	**Don't know**
Within the Roanoke Valley	Yes	No		
Outside the Roanoke Valley	Yes	No		

Compass Direction into this site:
(circle all that apply)

N	E	W	S

7 To where are the OUTBOUND shipments going?

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Office for Freight, Logistics and Transportation

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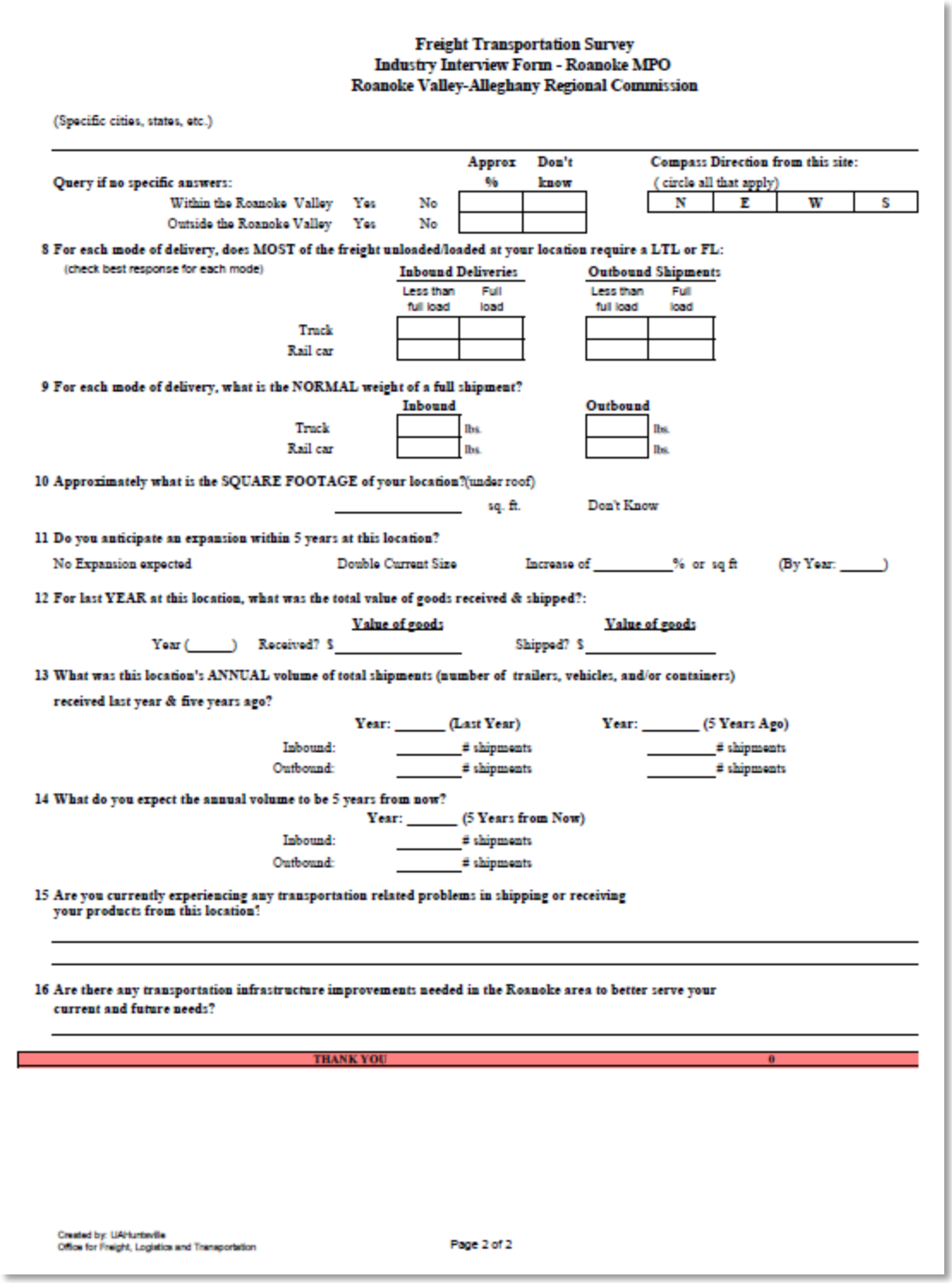

Freight Transportation Survey
Industry Interview Form - Roanoke MPO
Roanoke Valley-Alleghany Regional Commission

(Specific cities, states, etc.)

Query if no specific answers:			Approx %	Don't know
Within the Roanoke Valley	Yes	No		
Outside the Roanoke Valley	Yes	No		

Compass Direction from this site: (circle all that apply)

N	E	W	S

8 For each mode of delivery, does MOST of the freight unloaded/loaded at your location require a LTL or FL:
(check best response for each mode)

	Inbound Deliveries		Outbound Shipments	
	Less than full load	Full load	Less than full load	Full load
Truck				
Rail car				

9 For each mode of delivery, what is the NORMAL weight of a full shipment?

	Inbound		Outbound	
Truck		lbs.		lbs.
Rail car		lbs.		lbs.

10 Approximately what is the SQUARE FOOTAGE of your location?(under roof)

_____ sq. ft. Don't Know

11 Do you anticipate an expansion within 5 years at this location?

No Expansion expected Double Current Size Increase of _____% or sq ft (By Year: _____)

12 For last YEAR at this location, what was the total value of goods received & shipped?:

	Value of goods:		Value of goods:
Year (_____)	Received? $		Shipped? $

13 What was this location's ANNUAL volume of total shipments (number of trailers, vehicles, and/or containers) received last year & five years ago?

	Year: _____ (Last Year)	Year: _____ (5 Years Ago)
Inbound:	_____# shipments	_____# shipments
Outbound:	_____# shipments	_____# shipments

14 What do you expect the annual volume to be 5 years from now?

	Year: _____ (5 Years from Now)
Inbound:	_____# shipments
Outbound:	_____# shipments

15 Are you currently experiencing any transportation related problems in shipping or receiving your products from this location?

_____

_____

16 Are there any transportation infrastructure improvements needed in the Roanoke area to better serve your current and future needs?

_____

THANK YOU 0

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Office for Freight, Logistics and Transportation

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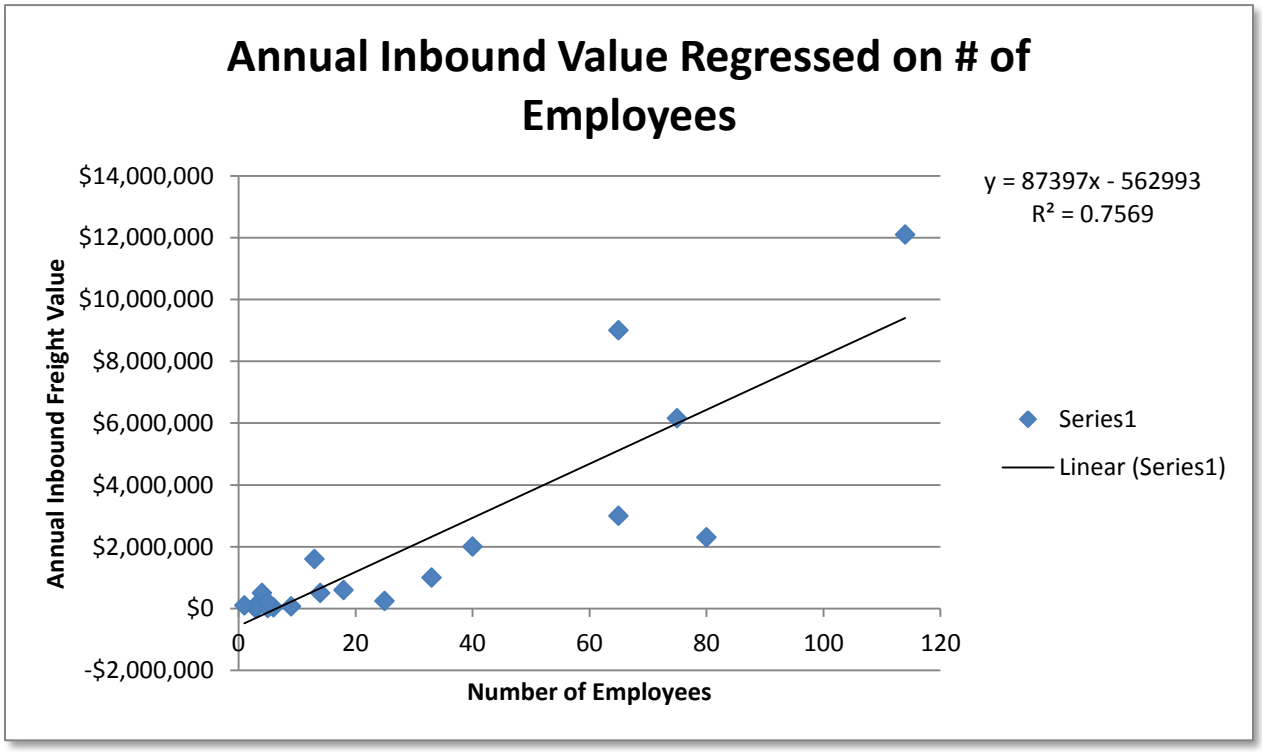
Analysis:

Ordinary Least Squares (OLS) linear regression analysis was used to model the relationship between variables in the survey results. For single variable regressions there were some relationships that

produced statistically significant results based on F-test for the entire regression equation and t-test and/or P-values for the individual parameters. The table below summarizes the status of the various single variable relationships. The significant relationships will be described first and the relationships that are not statistically significant will also be reported for informational purposes.

Statistical Significance of Results	Inbound	Outbound
Annual Freight Value per Employee	**Yes - Significant**	**Yes - Significant**
Annual Truck Weight per Employee	**Yes - Significant**	Not Significant for entire data set. Significant for sub-sets i.e. SCTG-33
Annual Volume (#of Shipments) per Employee	Not Significant for entire data set	Not Significant for entire data set

Annual Freight Value (Inbound) per Employee – Statistically Significant:



Regression Statistics								
Multiple R	0.87000568							
R Square	0.756909882							
Adjusted R Square	0.743404876							
Standard Error	1683944.377							
Observations	20							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1.5893E+14	1.5893E+14	56.04661357	6.22185E-07			
Residual	18	5.1042E+13	2.83567E+12					
Total	19	2.09972E+14						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	-562992.75	506748.8738	-1.110989642	0.281193347	-1627632.628	501647.1	-1627633	501647.1279
X Variable 1	87397.34079	11674.10325	7.486428626	6.22185E-07	62870.95996	111923.7	62870.96	111923.7216

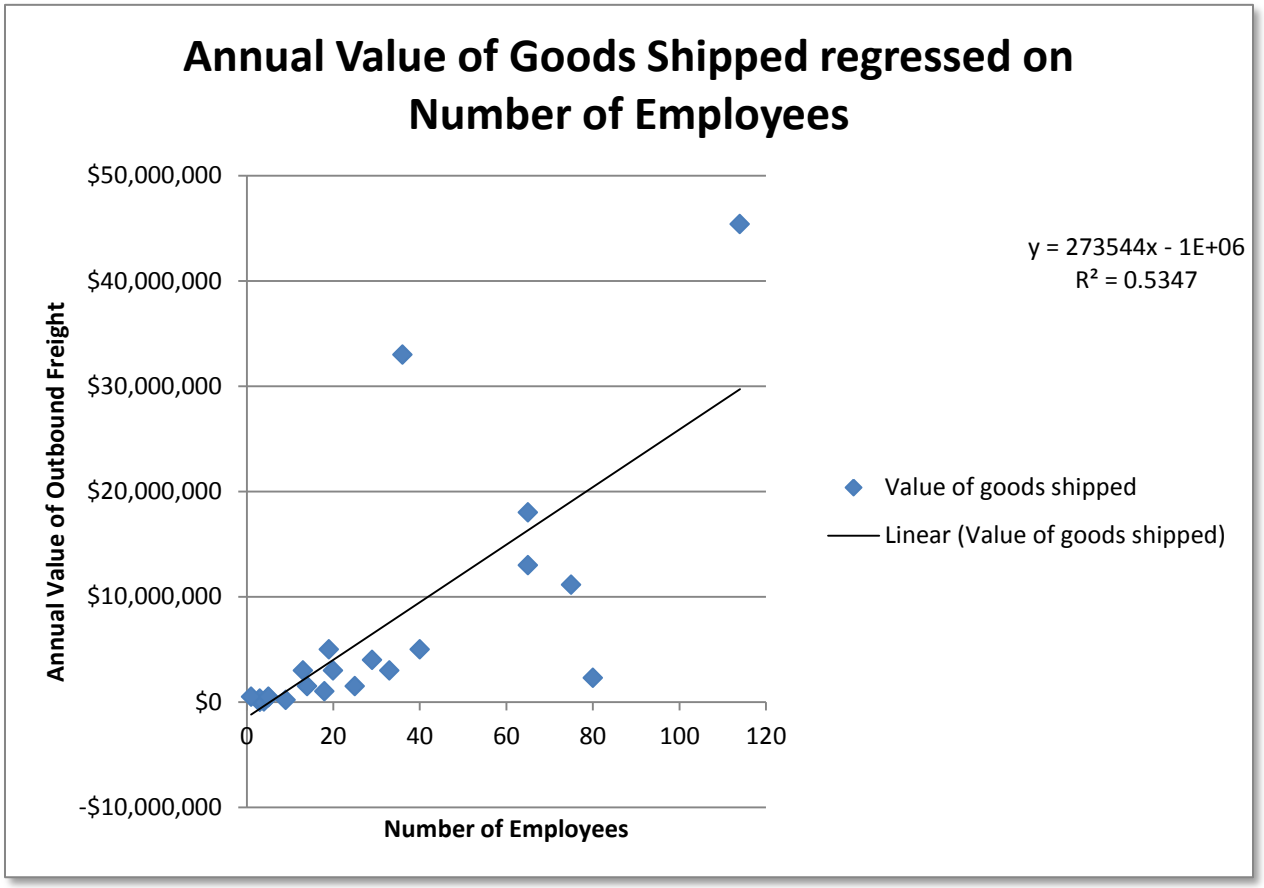
The relationship between the annual value of inbound freight value and the number of employees is described by the following equation: Annual Value Inbound = ($87,397 x Number of employees) - $562,993. The Adjusted R^2 of this model is 0.74 (note the graph displays R^2 instead of Adjusted R^2 because of Microsoft Excel default functionality), which means that approximately 74% of the variation in the data is explained by this equation. The regression equation as a whole is significant at the 1% level according to the Significance F value, and the variable itself is significant at the 1% level according to the P-value.

Essentially the equation provides an annual rate of $87,397 of inbound freight value generated per employee. This compares with a ratio of the mean inbound freight value/ mean number of employees which equals $68,017. A summary of these two results follows:

Estimate for amount of Annual Inbound Freight Value per Employee	
Coefficient of Regression Analysis	$87,397 per employee
Mean Value/ Mean Number of Employees	$68,017 average per employee

Computer illustration of right hand access lanes (i.e. "jug handle") to accommodate left hand turns - highlighted in orange

Annual Freight Value (Outbound) per Employee – Statistically Significant:



Regression Statistics	
Multiple R	0.731253751
R Square	0.534732048
Adjusted R Square	0.512576431
Standard Error	7972535.566
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.53407E+15	1.53407E+15	24.13528155	7.36665E-05
Residual	21	1.33479E+15	6.35613E+13		
Total	22	2.86886E+15			

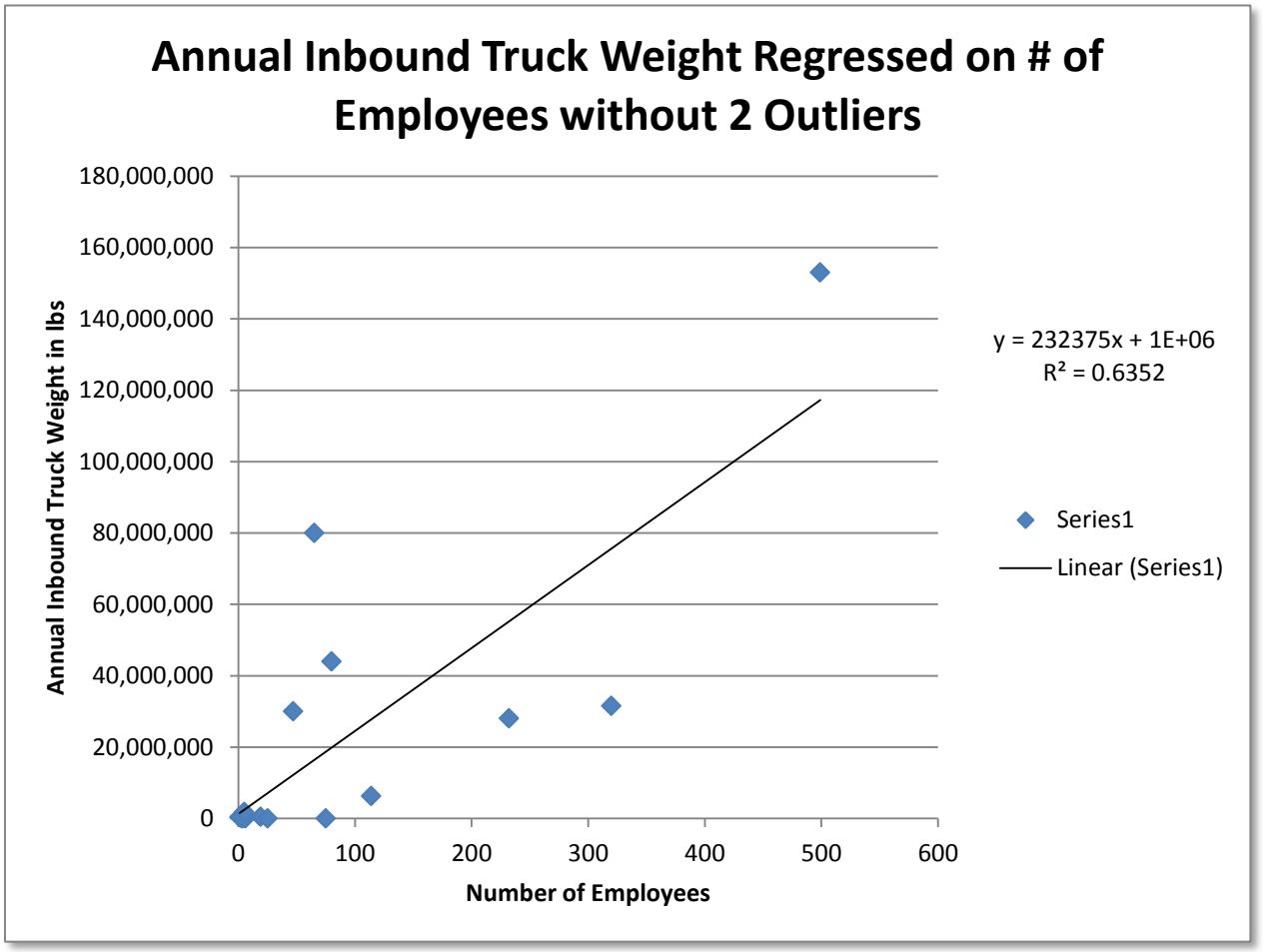
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1470970.478	2337849.551	-0.629198092	0.536004771	-6332794.77	3390853.815	-6332794.77	3390853.815
TOTAL EMPOYEES	273544.0663	55680.24195	4.912767198	7.36665E-05	157750.6642	389337.4683	157750.6642	389337.4683

The relationship between the annual value of outbound freight and the number of employees is described by the following equation: Annual Value Outbound = ($273,544 x Number of employees) - $1,470,970. The Adjusted R^2 of this model is 0.51 (note the graph displays R^2 instead of Adjusted R^2 because of Microsoft Excel default functionality), which means that approximately 51% of the variation in the data is explained by this equation. The regression equation as a whole is significant at the 1% level according to the Significance F value, and the variable itself is significant at the 1% level according to the P-value.

Essentially the equation provides an annual rate of $273,544 of outbound freight value generated per employee. This compares with a ratio of the mean outbound freight value/ mean number of employees which equals $223,717. A summary of these two results follows:

Estimate for amount of Annual Outbound Freight Value per Employee	
Coefficient of Regression Analysis	$273,544 per employee
Mean Value/ Mean Number of Employees	$223,717average per employee

Annual Truck Weight (Inbound) per Employee – Statistically Significant:



Regression Truck Weight on Employees						
SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.796970841					
R Square	0.635162521					
Adjusted R Square	0.613701493					
Standard Error	24051349.82					
Observations	19					
ANOVA						
	df	*SS*	*MS*	*F*	*ignificance F*	
Regression	1	1.71204E+16	1.71204E+16	29.59609	4.41E-05	
Residual	17	9.83395E+15	5.78467E+14			
Total	18	2.69543E+16				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95.0%*
Intercept	1333590.017	6484274.762	0.205665254	0.839495	-1.2E+07	15014213.92
TOTAL EMPOYEES	232375.4387	42714.27634	5.440228857	4.41E-05	142256.2	322494.6843

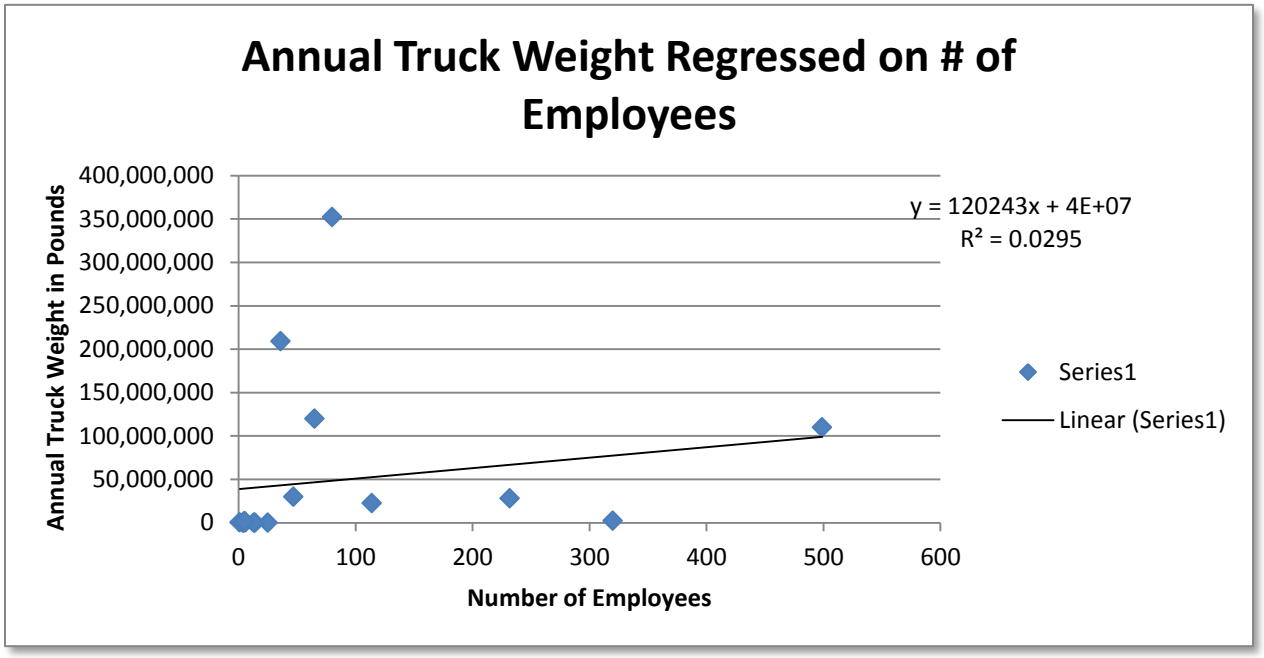
The relationship between the annual weight of inbound freight and the number of employees is described by the following equation: Annual Freight Weight Inbound (in lbs) = (232,375 lbs x Number of employees) + 1,333,590 lbs. The Adjusted R^2 of this model is 0.61 (note the graph displays R^2 instead of Adjusted R^2 because of Microsoft Excel default functionality), which means that approximately 61% of the variation in the data is explained by this equation. The regression equation as a whole is significant at the 1% level according to the Significance F value, and the variable itself is significant at the 1% level according to the t-stat and P-value.

Essentially the equation provides an annual rate of 232,375 lbs of inbound freight weight generated per employee. This compares with a ratio of the mean inbound freight weight/ mean number of employees which equals 249,100 lbs/employee. A summary of these two results follows:

Estimate for amount of Annual Inbound Freight Weight per Employee	
Coefficient of Regression Analysis	232,375 lbs per employee
Mean Inbound Weight/ Mean Number of Employees	249, 100 lbs average per employee

Computer illustration of right hand access lanes (i.e. "jug handle") to accommodate left hand turns - highlighted in yellow

Annual Truck Weight (Outbound) per Employee – Not Statistically Significant:



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.171654941
R Square	0.029465419
Adjusted R Square	-0.031192993
Standard Error	96461756.69
Observations	18

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	4.51993E+15	4.51993E+15	0.485759815	0.495828
Residual	16	1.48878E+17	9.30487E+15		
Total	17	1.53398E+17			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	38960234.24	26773163.75	1.455197249	0.164953783	-1.8E+07	95716806	-1.8E+07	95716806
TOTAL EMPOYEE	120242.9719	172523.7581	0.696964715	0.495827533	-245491	485977	-245491	485977

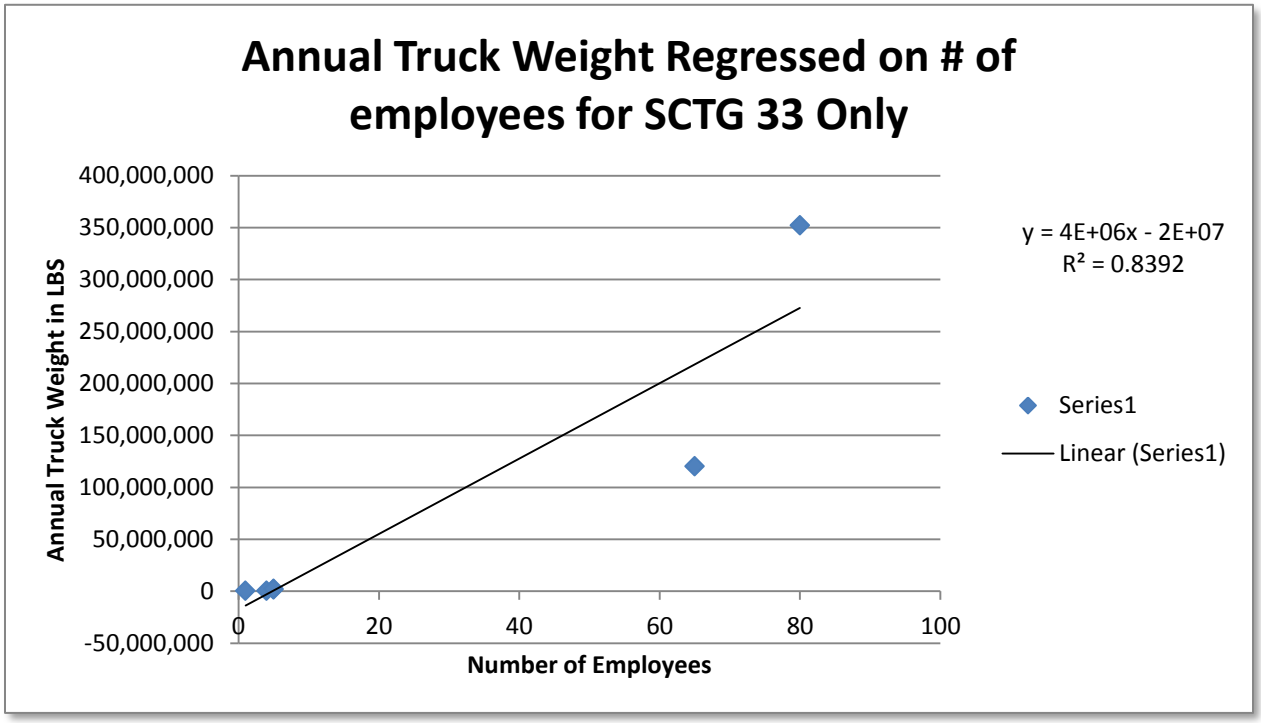
The relationship between the annual weight of outbound freight is not statistically significant. The Adjusted R^2 of this model is negative. The regression equation as a whole is not significant at any conventional significance level according to the Significance F value, and the variable itself is not significant at any conventional significance according to the t-stat and P-value.

This lack of significance could be due to the fact that many businesses are shipping out less than truckload (LTL) quantities due to logistics or just-in-time supply reasons. For instance a sophisticated retailer such as Wal Mart may have an integrated ordering system whereby when a certain amount of product is sold off the shelf an automatic replenishment order is sent to the supplier. This means that the supplier may have shipping weight per shipment that fluctuates directly with retail patterns and demand and does not correlate with number of employees at the supplier. It is noteworthy that the

difference between the regression coefficient rate and the mean is much larger than the previous example. This is probably due to the fact that the regression equation is not statistically significant. A summary of results follows (warning not statistically significant):

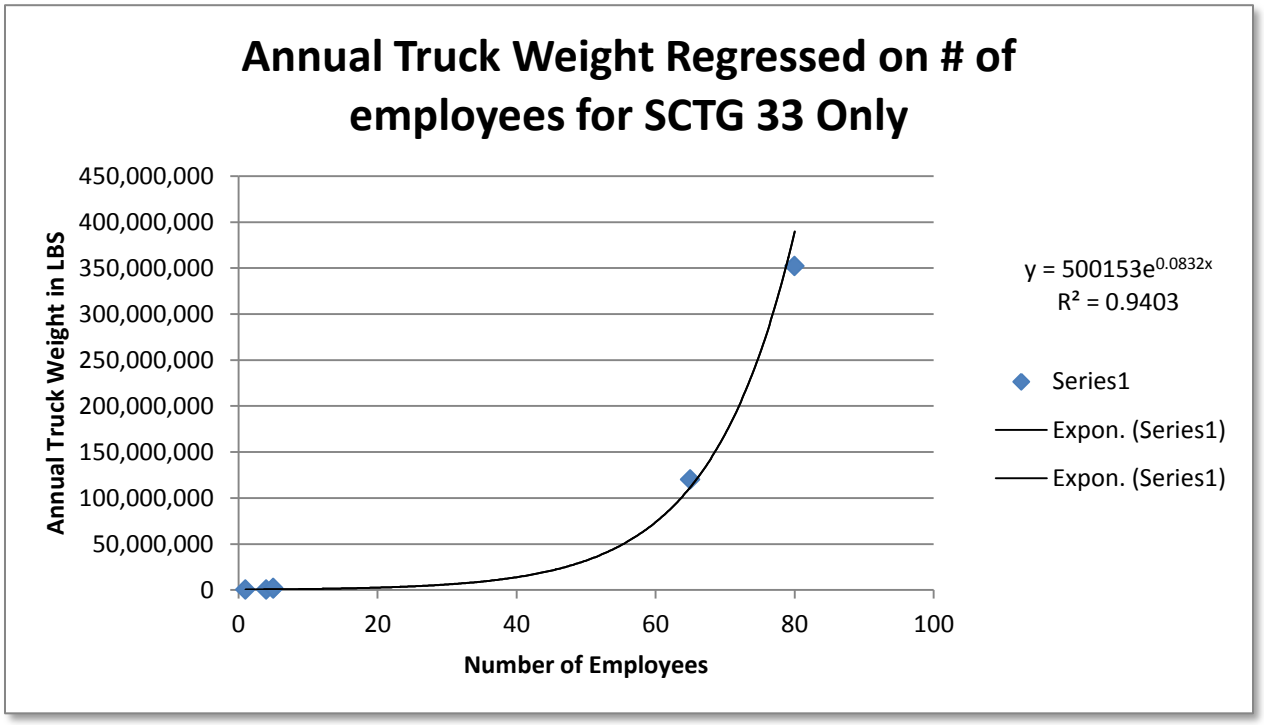
Estimate for amount for Annual Outbound Freight Weight per Employee	Not Statistically Significant
Coefficient of Regression Analysis	120,243 lbs per employee
Mean Inbound Weight/ Mean Number of Employees	595,690 lbs average per employee

If the analysis is narrowed to the businesses that fall within the standard transportation classification SCTG-33, which primarily includes metal work and metal fabricators, the results become statistically significant. However, there are only 6 data points that correspond with SCTG 33 in our sample. Following are the SCTG 33 results for comparison:

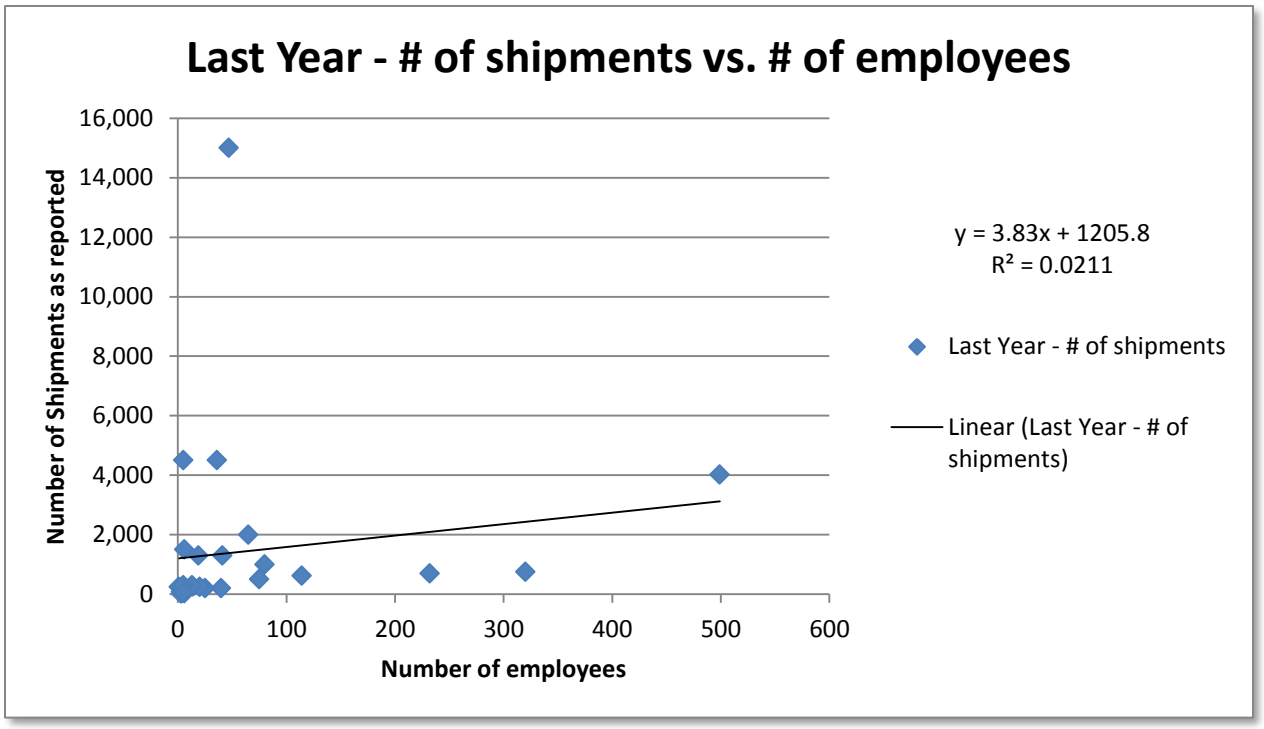


SUMMARY OUTPUT		For SCTG 33 Only						
Regression Statistics								
Multiple R	0.916100738							
R Square	0.839240563							
Adjusted R Square	0.799050703							
Standard Error	63566347.27							
Observations	6							
ANOVA								
	df	*SS*	*MS*	*F*	*ignificance F*			
Regression	1	8.43771E+16	8.43771E+16	20.88189847	0.010263			
Residual	4	1.61627E+16	4.04068E+15					
Total	5	1.0054E+17						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-17293043.16	33475978.06	-0.51658067	0.632695777	-1.1E+08	75651172	-1.1E+08	75651172
X Variable 1	3623801.619	793011.3893	4.569671593	0.010263342	1422049	5825554	1422049	5825554

Interestingly, an exponential regression fits the date for SCTG 33 even better than a linear regression (below):



Annual Volume (Inbound) # of shipments per Employee – Not Statistically Significant:



SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.14537266								
R Square	0.02113321								
Adjusted R Square	-0.0165155								
Standard Error	2985.66307								
Observations	28								
ANOVA									
	df	*SS*	*MS*	*F*	*Significance F*				
Regression	1	5003763.953	5003764	0.561326	0.460451755				
Residual	26	231768782.7	8914184						
Total	27	236772546.7							
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*	
Intercept	1205.80552	643.175342	1.8747695	0.072101	-116.2603333	2527.871	-116.26	2527.871	
TOTAL EMPOYEES	3.82995005	5.111937076	0.749217	0.460452	-6.677787093	14.33769	-6.67779	14.33769	

The relationship between the annual (inbound) volume - # of shipments is not statistically significant. In fact the regression output is very similar to the previous case of annual outbound truck weight. The Adjusted R^2 of this model is negative. The regression equation as a whole is not significant at any conventional significance level according to the Significance F value, and the variable itself is not significant at any conventional significance according to the t-stat and P-value.

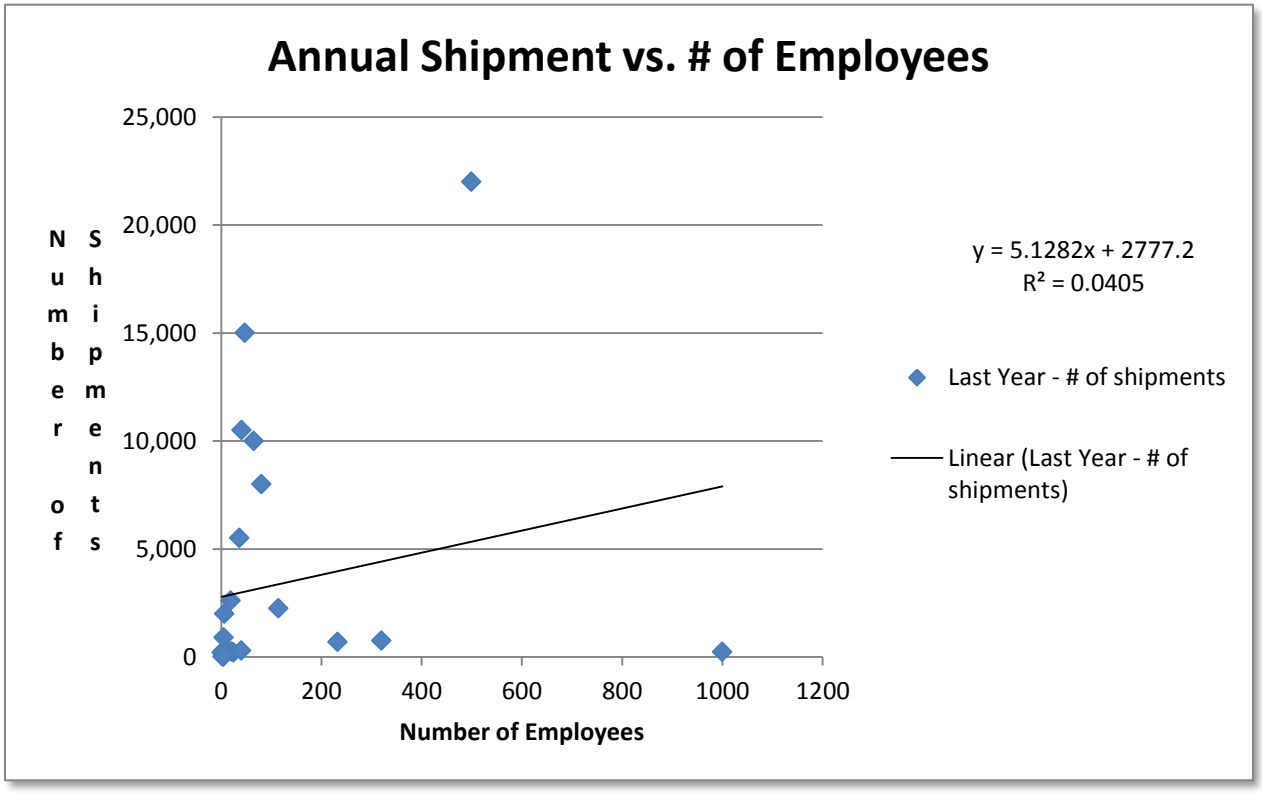
This lack of significance could be due confusion over the word "shipment." The researchers meant that the word "shipment" apply to a vehicle (i.e. truck) entering or leaving the premises. It became clear in the face-to-face interviews during Stage 1 of the data collection that some businesses use the term

"shipment" in a manner akin to an order or purchase order depending on which accounting or enterprise resources planning software they were using. In this regard a particular vehicle could have many "shipments" on it from their perspective. This confusion was cleared up in later versions of the survey instrument; however, it could have influenced results for this question. Also, similar to the case of annual outbound weight per employee, many businesses have switched to a supply chain management, logistics management or just-in-time type of approach for inputs and/or finished product. The number of "shipments" could be driven by upstream or downstream logistics management factors rather than the number of employees. This may not have been an issue for the annual value analyses because a bunch of small "shipments" would still aggregate up to a stable annual value of freight. For this and other variables that do not show statistical significance in the regression analysis, the mean (average) value per employee may be a better measure. Nevertheless, a summary of results follows (warning not statistically significant):

Estimate for amount for Annual Volume (Inbound) per employee	Not Statistically Significant
Coefficient of Regression Analysis	3.83 shipments per employee
Mean Inbound Weight/ Mean Number of Employees	23.80 shipments per employee

Once again there is a large discrepancy between the mean and the coefficient.

Annual Volume (Outbound) # of shipments per Employee – Not Statistically Significant:



SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.201212							
R Square	0.040486							
Adjusted R Square	-0.00123							
Standard Error	5622.397							
Observations	25							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	30678083	30678083	0.970477	0.334811818			
Residual	23	7.27E+08	31611352					
Total	24	7.58E+08						
	Coefficients	*Standard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2777.172	1248.29	2.224781	0.03619	194.8873247	5359.456407	194.8873247	5359.456407
TOTAL EMPOYEES	5.1282	5.205619	0.985128	0.334812	-5.640442957	15.896842	-5.64044296	15.896842

The relationship between the annual (outbound) volume - # of shipments is not statistically significant. In fact the regression output is very similar to the previous cases of annual (inbound) volume and annual outbound truck weight. The Adjusted R^2 of this model is negative. The regression equation as a whole is not significant at any conventional significance level according to the Significance F value, and the variable itself is not significant at any conventional significance according to the t-stat and P-value.

As in the previous case, this lack of significance could be due confusion over the word "shipment." The researchers meant that the word "shipment" apply to a vehicle (i.e. truck) entering or leaving the premises. It became clear in the face-to-face interviews during Stage 1 of the data collection that some businesses use the term "shipment" in a manner akin to an order or purchase order depending on which accounting or enterprise resources planning software they were using. In this regard a particular vehicle could have many "shipments" on it from their perspective. This confusion was cleared up in later versions of the survey instrument; however, it could have influenced results for this question. Also, similar to the case of annual outbound weight per employee, many businesses have switched to a supply chain management, logistics management or just-in-time type of approach for inputs and/or finished product. The number of "shipments" could be driven by upstream or downstream logistics management factors rather than the number of employees. This may not have been an issue for the annual value analyses because a bunch of small "shipments" would still aggregate up to a stable annual value of freight. For this and other variables that do not show statistical significance in the regression analysis, the mean (average) value per employee may be a better measure. Nevertheless, a summary of results follows (warning not statistically significant):

Estimate for amount for Annual Volume (Outbound) per employee	Not Statistically Significant
Coefficient of Regression Analysis	5.13 shipments per employee
Mean Inbound Weight/ Mean Number of Employees	31.80 shipments per employee

As with all the cases in which the regression model is not statistically significant, there is a gap between the coefficient of the regression and the mean per employee. In these cases it is probably advisable to go with the mean, rather than the regression model.

Multiple Regressions for Three Cases of Statistical Insignificance:

For the three cases in which the OLS regression is not significant when regressed on employees (annual truck weight outbound, annual volume inbound and outbound) a multivariate regression was performed using both employees and square feet under roof as independent variables. Results for these three cases follow:

Annual Truck Weight Outbound: - Multivariate regression not statistically significant.

Annual Outbound Weight regressed on employees and square feet under roof
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.392450591
R Square	0.154017466
Adjusted R Square	0.033162819
Standard Error	58207183.46
Observations	17

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	8.63555E+15	4.32E+15	1.2744	0.31012
Residual	14	4.74331E+16	3.39E+15		
Total	16	5.60686E+16			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	25705779.99	17077004.76	1.505286	0.15448	-10920752	62332312	-1.1E+07	62332312.5
TOTAL EMPOYEES	463172.7473	331933.4786	1.395378	0.18464	-248753.76	1175099	-248754	1175099.25
Square feet under roof	-349.8784297	323.4568071	-1.08169	0.29767	-1043.6243	343.8674	-1043.62	343.867424

The multivariate regression still does not produce an acceptable Adjuster R Square and the P-values for the variables are not statistically significant at any of the conventional significance levels (10%, 5% or 1%). Also, the Significance F for the regression as a whole is not statistically significant at any of the conventional significance levels (10%, 5% or 1%). In this case, the multivariate regression did not substantially help in building a better model.

Annual Volume (number of shipments) Inbound: - Multivariate regression not statistically significant.

Regression Statistics	
Multiple R	0.184500623
R Square	0.03404048
Adjusted R Square	-0.049956
Standard Error	3138.04997
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	7981495.885	3990748	0.40526	0.67147162
Residual	23	226489225.1	9847358		
Total	25	234470721			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	1412.08385	733.4583116	1.925241	0.06665	-105.19027	2929.358	-105.19	2929.35797
TOTAL EMPOYEES	9.917101467	11.86011	0.836173	0.41166	-14.617405	34.45161	-14.6174	34.4516083
Square feet under roof	-0.006487724	0.010948516	-0.59257	0.55925	-0.0291365	0.016161	-0.02914	0.01616101

The multivariate regression still does not produce an acceptable Adjuster R Square and the P-values for the variables are not statistically significant at any of the conventional significance levels (10%, 5% or 1%). Also, the Significance F for the regression as a whole is not statistically significant at any of the conventional significance levels (10%, 5% or 1%). In this case, the multivariate regression did not substantially help in building a better model.

Annual Volume (number of shipments) Outbound: - Multivariate regression statistically significant at the 10% confidence level.

SUMMARY OUTPUT

Multiple Regresssion - Annual Volume Out

Regression Statistics	
Multiple R	0.475077537
R Square	0.225698667
Adjusted R Square	0.151955682
Standard Error	5205.243093
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	165851847.6	82925924	3.06061206	0.068164001
Residual	21	568985668.9	27094556		
Total	23	734837516.5			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0*
Intercept	1297.389679	1308.124643	0.991794	0.332589301	-1423.004439	4017.783797	-1423	4017.78
TOTAL EMPOYEES	0.999493889	5.182886318	0.192845	0.848933186	-9.778908254	11.77789603	-9.77891	11.7779
Square Footage	0.020047255	0.009016659	2.223357	0.037299719	0.001296086	0.038798424	0.001296	0.0388

In this case the Adjusted R-square is not optimal; however the Significance F indicates that the regression model as a whole is significant at the 10% level. Similarly, the square feet coefficient is significant at the 5% level; however, the employees coefficient is still not significant and any of the conventional significance levels (10%, 5% or 1%). In this case the multivariate regression did help to achieve some statistical significance. Following is a single variable regression focusing on square feet

under roof:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.473632183
R Square	0.224327445
Adjusted R Squa	0.189069602
Standard Error	5090.067395
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	164844222.6	1.65E+08	6.36248345	0.019393379
Residual	22	569993293.9	25908786		
Total	23	734837516.5			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1347.881062	1253.295592	1.075469	0.29381829	-1251.294911	3947.057036	-1251.29491	3947.057036
Square Footage	0.020685902	0.008200893	2.522396	0.01939338	0.003678292	0.037693513	0.003678292	0.037693513

The R-Square and p-values are similar for the coefficient of square feet under roof as in the multivariate case indicating that the regression relationship between Annual Volume outbound and square feet under roof is significant.

Results Summary:

The following is a summary of results from the regression analyses. The statistically significant cases are depicted with green font and the non-significant cases are depicted in red font. The mean (average) is also given to compare with the regression coefficient. The regression coefficient can be thought of as a rate in the sense that when one more employee is added the annual outbound freight value increases by $273,544. A similar relationship holds for the other coefficients. The average is merely the average for the dataset.

	Inbound	Outbound
Annual Freight Value per Employee	Coefficient = $87,397/employee Mean = $68,017/employee	Coefficient = $273,544/employee Mean = $223,717/employee
Annual Truck Weight per Employee	Coefficient = 232,375 lbs/employee Mean = 249,100 lbs/employee	Coefficient = 120,243 lbs/employee Mean = 595,690 lbs/employee
Annual Volume (#of Shipments) per Employee	Coefficient = 3.83 shipments/employee Mean = 23.80 shipments/employee	Coefficient = 5.13 shipments/employee Mean = 31.80 shipments/employee

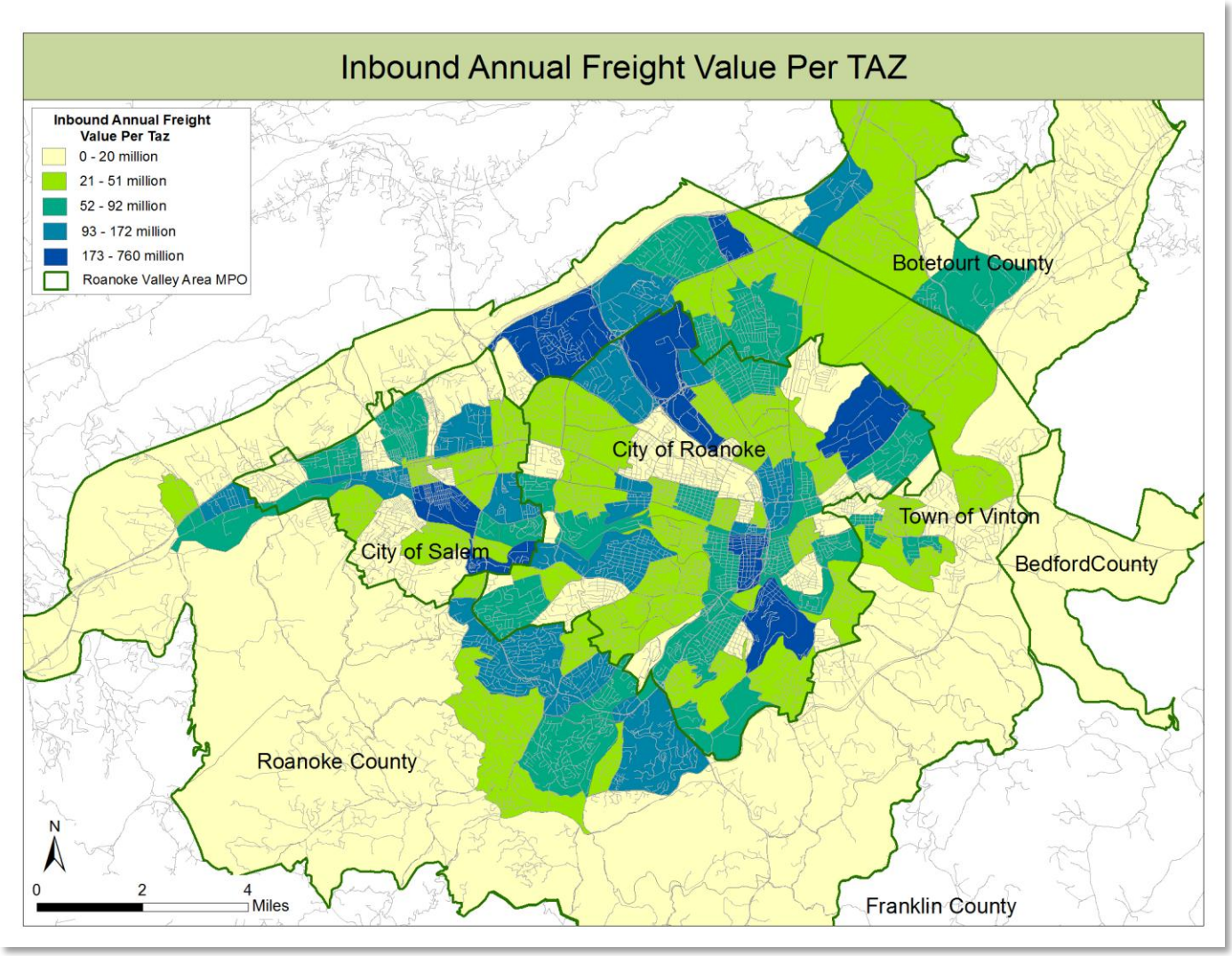
The three cases in which the regression does not yield statistically significant results the mean may be better suited to use for freight generation purposes. Please note that the gap between the regression coefficient value and the mean is much greater with the statistically insignificant results than with the statistically significant results.

The results can be useful to regional planning efforts. The statistically significant results for inbound and outbound freight value per employee will allow for an estimation of freight value at the TAZ level for transportation planning purposes. Freight value does not particularly help with traffic flow or congestion measures; however, it could be of use in a joint transportation planning/ economic development planning endeavor. The statistically significant result for annual inbound truck weight per employee could help by establishing freight attractions at the TAZ level for the region. The regression coefficients for the three statistically insignificant cases cannot be used with confidence in long-range planning. However, the means can be substituted as an alternative measure. There still may not be much confidence in using the means; nevertheless, the means represent the average of the actual data collected.

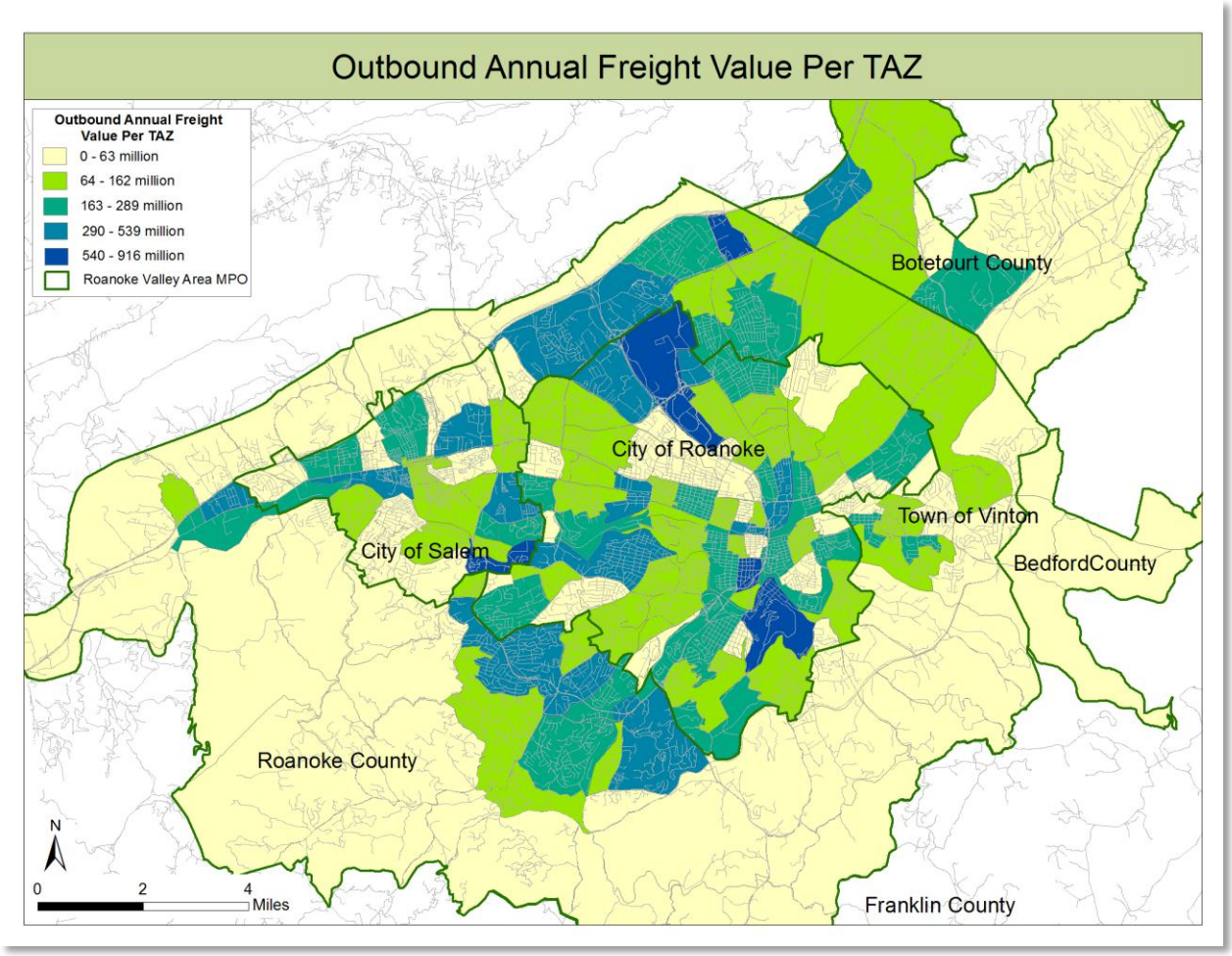
There are several possible reasons that contributed to the lack of statistical significance for the three cases. First of all, there was initial confusion between the accounting and/or information technology meaning of "shipment" and the transportation meaning of "shipment." The survey designers intended the word "shipment" to represent a vehicle carrying freight entering or leaving the premises. Some businesses use the word "shipment" to refer to a specific item such as a customer order generated by their accounting/information technology system. Thus, from their point of view a particular vehicle could carry many "shipments." This confusion was noticed early in the data gathering process and subsequent versions of the survey instrument clarified that shipment was intended to signify a vehicle carrying freight. Additionally, the widespread adoption of supply chain management and logistics management techniques by businesses and their suppliers and/or customers could contribute to a lack of statistical relationship between shipments and truck weight versus employees. For instance, a supplier to large retail establishments such as Wal-Mart or Target may have to conform to a delivery frequency dictated by the customers' logistics system, which is likely to be driven by sales and inventories. Thus the driver in the relationship are retail market and logistics management dynamics, not the number of employees at the supplier. The annual value results should be unaffected by these issues because the many small shipments required by a logistics management system would aggregate up to an annual value.

Application of Results to RVAMPO Study Area:

The freight generation rates per employee defined by the coefficients of the three statistically significant regression equations were applied at the TAZ level for the RVAMPO Study Area 2035.



Annual inbound freight value per TAZ, depicted on the preceding page, and annual outbound freight value per TAZ, depicted below, show similar geographic patterns as would be expected. The annual value ranges per color are higher in the outbound annual freight value map as would be expected by firms shipping in raw materials and then adding value and shipping out a more valuable finished product.



The geographic pattern for the inbound annual truck weight per TAZ, depicted on the next page, shows a somewhat similar pattern as the previous patterns pertaining to freight value with some slight variations. This is due to different relationships between value per employee and truck weight per employee estimated by the regression equations.

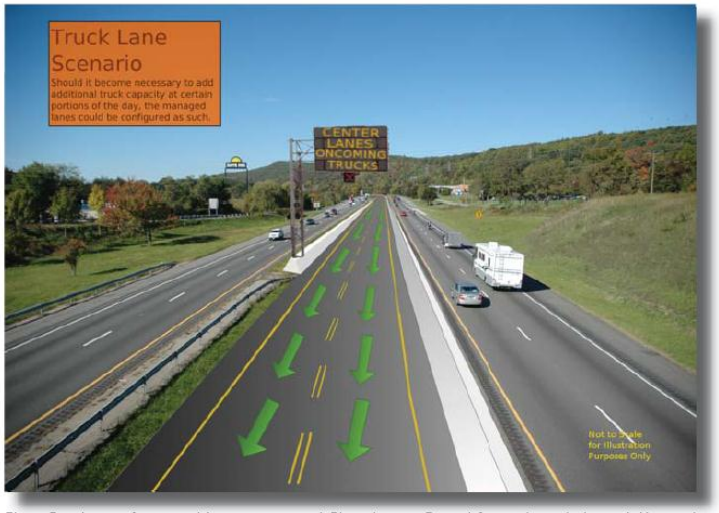
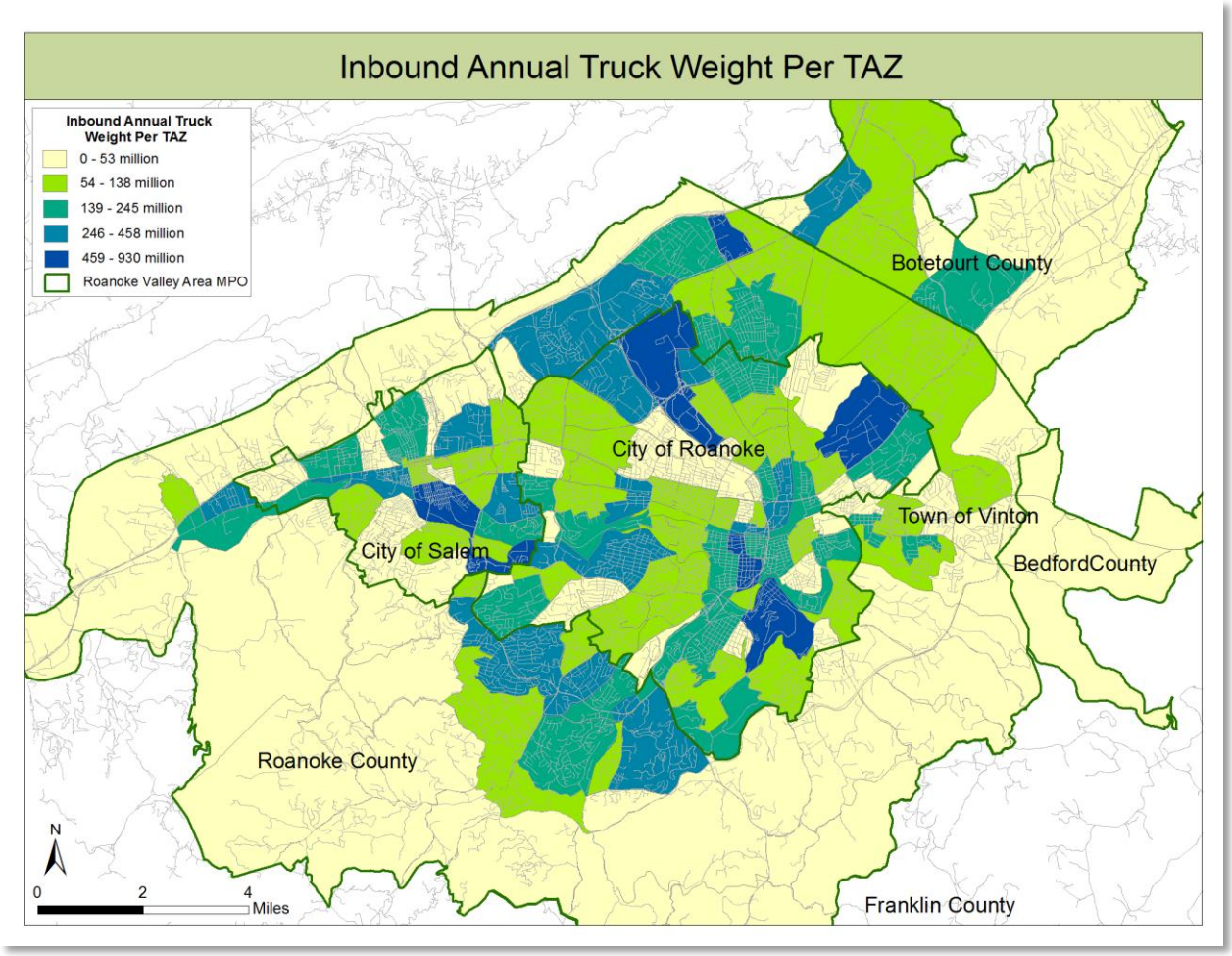


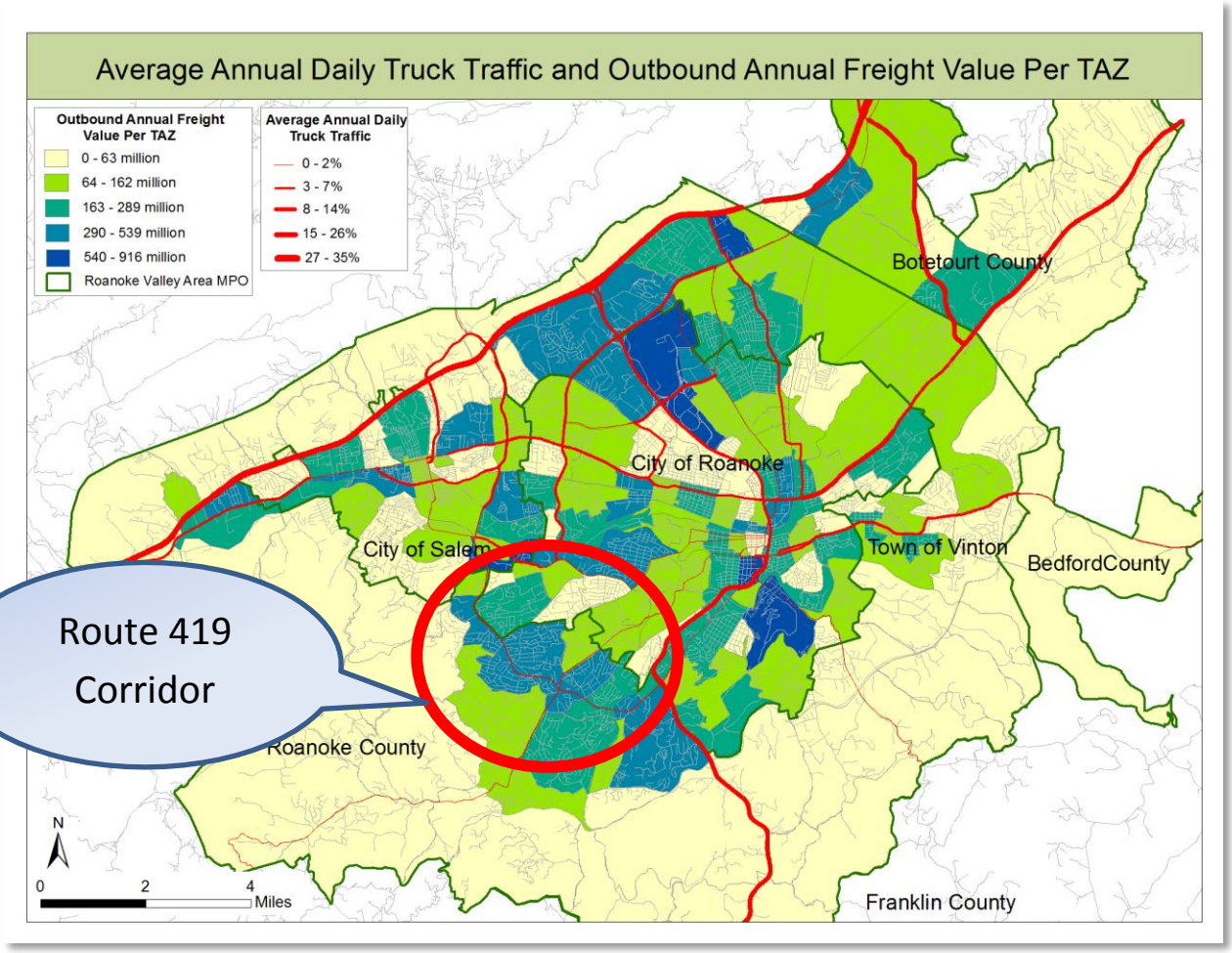
Photo-Simulation of managed lanes in current I-81 median configured for peak truck demand. Managed lanes could be coupled with a Variable Message Sign (center).



The map depicted on the next page relates the Outbound Annual Freight Value per TAZ to recent Average Annually Daily Traffic (AADT) Truck Percentages estimated from published VDOT traffic counts. In most cases higher AADT Truck Percentages are observed in close proximity to TAZs that are estimated to generate higher annual freight value according to the regression equation. However, the area along 419 "Electric Road," depicted inside the red circle below, shows medium to high annual freight value estimates and a relatively light AADT Truck Percentage. This is likely due to several factors:

- The employment along the corridor may currently be skewed toward office and retail uses.
- The regression equation likely over estimates freight generation for office and retail uses due to averaging effects from light industrial and industrial uses.

However, there are two areas of US 419 that have potential for current and future freight transportation impacts. The first area is from Starkey Road back to the interchange with US 220, and the second area is in parts of the City of Salem and Roanoke County near the Salem border. Any future upgrades and accommodations along US 419 should keep these two sections in mind.

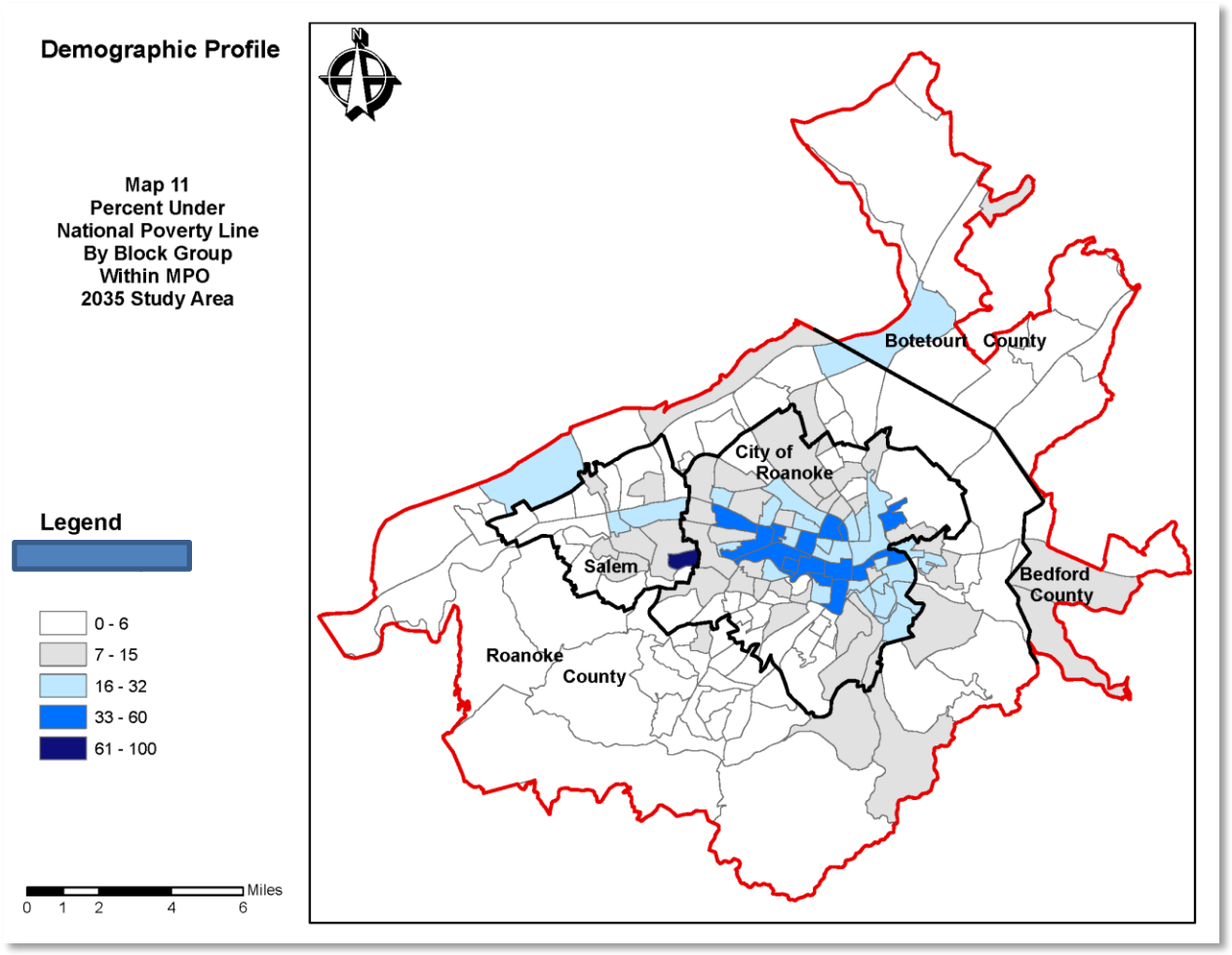


Environmental Justice Discussion:

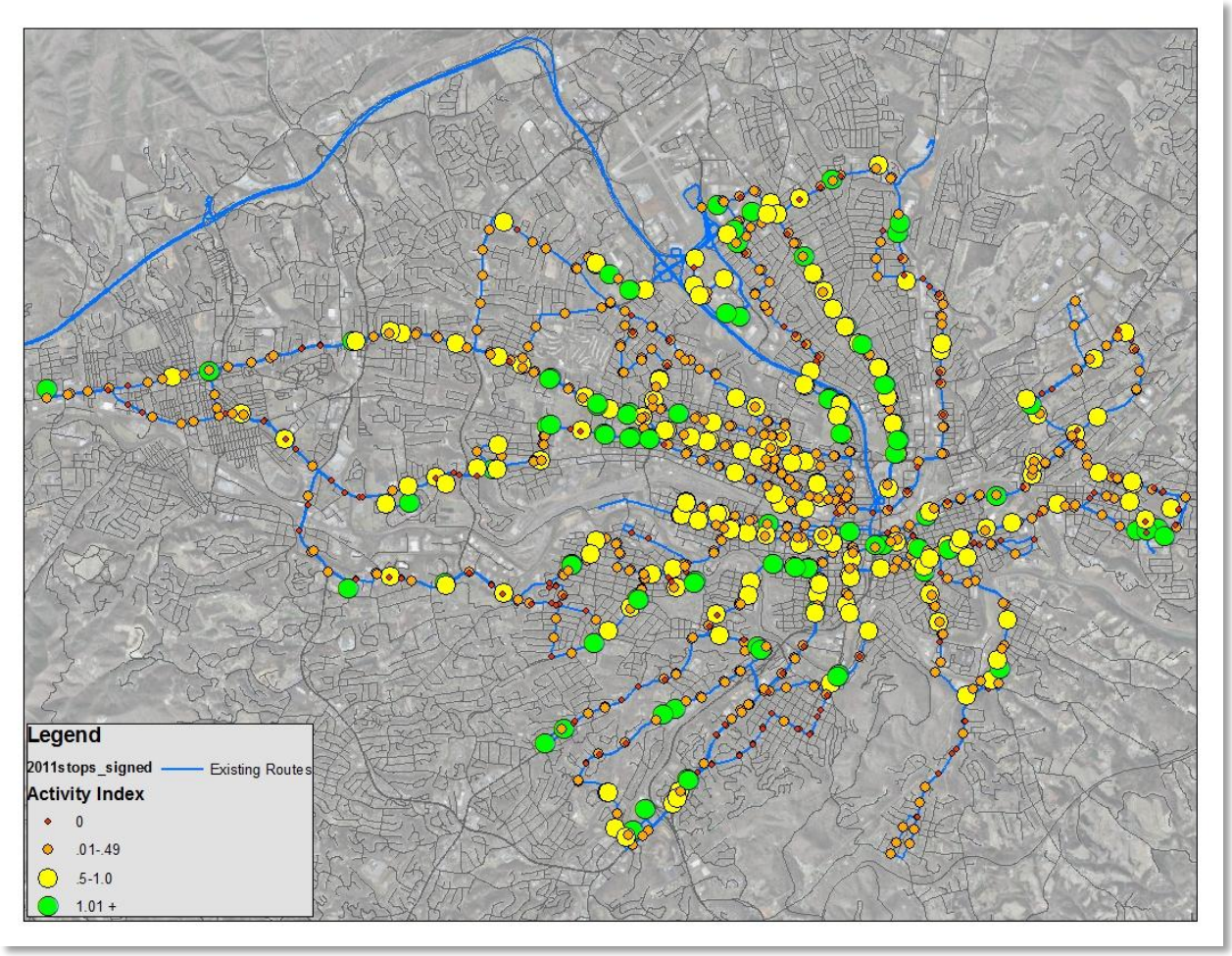
Shifting patterns of freight traffic provide both benefits and burdens for low-income and/or minority populations. On the one hand employment that generates freight value is often needed in low-income communities as it can pay better than other types of employment accessible to the population. On the other hand, increased freight traffic can pose safety and other challenges to residents of a particular neighborhood. It is beyond the scope of this document to evaluate whether there is a net benefit or burden to low income neighborhoods with increased freight related employment. As of the writing of this document, summer 2012, it is conceivable that community leaders would view freight related employment as a net benefit due to its potential to decrease unemployment and increase average wages. However, this cannot be demonstrated without a separate specific study on the matter.

The percentage of individuals under the national poverty line for the RVAMPO is depicted in the map on the following page. It should be noted that the geographic patterns in the freight generation maps and the poverty line map are not necessarily the same. At a planning level this would indicated that the populations that fall under the national poverty line may not necessarily be overburdened by freight producing businesses; however, they may not have greater access to employment and other benefits of

the businesses. In fact, there may be a "spatial mismatch" between the potential employment and an individual's access to transportation through public transportation or other means.

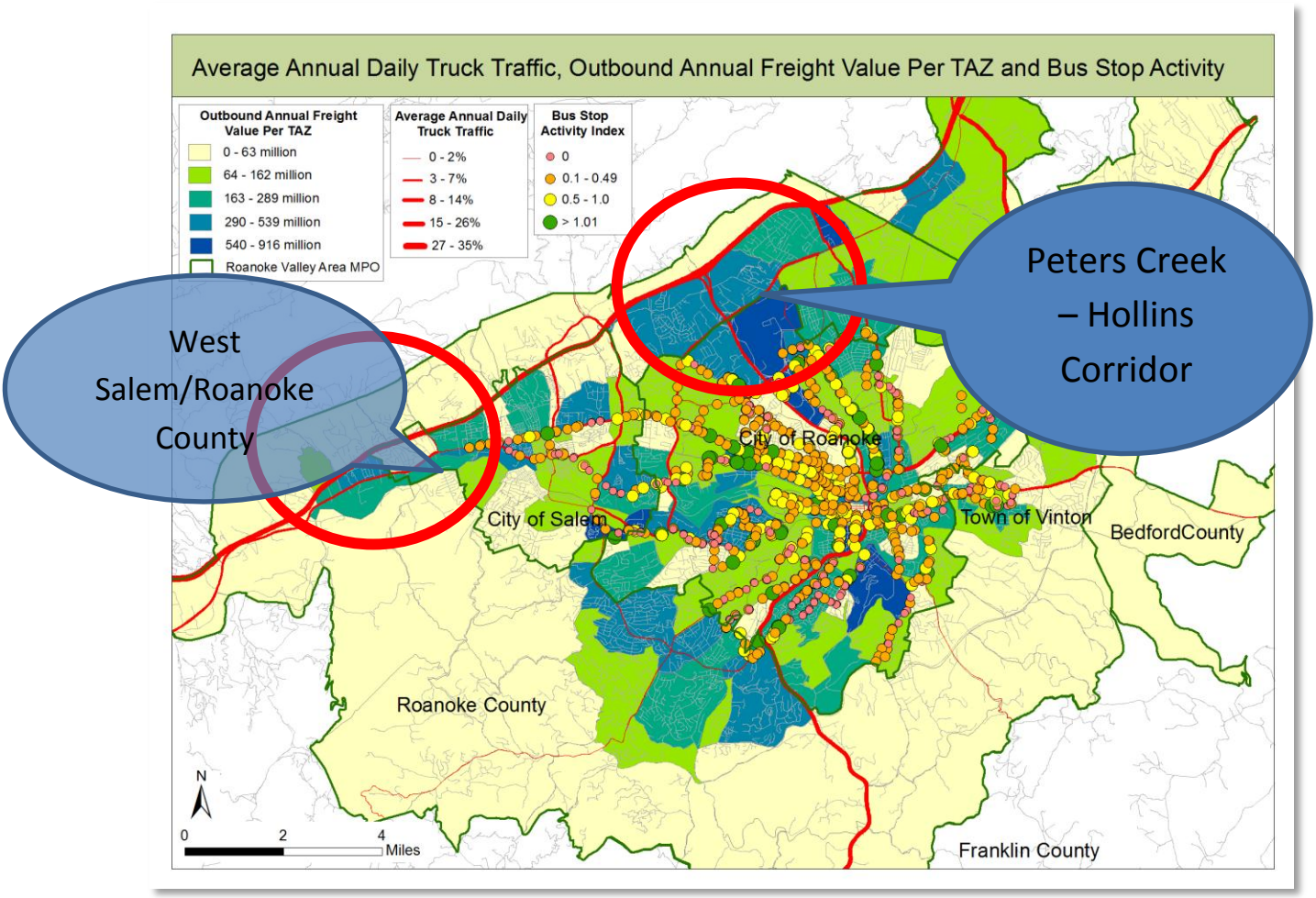


In order to discuss this concept of "spatial mismatch" between jobs related to freight and the residential locations of potential employees for those jobs this report will introduce some recent public transportation measures that were developed in the RVAMPO to analyze activity (boarding and alighting) at existing bus stops on the regions fixed route bus transit system. This is a novel approach to combine freight and public transportation analysis and measures together. The hope is that existing patterns in bus (public transit) usage will indicate whether the bus system can help to alleviate any potential spatial mismatch between potential employment related to freight and those who are seeking employment. In fact, several of the business stakeholders mentioned this issue during the freight interviews. They did not use the term "spatial mismatch;" however they described situations when they needed to hire for several positions that the candidates for those positions lived in a different part of the urban area and they could not use the bus to get to work because the bus lines did not extend out to that particular business. These businesses were advocating for increased public transit so that they could hire more seasonal employees.



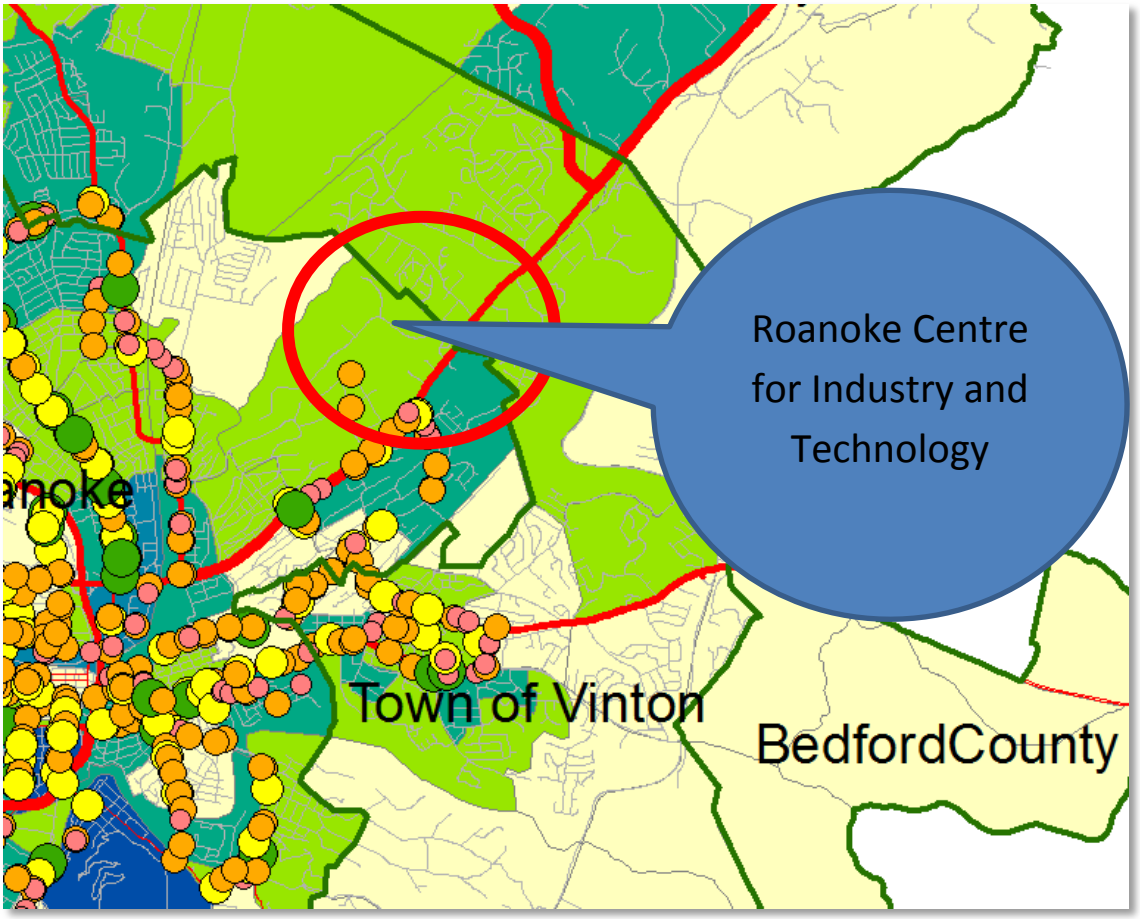
The map above uses data that was collected as a joint effort by RVAMPO and Valley Metro (Greater Roanoke Transit Company) staff. The data was collected between July 2010 and June 2011. Over 400 bus routes were randomly sampled yielding a 95% confidence level for the data collection period. An index was then constructed from the data for each bus stop using the following formula **Composite Activity Index = average usage * stop frequency.** The size and color of the dots above represent the Composite Activity Index for each of the bus stops on Valley Metro's fixed route system.

This data is overlaid on the outbound freight value per TAZ map that was developed using the regression relationship documented earlier in this report. The concept is to identify areas that are predicted to generate a lot of freight based on the regression relationship that don't currently have bus service and whose closest bus stops indicate a high activity index. It is anticipated that the combination of these two factors could indicate that there is potential to extend bus service to address potential employment spatial mismatch.



The two areas of note: Peters Creek – Hollins Corridor and West Salem/Roanoke County are depicted with the red circles in the map above. Each of these areas has a potential spatial mismatch between freight related employment and those who would benefit from such employment. Targeted rideshare marketing should be considered as a way to match potential employees who live in other areas to employment in these areas. In the case of the Peters Creek/Hollins area there is a corridor specific planning processes at the local level underway as of the writing of this document. The Hollins Area Plan can be found at the following link: http://www.roanokecountyva.gov/index.aspx?nid=341

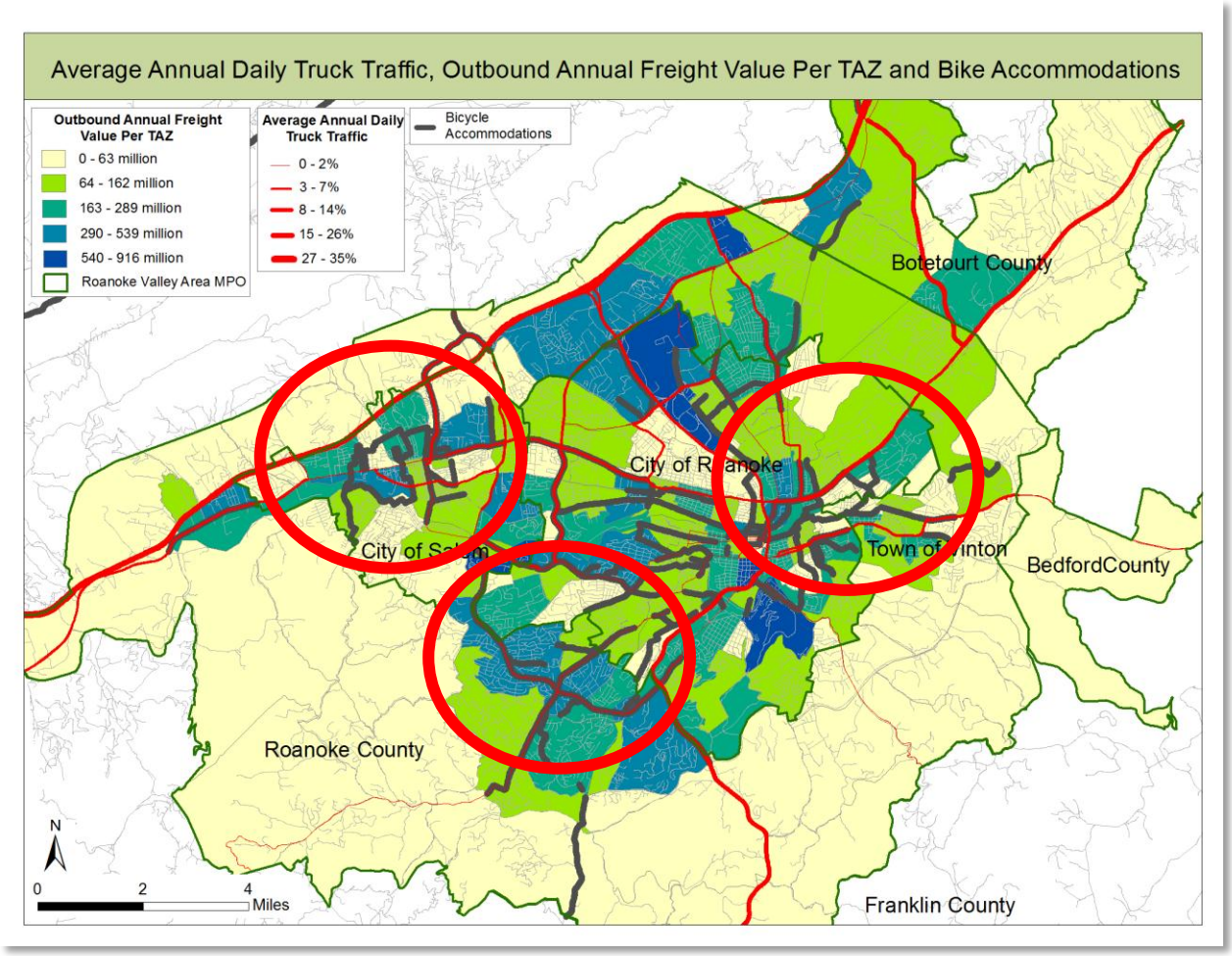
Much of the original feedback concerning the potential spatial mismatch between needed employees and potential employment came from freight interviews with businesses located in the Roanoke Centre for Industry and Technology in the City of Roanoke. A zoomed in section of the map depicts this area with a red circle (next page). It is ironic that that industrial park is just outside of the Valley Metro service area, and that the nearest bus stops show moderate to high activity. A separate discussion with stakeholders concerning this situation is taking place during Fiscal Year 2013.



Safety Discussion:

There are many safety issues that could be discussed with regards to freight transportation. This report will narrow its focus the potential safety issues that could result from the mixing of significant freight volumes and bicycle transportation in the same corridor. The photo on the next page shows a bicyclist beside a cement truck. The photo visually demonstrates the utility of bicycle lanes and wide shoulders in corridors that are likely to carry both freight transportation and bicycle transportation volumes.

It is beyond the scope of this report to delve into the details and design of bicycle facilities that can safely and harmoniously be used near corridors with substantial freight traffic volumes. Nonetheless, this report will highlight three areas within the RVAMPO Study Area that pose the potential to carry both significant freight and significant bicycle volumes. The three red circles depicted on the map on page 36 show areas that already have various bicycle accommodations, and are areas predicted to generate freight on a per TAZ basis. The three areas roughly correspond to the western half of the City of Salem, the Route 419 corridor and Vinton/NE City of Roanoke area. It is noteworthy that the Peters Creek/Hollins area that was discussed with reference to spatial mismatch between employees and freight generating businesses is not highlighted on the map. This is due to the lack of current bicycle accommodations in the area. Should more bicycle accommodations be constructed in the area they should be designed with potential safety issues with regards to freight transportation in mind.

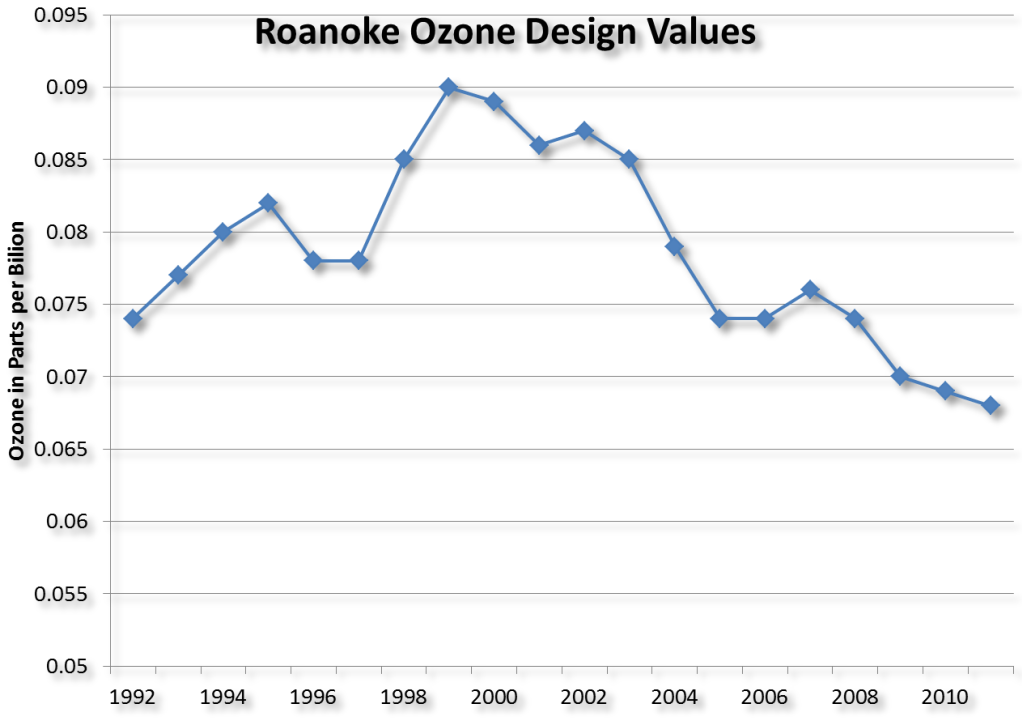

Average Annual Daily Truck Traffic, Outbound Annual Freight Value Per TAZ and Bike Accommodations
Outbound Annual Freight Value Per TAZ
0 - 63 million
64 - 162 million
163 - 289 million
290 - 539 million
540 - 916 million
Roanoke Valley Area MPO
Average Annual Daily Truck Traffic
0 - 2%
3 - 7%
8 - 14%
15 - 26%
27 - 35%
Bicycle Accommodations
Botetourt County
City of Roanoke
City of Salem
Town of Vinton
BedfordCounty
Roanoke County
Franklin County
N
0
2
4
Miles

Air Quality Discussion:

The RVAMPO study area is covered under an Ozone Early Action Compact (EAC) and an Ozone Early Action Plan (EAP), which were developed 2002-04. The EAC is essentially an agreement between local governments, the Virginia Department of Environmental Quality (DEQ) and the Federal Environmental Protection Agency (EPA) to pursue an Ozone EAP before an air quality plan would have been otherwise required under traditional nonattainment designation. The EAP must incorporate the same scientific rigor as the traditional approach and the EAP will be incorporated into the State Implementation Plan (SIP).

In early March 2008 the Federal EPA revised the nationwide 8-hour Ozone Standard to 75 parts per billion (ppb) based on a 3-year average. Indications are that the Roanoke Region's 3-year average for the 2006, 2007 and 2008 Ozone seasons are at 74 ppb, within the new nationwide standard. As such, it is likely that the EAC/EAP will continue to be regarded as successful, and that the RVAMPO transportation planning process will not have to include the traditional air quality conformity analyses for the major planning products.

In Spring and Summer 2011, the Federal EPA postponed a new adjustment of the nationwide 8-hour Ozone Standard until 2013. The Federal EPA has stated that the primary 8-hour Ozone Standard will be revised to a final value somewhere within the range of 60 ppb to 70 ppb. The Federal EPA asserts that the final standard will be set sometime in 2013.

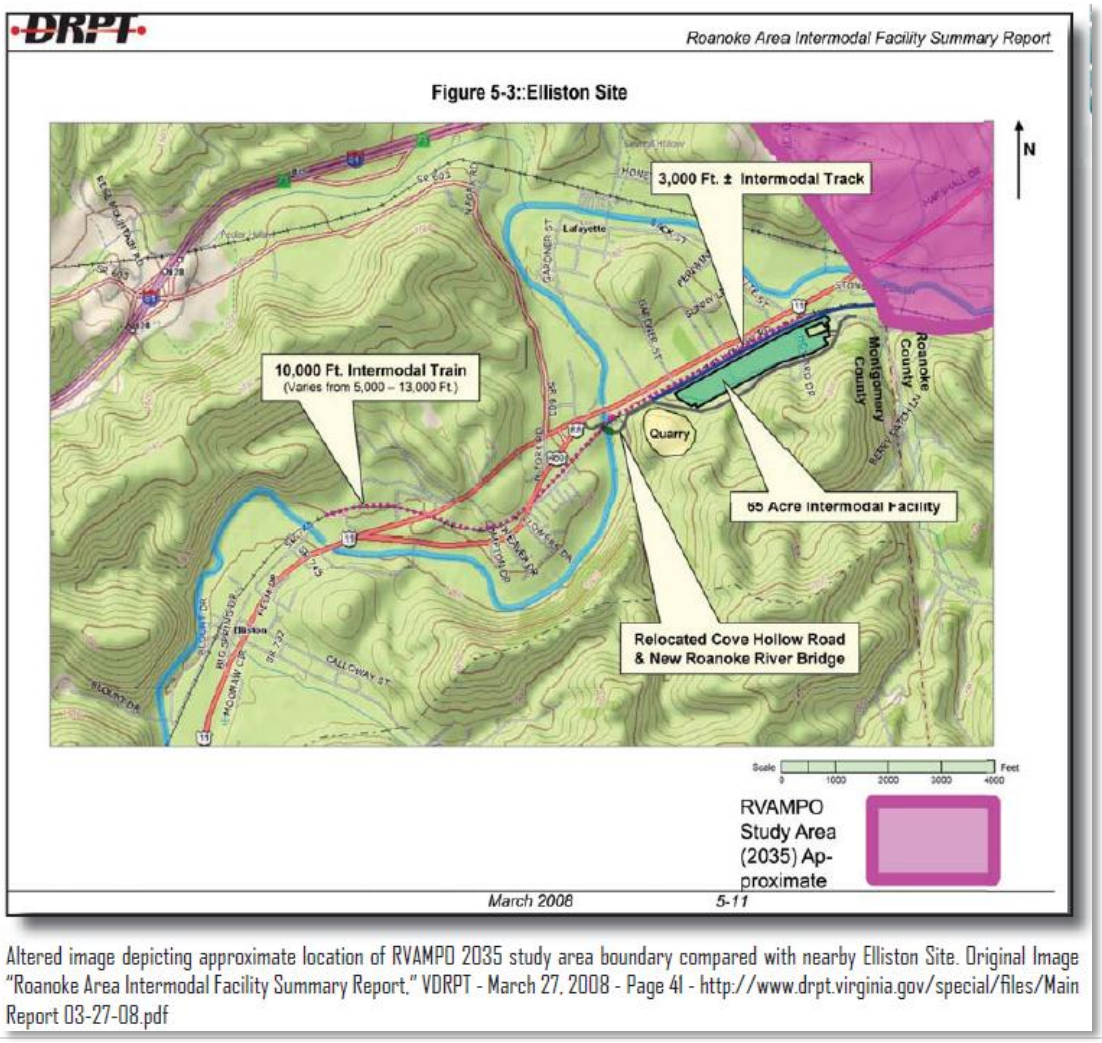


The chart on the previous page, provided by Virginia DEQ on 04-17-2012 summarizes the ground level ozone trends in the Roanoke Valley. The trends are downward which is positive for public health and the prospects of complying with future national Ozone standards.

Freight vehicle idling could pose a significant challenge to the RVAMPO Study Area's recent air quality improvements. Recent inquiries by RVAMPO staff have not uncovered any local level anti-idling ordinances in the Roanoke Valley. The localities involved in the original Ozone EAC/EAP process do have anti idling policies for their own fleets of vehicles. It is beyond the scope of this report to discuss the legal prospects of anti-idling ordinances in Virginia. It is hoped the large freight generators will voluntarily develop anti-idling policies for their place of business.

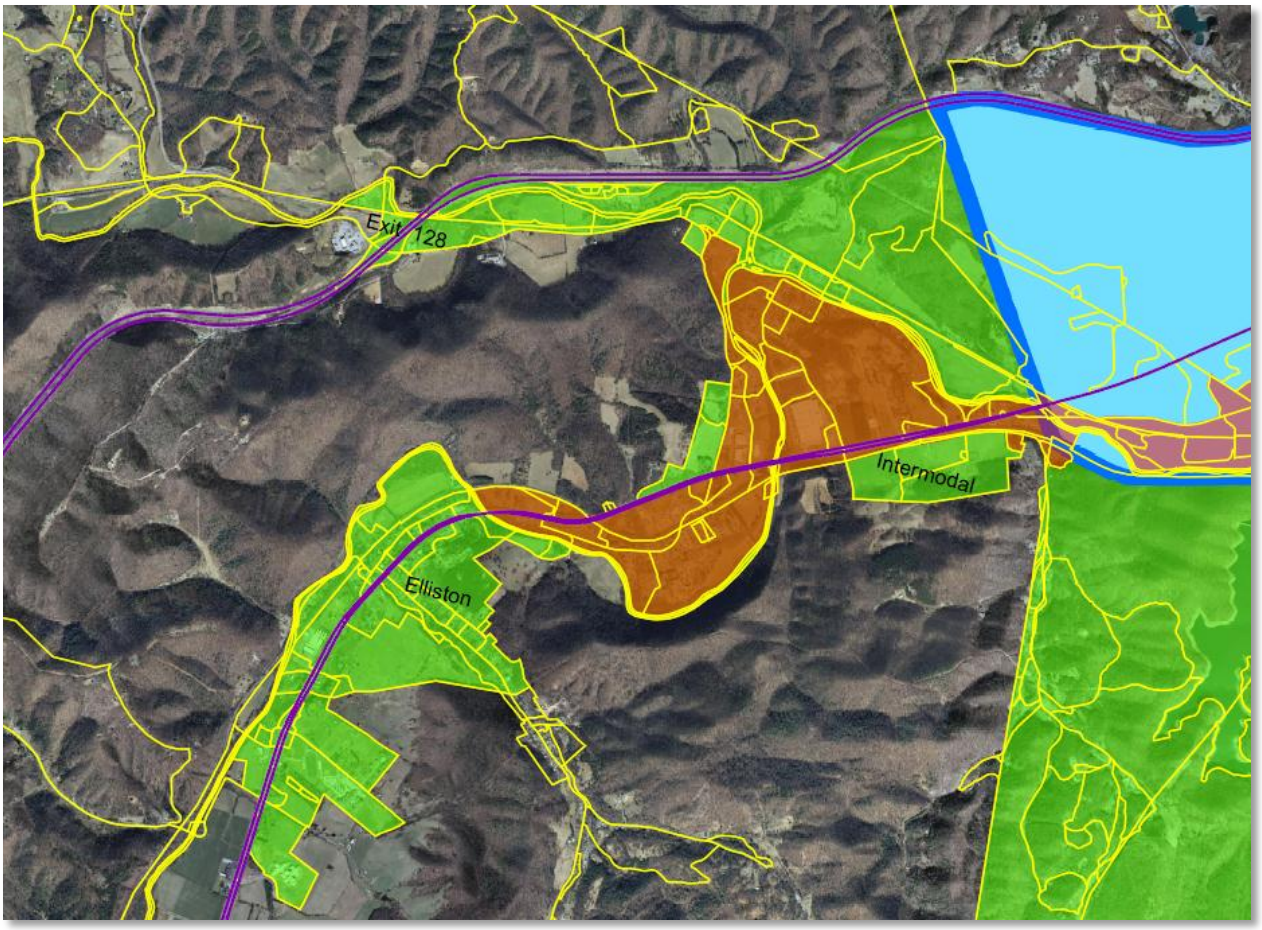
Intermodal Center in Elliston (Montgomery County):

In 2008, the Virginia Department of Rail and Public Transportation (VDRPT) selected a site in Elliston, Virginia for the regional Intermodal Freight Transfer facility for the multi-state Heartland Corridor Project with Norfolk Southern (NS). The Elliston location is just outside the RVAMPO 2035 study area for this plan. The following graphic illustrates the proximity of the selected site to the 2035 study area (shown in purple).



Altered image depicting approximate location of RVAMPO 2035 study area boundary compared with nearby Elliston Site. Original Image "Roanoke Area Intermodal Facility Summary Report." VDRPT - March 27, 2008 - Page 41 - http://www.drpt.virginia.gov/special/files/Main Report 03-27-08.pdf

Census 2010 results which were released in March 2012 indicates that the RVAMPO urbanized area boundary (UZA) now extends into Montgomery County. As such Montgomery County will have voting membership on the RVAMPO Policy Board by the Summer 2013. AS of the writing of this document, the RVAMPO Policy Board has invited Montgomery County to appoint a liaison member to both the RVAMPO Policy Board and the Transportation Technical Committee (TTC). The liaison member will be present at meetings to advise the RVAMPO and TTC on issues pertaining to a new RVAMPO Study Area Boundary 2040 and bylaws change to incorporate Montgomery County. The following map depicts the RVAMPO UZA (defined by Census Bureau) in Red, and staff recommendations for the RVAMPO Study Area Boundary 2040 in green. The proposed intermodal site is not included in the census defined UZA boundary (Red), it is included in the staff recommended study are boundary (Green). This issue of whether or not to include the proposed intermodal site in the new RVAMPO study area boundary will have to be decided through the MPO process before Summer 2013.

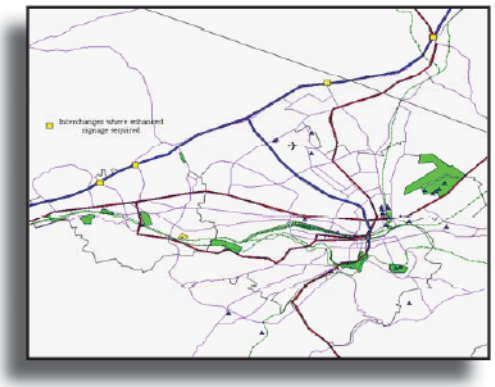


2002-03 Wilbur Smith Freight Study:

In 2002-03 RVAMPO and the Roanoke Valley Alleghany Regional Commission (RVARC) contracted with Wilber Smith Associates to conduct a regional freight study for the Roanoke Valley. That study used the Reebie (now Transearch) freight database and developed and in-depth analysis of freight flows to and from the Roanoke Valley. That study also included a freight stakeholder involvement process that

developed a list of the "Top 10 Freight Fast Action Projects" that should be considered in future plans. Below are the Ten Fast Action Projects from the original plan:

Project #1 Improve Highway Signs on I-81 and I-581

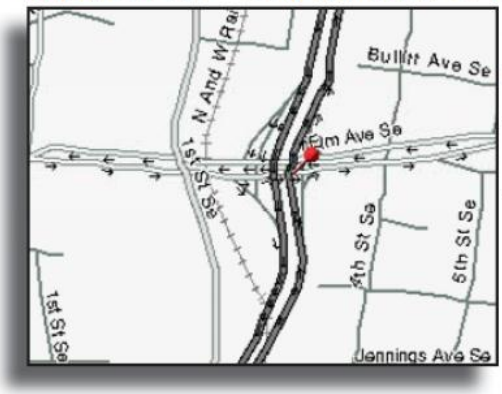


Source: Shipper Interviews
Jurisdiction: VDOT
Problem: Current traffic signs at major exits do not provide adequate information to truck drivers attempting to locate industrial centers.
Proposal: Install signs indicating exits to the City of Salem and Town of Vinton. List major industrial facilities

Project #2 Orange Ave & I-581

Source: Motor Carrier Survey
Jurisdiction: VDOT
Problem: Inadequate acceleration/deceleration lanes at interchange
Proposal: Redesign and extend entrance/exit ramps to accommodate large trucks. (note: current TIP references ramp acceleration projects)

Project #3 Elm Avenue & I-581

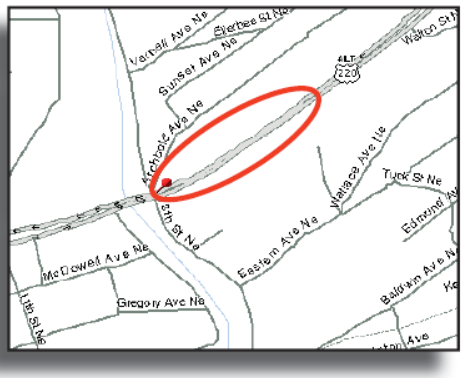


Source: Motor Carrier Survey
Jurisdiction: VDOT
Problem: Inadequate acceleration/deceleration lanes at interchange
Proposal: Redesign and extend entrance / exit ramps to accommodate large trucks. (note: current TIP references ramp acceleration projects)

Project #4 Elm Avenue & Williamson

Source: Motor Carrier Survey
Jurisdiction: City of Roanoke
Problem: Congested intersection – difficult to turn through with a truck
Proposal: Study traffic patterns to determine if an alternate route could be used by trucks, and/or conduct an operational analysis of the intersection.

Project #5 Orange Av. & 13th St. NE

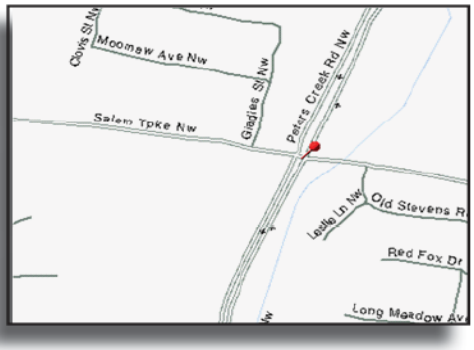


Source: Motor Carrier Survey
Jurisdiction: City of Roanoke
Problem: Traffic merges from 3 to 2 lanes creating a dangerous area as people attempt to beat trucks to the merge point.
Proposal: Conduct preliminary engineering analysis for possible road widening project.

Project #6 Salem Turnpike & Melrose Ave

Source: Motor Carrier Survey
Jurisdiction: VDOT
Problem: Dangerous intersection due to off-setting lanes, and just prior to the intersection Melrose has a narrow curve where many trucks go over the center line and encroach on east bound traffic lanes.
Proposal: Conduct an operational analysis

Project #7 Salem Turnpike & Peters Creek Road



Source: Motor Carrier Interviews
Jurisdiction: City of Roanoke
Problem: Signal functions poorly – "west bound is always green – east bound waiting to turn have to wait until next light cycle."
Proposal: Conduct an operational analysis of the intersection.

Project #8 Lynchburg Turnpike & Electric Road

Source: Motor Carrier Interviews
Jurisdiction: City of Salem
Problem: Inadequate overhead clear ance: bridge height is 13′9″ and many loads require 14″.
Proposal: Consider lowering the road bed 3″.

Project #9 US 460 and Granby Road

Source: Motor Carrier Survey
Jurisdiction: City of Roanoke
Problem: Very difficult for trucks to make a right hand turn off US 460 (Orange Av) onto Granby Rd. to access to Statesman Industrial Center.
Proposal: Conduct an operational analysis of the intersection.

Project #10 US 460 and Challenger Ave

Source: Motor Carrier Interviews
Jurisdiction: County of Roanoke
Problem: Turn lanes constructed for the Bonsack Wal-Mart are not wide enough to store trucks side by side in the two lanes.
Proposal: Widen turn lanes.

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Gifford, Jonathan, Zhenua Chen, Jing Li, Uma Kelekar, Nathaniel Zebrowski, and Xin Zhou. *Mega-regions and Freight: Evidence from Commodity Flow Survey and Freight Analysis Framework*. Transportation and Economic Development Center, George Mason University, 2007. Web. 2012.

Iding, Mirjam H.E., Wilhelm J. Meester, and Lori A. Tavasszy. *Freight Trip Generation by Firms: Paper for the 42nd European Congress of the Regional Science Association Dortmund, 2002*. 2002. Web. 2012.

Jones, Elizabeth G., and Anshul Sharma. Proc. of Development of Statewide Freight Trip Forecasting Model for Nebraska, Transportation Research Board Annual Meeting 2003, Washington DC. Jan. 2003. Web. May 2012.

University of Alabama in Huntsville, College of Business Administration, Center for Management and Economic Research. *The Mobile Area Metropolitan Planning Organization Freight Plan Final Report.* Project No. SARPC 07-001, June 21, 2010