Introduction + Overview

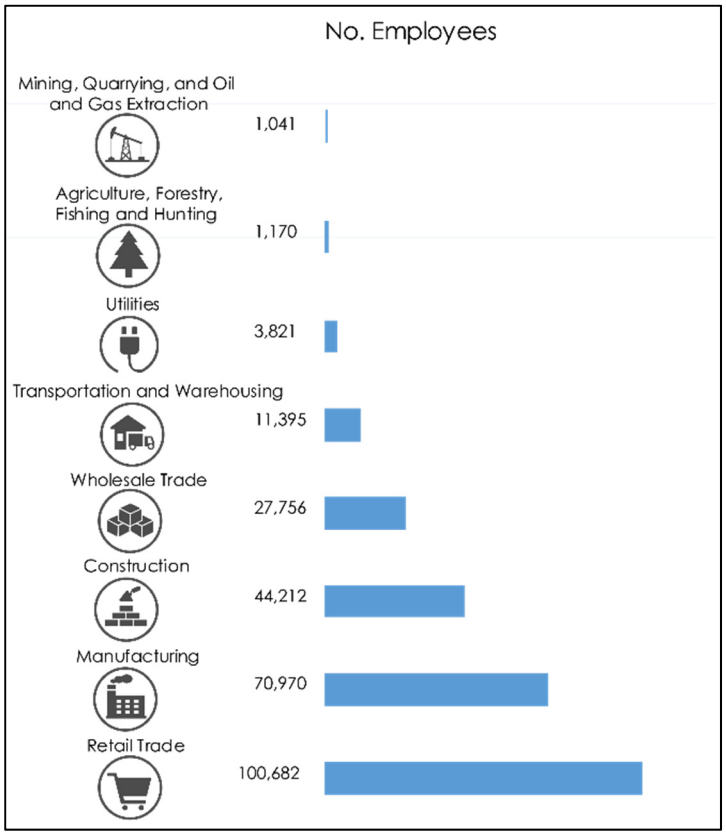
This is the first comprehensive multimodal freight plan prepared for the Triangle Region of North Carolina. The region covers an eight-county area centered on the cities of Raleigh and Durham. It boasts renowned universities, cutting edge technology companies located particularly in the Research Triangle Park (RTP), and the region's population growth rates have been among the fastest in the country. Projections presented here show that growth will continue, and the associated pressures will need to be managed. This Triangle Regional Freight Plan is a joint effort of the Capital Area and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organizations (CAMPO and DCHC MPO), in association with the North Carolina Department of Transportation (NCDOT). Its purpose is to contend with these pressures, support the benefits the freight sector brings to the economy and families of the region, and preserve the character of the region that is so much of its appeal as a place to live and work.

Those benefits are substantial. Industries dependent on freight transportation make a $21 billion contribution to the region's economy, accounting for one-third of its Gross Regional Product and over a quarter of a million jobs in the Triangle region. They include businesses engaged in the construction trade, agricultural producers, high technology companies, and the retailers supplying the household goods that put shirts on resident's backs, smartphones in their hands, and food on their tables.

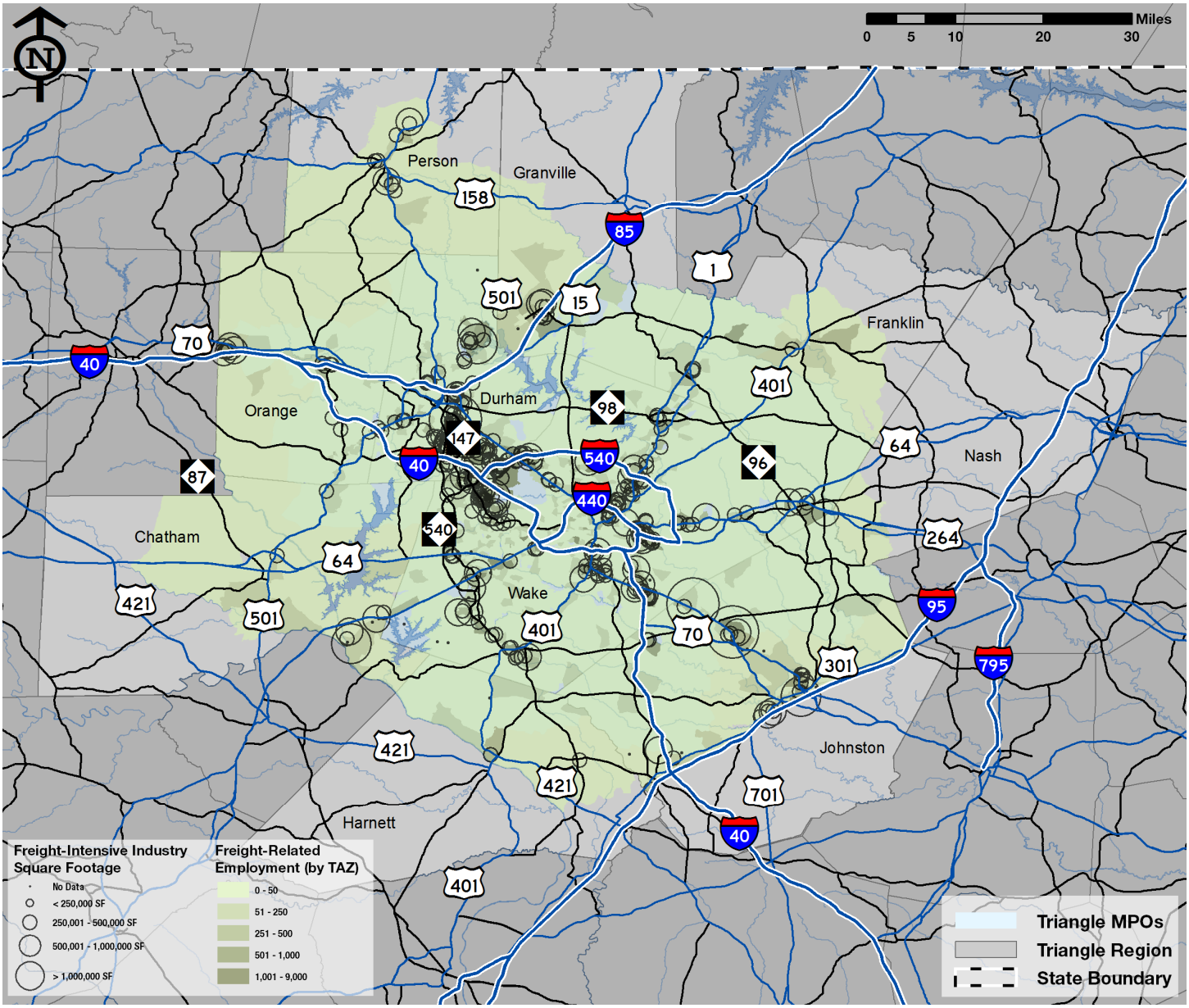
Industries dependent on freight transportation make a $21 billion contribution to the region's economy, accounting for one-third of its Gross Regional Product.

Freight-dependent employers are located throughout the region, but those responsible for large volumes from freight-intensive activities such as manufacturing or warehouse distribution are concentrated amidst the dual population centers of Raleigh and Durham, and along the major state and interstate highways. All told, the Triangle Region handled 82 million tons of freight worth $116 billion in 2012. The next three decades are forecasted to see freight tonnage increase by one-third, yet the value of that freight will more than double. This difference points to the importance of valuable goods manufactured in the region's technology sector, and to the growth in consumer products coming to the region from the world. Both sets of goods are time sensitive, with fast, reliable delivery a fundamental requirement and service standards climbing. The availability of same-day delivery for some products ordered on-line is an obvious example of the trend, yet the reliability of service is subject to overcoming the delays and higher costs associated with traffic congestion, and to the ability to locate logistics facilities where they are needed.

The Triangle Region handled 82 million tons of freight worth $116 billion in 2012.



Triangle Region Employment by Freight-Dependent Industry, (InfoUSA – 2013)



Freight-Dependent Employment and Freight-Intensive Industries (InfoUSA – 2013, Westat – 2015)

The Triangle Regional Freight Plan sets forth a $7.2 billion program of freight policies and investments for the next two decades, fulfilling the region's vision of what it wants its freight transportation system to be:

The Triangle Region's goods movement system will be safe and efficient, provide multimodal interconnectivity, enhance economic competitiveness, create jobs, and promote innovation, while reducing environmental impacts and improving local communities' quality of life.

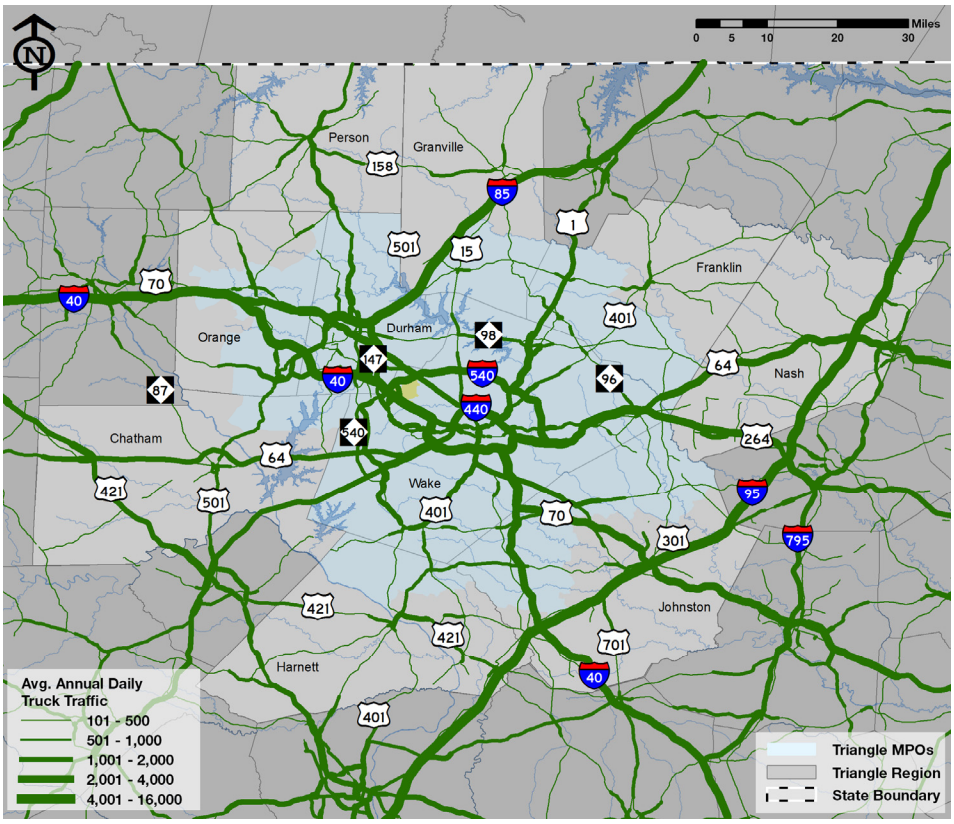
The vision is articulated through seven goals for the regional freight system, consistent with the overarching goals of the Metropolitan Transportation Plan (MTP). Each goal is paired with a set of objectives to guide its achievement, and associated with a series of performance measures to monitor progress in carrying it out. For example, one measure of progress toward the goal of managing system reliability is improvement in the average clearance time for accidents on principal roadways. Performance measures are designed to link actions to goals, help prioritize projects, manage performance, communicate results, and strengthen accountability.

Freight Plan Goals	Freight Plan Objectives
 **Manage Congestion and System Reliability** Allow goods to move with minimal congestion and time delay, and greater predictability.	Relieve congestion on heavily-traveled truck routes, including through the encouragement of expanded rail transportation. Reduce economic losses due to transportation crashes and incidents. Establish and designate truck routes consistent with federal, state and local regulations, and incorporate flexibility in routes to reduce the risk from disruption.
 **Improve Infrastructure Condition** Increase proportion of highways and highway assets in "good" condition.	Ensure maximum regional mobility through improvements to and maintenance of the road and highway network. Provide safe, reliable, efficient and well-maintained goods movement facilities.
 **Promote Multimodal and Affordable Choices** Increase utilization of non-truck travel modes	Relieve congestion on heavily-traveled truck routes, including through the encouragement of expanded rail transportation. Improve mobility and access to intermodal operations and facilities.
 **Promote Safety and Health** Increase safety and security of transportation users.	Reduce fatality, injury, and crash/incident rates on all modes. Improve the ability to identify high accident locations, and evaluate their impacts in TIP project prioritization. Partner with Law Enforcement and Emergency Response agencies to provide support and reduce delay during traffic incident management events. Reduce economic losses due to transportation crashes and incidents.
 **Protect Environment and Minimize Climate Change** Reduce mobile source emissions, GHG, and energy consumption.	Promote the adoption of efficient freight vehicles and technologies offering safer, environmentally cleaner performance. Plan and design our community centers for the timely and fuel efficient supply of goods necessary for living and working.
 **Stimulate Economic Vitality** Increase economic growth and prosperity that supports communities and businesses.	Ensure a productive operating environment for freight transportation in the region. Plan and preserve industrial land uses for job creation and efficient service to markets and population.
 **Ensure Equity** Link land use and transportation planning and ensure that transportation investments do not create a disproportionate burden for any community.	Ensure the alignment of land use planning and the siting of freight producing and staging facilities for compatibility and safe, productive function. Reduce environmental and community impacts from goods movement operations to create healthy communities and a clean environment, and improve quality of life for those communities most impacted by goods movement.

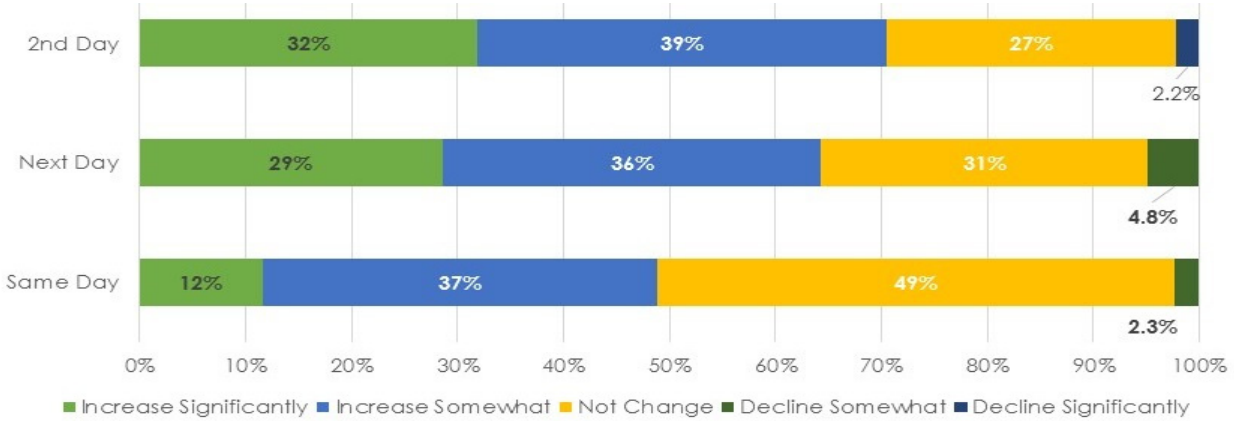
Strategic Recommendations and Implementation Plan

A high-quality freight transportation network must be multimodal in nature because private industry supply chains use a portfolio of modal options to manage a diversity of needs. However, the connective tissue of this network is motor carriage, because the linkage from airports and rail terminals to business sites is supplied most frequently by trucks. In addition, the efficiency, flexibility and pervasiveness of trucking make it the mode of choice for the majority of supply chain transport. Trucks handle more than 80 percent of freight in the Triangle Region, and they blanket the territory. The quality of truck service faces challenges not only from rising roadway congestion, but from faster delivery requirements: two-thirds of supply chain managers expect their need for next day deliveries to increase, and almost half expect an increase for same day deliveries. A key strategy to contend with this is the establishment of a network of Strategic Freight Corridors (SFC).

Average Annual Daily Truck Traffic (2014 – NCDOT)



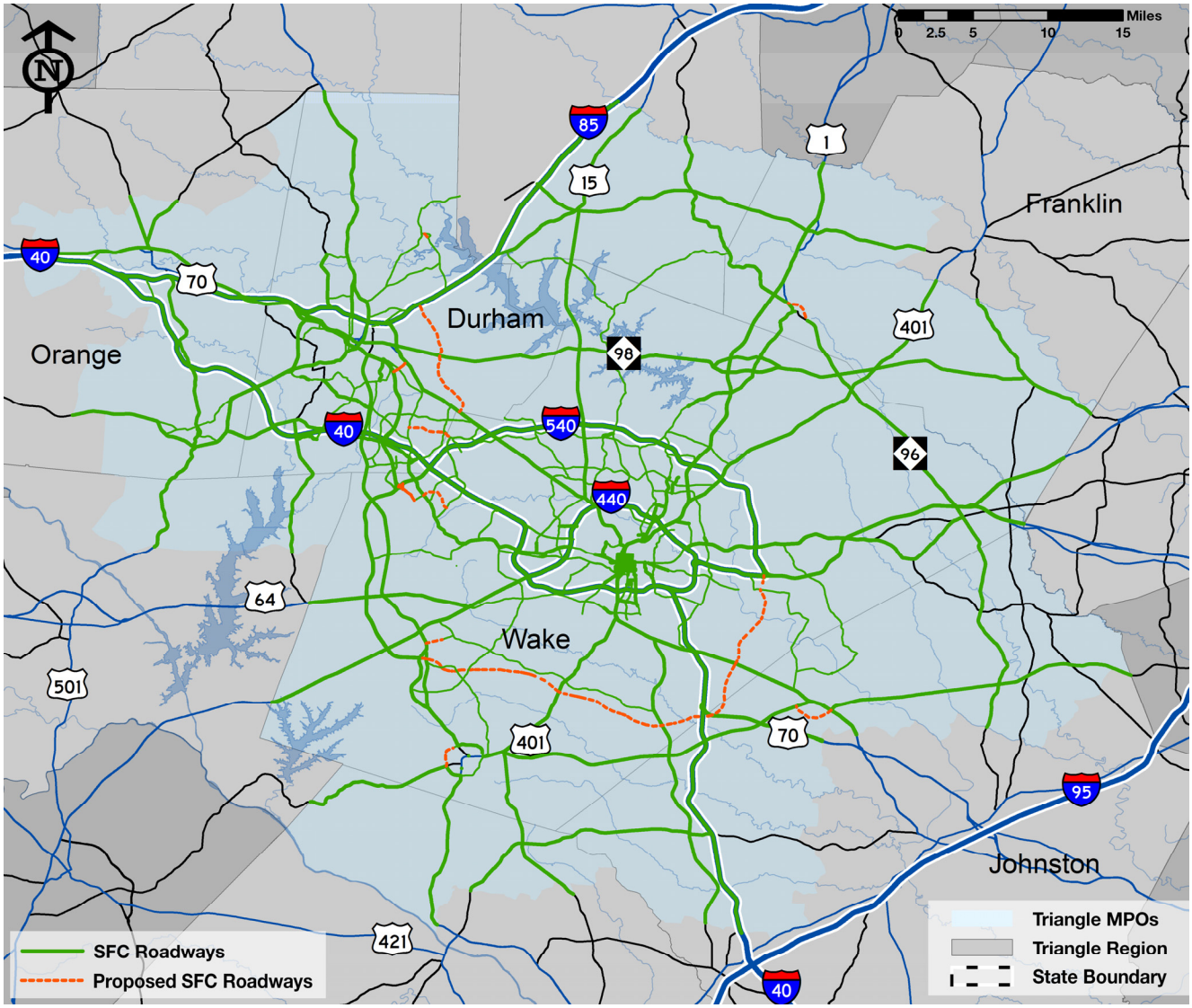
3-Year Outlook – Truck Delivery Range of Distribution Centers (Tompkins International)



The SFC is a forward-looking core roadway freight network that captures and combines the highways, arterials and connectors that are most needed to serve business, population and the regional economy through better performance in terms of speed, reliability, cost, productivity, and safety. The network is focused on existing and future forecast truck volumes in the region, future freight related improvement projects, and efficient routes to support first miles, last miles, and cross-town travel. The SFC:

- Allows limited financial and management resources to be concentrated on key facilities;
- Provides rapid accessibility to major clusters of freight generation and consumption, including future ones;
- Facilitates cross-town travel so that clusters and multimodal facilities are well connected;
- Affords route redundancy to reduce the risk from delay and disruption;
- Anticipates the introduction of new technologies.

The SFC reflects a multi-faceted analysis of range of data, input from public agencies and private sector stakeholders, land use and transportation plans, local ordinances, residential development, and pedestrian and bicycle usage of urban areas. The network contains 1,250 miles: 155 miles of Interstates, 277 miles of U.S. Routes, 359 miles of NC Routes, 348 miles of SR Routes, 63 miles of Other Routes, and 48 miles of future proposed roads.



Strategic Freight Corridors, Version 4.0

Fulfilling its purpose as the focal point for roadway freight investment, project recommendations for the SFC system were defined based on accessibility, mobility, reliability and safety needs, and future development or redevelopment opportunities. This process recognized three tiers of SFC corridors:

- **Trade Routes**, connecting the region with other regions and external freight facilities such as ports and rail intermodal terminals. These routes are economic links to principal trading partners.
- **Distribution/Connectivity Routes**, connecting freight industry clusters, freight-intensive industries, freight-oriented development (FOD) and urban activity centers. These routes are the backbone of efficient navigation of the supply chain and freight distribution network, now and in the future.
- **Critical Access Routes**, providing connection to existing industrial sites and potential redevelopment areas. These routes afford local access to major freight-related facilities and industries.

Project Development Framework for Strategic Freight Corridors

		Strategic Freight Corridors (SFC)		
		Trade Routes	Distribution/ Connectivity Routes	Critical Access Routes
Freight Industry Cluster	RDU Airport-Morrisville	I-40	I-540	Aviation Pkwy, McCrimmon Pkwy
	Research Triangle Park	I-40	I-540, NC 147	
	North Durham	I-85	US 501	Northern Durham Pkwy (Future), Old Oxford Rd, Hamlin Rd
	Capital Blvd-Atlantic Ave Area		I-440, US 1, US 401 (North)	Atlantic Ave, Wake Forest Rd, Falls of Neuse Rd
	South Raleigh-Garner Area	I-40	Us 401 (South), US 70	US 70 Business
FOD Opportunity Area	Mebane-Efland-Buckhorn	I-40/I-85	US 70	
	RDU Airport Vicinity	I-40	I-540, NC 147, NC 55	S Miami Blvd, S Alston Ave, TW Alexander Dr, Globe Rd
	Butner-Creedmoor	I-85	NC 56, NC 50 (Creedmoor Rd)	
	Wake Forest-Youngsville		US 1 (Capital Blvd)	
	East Franklinton		US 1, NC 56	
	Knightdale-Wendell-Zebulon	I-87, US 64-264 (Future I-87)	US 64 Business	
	Clayton	I-40	US 70	US 70 Business, NC 42
	Smithfield-Selma	I-95, US 70	US 70	US 70 Business
	Apex, Holly Springs and Fuquay-Varina		I-540, NC 540 (Future Southern Wake Expwy and E. Wake Expwy)	US 64, US 1, US 401 (South), NC 55,
	Moncure-Executive Jetport Area-Sanford		US 1	
	Pittsboro-Siler City		US 64	
Activity Centers	CBDs In Raleigh, Durham, Chapel Hill, Cary and Apex	I-40, I-85	US 501 (Roxboro Rd), US 401 (S Saunders St), US 64 (Apex)	US 1 (Capital Blvd), New Bern Ave, S Saunders St
	Duke, UNC, and NC State Universities		US 15-501, NC 54, I-440, NC 147	
	Duke, UNC, Rex and WakeMed Hospitals		I-440, NC 147, US 15-501, NC 54, US 1/US 64	US 64 Business (New Bern Ave)
	Shopping Centers at South Square, Southpoint, Brier Creek, Crossroads, Crabtree, and Triangle Town Center	I-40	I-440, I-540	US 1, US 70, NC 50

The three tiers of SFC corridors were targeted for mobility, safety, connectivity, and economic development improvements based on technical analysis and stakeholder input. Projects were derived from state and metropolitan plans but included new recommendations where there were gaps compared to freight needs. Planning-level project costs were estimated, and the year for implementation accelerated in locations where the need may become acute sooner. Projects then were organized into strategy packages based on the three tiers of the SFC network. The total investment is $7.2 billion; 80 percent occurs by 2030, in roughly equal portions in the periods through 2025 and from 2025 to 2030.

Strategy Package Project Investments

Project Costs by Implementation Year ($Millions)						
Strat. Package	By 2025	By 2030	By 2035	By 2040	Total	Major Corridors
Distribution Routes	$1,934.3	$1,817.6	$711.3	$174.6	$4,673.8	NC 540, US 1, US 70, I-440, US 401
Trade Routes	$968.2	$567.0	$337.0	-	$1,872.2	I-40, I-85, US64/I-87, US 70
Access Routes	$140.3	$351.9	$72.3	$88.9	$653.4	Mixed local
Total	**$3,024.8**	**$2,736.5**	**$1,120.6**	**$263.5**	**$7,163.4**	

- The Distribution Routes package accounts for $4.7 billion and 65 percent of the investment because of the number and variety of its roadways, and their role in penetrating and connecting the region. Thirteen routes are affected, of which the largest is the new NC 540 toll road projected at nearly $1 billion. Most expenditures are scheduled by 2030, with about half of those before 2025.
- Trade Routes account for $1.9 billion and 26 percent of investment. I-40 is due for the lion's share of the trade package at $1.4 billion because it is the interstate backbone of the region. Expenditures are largest through 2025, and do not extend beyond 2035.
- Access Route investment represents $0.6 billion and 9 percent of the total. Access Routes are scattered by nature because of their local purpose, with 18 projects affecting 17 different facilities. Half of these investments are scheduled between 2025 and 2030.

Each package of investments is accompanied by relevant actions from the three sets of strategic programs: roadway, development, and multimodal. Roadway programs for the SFC system encompass codification of truck route design standards, evaluation of tolling opportunities with revenue reinvestment, monitoring of bridge volumes and conditions, and annual safety assessments. Highlights of other programs are:

Roadway

- Truck Parking: evaluate capacity and initiatives for drivers of long distance and local freight.
- Signage: provide wayfinding across the SFC system, and in freight clusters, FOD opportunity areas, and activity centers.
- ITS: form a task force on automation in freight transportation, coordinated with passenger efforts and examining vehicle to infrastructure technology on the SFC and signal prioritization.

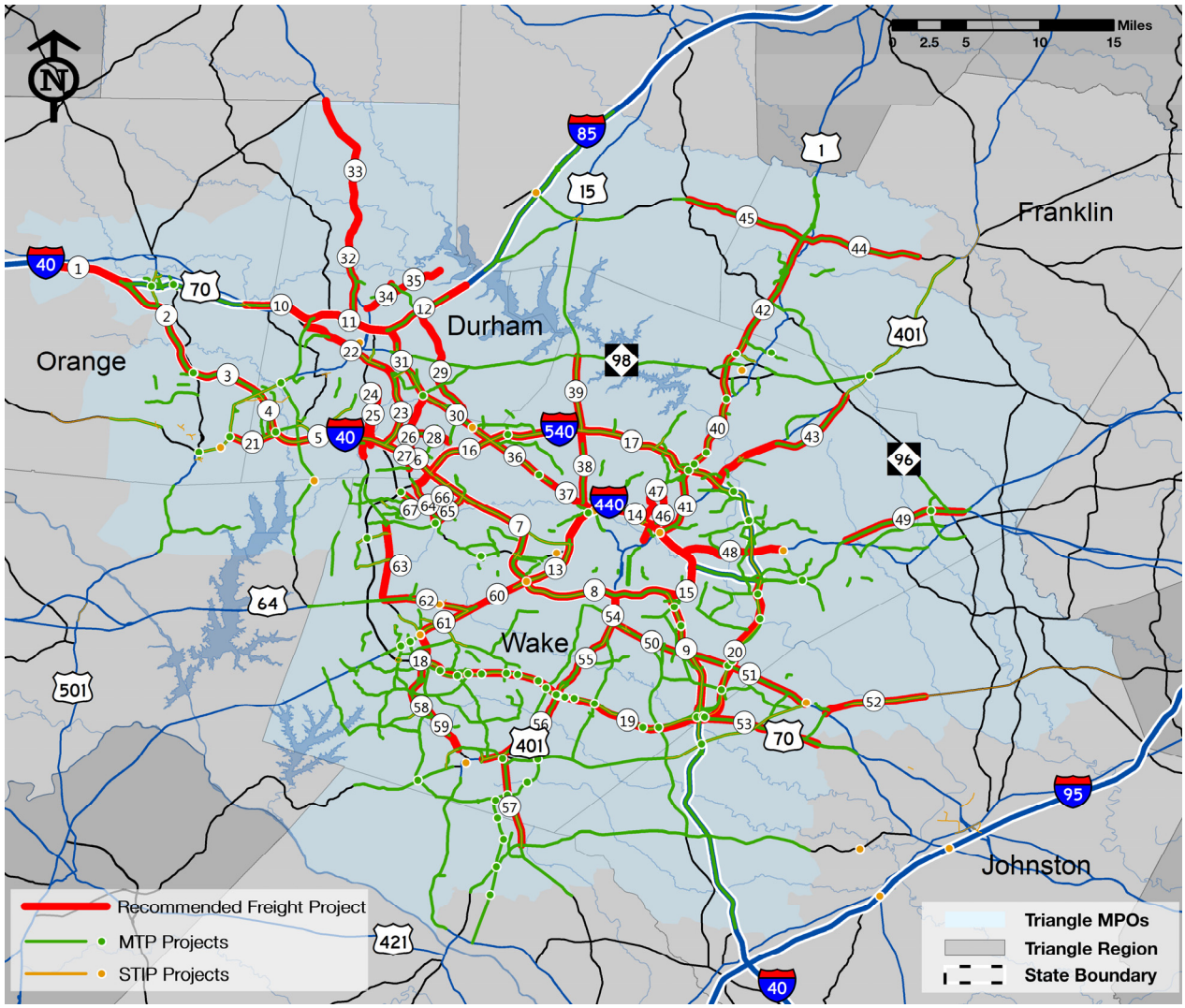
Development

- Distribution Centers: foster DC development in multiple areas to support diverse points of access to the regional market.
- Redevelopment: support redevelopment in older freight clusters, especially those in close-in locations.
- CNG Access: encourage expansion of Compressed Natural Gas fueling stations to protect air quality and hedge against rising diesel prices.

Multimodal

- Marine: advance improvements on port access corridors, chiefly I-40 south of Raleigh and the U.S. 64/I-87 corridor to Norfolk.
- Rail: advance improvements on the rail intermodal access corridor I-85 to Greensboro and U.S. 64/I-87 to Rocky Mount; seek to retain rail carload service; improve railway-roadway at-grade crossings; support Go Triangle passenger rail programs for their indirect benefits to freight.
- Air: advance improvements on airport access corridors: on I-40, I-540 and U.S. 70 for RDU; I-85 north and south for external airports.

Map of Recommended Freight Projects



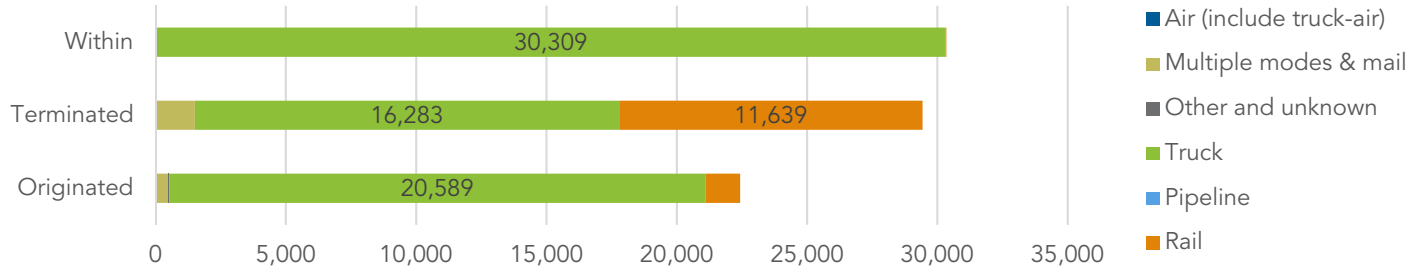
Summary of Recommended Programs to Advance Regional Goals

Recommended Programs		
Roadway	Development	Multimodal
SFC System	Foster Development of DCs	Marine
Truck Parking	Support Redevelopment	Rail
Signage		
Intelligent Transportation Systems	Expand Access to Compressed Natural Gas Fueling Stations	Air

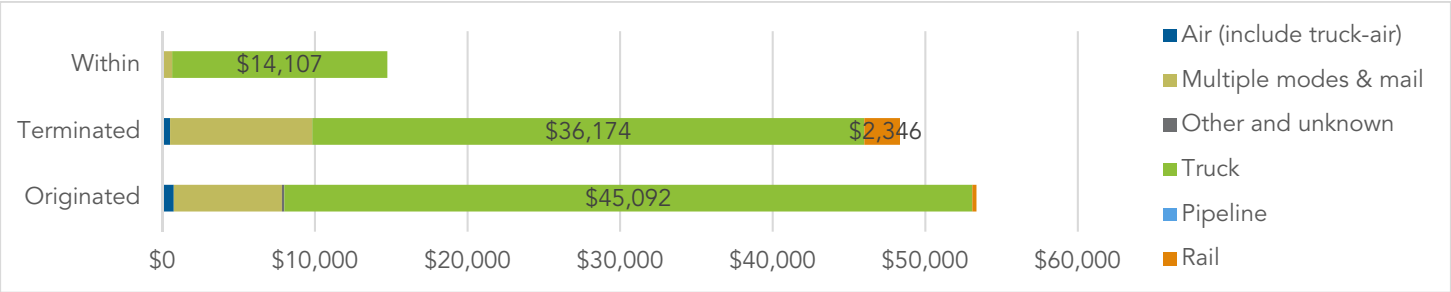
Freight Traffic and Forecast

In 2012, Raleigh-Durham originated or received 82 million tons of freight valued at 116 billion dollars. This represented roughly 19 percent of all value moved in North Carolina, highlighting the importance of Raleigh-Durham to the State's economy. Trucking was the predominant mode, representing 82 percent of the volume in tonnage and in dollar terms. Rail played a specific function in bringing freight to the region, accounting for 11.6 million terminated tons in 2012 – most of it coal shipments for electricity generation. Rail as a whole was responsible for 16 percent of all tonnages and 2 percent of value. Multiple modes and mail moved 15 percent of the volume of goods by value, totaling 16 billion dollars. This category includes rail-truck intermodal as well as small package shipments (such as UPS and USPS); rail intermodal in the Triangle Region is handled by trucking to and from terminals outside the area. The air mode did not carry significant tonnage, yet it was used extensively in the movement of high value commodities that are particularly important to the region.

Freight Flow Overview – 2012 Tonnage (BTS/FHWA, FAF4 – 2016)



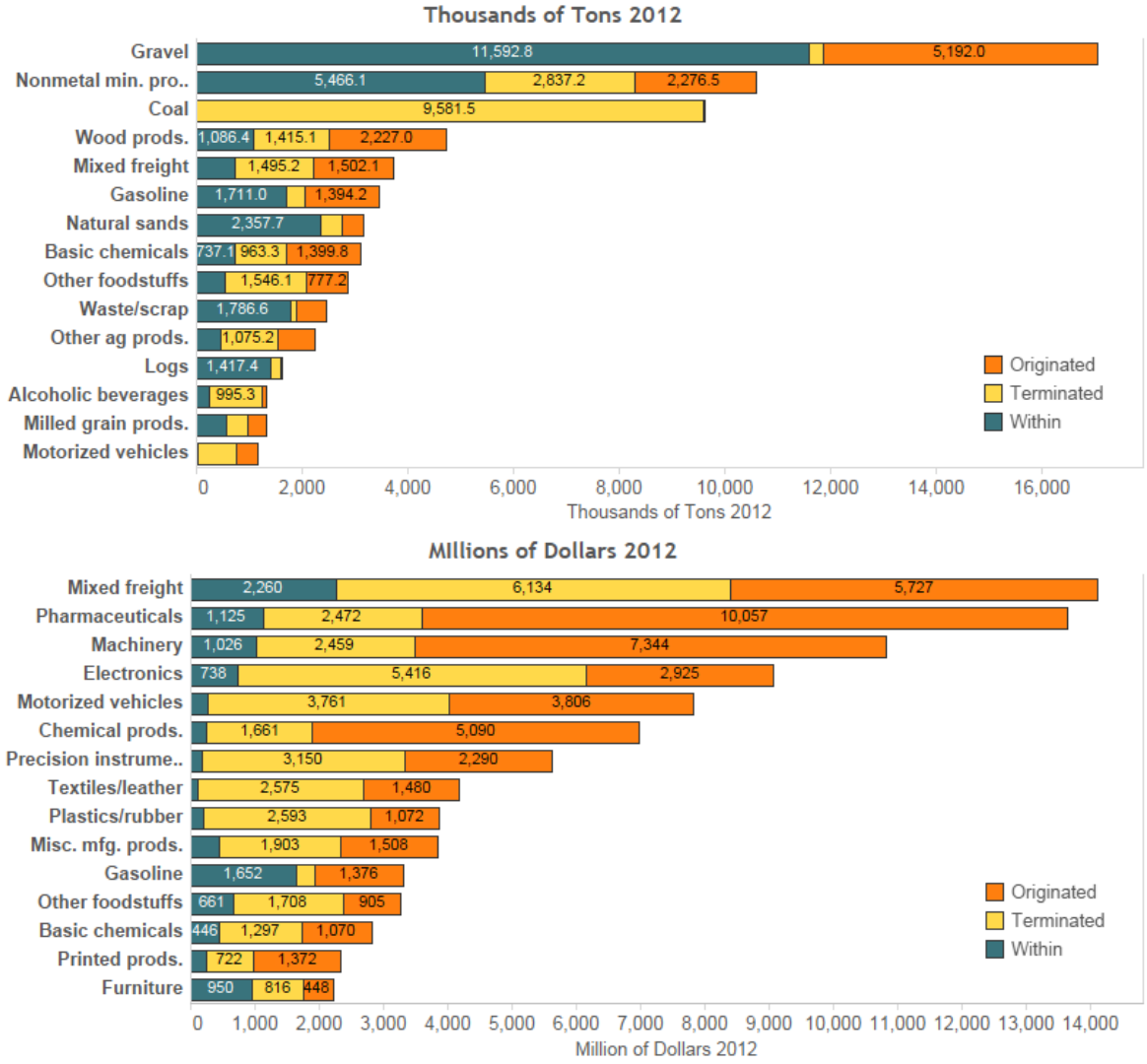
Freight Flow Overview – 2012 Value (BTS/FHWA, FAF4 – 2016)



Originated freight was 46 percent of the value of shipments in 2012 and the largest category. This is a positive finding because originated freight broadly corresponds to economic production and terminated freight to consumption (such as the population's demand for consumer goods). It is an uncommon finding, too, because consumption goods often represent the main driver of economic activity and freight flows in comparable U.S. cities. Moreover, originated freight is a greater factor in dollar terms than it is by tonnage, indicating that the goods shipped out to the world from the Triangle Region have high value. The difference between weight and value is even more pronounced for freight that stays within the region: local activity is 37 percent of tonnage yet just 13 percent of dollars.

In fact, the blend of goods accounting for tonnage volume is markedly different from the blend that drives the dollar volume. The top 15 commodities represented 83 percent of tons and 80 percent of value moved – but the top three goods by weight are not among the top 15 by value, and the two lists of fifteen have only five commodity groups in common. The largest commodity flows by weight were gravel moving mainly within the region, non-metallic mineral shipments (such as gypsum, clay and salt) that are about half local, and coal coming into the region. The tonnage profile overall is characterized by bulk goods, many of them associated with construction activity. By contrast, the largest commodity flows by value were mixed freight (typically consumer goods), pharmaceuticals, machinery, and electronics. The majority of this volume was originated shipments, with local freight just a minor component. The value profile overall reflects the high-tech structure of the local economy, supporting a large proportion of outbound shipments and a robust consumer economy that demands inbound shipments of retail goods.

Top 15 Commodities by Flow Type (BTS/FHWA, FAF4 – 2016)



Tonnage for the Triangle Region is expected to grow 30 percent through 2045, according to federal forecasts. Originated shipments will grow the fastest at almost 50 percent, which again is a positive sign for the economy. An additional 25 million tons will move in the region during this period, and almost all the added volume is projected to move by truck on Triangle roadways. The share of terminated freight tonnage carried by trucks rises from 55 percent to 66 percent, while the truck shares of originated and local freight stays steady at 92 percent and nearly 100 percent, respectively. The large shift in terminated tonnage is primarily caused by declines in coal shipments by rail, reflecting a nationwide trend toward replacing coal with relatively cheap and abundant domestic natural gas for electric power generation.

Thousands of Tons (2012 to 2045 – BTS/FHWA, FAF4.1 – 2016)

	Originated		Terminated		Within		Total	
Mode	2012	2045	2012	2045	2012	2045	2012	2045
Air (Including Truck-Air)	11	127	12	131	0	0	23	258
Multiple Modes & Mail	499	942	1,497	1,614	12	20	2,008	2,575
Other & Unknown	13	13	0	148	0	9	13	170
Pipeline	0	0	0	0	0	0	0	0
Rail	1,320	1,473	11,639	11,356	27	17	12,985	12,846
Truck	20,589	30,900	16,283	25,670	30,309	34,540	67,181	91,110
Total	**22,431**	**33,455**	**29,431**	**38,919**	**30,348**	**34,587**	**82,210**	**106,960**

Mode	Originated		Terminated		Within		Total	
	2012	2045	2012	2045	2012	2045	2012	2045
Air (Including Truck-Air)	0.1%	0.4%	0.0%	0.3%	0.0%	0.0%	0.0%	0.2%
Multiple Modes & Mail	2.2%	2.8%	5.1%	4.1%	0.0%	0.1%	2.4%	2.4%
Other & Unknown	0.1%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.2%
Pipeline	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rail	5.9%	4.4%	39.5%	29.2%	0.1%	0.1%	15.8%	12.0%
Truck	91.8%	92.4%	55.3%	66.0%	99.9%	99.9%	81.7%	85.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The value of shipments for the Triangle Region is forecast to grow considerably more, increasing by 130 percent through 2045. Originated shipments once again set the pace, climbing 143 percent over the period. An additional 152 billion dollars' worth of goods will be carried in the region, with two-thirds of the added volume handled by trucks. Most of the rest of the new volume is projected to move by air and multiple modes, with increases great enough that the share of value shipped by truck drops from 82 percent in 2012 to 74 percent by 2045.

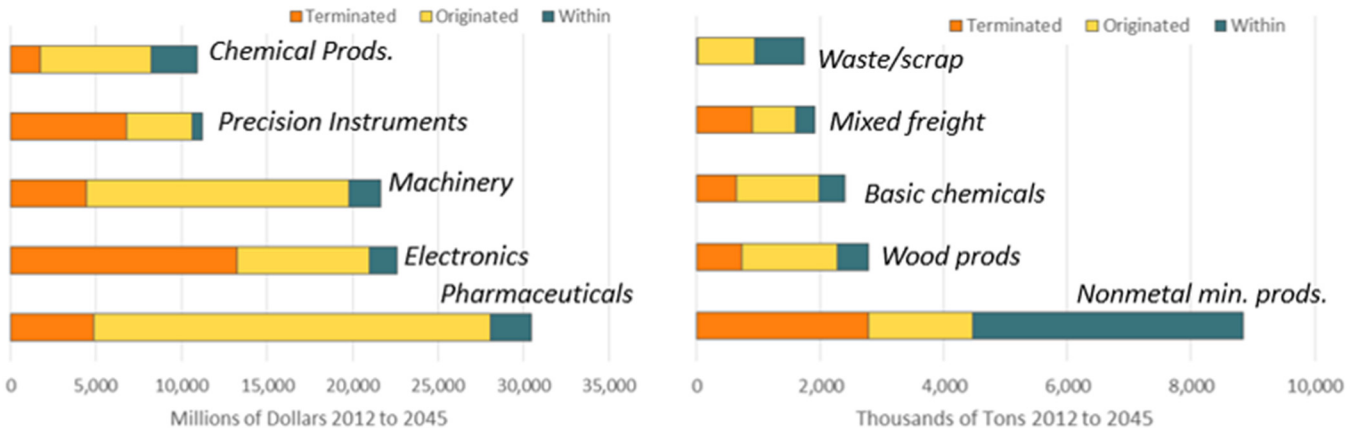
Millions of Dollars (2012 to 2045 – BTS/FHWA, FAF4.1 – 2016)

Mode	Originated		Terminated		Within		Total	
	2012	2045	2012	2045	2012	2045	2012	2045
Air (Including Truck-Air)	$753	$11,394	$507	$13,192	$0	$0	$1,260	$ 24,586
Multiple Modes & Mail	$ 7,084	$20,805	$ 9,325	$15,666	$649	$ 1,301	$ 17,058	$ 37,773
Other & Unknown	$162	$728	$1	$ 1,970	$0	$235	$ 163	$2,933
Pipeline	$0	$0	$0	$0	$0	$0	$0	$0
Rail	$273	$ 4,089	$ 2,346	$667	$0	$0	$2,620	$4,756
Truck	$45,092	$67,875	$36,174	$98,046	$14,107	$32,234	$ 95,373	$198,154
Total	**$53,363**	**$104,890**	**$48,354**	**$129,542**	**$14,757**	**$33,770**	**$116,473**	**$268,202**

Mode	Originated		Terminated		Within		Total	
	2012	2045	2012	2045	2012	2045	2012	2045
Air (Including Truck-Air)	1.4%	10.9%	1.0%	10.2%	0.0%	0.0%	1.1%	9.2%
Multiple Modes & Mail	13.3%	19.8%	19.3%	12.1%	4.4%	3.9%	14.6%	14.1%
Other & Unknown	0.3%	0.7%	0.0%	1.5%	0.0%	0.7%	0.1%	1.1%
Pipeline	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rail	0.5%	3.9%	4.9%	0.5%	0.0%	0.0%	2.2%	1.8%
Truck	84.5%	64.7%	74.8%	75.7%	95.6%	95.4%	81.9%	73.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

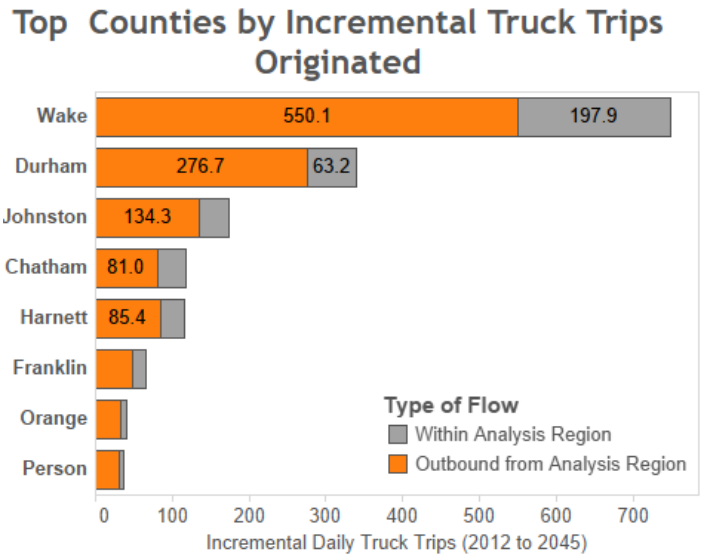
The commodity sources of value growth are led by pharmaceuticals, electronics, and machinery, all of them already top producers for the region. Non-metallic minerals are the leader in tonnage, particularly in the local market; wood products and basic chemicals contribute to originated tons.

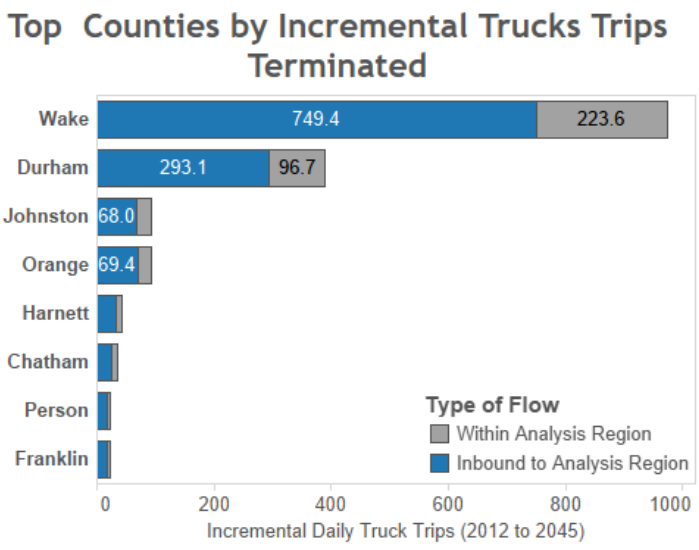
Top Growing Commodities by Value and Tons, 2012 to 2045 (real 2012 dollars – BTS/FHWA, FAF4.1 -2016)



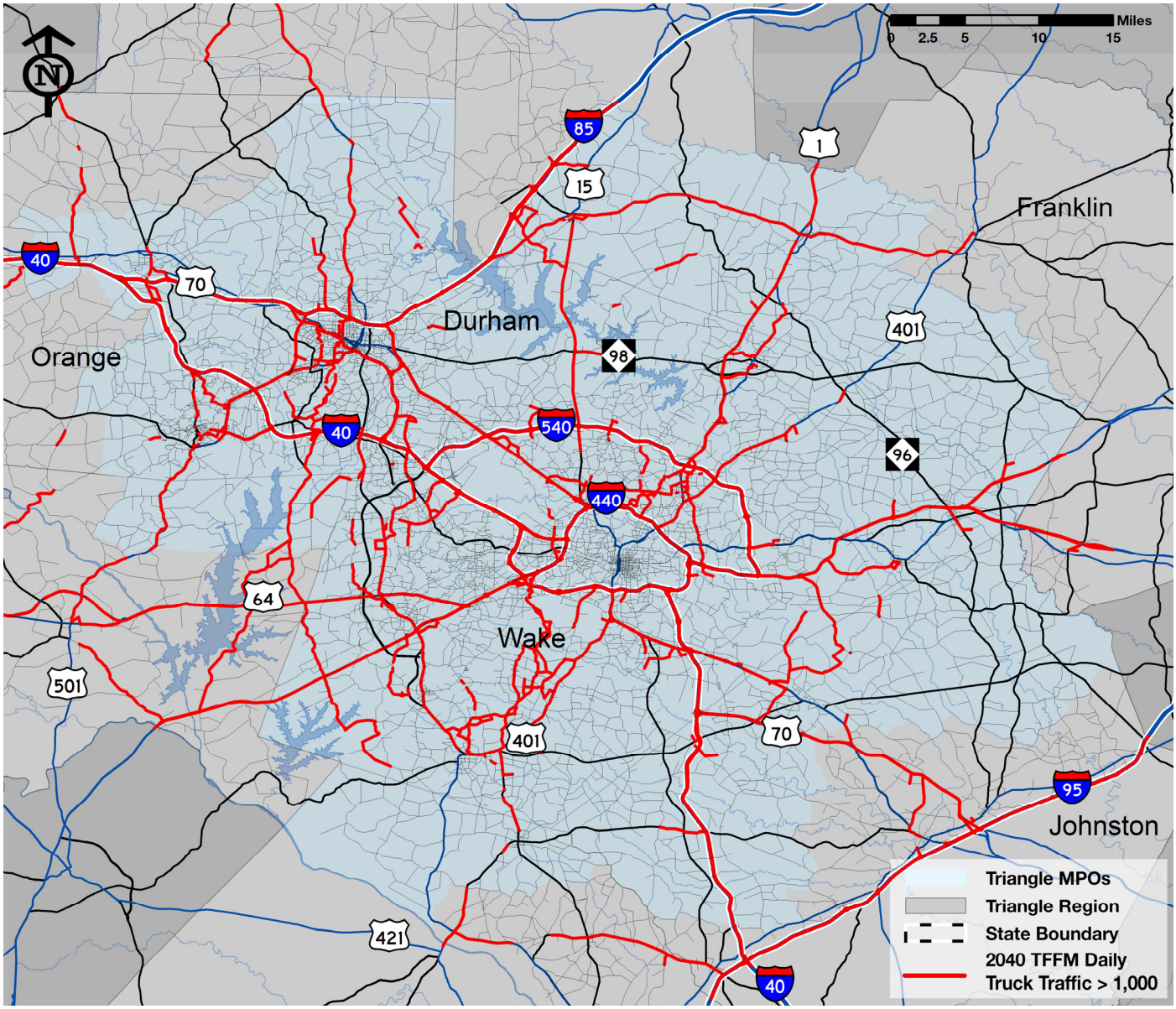
Growth in tonnage is the key factor for increase in the physical demand on infrastructure. The forecast places the burden of added tonnage on roadway freight. New truck activity will appear across the territory, but the preponderance will be in Wake and Durham counties at the heart of the region. Truck volumes exceeding 1,000 per day will be pervasive in the network within two decades. The investments and programs outlined in this Plan will be crucial preparations for this future.

Incremental Truck Trips per day 2012 to 2045 (WSP Disaggregation of FAF – 2016)





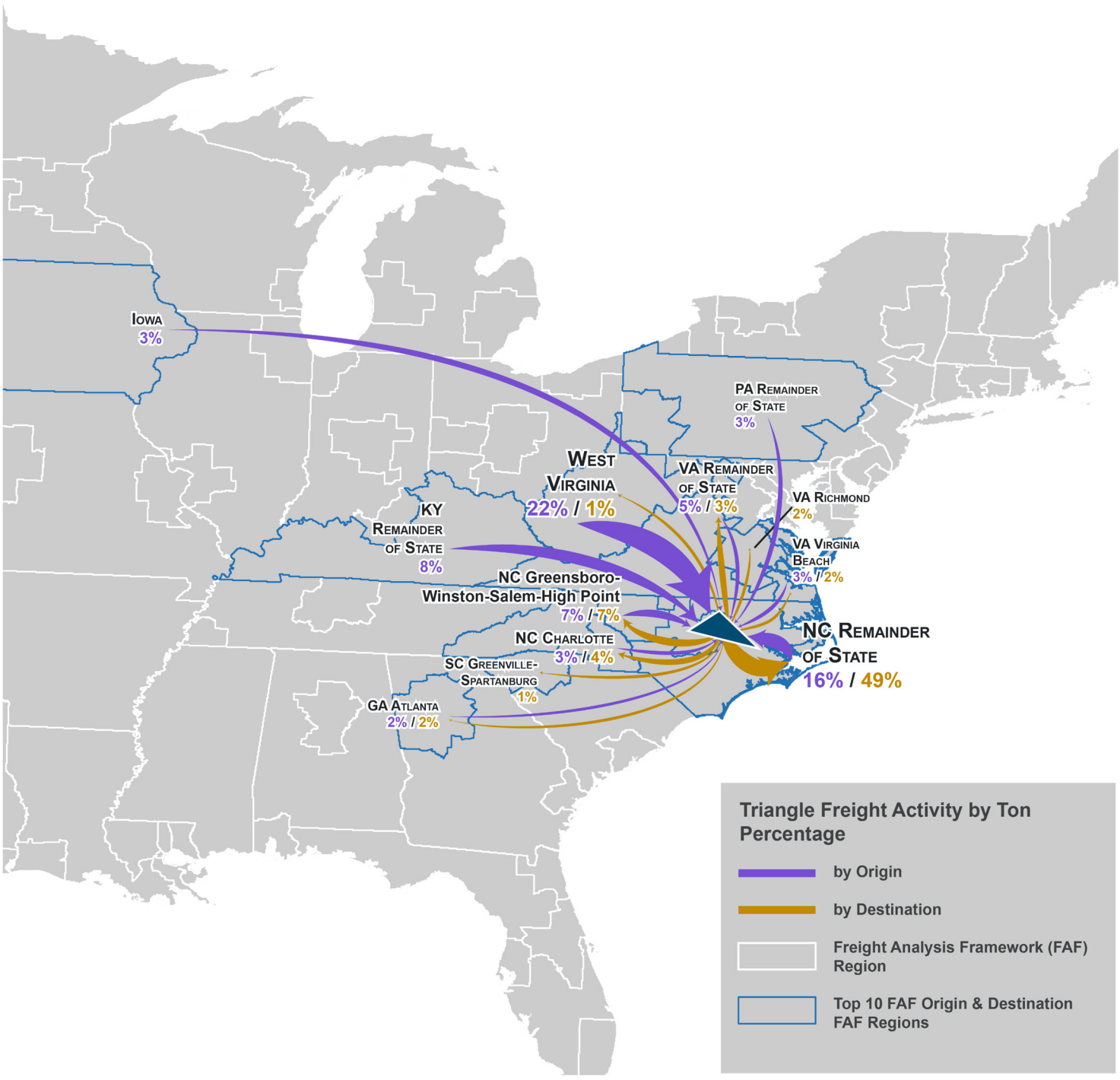
Roadways with 2040 Daily Truck Traffic > 1,000 (Triangle Freight Forecasting Model)



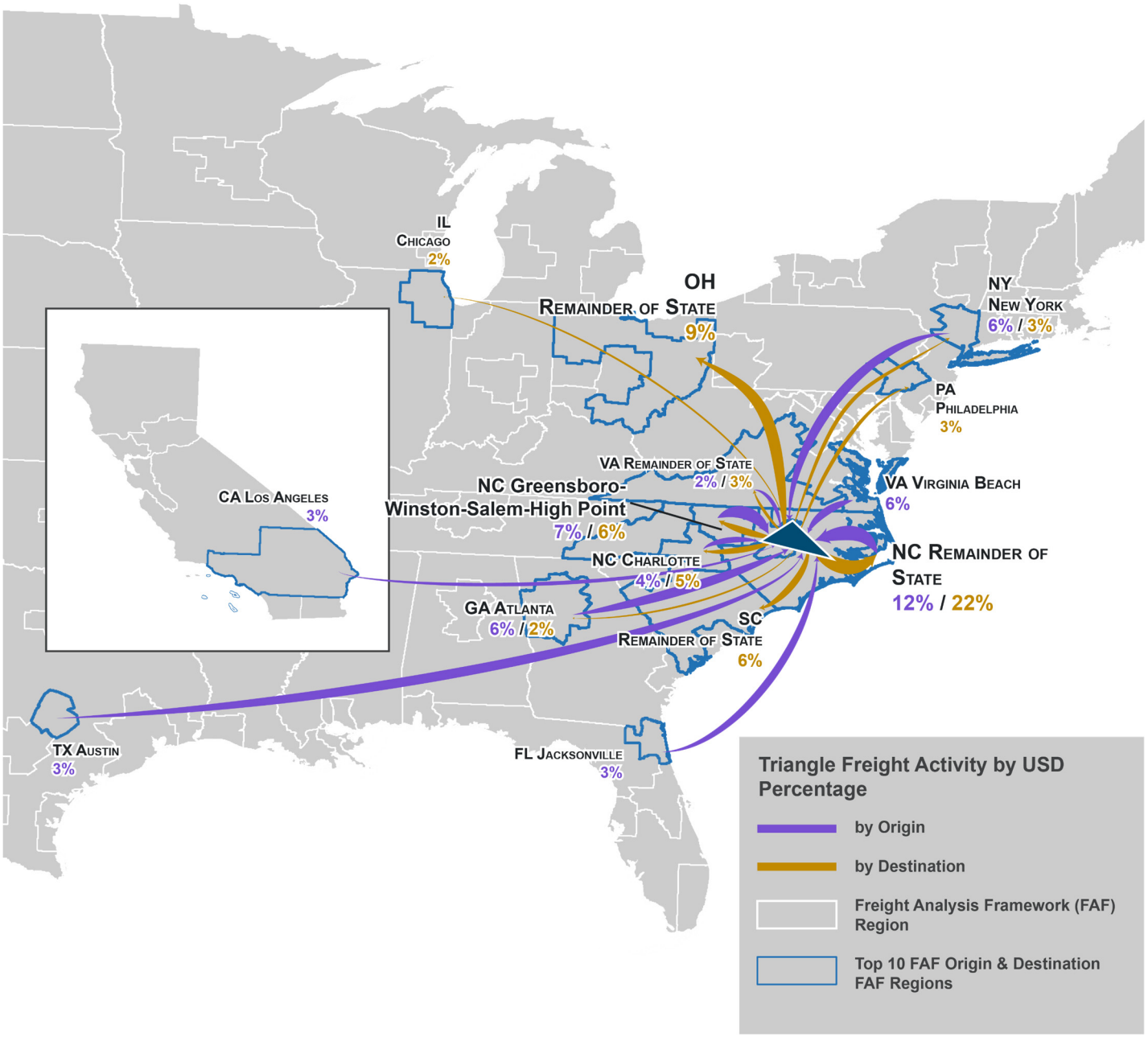
Modal Profiles

The Triangle Region relies upon multiple freight modes to do business across the eastern seaboard, the country and the world. While motor carriage is the primary way the region receives goods and ships them to market, all modes are important, and this includes seaports and airports outside the state that are accessed by highway and rail.

Top 10 Origins and Destinations of Shipments to/from Raleigh-Durham by Tons, 2012



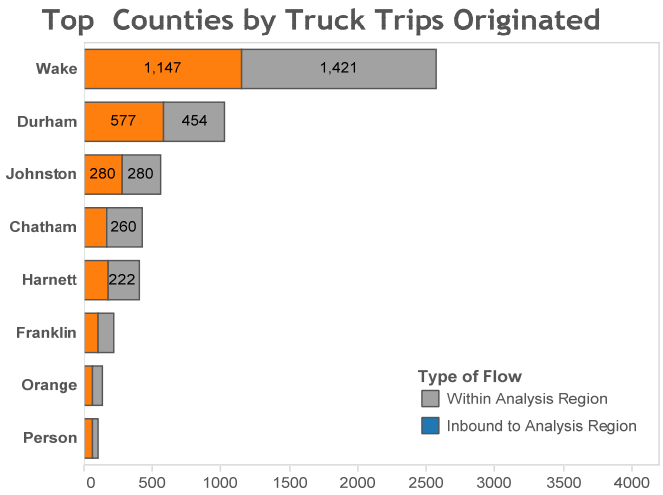
Top 10 Origins and Destinations of Shipments to/from Raleigh-Durham by Value, 2012

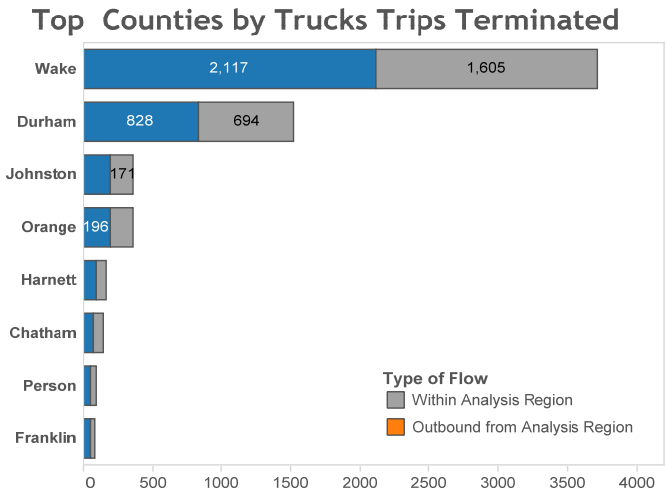


Truck

Thousands of trucks move on Triangle Region roadways every day. The greatest concentrations are in Wake and Durham counties, both for originated and terminated freight. Substantial portions are traffic that remains within the region, crossing from Wake County to Durham, Durham to Wake, and throughout the adjacent counties as well. Trucks representing the largest tonnage volumes are carrying bulks and wood products associated especially with construction activity, plus gasoline moving to fueling stations and mixed consumer products. The top five commodities represent 56 percent of truck tonnage. The top five trucked commodities in value terms are 47 percent of the modal volume, yet the set of goods is different. Mixed consumer products are the largest, followed by pharmaceuticals, machinery and electronics, and new automobiles – a blend of goods reflecting Triangle Region manufacturing and its consumer market. Several of the same high value products also are important in small package trucking and rail-truck intermodal carriage.

Truck Trips Originated and Terminated (Average Weekday, 2012; disaggregated FAF4 by WSP)





Top Commodities (Tonnage and Value) Moved by Truck (BTS and FHWA, FAF3.5, FAF4, 2016)

Commodity Name	Tons (000s) 2012	Percent of Total	Commodity Name	Value ($M) 2012	Percent of Total
Gravel	15,886.7	23.65%	Mixed Freight	$13,237	13.88%
Nonmetal Mineral Products	10,009.7	14.90%	Pharmaceuticals	$10,063	10.55%
Wood Products	4,532.3	6.75%	Machinery	$9,168	9.61%
Mixed Freight	3,678.5	5.48%	Motorized Vehicles	$6,517	6.83%
Gasoline	3,310.9	4.93%	Electronics	$6,250	6.55%
Total	67,181.1		Total	$95,373	

Because so much of the region's freight is handled over the road and other modes frequently depend on motor carriage for connection, the performance of trucking is crucial to the Triangle Region. Reliability of transportation is the top concern of shippers and can be measured with a Buffer Time Index. The index gauges the extra minutes and hours a truck line must build into its schedule to be sure of arriving on time – much like airline schedules are longer than the time it should take to fly. An index of 0.6 signifies 60 percent extra time, and an index of 1.0 signifies 100 percent extra time compared to the average duration of travel. The higher the index, the more costly it is to be on time, because the schedules are longer and the truck and driver can do less work per hour.

About one-third of the Triangle roadway network exceeds a Buffer Time Index of 1.0 during the peak times throughout the day. In other words, schedules must be more than doubled on one out of three miles of the network. The roads affected are in most parts of the region, but are especially prevalent on the routes between Raleigh, Durham, and Research Triangle Park. Buffers are needed, of course, because of congestion: the heavy volume of vehicles on highways causing traffic to slow, and made worse by bad weather, vehicle malfunctions, construction, incidents, and other influences.

Amount of Network Exceeding Buffer Time Index of 1.0, Nov. 2014 – Oct. 2015 (NPMRDS, WSP analysis)

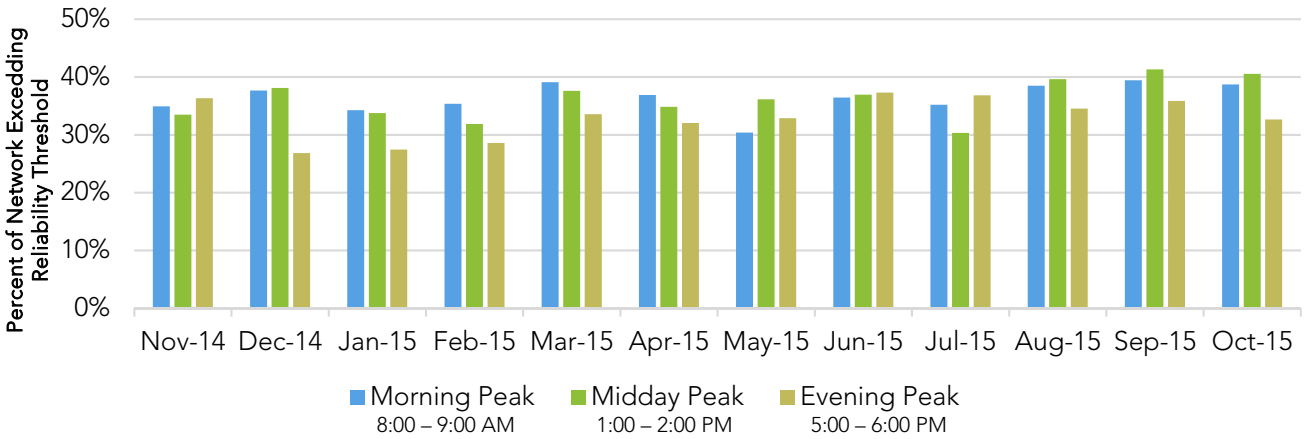
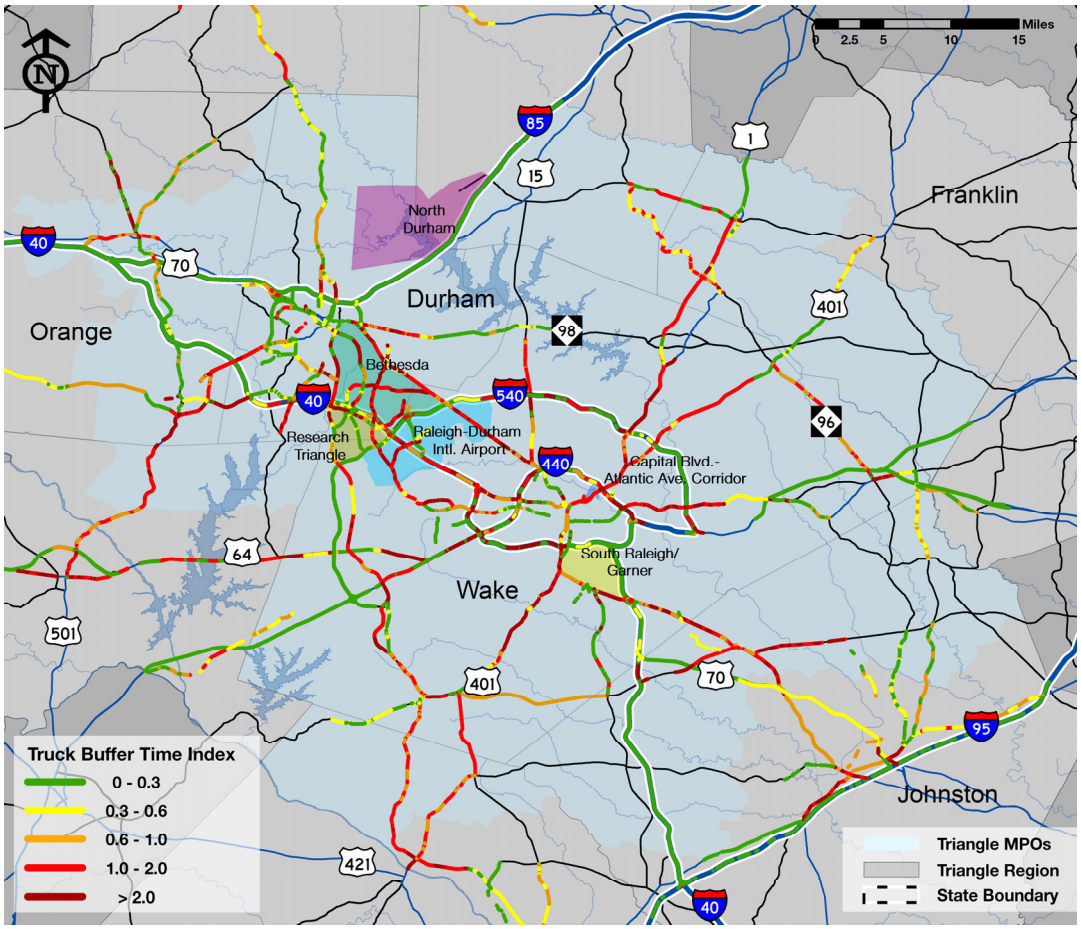
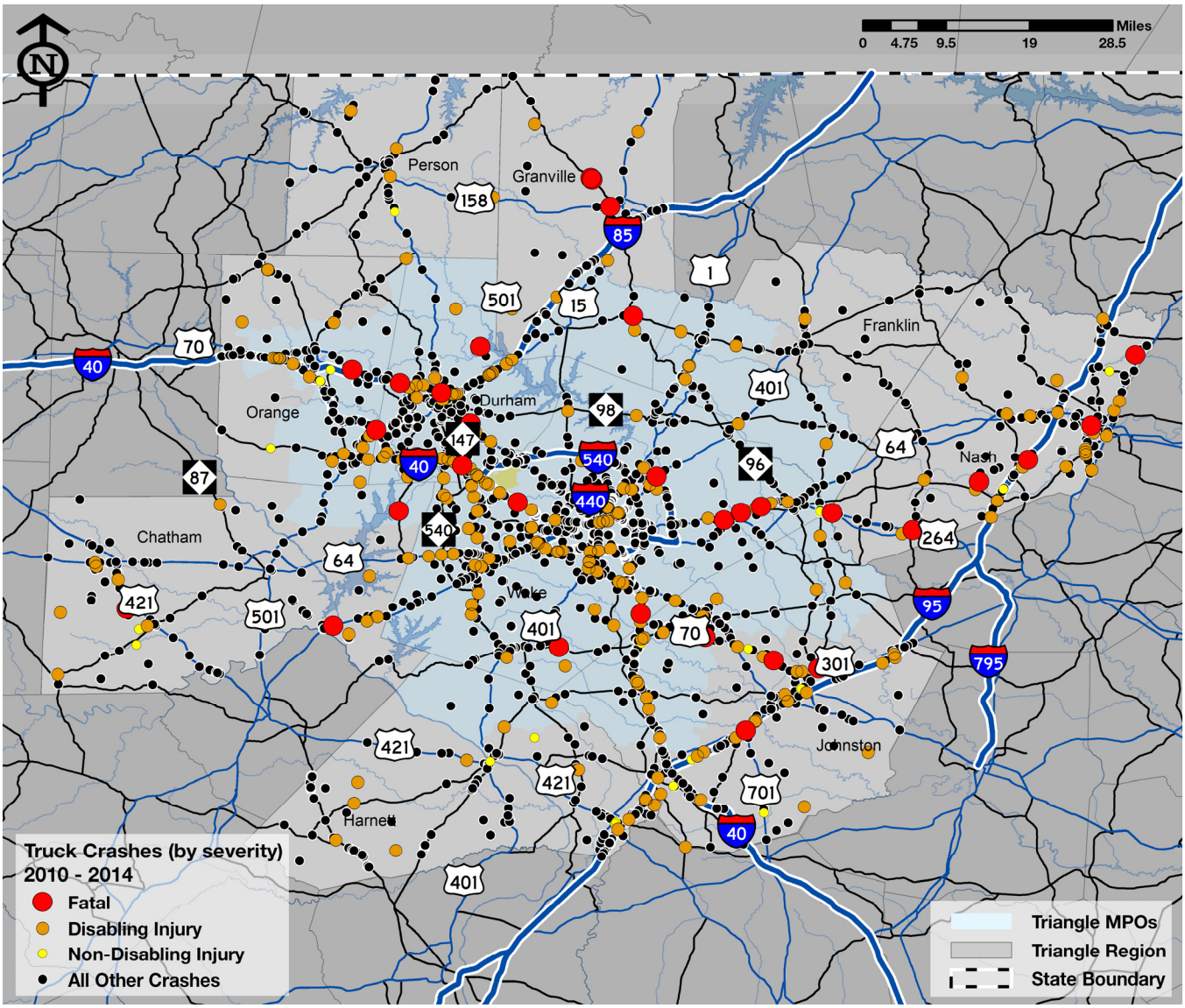


Figure 1: Truck Buffer Time Index (8:00 – 9:00 AM), April 2015 (NPMRDS, WSP analysis)



Safety incidents are a second critical aspect of roadway freight performance. Truck-related vehicle crashes occur almost everywhere on the region's network. While the more severe crashes are the least frequent, safety is a pervasive concern. The strategic investment packages planned for the SFC system are designed to improve truck performance in the dimensions of safety and reliability as well. The new technologies associated with connected and automated vehicles also promise safety gains for passenger and for freight traffic.

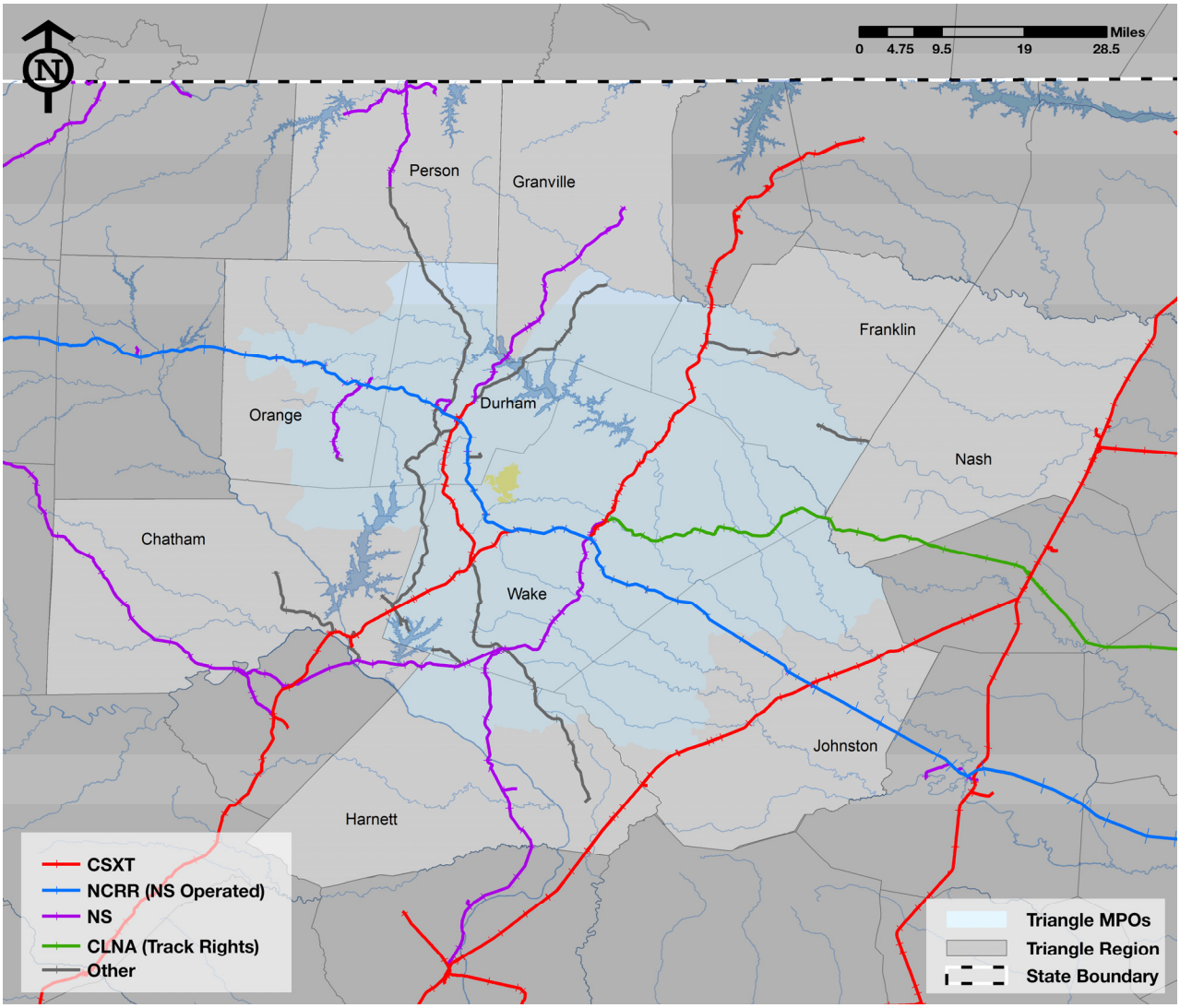
Location of Truck-Related Crashes (2010 – 2014; NCDOT Crash Records)



Rail

The Triangle Region is served by the two principal freight rail systems of the eastern U.S.: the Norfolk Southern Railway (NS) and CSX Transportation. These two Class I railroads and the state–owned shortline North Carolina Railroad (NCRR) account for over 300 miles of active track in the region and carry its 13 million tons of rail freight, with NS providing service on the NCRR lines. CSX operates a classification yard for assembling trains in Raleigh; NS classification yards are in Raleigh and Selma. Intermodal service is provided from outside the region, by NS from its terminal in Greensboro, and by CSX from Charlotte with a new terminal planned in Rocky Mount.

Triangle Region Rail Inventory (BTS NTAD)



Ninety percent of rail tonnage in the region is terminated freight; unit trains of coal delivered for electric power generation in Person County are the largest component. The top five commodities account for 85 percent of rail tonnage and all are bulks: coal is nearly two-thirds of the traffic by itself, followed by gravel and non-metallic minerals, beverage-grade alcohol and chemicals. The top five rail commodities in value terms are 67 percent of the modal volume, and the profile is similar: coal and bulks, but with deliveries of new automobiles also in the picture.

Top Commodities (Tonnage and Value) Moved by Rail (BTS and FHWA, FAF3.5, FAF4, 2016)

Commodity Name	Tons (000s) 2012	Percent of Total	Commodity Name	Value ($M) 2012	Percent of Total
Coal	8,554.1	65.88%	Coal	$603	23.02%
Gravel	918.1	7.07%	Alcoholic Beverages	$442	16.87%
Alcoholic Beverages	603.5	4.65%	Basic Chemicals	$432	16.49%
Nonmetal Mineral Products	540.0	4.16%	Fertilizers	$138	5.27%
Basic Chemicals	441.5	3.40%	Motorized Vehicles	$138	5.27%
Total	**12,985.2**		**Total**	**$2,620**	

Growth is a challenge for rail freight. While traffic in many commodities carried in the region is expected to rise, U.S. demand for coal has been declining because of shifts by electric utilizes to domestic natural gas. One potential source of new growth is CSX's plan to develop an intermodal terminal at Rocky Mount, east of the Triangle Region on the U.S. 64/I-87 corridor. This "Carolina Connector" terminal would offer local shippers improved intermodal service to ports and national markets, and could handle nearly 120,000 containers of freight for the area surrounding Raleigh and Greensboro.

To protect rail performance, two of the region's high-traffic freight rail corridors have been identified for improvements in NC DOT's "Investment Program": the NS line between Greensboro and Selma, and the CSX line east of Raleigh through Rocky Mount. In addition, improvements for railway-roadway at-grade crossings are able to support rail service by addressing safety and travel delays at these locations where rail and road traffic intersect. Ten projects for grade separation have been identified in Triangle Region plans, with four scheduled by 2025.

Railway-Roadway Grade Separation Projects

Rail Road Grade Crossing	Cost Estimate (Million $)	STIP Construction Year	MPO
Mangum St and Blackwell St	100	Post 10-yr	DCHC
Ellis Rd	5.3	2026	DCHC
Cornwallis Rd	13.7	2020	DCHC
Maynard Rd	38	2024	Capital Area
New Hope Church Rd	15.4	2020	Capital Area
Gresham Lk Rd	11	2027	Capital Area
Durant Rd	12.5	2019	Capital Area
E Milbrook Rd	n.a.	Post 2045	Capital Area
NC 96 (Main St) in Youngsville	n.a.	Post 2045	Capital Area
NC 56 in Franklinton	n.a.	Post 2045	Capital Area

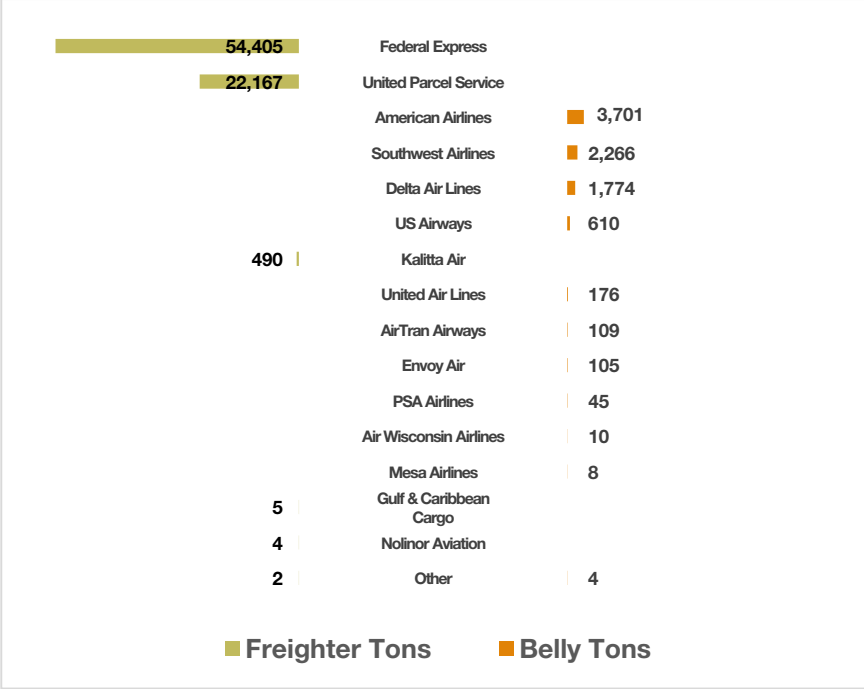
Air

The Raleigh-Durham International Airport (RDU) is the primary airport in the Triangle Region with both passenger and freight operations, and is the third-busiest airport in North Carolina in terms of cargo volumes. RDU has two designated areas for air cargo operations totaling over 672,000 SF of cargo space. The North Cargo facilities house RDU's two all-cargo carriers, FedEx and UPS, who carry most of the domestic cargo. The South Cargo facilities are located near Aviation Pkwy, and are reserved for cargo shipped via commercial airlines, who chiefly carry international cargo via direct flights or connections.

RDU handled 86 thousand tons in 2013. Almost 90 percent was carried by the domestic freighter airlines FedEx and UPS, and the airport overall averaged 40 freighter flights per week. The great majority of RDU's air cargo is domestic—only 4 percent of cargo has an international origin or destination, which chiefly moves in the belly (baggage hold) of passenger flights. International service options are considerably greater at such larger airport hubs as Atlanta, Charlotte, and New York, and the region's overseas air cargo is often trucked to flights from those facilities.

Raleigh-Durham International Airport Cargo Facilities

Air freight attracts high-value and relatively low-weight commodities, and its role in the region's freight is better understood from the perspective of the dollar value of products rather than its comparatively modest tonnage. The top five air commodities represent 85 percent of the value carried by the mode, and four of the five rank among the top seven products by value for the entire region: pharmaceuticals, machinery, electronics, and precision instruments. These are sophisticated products that reflect the high-technology profile of the region's economic base, and the importance of air cargo in supporting it.



Main Cargo Airlines Serving RDU Airport (BTS T-100 Segment Data, 2013)

Currently, there are no plans to expand capacity at RDU and projected volumes do not require it. However, in 2014, the Raleigh-Durham Airport Authority along with the Urban Land Institute (ULI) reviewed the airport's physical assets and developed a set of recommendations that would benefit the greater region.[1] The report identified several opportunities for cargo expansion on-site, including setting aside 50 acres for the development of cargo operations in the northeast part of RDU's campus, which would include refrigerated space and other amenities. The report also suggested that RDU increase efforts to expand international cargo operations, specifically for furniture and pork products, both of which are major products manufactured in North Carolina.

Top Commodities (Tonnage and Value) Moved by Air (BTS and FHWA, FAF3.5, FAF4, 2016)

Commodity Name	Tons (000s) 2012	Percent of Total	Commodity Name	Value ($M) 2012	Percent of Total
Electronics	4.1	17.52%	Precision Instruments	$424	33.65%
Precision Instruments	3.2	13.68%	Pharmaceuticals	$275	21.83%
Printed Products	2.6	11.11%	Electronics	$223	17.70%
Wood Products	2.4	10.26%	Printed Products	$91	7.22%
Pharmaceutucals	1.9	8.12%	Machinery	$63	5.00%
Total	23.4		Total	$1,260	

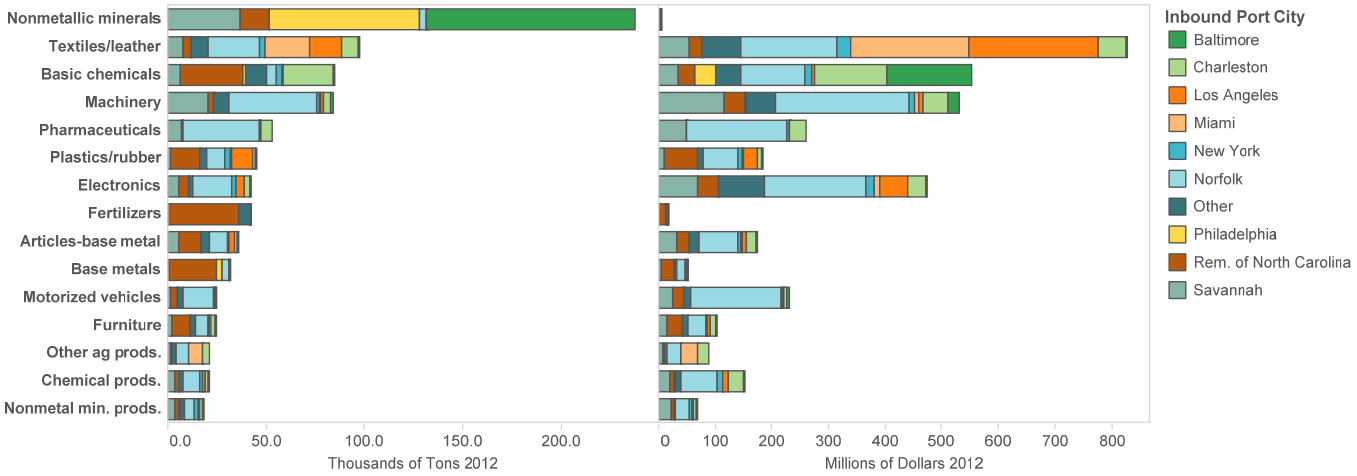
[1] An Urban Land Institute (ULI) Advisory Services Panel Report. http://connect.rdu.com/wp-content/uploads/2015/01/ULIfinal.pdf

Seaports

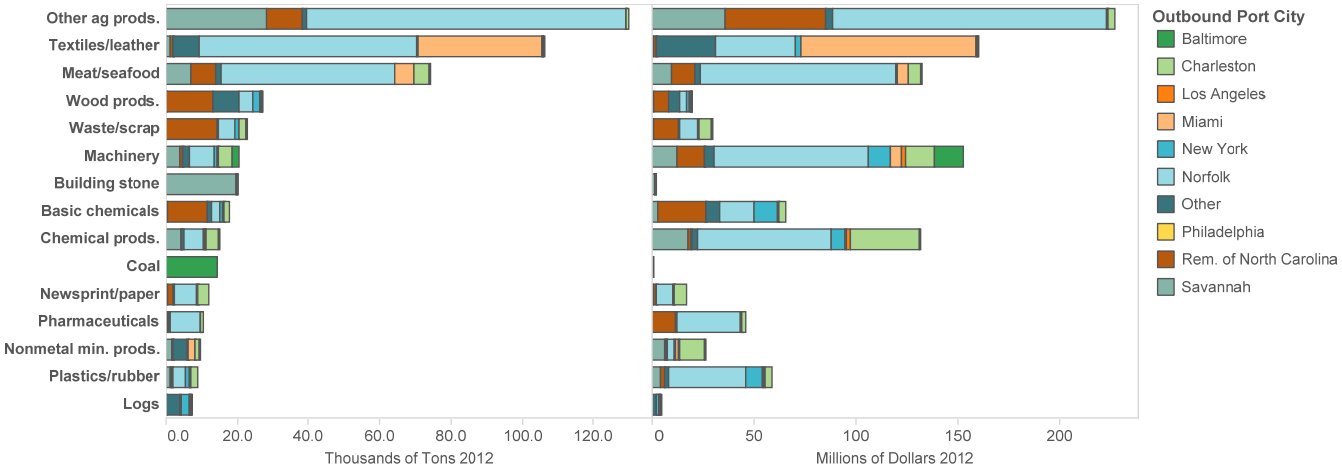
Many of the products produced and consumed in the Triangle region are traded around the world, often traveling to the U.S. by ship. Over half a million tons of freight were exported from the region through seaports in 2012, and almost 1 million tons were imported. The ports of Norfolk, VA and Savannah, GA, and the North Carolina ports of Wilmington and Morehead City handled 74 percent of the exports, and 55 percent of the imports. These ports can be reached by road and rail, and CSX plans to improve intermodal service to Wilmington in association with the Carolina Connector. Norfolk – less than 200 miles away – was the largest facility for Triangle region imports and exports, moving half a million tons in total. Many other ports enter the picture in smaller volumes, chiefly on the Atlantic coast but as far distant as Los Angeles.

Textiles, chemicals and machinery are top import commodities measured by tons and by product value. Non-metallic minerals are the largest by tonnage, and electronics are prominent by value. Top export commodities by tons and value are agricultural products, textiles, meat and seafood, with machinery and chemical products also important in dollar terms.

Port Cities for International Inbound Waterborne Shipments to Raleigh-Durham (BTS and FHWA, FAF4.1, 2016)



Port Cities for International Outbound Waterborne Shipments from Raleigh-Durham (BTS and FHWA, FAF4.1, 2016)

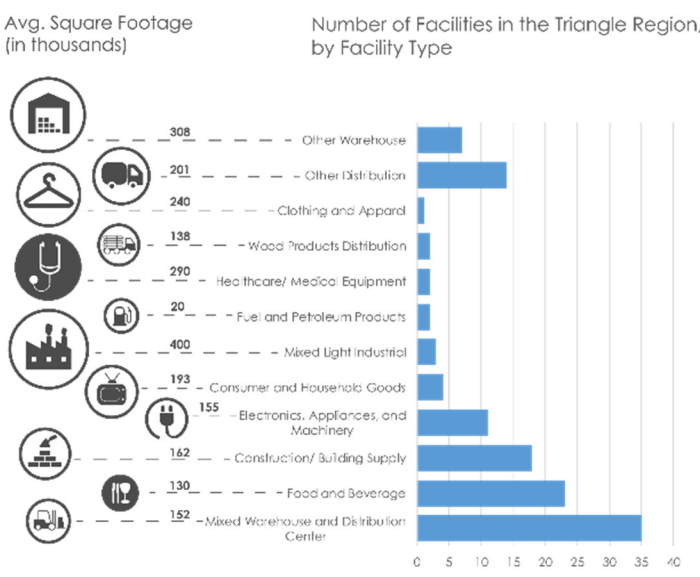


Over the coming decades, the region's imports and exports are forecast to grow in tons at a combined growth rate of 3.9 percent per year. This is significantly faster than the growth expected for domestic traffic, and indicates increasing importance for the region's roadway and railway trade routes. One factor in this outlook is the 2016 expansion of the Panama Canal, which enabled larger ships to cross between oceans. This is expected to be advantageous to Atlantic ports, especially in the southeast, and is beneficial for Triangle Region shipping.

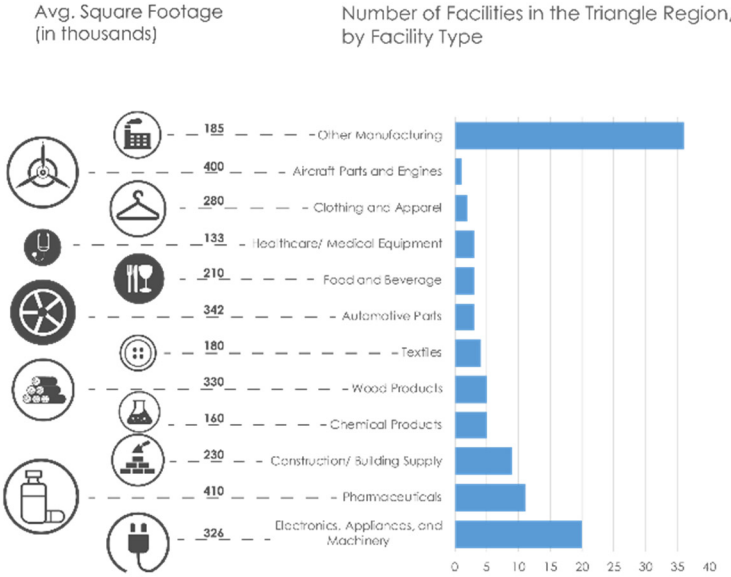
Land Use and Economic Development

Freight-intensive industries account for relatively large amounts of shipping at their facilities. There are about 400 of these facilities in the Triangle Region utilizing almost 60 million square feet (SF) of building space. More than half the facilities are either warehouse distribution centers or manufacturing plants, which together represent 70 percent of the square footage. The average size for both types of facility ranges mainly from 130 thousand to 400 thousand SF.

Warehouse/ Distribution Center Facility Types in the Triangle Region (Westat - 2015)



Manufacturing Facility Types in the Triangle Region (Westat - 2015)

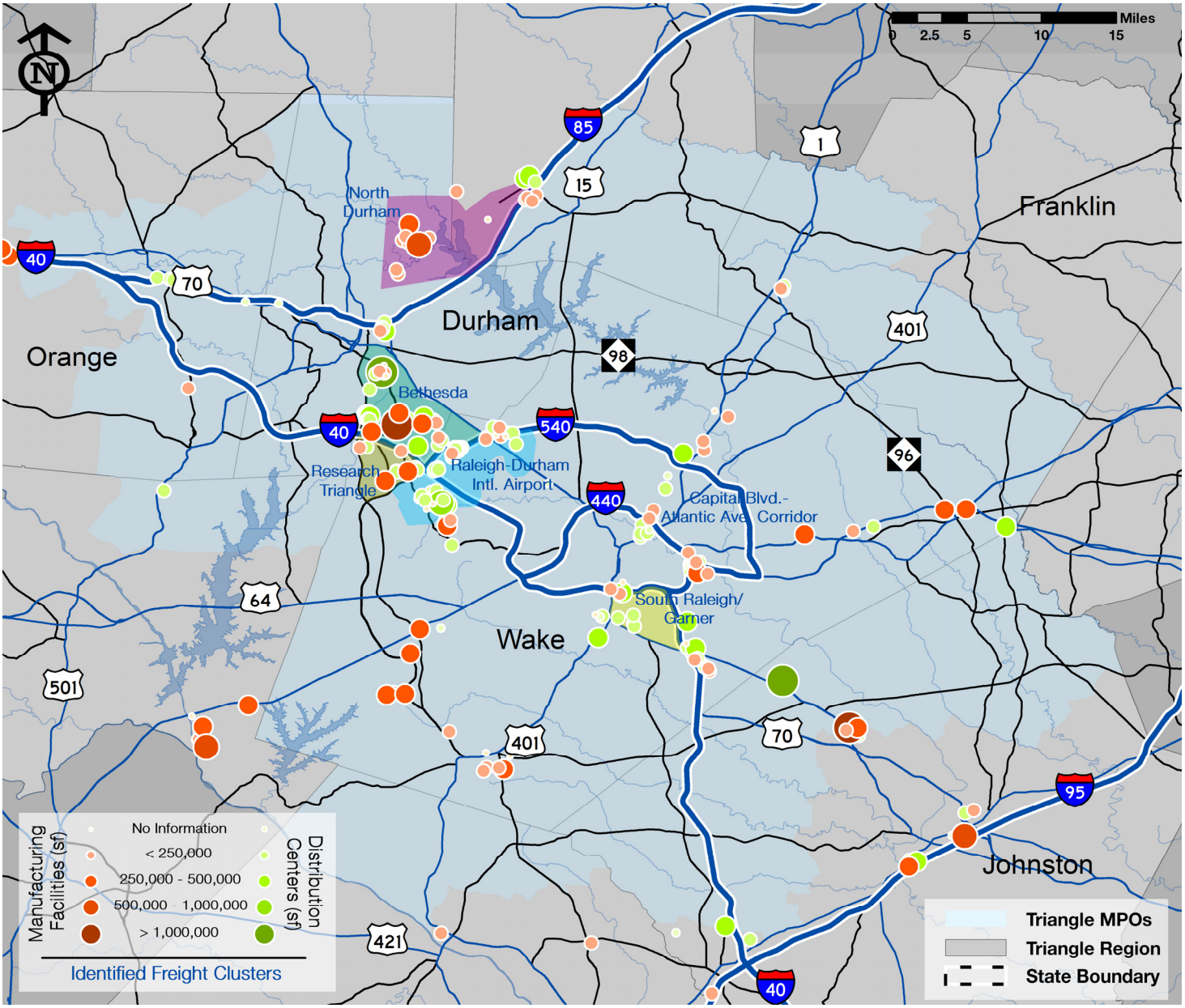


While factories and DCs are in many parts of the region, they tend to concentrate in clusters that have other forms of freight-related employment as well. There are six primary freight clusters in the Triangle Region, located in an arc from North Durham to South Raleigh:

- South Raleigh/Garner
- Capitol Avenue-Atlantic Blvd. Corridor
- RDU Airport
- Bethesda
- Research Triangle
- North Durham

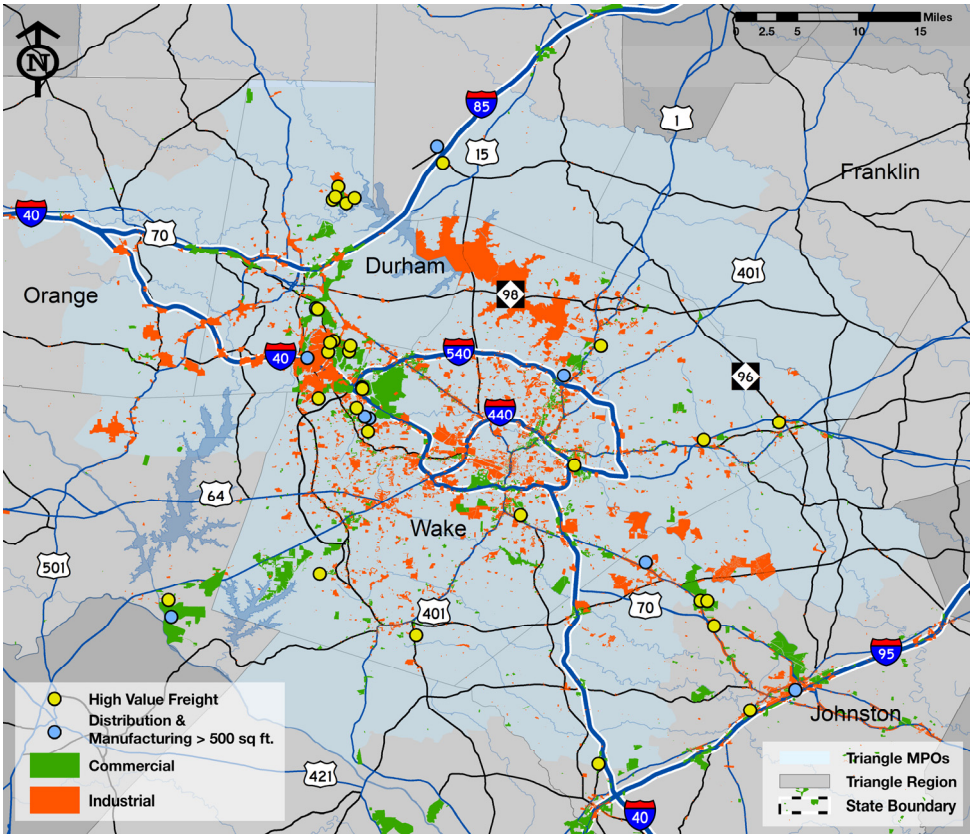
Clusters can have more of a manufacturing or distribution character, but generally perform in dual roles. This is partly a reflection of land use policies, and partly because of combined functions: factories can serve as distribution points, and DCs may perform final-stage manufacturing.

Freight-Intensive Industry and Freight Clusters in the Triangle Region

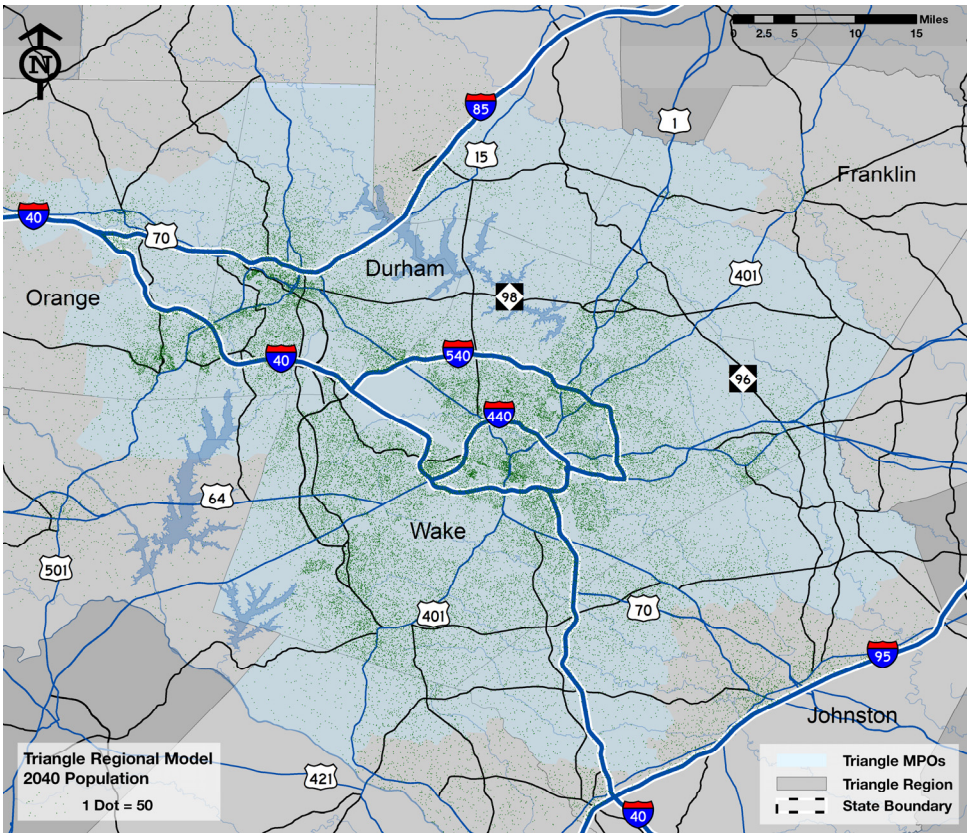


Facilities with the largest footprints and those producing the highest value goods are especially important to freight volumes in the region and to the significance of freight in the local economy. The commercial and industrial land use surrounding these facilities reveals sparse distribution of commercial parcels and limited availability of industrial parcels. A majority of these facilities may not have adequate square footage to grow at their current location, and any future expansions could require mitigation strategies for negative impacts on adjacent land uses – impacts such as air quality, noise and traffic safety. Appropriate zoning overlay districts (e.g., Freight Village, Warehousing and Logistics) are called for, as well as designated truck routes, access to intermodal facilities, and sharing of real-time traffic congestion information with shippers and receivers. As the region's population grows in number and density, the pressure on freight facilities from competing land uses will rise alongside, and will affect the operation of the SFC network as well.

Land Uses Surrounding High Value and Larger Distribution and Manufacturing Freight Facilities



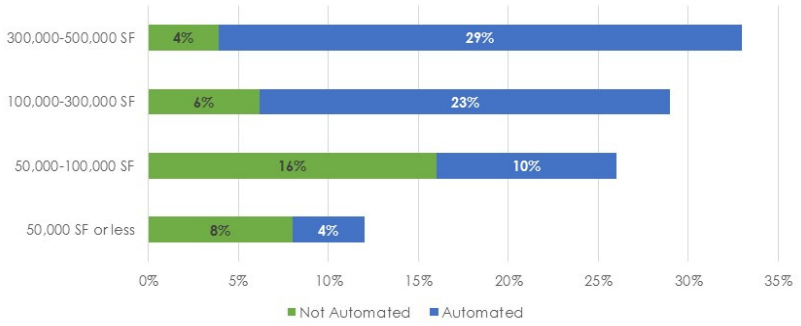
SFC Network with 2040 Population Density Dots Overlay (Triangle Regional Model)



Freight facilities could adapt to future land use constraints yet generate more volume on the SFC system.

An offsetting influence is emerging from supply chain facility trends. Supply chain managers nationally expect that the DCs closest to end markets (as most are in the Triangle Region) will be relatively small, with two-thirds under 300 thousand SF. This is comparable to the region's profile now, but the DCs increasingly are being automated. Automated warehouses store and handle more goods horizontally and vertically in the building, with the result that they can multiply the amount of freight generated per acre. Factory automation is increasing as well, as new technologies affect more manufacturing processes. These developments may mean that freight facilities could adapt to future land use constraints yet generate more volume on the SFC system.

The DCHC and Capital Area MPOs work collaboratively with TJCOG for land use planning and analysis. From tools and forecasts that are part of this collaboration, eleven Freight-Oriented Development (FOD) opportunity areas were identified for this Freight Plan. They are located in and around the region's population and activity centers, they can support recent supply chain trends, and they build on NCDOT's 2011 Seven Portals Study on economic development for the Triangle region. The FOD opportunity areas are in two categories:



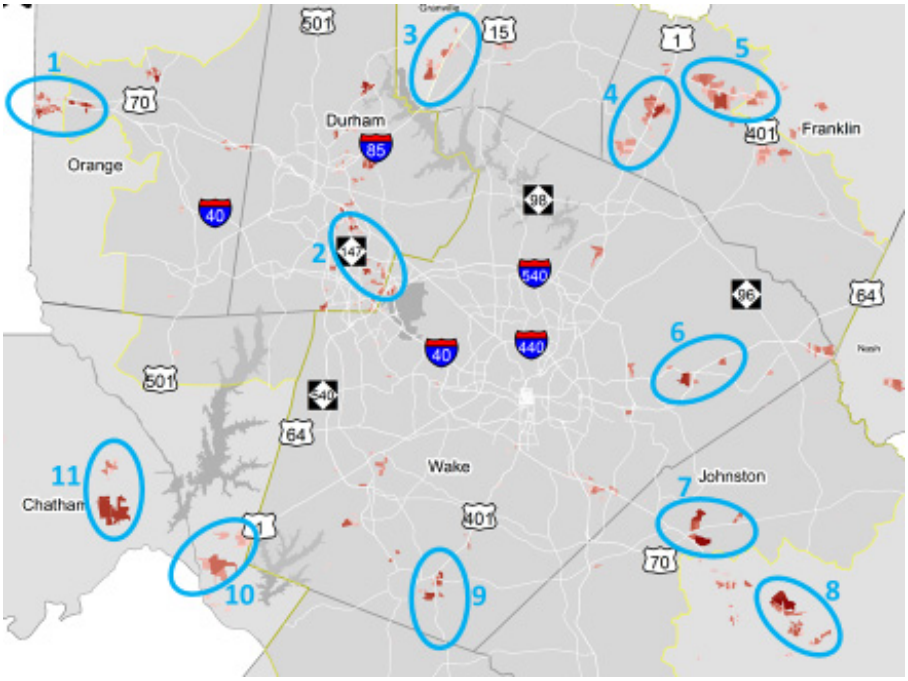
3 Year Outlook for Size & Automation of DCs Closest to Market (Tompkins Int'l)

- Infill and adaptive redevelopment sites that are located within existing freight clusters
- Greenfield new development sites that are located around the region's periphery

The eleven FOD areas are in six Triangle Region counties. They contain nearly 200 large parcels totaling 2.8 million buildable industrial square feet. The average parcel accommodates 345 thousand SF and thus is well aligned with the outlook for facility demand.

Strategies for land use and economic development in the FOD opportunity areas differ by category. For example, preservation of sites and protection of routes is important for infill and adaptive reuse locations; greenfield locations need a variety of guidance for planning, and they need zoning that anticipates the future.

Freight-Oriented Development Opportunity Areas (Triangle CommunityViz 2.0 Model, TJCOG's Connect 2045 Community Plan Scenario, Industrial Square Footage Data)



Infill and Adaptive Reuse FOD Area Strategies	Greenfield FOD Area Strategies
Adopt access management strategies	Conduct market studies and environmental reviews
Adopt zoning ordinances to preserve the industrial sites	Provide infrastructure and utility services
Collaborate with EDPNC for reuse of buildings and land	Collaborate to identify funding sources
Monitor truck traffic and performance at freight clusters	Adopt special freight zoning districts to guide growth allocations and define freight priority areas
For high-value clusters, monitor performance and disseminate data in real time	Establish criteria for market incentives adequate to attract higher pay jobs
Adopt design standards adequate for heavy truck movements	Provide consistent zoning designation across the region
Discourage new housing developments next to FOD areas	Address size and density requirements for defining new areas
Discourage location of facilities that ship hazardous materials	
Encourage new technology improving emissions, noise, safety and security	
Protect rail freight corridors from encroachment	
Protect communities of concern through urban design, streetscape, and other standards	

The Triangle Regional Freight Plan puts the region on a path that preserves and strengthens the contribution of freight transportation to the region's economy, keeps its households supplied with the goods for everyday life, and helps maintain the character and attractiveness of the region for years to come.