5. Food Manufacturing Supply Chain

5.1 Supply Chain Economic Contribution

The manufacturing sector is one of the largest sectors of the U.S. economy and includes a wide variety of goods represented by 21 subsectors.[1] All food manufacturing industries in Florida, except paper manufacturing and beverage and tobacco product manufacturing, have a competitive advantage relative to their counterparts at the national level. Therefore, food manufacturing in Florida shows high potential to expand within the local market and it is also a crucial sector for Florida resilience. According to FEMA, "even supply chains that were previously functioning well can experience significant disruption, generating acute life-safety challenges and quickly turning a disaster into a catastrophe."[2] Food, one of the first commodities to be on the public radar during a disruptive events, can drive to consumer uncertainty increasing demand and shortages when left unmanaged. Hence, maintaining the continuous flow of food from production to consumption, is as important as maintaining the flow of water, electricity, and fuel.

The food manufacturing subsector alone is comprised by the nine industry groups presented in Table 37.

TABLE 1. FOOD MANUFACTURING SECTOR -COMPOSITION AND ECONONOMIC CONTRIBUTION IN 2022

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
NAICS 3111 Animal food manufacturing	844	$57	$148
NAICS 3112 Grain and oilseed milling	306	$31	$54
NAICS 3113 Sugar and confectionery product manufacturing	2,447	$164	$428
NAICS 3114 Fruit and vegetable preserving and specialty food manufacturing	6,234	$442	$1,091
NAICS 3115 Dairy product manufacturing	2,790	$150	$488
NAICS 3116 Animal slaughtering and processing	2,750	$138	$481
NAICS 3117 Seafood product preparation and packaging	1,717	$84	$300
NAICS 3118 Bakeries and tortilla manufacturing	11,344	$507	$1,985
NAICS 3119 Other food manufacturing	7,115	$427	$168
NAICS 311 Food manufacturing	**35,547**	**$2,000**	**$6,220**

[1] NAICS 311, 312, 313, 314, 315, 316, 321, 322, 323, 324, 325, 326, 327, 331, 332, 333, 334, 335, 336, 337 and 339.
[2] Supply Chain Resilience Guide. FEMA (2019).

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
Florida All Industries	9,358,228	$596,788	$1,439,065
Food Manufacturing Supply Chain Share (%)	0.38%	0.34%	0.43%

Source: Cambridge Systematics Analysis using data from BLS and BEA 2022. U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (QCEW). NAICS-Based Data Files https://www.bls.gov/cew/downloadable-data-files.htm

Florida's top food manufacturing companies include a wide variety of companies listed in Table 38.

TABLE 2. FLORIDA TOP FOOD MANUFACTURING COMPANIES

Top Food Manufacturing Companies	Total Jobs	Share (%)
Tropicana Products Inc.	2,248	5.6%
Kraft Heinz Foods Company	1,962	4.9%
Cutrale Citrus Juices USA Inc.	1,000	2.5%
Cheney Ofs Inc.	860	2.2%
Citrus World Inc.	741	1.9%
Florida Crystals Food Corp.	602	1.5%
G Roe Wm & Sons Inc	500	1.3%
Sugar Cane Growers Cooperative of Florida	469	1.2%
Bimbo Bakeries USA Inc	451	1.1%
Conopco Inc.	419	1.0%
Top Food Manufacturing Companies	9,252	23.1%
All Food Manufacturing Companies	40,081	100%

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020).

Conclusion

Several key findings are associated with the food manufacturing supply chain's contribution to the Florida economy in 2022.

Overall Strength of Florida's Food Manufacturing Sector

- The Florida food manufacturing subsector, led by **bakeries and tortilla production**, significantly contributes to the state's economy with key industries collectively supporting over $41.8 billion in sales revenue and 143,891 jobs.

Bakeries and Tortilla Manufacturing

- Largest industry in Florida's food manufacturing subsector.
- Accounted for 32% of the subsector's GSP, supported more than 11,000 jobs, and paid $0.5 billion in wages.

Fruit and Vegetable Preserving and Specialty Food Manufacturing

- Second largest industry in the subsector.
- Contributed 18% to the subsector's GSP, employed more than 1,000 people, and paid $0.4 billion in wages.

Other Important Food Industries: Dairy Product Manufacturing, Animal Slaughtering and Processing, Sugar and Confectionery Product Manufacturing

- Together, these industries accounted for 22% of the subsector's GSP, generated almost 8,000 jobs, and paid almost $0.5 billion in wages.

Diversity of Food Manufacturing Companies and Employment Contribution

- Includes citrus processing, sauce and beans production, bakeries, meat and seafood packaging, and dairy product manufacturing.
- Top companies generated 9.2 thousand jobs.
- Represent 23% of total employment within the food manufacturing subsector.

Employers of Note: Tropicana Product Incorporated, and Kraft Heinz Foods Company

- Tropicana Product Incorporated is the leading citrus juice manufacturer, employing nearly 2.25 thousand people, and accounting for more than 5% of total food manufacturing jobs in Florida.
- Kraft Heinz Foods Company created nearly 2 thousand jobs, approximating 5% of the subsector's total employment.

5.2 Supply Chain Market Analysis

Commodity Flow Analysis

Table 39 presents the directional flows for the food manufacturing supply chain in 2022.

TABLE 3. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - DIRECTIONAL COMMODITY FLOWS BY TONNAGE AND VALUE IN 2022

Directional	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Intra	33,584	60%	$40,519	54%
Inbound	13,680	25%	$23,263	31%
Outbound	8,462	15%	$10,988	15%
Total	55,726	100%	$74,769	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

Table 40 presents Florida imports and exports and total trade for the food manufacturing supply chain, including the breakdown between domestic and international trade, in 2022.

TABLE 4. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – DOMESTIC AND INTERNATIONAL TRADE IN 2022

Trade	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Domestic Exports	7,914	34%	$9,789	25%
International Exports	932	4%	$2,422	6%
Total Exports (E)	8,847	38%	$12,211	32%
Domestic Imports	12,768	55%	$19,998	52%
International Imports	1,564	7%	$6,389	17%
Total Imports (I)	14,331	62%	$26,387	68%
Total Trade = (E) + (I)	23,178	100%	$38,598	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

Top Domestic Trading Partners

Table 41 and Table 42 shows Florida's top 10 domestic trading partners by value for the food manufacturing supply chain in 2022.

TABLE 5. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY TONNAGE IN 2022

State	Domestic Exports (Thousand Tons)	State	Domestic Imports (Thousand Tons)
Georgia	2,199	Georgia	2,385
Alabama	494	California	932
New Jersey	482	Virginia	894
North Carolina	411	Illinois	863
Ohio	351	Texas	809

State	Domestic Exports (Thousand Tons)	State	Domestic Imports (Thousand Tons)
South Carolina	349	Alabama	802
Illinois	337	North Carolina	731
Texas	325	New York	666
Pennsylvania	304	Tennessee	578
California	282	Pennsylvania	452
Top 10 (Tonnage)	*5,534*	*Top 10 (Tonnage)*	*9,112*
Top 10 (Percentage)	*70%*	*Top 10 (Percentage)*	*71%*
Total	7,914	Total	12,768

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

TABLE 6. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY VALUE IN 2022

State	Domestic Exports (Million USD)	State	Domestic Imports (Million USD)
Georgia	$2,035	California	$2,530
California	$651	Georgia	$2,480
New Jersey	$643	Texas	$1,127
Illinois	$573	New Jersey	$1,123
Ohio	$487	Virginia	$1,099
Texas	$469	North Carolina	$1,010
New York	$397	Illinois	$984
Pennsylvania	$382	Kentucky	$953
North Carolina	$376	Tennessee	$853
South Carolina	$269	Wisconsin	$821
Top 10 (USD)	*$6,282*	*Top 10 (USD)*	*$12,980*

State	Domestic Exports (Million USD)	State	Domestic Imports (Million USD)
Top 10 (Percentage)	*64%*	*Top 10 (Percentage)*	*65%*
Total	$9,789	Total	$19,998

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida.
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

Top Foreign Trading Partners

Table 33 shows Florida's top foreign trading partners for imports and exports in 2022 based on value (USD).

TABLE 7. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – FOREIGN TRADING PARTNERS BY VALUE IN 2022

Foreign Trading Partners	International Exports ($ Million USD)	Foreign Trading Partners	International Imports ($ Million USD)
Mexico	$485	Canada	$810
Dominican Republic	$328	Mexico	$485
Canada	$238	Brazil	$370
Bahamas	$209	Switzerland	$323
Panama	$177	Spain	$208
Guatemala	$160	Chile	$200
Costa Rica	$143	Colombia	$175
Colombia	$134	Italy	$144
Honduras	$127	Thailand	$135
Jamaica	$105	Vietnam	$129
Top 10 (Million USD)	*$2,105*	*Top 10 (Million USD)*	*$2,978*
Top 10 (Percentage)	*59%*	*Top 10 (Percentage)*	*59%*
Total	*$3,594*	*Total*	*$5,015*

Source: USA Trade Online data, 2022
Note: Trade values were extracted from the USA Trade Online based on NAICS 311 (Food manufacturing).

Conclusion

Several key findings are associated with the supply chain market analysis of the food manufacturing supply chain.

Directional Flows in the Food Manufacturing Supply Chain (2022):

- Intra-Movements: In 2022, Florida's food manufacturing supply chain was dominated by intra-movements, accounting for 60% of the tonnage and 54% of the value, with inbound and outbound movements comprising the remainder.
- Inbound Movements: 14 million tons (25% of total tonnage) and $23 billion (31% of total value).
- Outbound Movements: 8 million tons (15% of total tonnage), and $11 billion (15% of total value).

Imports within Florida's Food Manufacturing Supply Chain:

- Florida's food manufacturing supply chain heavily relies on domestic imports, which constitute the majority of the state's total trade both by tonnage and value, while exports hold a smaller share.
- Imports comprise 62% of total trade by tonnage, and 68% of total trade by value (USD).
- Domestic imports comprise 55% of total trade by tonnage, and 52% of total value (USD).

Exports within Florida's Food Manufacturing Supply Chain:

- Florida's food manufacturing exports are among the largest of the key supply chains analyzed for this report, which displays the vital contribution it provides to the nation.
- Florida food manufacturing exports 38 percent of total trade by tonnage, and 32 percent of total trade by value (USD).
- The majority of these food manufacturing exports are comprised of domestic exports, with 34 percent of this tonnage and 25 percent of total export value (USD).
- Florida food manufacturing exports to its top 10 domestic partners accounts for 70 percent in tonnage (8 million tons), and 64 percent in value ($10 billion) of total domestic exports.
- Food manufacturing imports from Florida's top 10 domestic partners accounts for 71 percent in tonnage (13 million), and 64% in value ($20 billion) of total domestic imports.
- Primary export partners in value and tonnage include Georgia, California, Illinois, Ohio, New Jersey, North Carolina, and Texas.
- Primary import partners in value and tonnage include Georgia, California, Virginia, Illinois, Texas, New Jersey, and Virginia.

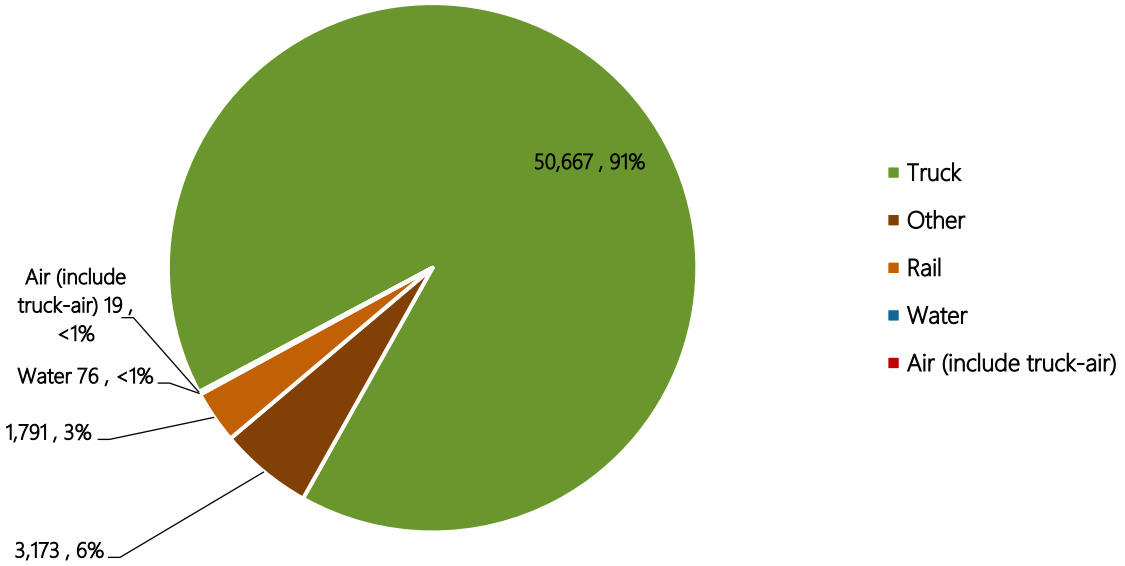
Florida's International Food Manufacturing Trade

- In 2022, Florida's food manufacturing international imports totaled $5 billion in value and international exports totaled $3.6 billion in value.
- The state's top 10 foreign trading partners for imports represent 59% of the total import value, with top three import destinations being Canada, Mexico, and Brazil.
- Florida's top 10 foreign trading partners for exports also make up 59% of the total export value, with top three export destinations including Mexico, Dominican Republic, and Canada.

5.3 Supply Chain Dominant Freight Modes

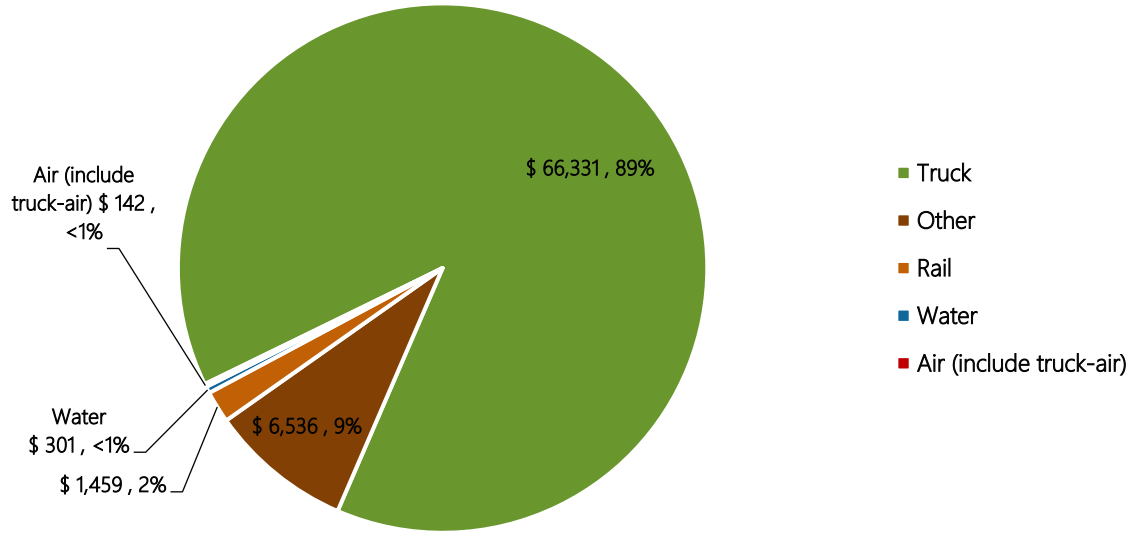
Figure 43 and Figure 44 show the mode split by tonnage and value for the combined intra, inbound, and outbound flows for the food manufacturing supply chain in Florida in 2022.

FIGURE 1. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - TONNAGE (THOUSAND TONS) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

FIGURE 2. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - VALUE (MILLION USD) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

Table 44 and Table 45 show the mode split by tonnage, value, and direction for each freight mode for the food manufacturing supply chain in the State in 2022.

TABLE 8. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - MODE SPLIT BY TONNAGE IN 2022

	Tonnage (Percentage)			
Mode	**Intra** (Thousand Tons)	**Inbound** (Thousand Tons)	**Outbound** (Thousand Tons)	**Total by Mode**
Truck	32,995 (98%)	11,097 (81%)	6,575 (78%)	50,667
Other	190 (1%)	1,468 (11%)	1,515 (18%)	3,173
Rail	349 (1%)	1,083 (8%)	359 (4%)	1,791
Water	50 (<1%)	23 (<1%)	3 (<1%)	76
Air (include truck-air)	<1 (<1%)	9 (<1%)	10 (<1%)	19
Total	33,584 (100%)	13,680 (100%)	8,462 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

TABLE 9. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - MODE SPLIT BY VALUE IN 2022

	Value in Million USD (Percentage)			
Mode	**Intra**	**Inbound**	**Outbound**	**Total by Mode**
Truck	$39,396 (97%)	$19,552 (84%)	$7,383 (67%)	$66,331
Other	$538 (1%)	$2,812 (12%)	$3,186 (29%)	$6,536
Rail	$408 (1%)	$703 (3%)	$348 (3%)	$1,459
Water	$177 (<1%)	$115 (<1%)	$10 (<1%)	$301
Air (include truck-air)	<$1 (<1%)	$81 (<1%)	$61 (1%)	$142
Total	40,519 (100%)	23,263 (100%)	10,988 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include milled grain products and preparations, and bakery products (SCTG 6), other prepared foodstuffs, fats and oils (SCTG 7), and alcoholic beverages and denatured alcohol (SCTG 8).

Conclusion

Several key findings are associated with the dominant freight mode analysis of the food manufacturing supply chain.

Mode Split in the Food Manufacturing Supply Chain

- Truck transportation dominates, accounting for 91% of total tonnage and 89% of total value (in USD).
- Other (flyaway aircraft shipments, shipments with undetermined mode, multiple mode shipments and parcel delivery services or couriers) accounted for 3% of total tonnage and 6% of total value (in USD).
- Rail handles a smaller share, representing 3% of tonnage and 2% of value.

Intra Flows (Within Florida):

- Trucks are pivotal in Florida's food manufacturing sector, handling 98% of intra-state tonnage and 97% of intra-state value, with all other modes playing minimal roles.

Inbound Flows (Originating Beyond Florida):

- Trucks, other, and rail lead, comprising 81% (trucks), 11% (other), and 8% (rail) of inbound tonnage and 84% (truck), 12% (other), and 3% (rail) of inbound value.

Outbound Flows (Originating Within Florida):

- Trucks transport 78% of tonnage and 67% of value (in USD).
- Other (flyaway aircraft shipments, shipments with undetermined mode, multiple mode shipments and parcel delivery services or couriers) transports 18% of tonnage and 29% of value (in USD).
- Rail transports 4% of outbound tonnage and 3% of value (in USD).
- Despite the dominance of trucks, "other" modes account for a substantial 18% of outbound tonnage and 29% of value, indicating a notable reliance on diverse transportation methods for higher-value shipments.

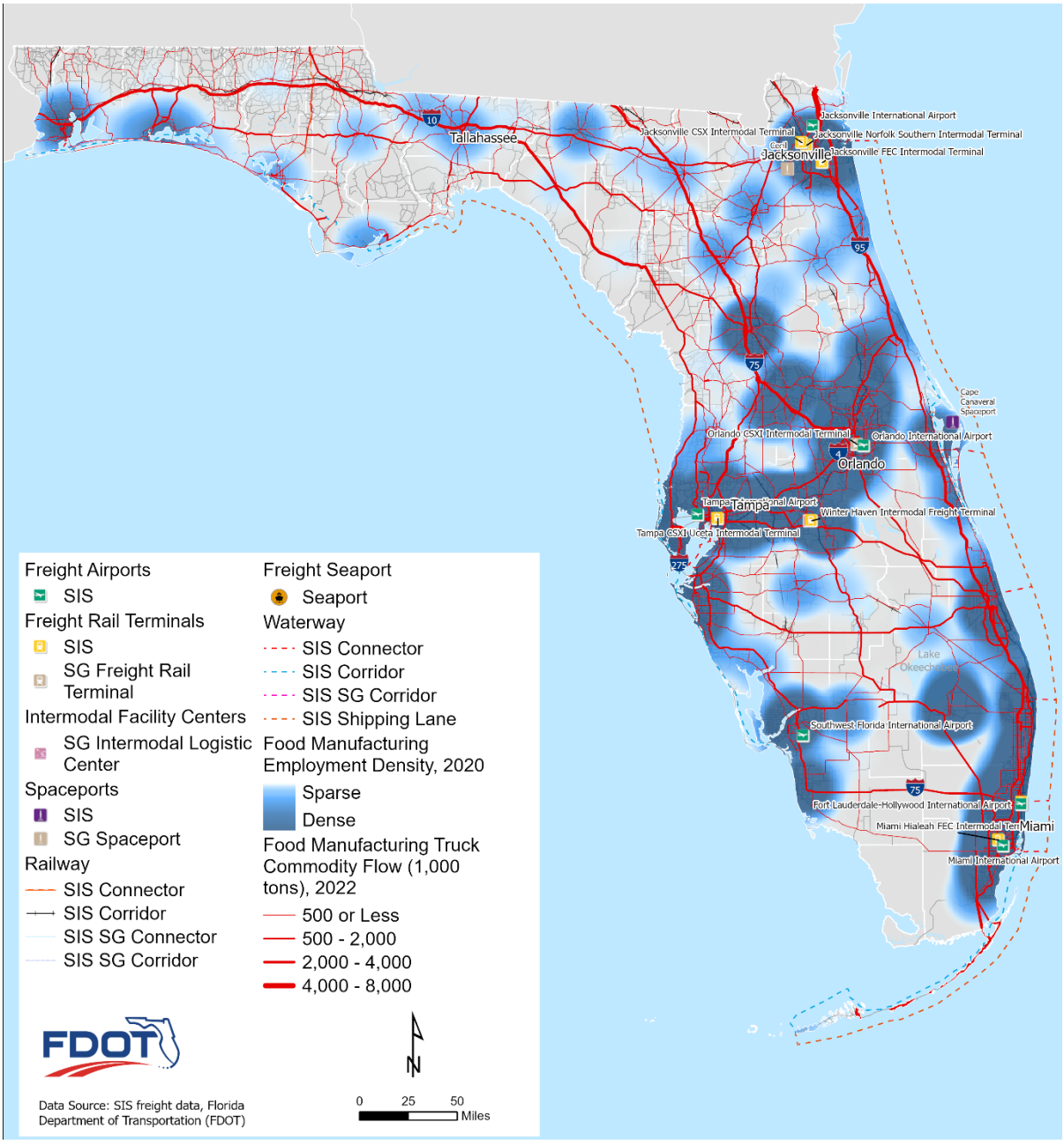
5.4 Initial Qualitative Assessment of Areas of Risk

Critical Florida Transportation Network Components

The Florida's food manufacturing supply chain relies on Florida's SIS to move food products, such as animal food, milled grain products, sugar and confectionary products, fruits, vegetables, seafood, meat, dairy, and beverages, from producers to consumers.

Figure 45 illustrates truck commodity flows and concentration of employment for the food manufacturing supply chain in the State. These concentrations include a range of business establishments, from small companies with one employee to large corporations with 1,800 employees. Among the 3,561-food manufacturing supply chain business establishments in Florida, close to 97 percent have between 1 and 50 employees, 3 percent of the businesses have between 51 and 500 employees, and only 5 businesses have over 500 employees. Truck flows on the major interstates (e.g., I-4, I-10, I-75, I-95) highlight the pivotal role of the interstate highway system in connecting the employment clusters across the State. I-10 and US Route 98 serve as a critical corridor connecting the employment clusters in the Panhandle region. I-95 serves as a significant interstate corridor facilitating substantial movements in Southeast Florida. In Central Florida region, I-4 and Turnpike carry most of the food manufacturing commodities.

FIGURE 3 FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN - COMMODITY FLOWS BY TRUCK AND EMPLOYMENT DENSITY



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

Disruptor Events and Areas of Risk

An estimated 44 million people face food insecurity in the United States, whereas one in five children and over 2 million people reportedly face hunger in Florida.[3] According to the United States Agency for International Development (USAID), accessibility to adequate food supply or the resources needed to maintain dietary needs are two of the biggest factors impacting food security.[4] In the past five years alone, food product pricing has grown faster than historical rates, increasing by 9.9 percent in 2022 and 5.8 percent in 2023 due to a combination of economic inflation and supply chain issues.[5] Providing adequate, safe, and affordable food products remain essential to human health and quality of life.

The Florida SIS plays a crucial role in connecting households with food products while the Florida Department of Agriculture and Consumer Services (FDACS) Division of Food and Safety ensures food safety.[6] For instance, the Second Harvest Food Bank relies on local roadways to facilitate over 15 million mobile food deliveries to families experiencing food insecurity in central Florida.[7] Beyond the rising costs of food products, challenges like shifts in consumer demand, product shelf life, aging transportation infrastructure, natural disasters, policy changes, and trade barriers can potentially disrupt the food manufacturing supply chain.

Similar to the agriculture supply chain, the recent COVID-19 pandemic exposed several areas of risk within the food manufacturing supply chain, resulting in food production manufacturing delays, retail shortages, and consumer demand shifts from in-person grocery shopping to e-commerce grocery delivery.[8] According to the Food and Drug Administration (FDA), online grocery and beverage delivery sales grew by 55 percent between 2019 to 2020 and expected to continuously grow by 27 percent annually from 2023 to 2030, marking a major shift in food product demand changes due to COVID-19 stay-at-home orders. [9]

Additionally, climate hazards or extreme weather events have a risk of delaying or disrupting the food production supply chain, especially in regard to perishable food products such as meat and dairy. For example, a rise in environmental temperature can accelerate the deterioration of perishable foods and may increase the

[3] Feeding America: https://www.feedingamerica.org/hunger-in-america/florida
[4] Peace Corps: https://www.peacecorps.gov/educators/resources/global-issues-food-security/#
[5] U.S Economic Research Service: https://www.ers.usda.gov/data-products/food-price-outlook/summary-findings/
[6] Florida Department of Agriculture and Consumer Services: https://www.fdacs.gov/Business-Services/Food/Food-Establishments/Wholesale-Manufactured-Food-Program
[7] Second Harvest Food Bank of central Florida: https://www.feedhopenow.org/site/SPageServer/?NONCE_TOKEN=9C16F69BF97DB107C5B8ABA476DA696C&pagename=about_hunger
[8] USDA Economic Research Service: https://www.ers.usda.gov/amber-waves/2024/february/new-survey-data-show-online-grocery-shopping-prevalence-and-frequency-in-the-united-states/
[9] USDA Economic Research Service: https://www.ers.usda.gov/amber-waves/2024/february/new-survey-data-show-online-grocery-shopping-prevalence-and-frequency-in-the-united-states/

risk of foodborne illnesses, whereas heavy rain events or hurricanes have the potential to damage food manufacturing warehouses and connecting transportation infrastructure.[10]

Potential Impacts to Florida's SIS

The effects of disruption events, including storm surge, floodplain, wildfire, sinkhole, sea level rise, strong wind, lightning, and extreme heat, on Florida's SIS infrastructure that carries the food manufacturing supply chain are summarized in this section.

Storm Surge

The food manufacturing supply chain depends on local roadways, major highways, and interstates to link food manufacturing facilities with freight distribution routes throughout the state. Depending on storm severity, storm surge poses a significant risk to local roadways and food manufacturing hubs near Tampa and south of Tampa, as well as along the southeast coast, and northeast coast around Jacksonville.

As shown in Figure 46, the panhandle and gulf coast regions may experience the highest levels of storm surge in the state, impacting U.S 98. While these areas do not have high food manufacturing employment density, U.S 98 remains a critical connector between the northwest region and the rest of the state, providing access to I-10, I-4 near Orlando, I-75 and I-275 in Tampa. The highest density of food manufacturing employment is in the Tampa area, southeast Florida and along the I-4 corridor. Storm surge has the potential to affect food manufacturing facilities and operations on the gulf and southeast coast, connection to I-4, I-75, and I-95, and operations to the nearby Port Tampa Bay and Seaport Manatee on the gulf coast, as well as Port of Palm Beach, Port Everglades and PortMiami in the southeast. Other areas with dense food manufacturing employment density which may be impacted by storm surge include northwest Florida in Jacksonville and areas around Lake Okeechobee. In Jacksonville, I-95 could also be impacted by storm surge heading north towards Georgia, as well as I-295 around the city. Around Lake Okeechobee, I-75 through Fort Meyers and across to Fort Lauderdale may be affected as well as U.S. 27.

Floodplain

The 100- and 500-year floodplains cover most of the state, including regions with high food manufacturing employment density, the Tampa Bay area, southeast Florida, and northeast Florida. Like storm surge, flooding may cause road closures, traffic delays, and freight delays. Major Florida interstates for the food manufacturing supply chain, including I-4, I-10, I-75 and I-95, are located in the 100-year floodplain. Additionally, as shown in Figure 47, the 500-year floodplain risk is most prominent in southeast Florida, causing disruptions food manufacturing facilities and distribution shipments at the Port Everglades and PortMiami.

Wildfire

[10] American Journal of Transportation: https://www.ajot.com/news/the-impact-of-temperature-fluctuations-on-perishable-goods-during-transit#:~:text=Temperature%20fluctuations%20can%20accelerate%20the,shelf%20life%20and%20increased%20waste.

As shown in Figure 48, the potential for wildfires is consistent across Florida. However, a wildfire event may pose the greatest risk to both the central and south Florida regions, as these areas contain high food manufacturing employment density and moderate to high wildfire risk. Specifically, I-75 and I-4 providing connection to Port Tampa Bay, SeaPort Manatee and I-10 may be impacted by wildfires, which could affect roadways and bridges and cause traffic delays or congestion.

Sinkhole

Figure 49 explains that sinkholes cause the greatest risk to roadways in and around the panhandle region and the northwest coast. Sinkholes have the potential to create disruptions along I-4, I-10, I-75, U.S 19, U.S 98, and U.S 90 and may impact food manufacturing employment areas near Tampa. Sinkhole events could also impact delays to food manufacturing freight shipments along major roadways and at Port Tampa Bay and Seaport Manatee.

Sea Level Rise

The risk of sea level rise does not affect many high-volume food manufacturing shipping roadways. The major highway potentially affected by one foot of sea level rise is I-275 across Tampa Bay. Sea level rise also has the potential to impact several seaports transporting food manufacturing shipments and high food manufacturing employment areas. In particular, sea level rise may affect food manufacturing operations at and around JaxPort, Port Everglades, SeaPort Manatee, Port Tampa Bay, Port of Palm Beach and Port Miami. The sea level rise hazard will have less of an impact on inland and intrastate movements. The depth and risk of sea level rise across the Florida coastline is evident in Figure 50.

Severe Thunderstorm and Strong Winds

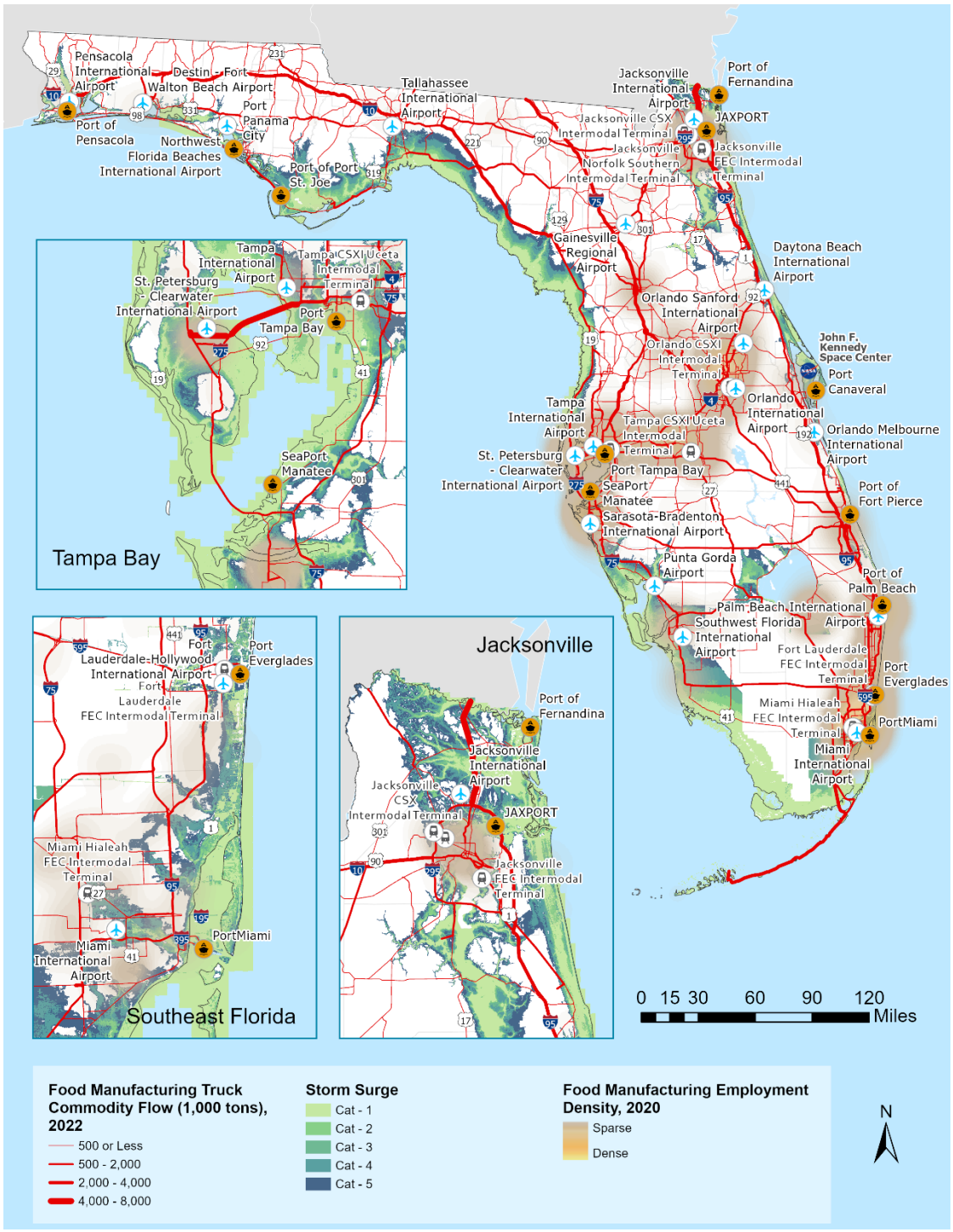
Severe thunderstorms are common in Florida and can disrupt the food manufacturing supply chain, bringing the risk of lightning and strong winds. Strong wind has the potential to disrupt truck travel along these routes, blocking roadways with debris and delaying the supply chain. Strong wind risk is high in dense food manufacturing employment areas along the I-4 corridor in central Florida. As shown in Figure 55, the risk for strong winds is concentrated in the panhandle and down the center of the state. This area includes the high-volume food manufacturing truck routes of I-4, I-10, I-75, I-95, U.S. 19 and U.S. 98. Figure 54 shows the potential for lightning is consistent and high across the state and high-volume food manufacturing truck routes. These routes include the major interstates and highways, rail lines and seaports. The lightning risk is very high in dense food manufacturing employment areas of Tampa Bay, Southeast Florida around the Miami Hialeah FEC Intermodal Terminal, Lake Okeechobee, and Jacksonville. Lightning strikes could cause damage to infrastructure, delays in freight shipment as well as danger to employees in the area.

Extreme Heat

Cases of extreme heat can potentially degrade roadways and cause the asphalt to deteriorate or buckle. This damage to roadways can disrupt the food manufacturing supply chain if their shipping routes are under construction or closed. Figure 56 shows the highest risk areas for extreme heat effects are central and southwest Florida. The high-volume food manufacturing trucking interstates of I-4, I-10, and I-75 cross areas with 41-50 days with temperature of 95 degrees, the most severe situation for extreme heat. This area contains Port Tampa

Bay and Seaport Manatee and has a high food manufacturing employment density. If the infrastructure, seaports and food manufacturing facilities experience construction or delays due to extreme heat effects, the food manufacturing supply chain could see disruptions throughout the state.

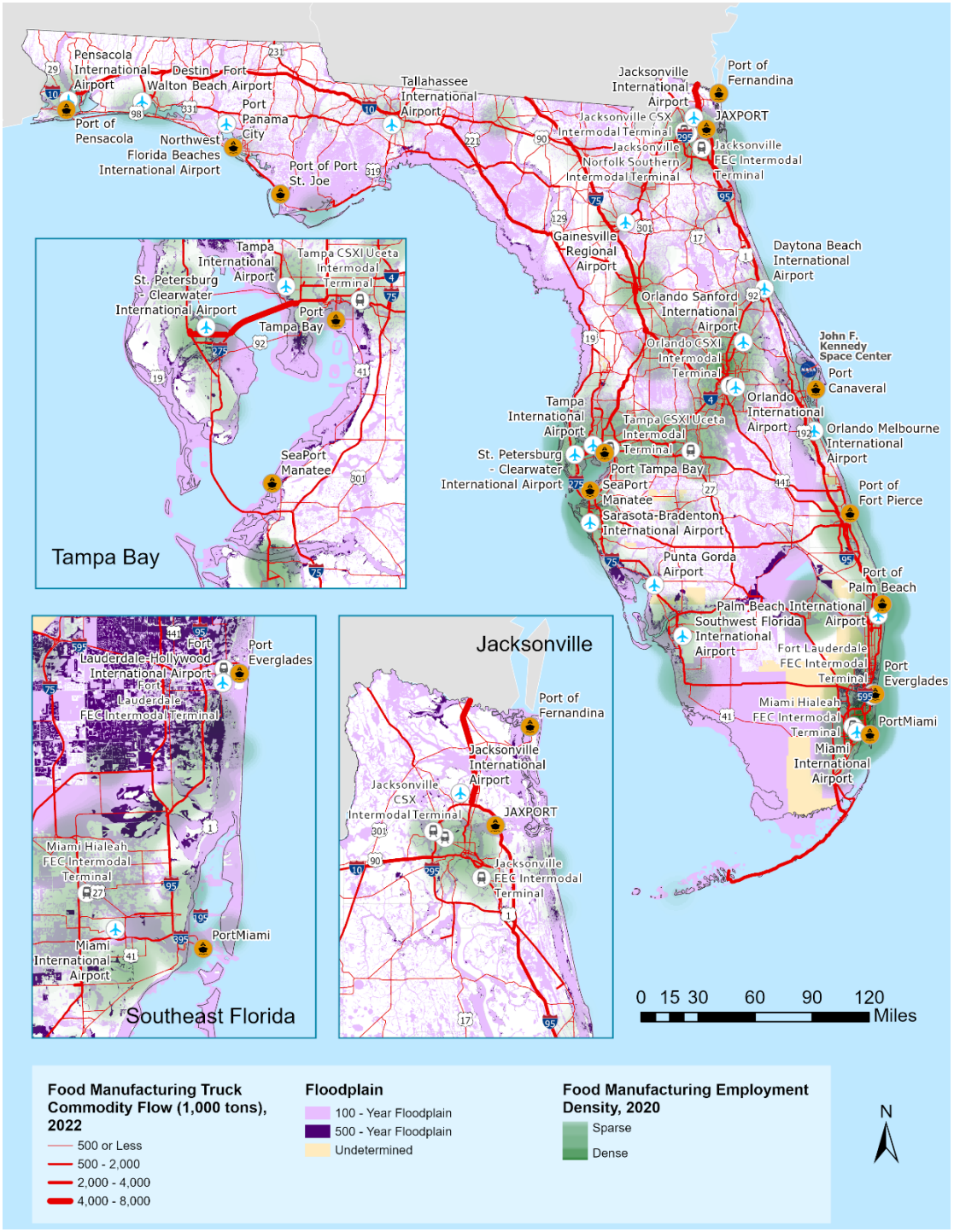
FIGURE 4 FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – STORM SURGE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

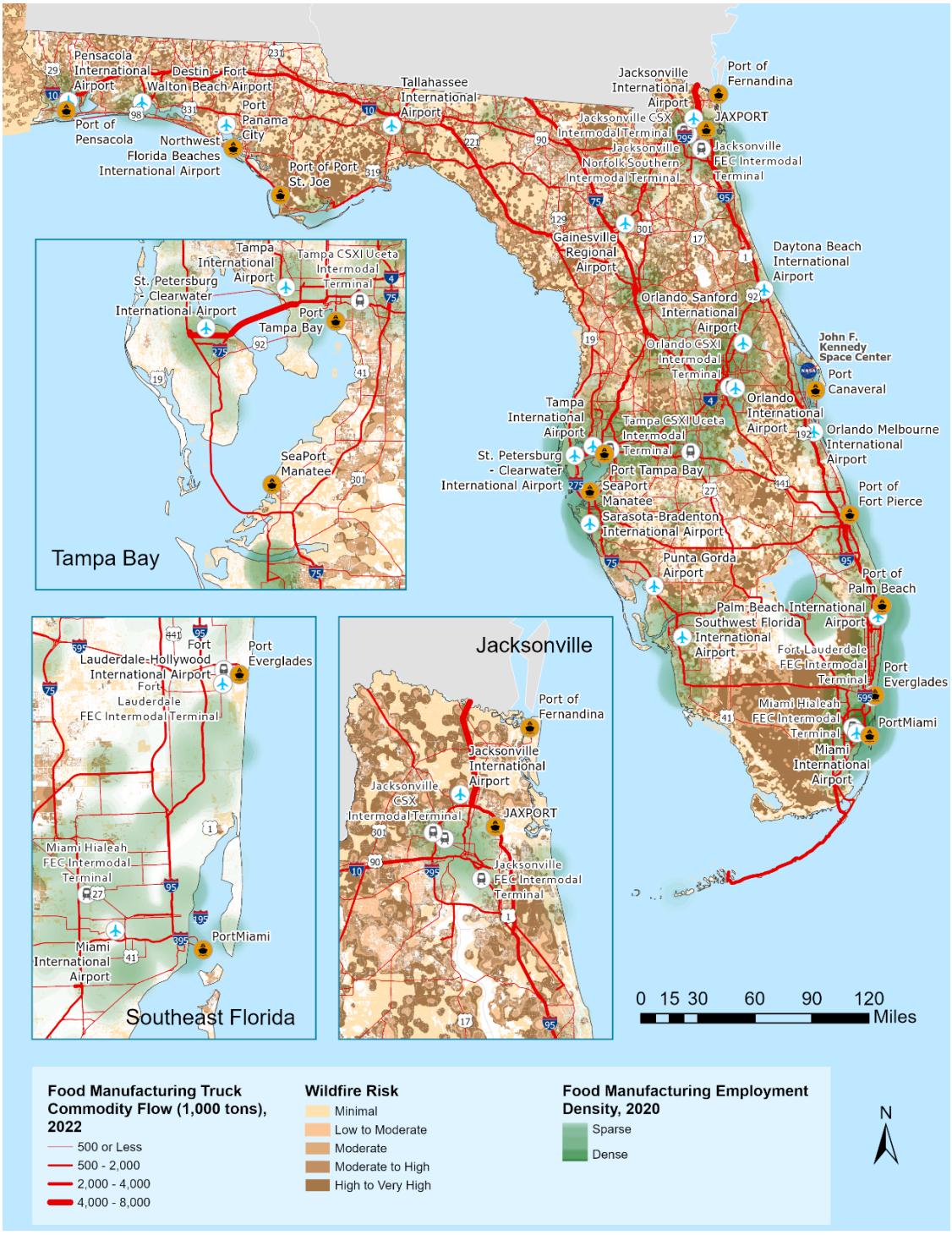
FIGURE 5. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – FLOODPLAIN HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

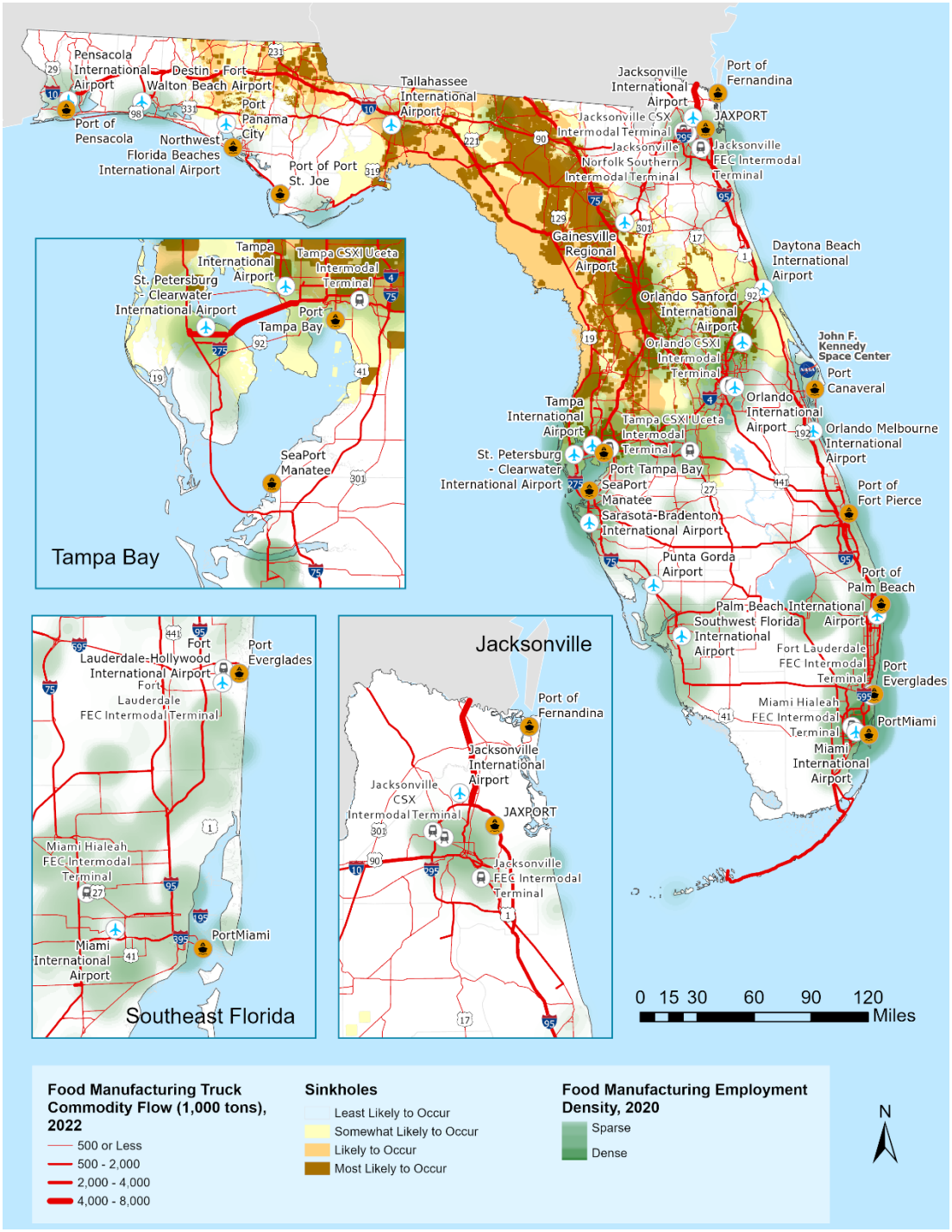
FIGURE 6. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – WILDFIRE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

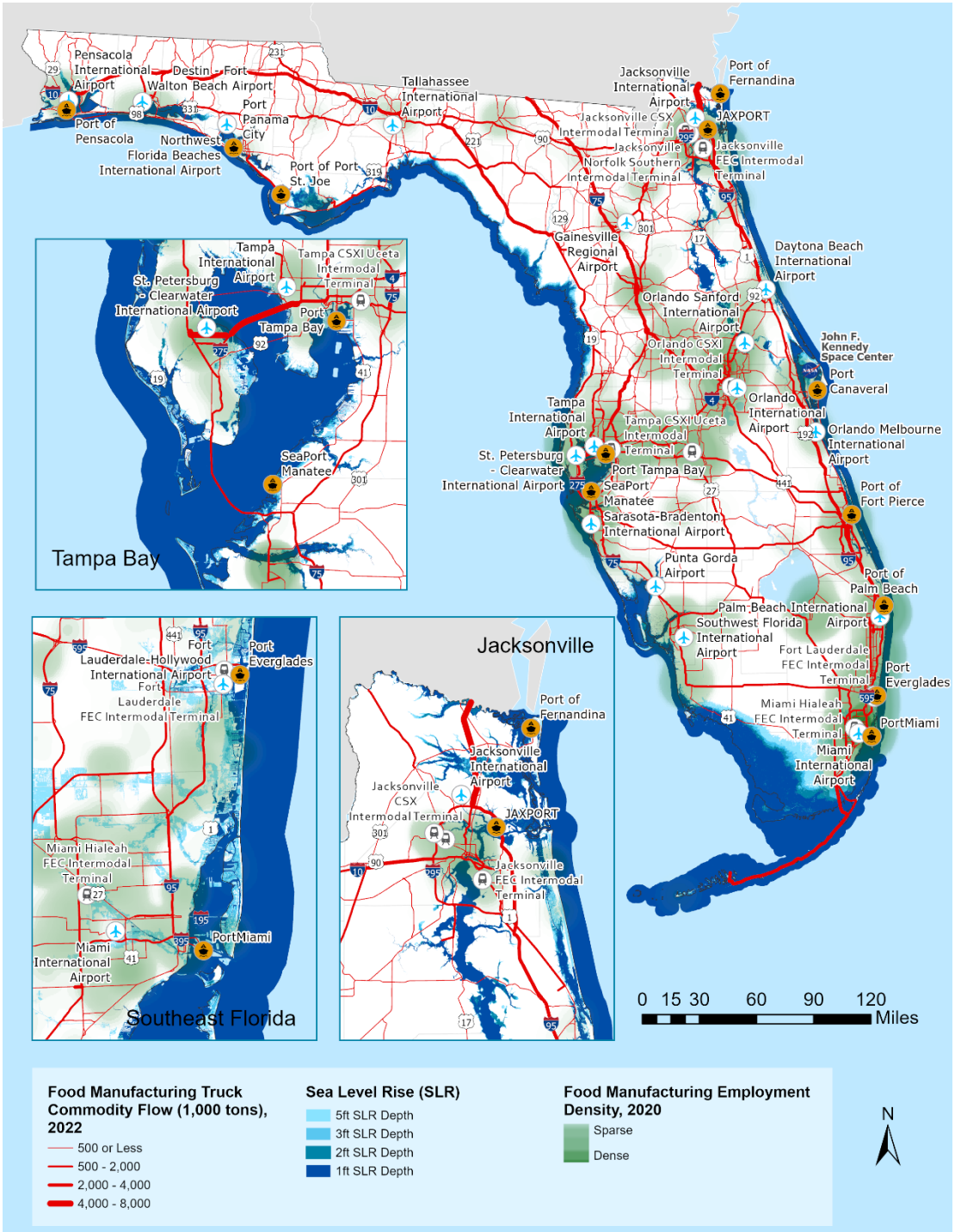
FIGURE 7. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN – SINKHOLE HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

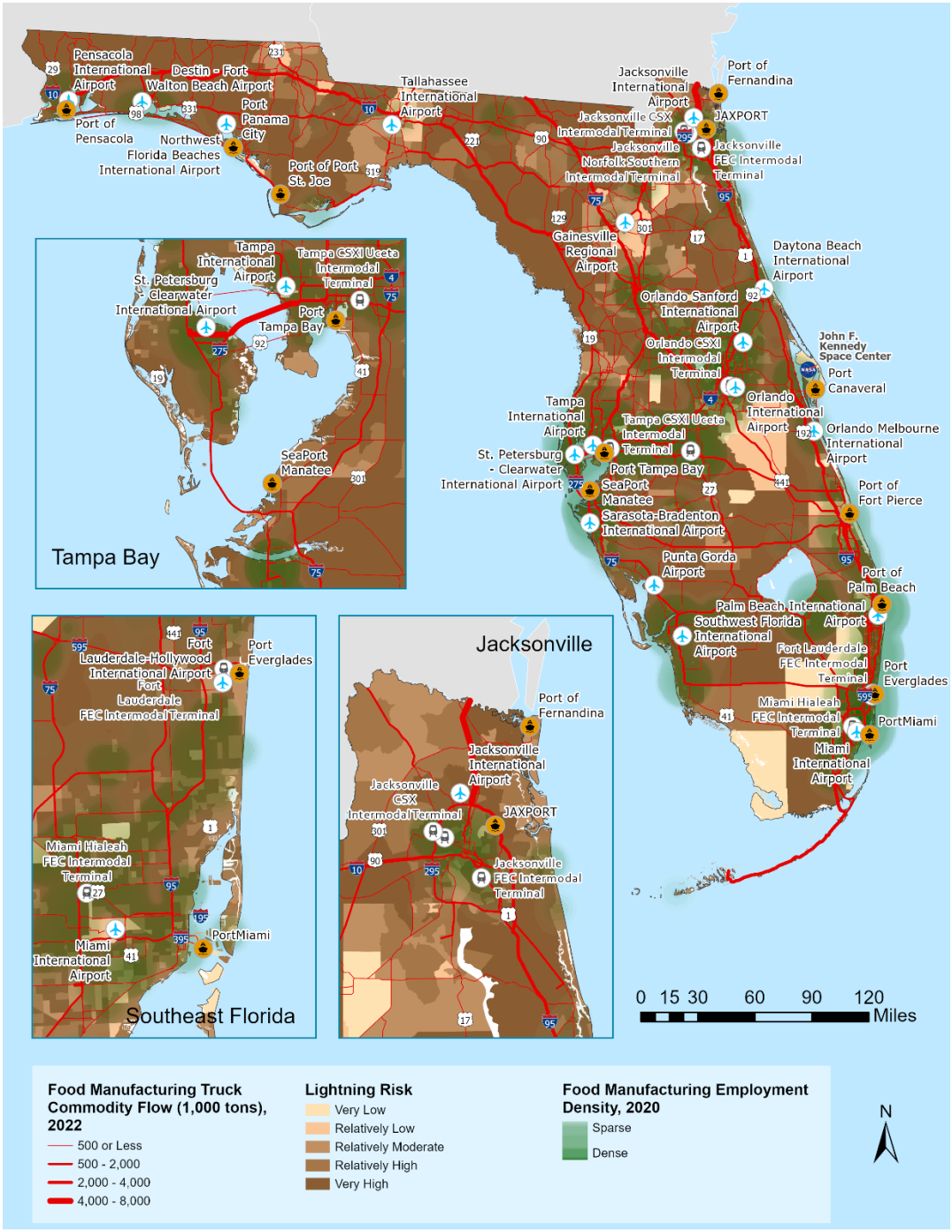
FIGURE 8. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN SEA LEVEL RISE – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

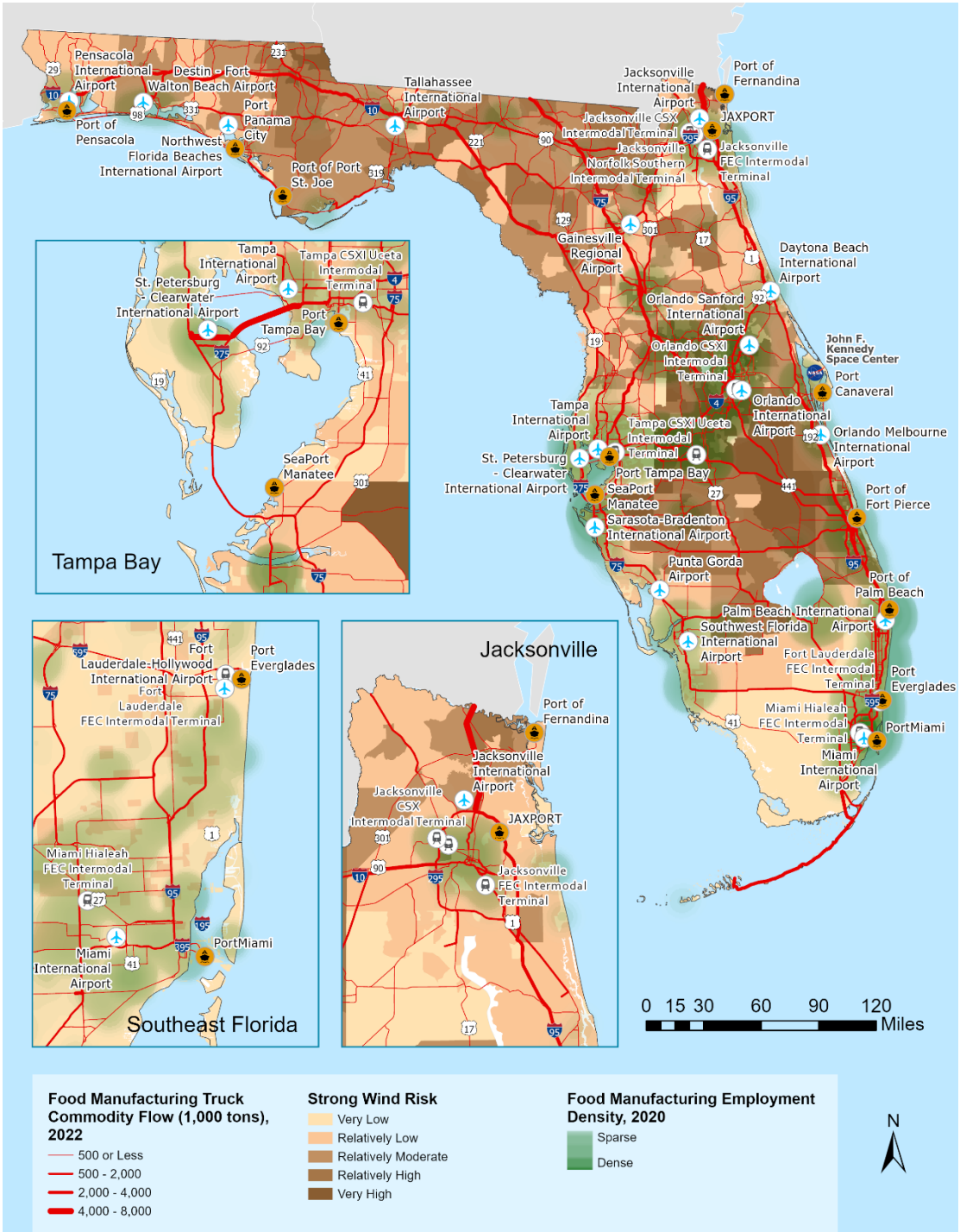
FIGURE 9. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN LIGHTNING – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

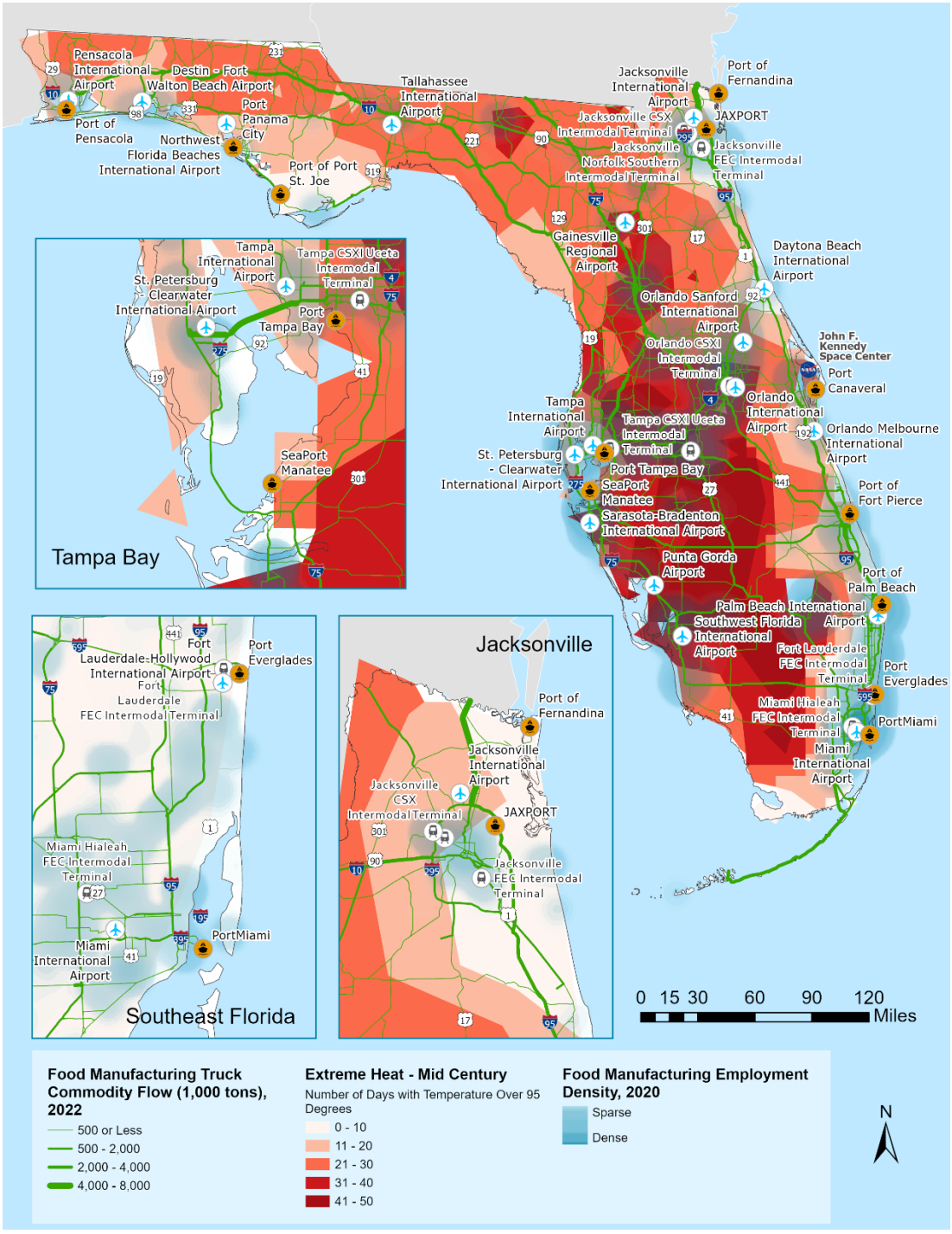
FIGURE 10. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN STRONG WINDS – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).

FIGURE 11. FLORIDA'S FOOD MANUFACTURING SUPPLY CHAIN EXTREME HEAT – HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Food manufacturing truck commodity tons include milled grain prods (SCTG 6), other foodstuffs (SCTG 7), alcoholic beverages (SCTG 8), and tobacco prods (SCTG 9). Employment density includes employment in food manufacturing (NAICS 311).