3. Construction Materials Supply Chain

3.1 Supply Chain Economic Contribution

Florida's construction sector is one of the strongest economies in Florida supporting both population and economy growth and the tourism sector. In 2022, Florida was the fastest growing in the United States based on population.1 It is also one of the most visited by both domestic and international visitors.2,3 These factors have greatly contributed to the strong construction sector. The sector is comprised of industries that build residential and nonresidential buildings, utility systems, highways, streets, bridges, as well as land subdivision industries and equipment contractors. Table 13 lists the primary subsectors that make up the construction industry. The Florida construction sector, as a whole, is a strong sector based on employment concentration and growth. Table 14 summarizes the construction sector's contribution to Florida's economy in 2022.

TABLE 1. FLORIDA CONSTRUCTION SECTOR COMPOSITION

NAICS Code	Industry Subsector
2361	Residential Building Construction
2362	Nonresidential Building Construction
2371	Utility System Construction
2372	Land Subdivision
2373	Highway, Street, and Bridge Construction
2381	Foundation, Structure, and Building Exterior Contractors
2382	Building Equipment Contractors
2383	Building Finishing Contractors
2389	Other Specialty Trade Contractors

Source: 23 - Construction. NAICS Code Description. NAICS Association

TABLE 2. CONTRIBUTION OF THE CONSTRUCTION SECTOR TO FLORIDA ECONOMY IN 2022

Industry	Employment (Jobs)	Wages (Millions of USD)	GSP (millions of dollars)
Construction of buildings	122,324	$9,923	$15,775
Heavy and civil engineering construction	80,728	$5,828	$10,410
Specialty trade contractors	401,518	$22,342	$51,779
Construction Industry	**604,571**	**$38,093**	**$77,489**
Florida All Industries	**9,358,228**	**$596,788**	**$1,439,065**
Construction Industry Share (%)	**6.5%**	**6.4%**	**5.4%**
Building material and garden equipment and supplies dealers	99,804	$4,129	$10,207

[1] New Florida Estimates Show Nation's Third-Largest State Reaching Historic Milestone. Census Library.
[2] Florida Sets New Visitation Record in Third Quarter. Office of Florida Governor.
[3] US States & Cities Visited by Overseas Travelers. International Trade Administration. Department of Commerce.

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

Companies within the construction sector perform a wide array of activities, ranging from construction of buildings and engineering projects to those dealing with maintenance, repairs, roofing, plumbing, and other construction-related activities. Table 15 lists the largest employers in Florida within the construction sector based on number of direct jobs.

TABLE 3. LARGEST CONSTRUCTION COMPANIES IN FLORIDA

Company Name	Total Jobs
Superior Contracting Corporation	849
Baker Concrete Construction Inc.	800
Carpenter Contractors of America Inc.	800
McDonald Construction Corp	425
Boreal LLC	402
Sears Home Improvement Products Inc.	400
Collis Roofing Inc.	635
W.W. Gay Mechanical Contractor Inc.	600
Bch Mechanical L.L.C.	450
Aduddell Industries Inc.	369

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

Note: Construction companies that are also involved in property management were excluded from this list.

This analysis focused on the supply chain of two building materials, natural sands and gravel, which are key for the construction sector as well as resilience. For instance, sandbags are widely used to protect homes from heavy hurricane rainfall and flooding. The top construction sand and gravel mining companies in Florida are listed in Table 16.

TABLE 4. TOP CONSTRUCTION SAND AND GRAVEL MINING COMPANIES

Top Construction Sand and Gravel Mining Companies	Total Jobs	Total Jobs (%)
Legacy Vulcan LLC	78	16%
Bonita Grande Mining LLC	50	11%
Bergeron Sand & Rock Mining Inc.	39	8%
SMR Aggregates Inc	35	7%
Bermont Excavating LLC	15	3%
C C Calhoun Inc	15	3%
Garcia Mining Company LLC	15	3%
Top Construction Sand and Gravel Mining Companies	247	52%
All Construction Sand and Gravel Mining Companies	474	100%

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

Conclusion

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

Overall Strength of Florida's Construction Sector

- The Florida construction sector contributed $77 billion to Florida's Gross State Product (GSP), representing 5.4% of the state GSP.
- Specialty trade contractors contributed nearly 4% to Florida's GSP and generated over 401,000 direct jobs (about 67% of direct jobs in the construction sector).

Building Construction Impacts

- Construction of buildings (including residential and nonresidential) accounted for $15.6 billion of Florida's GSP, equivalent to 1.1% of the state GSP.

Heavy and Civil Engineering Construction

- The heavy and civil engineering construction sector significantly contributed to Florida's economy:
- Added 80,000 direct jobs.
- Generated almost $6 billion in wages.
- Contributed $10 billion to Florida's GSP in 2022.[4]

Supply Chain Analysis for Building Materials

- The analysis focuses on the supply chain of two critical building materials: natural sands and gravel.
- These materials are essential not only for the construction sector but also for resilience efforts.
- For example, sandbags play a crucial role in protecting homes during heavy hurricane rainfall and flooding.

Significance of Construction Sand and Gravel Mining Companies:

- The top construction sand and gravel mining companies in Florida were examined.

4 Source: https://www.agc.org/sites/default/files/users/user21902/FL-US construction fact sheet_92023.pdf

- These establishments, along with the entire supply chain, contribute significantly to resilience efforts, especially during disruptive events like natural disasters.
- In 2020, these industries accounted for over 50% of job creation within the sand and gravel mining sector in Florida.[5]

3.2 Supply Chain Market Analysis

Commodity Flow Analysis

Table 17 presents the directional flows for the construction materials supply chain in 2022. Intra-movements are the most dominant flows by tonnage and value (USD) with 241 million tons (87 percent of total tonnage) and $5.9 billion (70 percent of total value). Inbound movements make up 11 percent of total tonnage with 30 million tons and 18 percent of total value at $2 billion. Outbound movements have the least share with only 2 percent of total tonnage (5 million tons) and 12 percent of total value ($1 billion).

TABLE 5. FLORIDA'S CONSTRUCTION MATERIALS 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	241,115	87%	$5,857	70%
Inbound	29,955	11%	$1,518	18%
Outbound	4,848	2%	$1,046	12%
Total	275,918	100%	$8,421	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Table 18 outlines Florida's construction materials trade, emphasizing both imports and exports for both domestic and international trade. Domestic imports represent the most substantial portion, highlighting Florida's preference for sourcing materials within the United States.

5 Source: https://www.agc.org/sites/default/files/users/user21902/FL-US construction fact sheet_92023.pdf

TABLE 6. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – DOMESTIC AND INTERNATIONAL TRADE IN 2022

Trade	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Domestic Exports	3,904	10%	$953	34%
International Exports	295	1%	$87	3%
Total Exports (E)	4,199	11%	$1,040	38%
Domestic Imports	29,256	76%	$1,391	50%
International Imports	4,869	13%	$339	12%
Total Imports (I)	34,124	89%	$1,730	62%
Total Trade = (E) + (I)	38,323	100%	$2,770	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Top Domestic Trading Partners

Table 19 and Table 20 shows Florida's top 10 domestic trading partners by tonnage and value for the construction materials supply chain.

TABLE 7. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY TONNAGE IN 2022

State	Export (Thousand Tons)	State	Import (Thousand Tons)
Georgia	2,263	Georgia	12,002
South Carolina	355	Alabama	4,651
Texas	293	Kentucky	4,504
Alabama	232	Colorado	1,897
Tennessee	150	Texas	1,590
North Carolina	82	Tennessee	1,325
Nebraska	79	Illinois	1,229

State	Export (Thousand Tons)	State	Import (Thousand Tons)
Pennsylvania	60	Mississippi	978
Ohio	40	North Carolina	249
Iowa	40	Virginia	221
Top 10 (Tonnage)	3,594	*Top 10 (Tonnage)*	*28,646*
Top 10 (Percentage)	92%	*Top 10 (Percentage)*	*98%*
Total	3,904	Total	29,256

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Table 20 shows Florida's top 10 domestic trading partners by value for the construction materials supply chain. The top trading states by value (USD) are similar to that by tonnage although the rankings are slightly different. Florida's top 10 domestic partners by export value (USD) account for 86 percent of total domestic exports. Among the top five domestic exporters are Georgia, South Carolina, Tennessee, Texas, and Pennsylvania. Florida's top 10 domestic partners by import value (USD) account for 81 percent of total domestic imports. Among the top five domestic importers are Georgia, Kentucky, California, Alabama, and Tennessee.

TABLE 8. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY VALUE IN 2022

State	Export (Million USD)	State	Import (Million USD)
Georgia	$356	Georgia	$254
South Carolina	$148	Kentucky	$235
Tennessee	$71	California	$136
Texas	$58	Alabama	$135
Pennsylvania	$40	Tennessee	$78
Ohio	$39	Texas	$67
North Carolina	$38	Illinois	$58
Alabama	$32	Virginia	$56
Kentucky	$21	Colorado	$53

State	Export (Million USD)	State	Import (Million USD)
Indiana	$17	Mississippi	$50
Top 10 (Million USD)	*$820*	*Top 10 (Million USD)*	*$1,122*
Top 10 (Percentage)	*86%*	*Top 10 (Percentage)*	*81%*
Total	$953	Total	$1,391

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Top Foreign Trading Partners

Table 21 shows Florida's top foreign trading nations for construction materials imports and exports in 2022 based on value (USD), with international imports totaling $3,367 million and international exports totaling $538 million in 2022. Florida's top 10 foreign trading partners for imports account for 64 percent of total import value (USD). The top three foreign importers of Florida construction commodities are Canada, Italy, and Turkey. Florida's top 10 foreign trading partners for exports account for 65 percent of total export value (USD). The top three foreign exporters are Canada, Jamaica, and Turks and Caicos Islands.

TABLE 9. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – FOREIGN TRADING PARTNERS BY VALUE IN 2022

Foreign Trading Partners	International Exports ($ Million USD)	Foreign Trading Partners	International Imports ($ Million USD)
Canada	$54	Canada	$305
Jamaica	$54	Italy	$275
Turks and Caicos Islands	$51	Turkey	$273
Bahamas	$49	Netherlands	$263
Mexico	$38	Colombia	$242
Dominican Republic	$37	Bahamas	$220
Venezuela	$29	Mexico	$218
Panama	$14	Norway	$135
Ecuador	$13	Russia	$111
Cayman Islands	$12	Peru	$108

Foreign Trading Partners	International Exports ($ Million USD)	Foreign Trading Partners	International Imports ($ Million USD)
Top 10 (Million USD)	$352	Top 10 (Million USD)	$2,150
Top 10 (Percentage)	65%	Top 10 (Percentage)	64%
Total	$538	Total	$3,361

Source: USA Trade Online data, 2022

Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Conclusion

Several key findings are associated with the supply chain market analysis of the construction material supply chain.

Directional Flows in the Construction Materials Supply Chain (2022):

- Intra-movements dominate both tonnage and value, accounting for 87% of total tonnage (241 million tons) and 70% of total value ($5.9 billion).
- Inbound movements constitute 11% of total tonnage (30 million tons) and 18% of total value ($2 billion).
- Outbound movements have the smallest share, representing 2% of total tonnage (5 million tons) and 12% of total value ($1 billion).

Florida's Economic Growth and Infrastructure Investment:

- The construction industry experiences increased demand for goods and services due to Florida's economic growth driven by factors like population migration, tourism, and business development.
- Significant investments in transportation infrastructure, including projects like I-4 Ultimate and port upgrades, contribute to this growth.

Florida's Construction Materials Trade:

- Total imports account for 89% of tonnage and 62% of value (in USD).
- Domestic partners contribute significantly, representing 76% of total import tonnage and 50% of import value.

Export Dynamics:

- Total exports constitute 11% of tonnage and 38% of value (in USD).
- Domestic partners play a major role, contributing 10% of export tonnage and 34% of export value.
- Among the top five domestic export destinations by tonnage are Georgia, South Carolina, Texas, Alabama, and Tennessee.
- Among the top five domestic export destinations by value are Georgia, South Carolina, Tennessee, Texas, and Pennsylvania.

Reliance on Domestic Imports:

- Florida heavily relies on domestic imports for construction materials, as indicated by the high percentage of total imports.[6]
- Florida's top 10 domestic trading partners based on tonnage contribute 92% of total domestic export tonnage.

Import Dynamics:

- Imports of construction materials from Florida's top 10 domestic partners represent 98% of total domestic import tonnage.
- The top five domestic importers by tonnage include Georgia, Alabama, Kentucky, Colorado, and Texas.[7]
- Florida's top 10 domestic partners by import value account for 81% of total domestic imports.
- The top five domestic importers by value include Georgia, Kentucky, California, Alabama, and Tennessee.

Import-Export Discrepancy

- The value of construction materials imports into Florida is six times higher than the value of exports.
- In 2022, Florida's international imports totaled $3,367 million, while international exports amounted to $538 million.
- This indicates Florida's heavy reliance on imports to meet demand.

Top Foreign Trading Partners

- Florida's top 10 foreign trading partners for imports contribute to 64% of the total import value (USD).
- Canada, Italy, and Turkey are the leading foreign importers of Florida construction commodities.
- Similarly, Florida's top 10 foreign trading partners for exports account for 65% of total export value (USD).
- Canada, Jamaica, and Turks and Caicos Islands are the top foreign exporters.

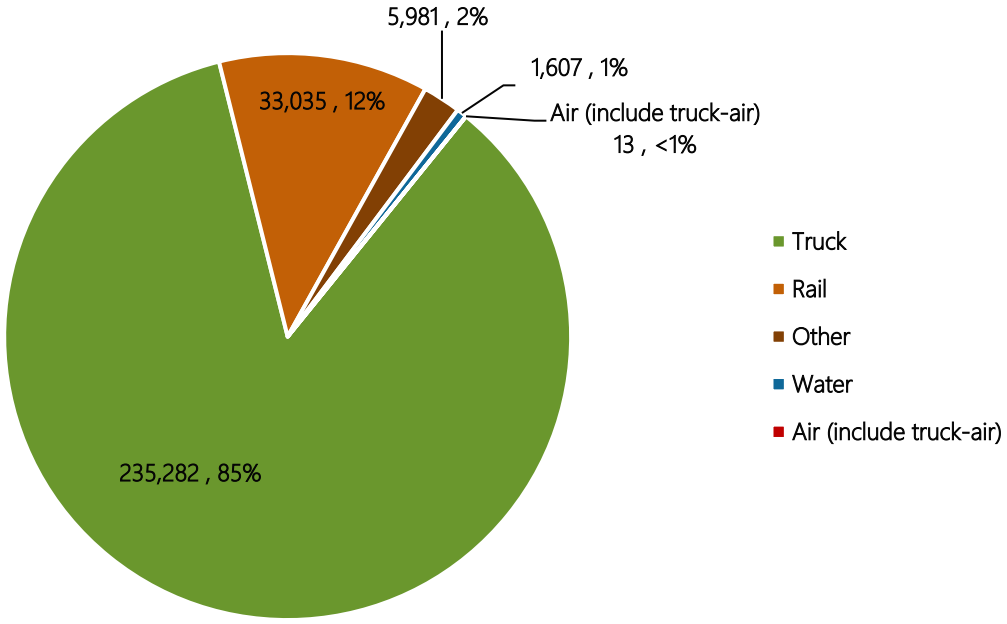
3.3 Supply Chain Dominant Freight Modes

Figure 18 and Figure 19 show the mode split by tonnage and value for the combined intra, inbound, and outbound flows for the construction materials supply chain.

6 Source: https://www.agc.org/sites/default/files/users/user21902/FL-US construction fact sheet_92023.pdf

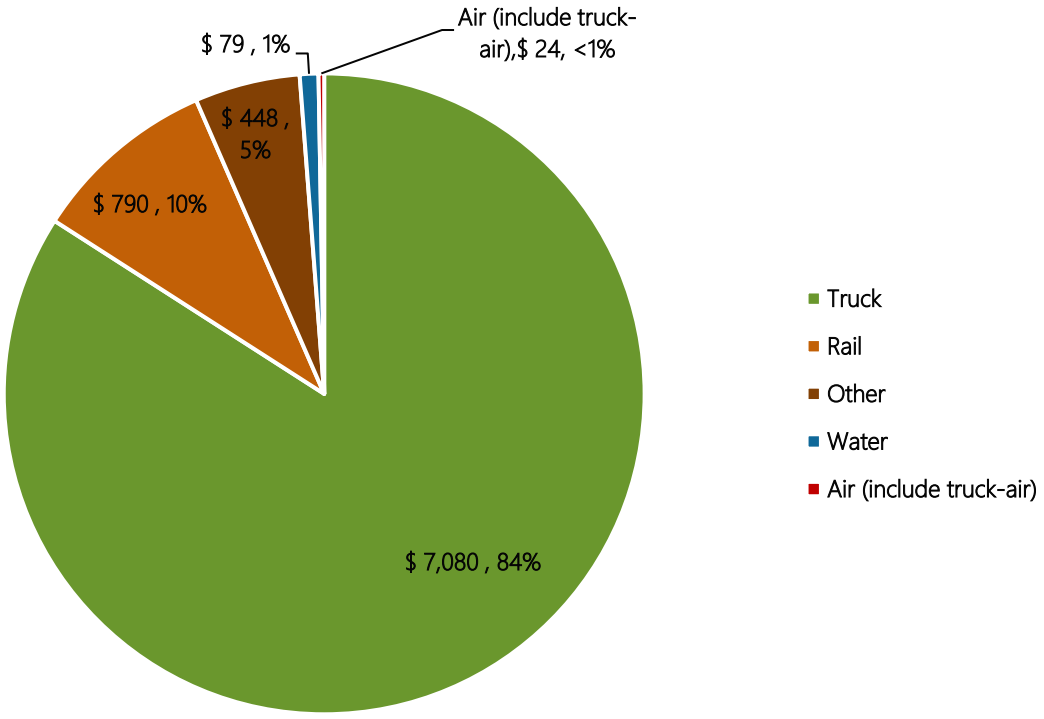
7 Source: https://www.agc.org/sites/default/files/users/user21902/FL-US construction fact sheet_92023.pdf

FIGURE 1. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - TONNAGE (THOUSAND TONS) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS IN 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

FIGURE 2. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – VALUE (MILLION USD) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS IN 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Table 22 and Table 23 show the mode split by tonnage, value, and direction for each freight mode for the construction materials supply chain, with trucks and rail comprising the majority of modal movements for intra (Truck: 92%), inbound (Rail: 57%), and outbound (Trucks: 60%) flows.

TABLE 10. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - MODE SPLIT BY TONNAGE IN 2022

	Tonnage (Percentage)			
Mode	**Intra**	**Inbound**	**Outbound**	**Total by Mode**
Truck	223,017 (92%)	9,334 (31%)	2,931 (60%)	235,282
Rail	14,379 (6%)	17,039 (57%)	1,617 (33%)	33,035
Other	3,714 (2%)	1,975 (7%)	292 (6%)	5,981

	Tonnage (Percentage)			
Mode	Intra	Inbound	Outbound	Total by Mode
Water	5 (<1 %)	1,601 (5%)	<1 (<1%)	1,607
Air (include truck-air)	<1 (<1%)	5 (<1 %)	8 (<1 %)	13
Total by Direction	241,115 (100%)	29,955 (100%)	4,848 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

TABLE 11. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - MODE SPLIT BY VALUE IN 2022

	Value (Percentage)			
Mode	Intra (Million USD)	Inbound (Million USD)	Outbound (Million USD)	Total by Mode
Truck	$5,554 (95%)	$688 (45%)	$838 (80%)	$7,080
Rail	$115 (2%)	$543 (36%)	$132 (13%)	$790
Other	$186 (3%)	$189 (12%)	$72 (7%)	$448
Water	$2 (<1%)	$77 (5%)	<$1 (<1%)	$79
Air (include truck-air)	<$1 (<1%)	$21 (1%)	$3 (<1%)	$24
Total by Direction	5,857 (100%)	1,518 (100%)	1,046 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,
Note: Commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15).

Conclusion

Several key findings are associated with the dominant freight mode analysis of the construction material supply chain.

Mode Split in the Construction Materials Supply Chain

- Truck transportation dominates, accounting for 85% of total tonnage and 84% of total value (in USD).
- Rail handles a smaller share, representing 12% of tonnage and 10% of value.
- Water transport, while important, contributes only 1% to both tonnage and value in the construction materials supply chain.

Intra Flows (Within Florida):

- Truck dominates, accounting for 92% of total intra flows (223 million tons).
- Rail is the second leading mode.
- Together, truck and rail represent nearly 100% of commodity movements (by tonnage) and 93% by value.

Inbound Flows (Originating Beyond Florida):

- Rail and truck are the leading modes, comprising 88% of total inbound tonnage.
- Rail dominates with 57% of tonnage, followed by truck (31%).
- Water transport plays a minor role (5% of tonnage).
- Rail and truck account for about 81% of total value.

Outbound Flows (Originating Within Florida):

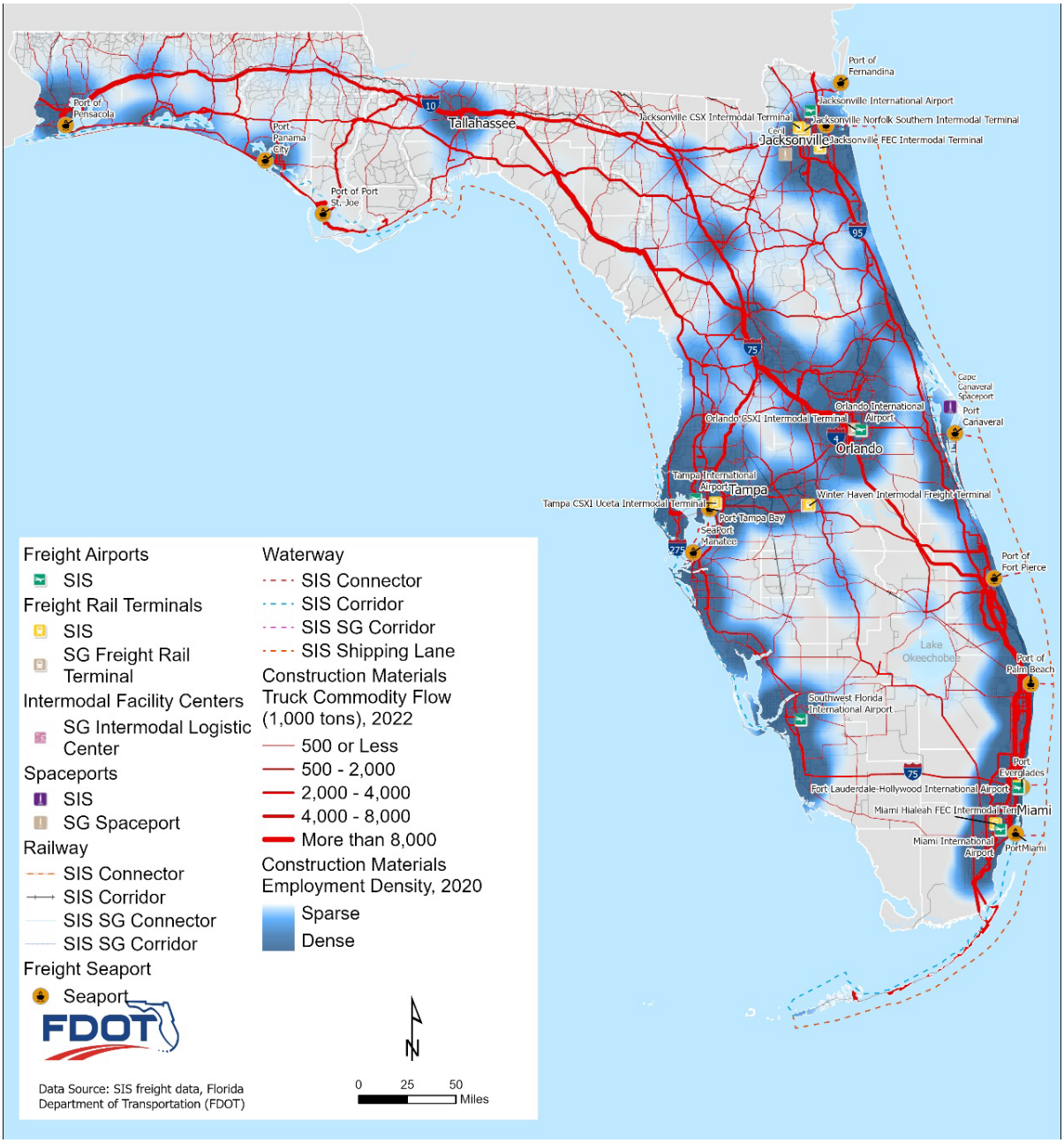
- Truck and rail dominate by tonnage and value.
- Truck: 60% of tonnage, 80% of value.
- Rail: 33% of tonnage, 13% of value.

3.4 Initial Qualitative Assessment of Areas of Risk

Critical Florida Transportation Network Components

Figure 20 illustrates truck commodity flows in tonnage and concentration of employment for the construction materials supply chain, with major movements handled by Interstate Highway and US routes. The construction materials supply chain is also supported by CSX Transportation (Class 1), Norfolk Southern (Class 1) and the Florida East Coast (Class 2) railroad lines. As identified in the Florida Rail System Plan (2023), construction materials are a major commodity moved by Norfolk Southern Railway servicing several markets along the East Coast between New York City and Jacksonville, whereas the Florida East Coast railway lines move aggregate carloads to key locations such as Miami and St. Augustine. Additionally, Florida's seaports including JaxPort, Port Panama City, SeaPort Manatee, Port of Pensacola, Port Tampa Bay, and Port Canaveral, remain critical to the construction materials supply chain, importing aggregates such as gravel and natural sands.

FIGURE 3 FLORIDA'S CONSTRUCTION MATERIALS 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: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

Disruptor Events and Areas of Risk

According to the Florida Chamber of Commerce, more than 26 million people will reside in Florida by 2030.[8] In preparation, FDOT continues to seek opportunities to prepare Florida's infrastructure to support large volumes of people and goods while remaining resilient to uncertainties. The future of Florida will require continuous and strategic transportation improvement investments. In 2022, FDOT's Five-Year Work Program allocated an estimated $4.4 billion to construct 180 new highway lane miles, $1.2 billion to resurface 2,690 lane miles, and $236.6 million for bridge maintenance repairs and replacements, among other multimodal investments.[9]

The construction materials supply chain remains vulnerable to several disruption risks including material and labor shortages, the cost of inflation, geopolitical uncertainties, and severe weather events. Many of these risks were exposed during the COVID-19 pandemic, resulting in construction material backlogs and prolonged construction project timelines. For Florida's transportation system, delays or disruptions to the construction materials supply chain may result in traffic delays, congestion, or potential route closures. For example, FDOT embarked on the Gateway Expressway project in 2017, to construct two new tolled expressways in Pinellas County, but COVID-19 delays and hurricanes caused significant project delays.[10]

Florida's geographical location and inherent susceptibility to extreme weather events also pose strains on the construction materials supply chain. As noted in Section 3.1, Floridian's depend on the availability of sandbags, a critical construction material, to protect their homes or businesses from water inundation during hurricane or tropical storm events. Additionally, Floridian's look to the construction material supply chain and FDOT to help rebuild and recover post-event. For example, in 2022 Hurricane Ian severely damaged roadways and bridges hindering access from the mainland to Pine Island and Sanibel Island.[11] However, FDOT quickly restored access to the stranded communities by "paving the way" back to the mainland and completing temporary bridge repairs in less than three days.[12]

Potential Impacts to Florida's Transportation System

The following section describes the initial assessment to identify how and where disruption events including storm surge, floodplain, wildfire, sinkhole, sea level rise, severe thunderstorm, and extreme heat may impact Florida's transportation infrastructure, including designated SIS facilities, that support the construction materials supply chain. A description of these risks, particularly in regard to loss of transportation network and supply chain reliability is provided below.

[8] Florida Chamber of Commerce, The Florida 2030 Blueprint: https://www.flchamber.com/florida-2030/

[9] Florida Department of Transportation (FDOT), News Release (2022): Florida Department of Transportation's Commitment to Communities Stronger Than Ever in 2022 (fdot.gov)

[10] Florida Department of Transportation (FDOT), Gateway Expressway and I-275 Express Lanes: https://www.fdottampabay.com/project-files/433880-1-52-01-folder-590010090/FAQs%20for%20webpage%20with%20no%20spaces%20between%20q%26a.pdf

[11] Florida Department of Transportation (FDOT), News Release (2022): Florida Department of Transportation's Commitment to Communities Stronger Than Ever in 2022 (fdot.gov)

[12] Florida Department of Transportation (FDOT), News Release (2022): Florida Department of Transportation's Commitment to Communities Stronger Than Ever in 2022 (fdot.gov)

Storm Surge

As shown in Figure 21, storm surge has the greatest potential of disrupting the construction materials supply chain in the Northwest, Northeast, Southwest, and Southeast regions. In the Northeast and Northwest regions, storm surge may disrupt commodity flows along I-10 and US 98, limiting transport of aggregate imports from the Port of Pensacola and Port Panama City to the rest of the state. In the Northeast region, storm surge may impact truck travel along I-295 and rail lines connecting to the Jacksonville FEC Intermodal Terminal, Jacksonville CSX Intermodal Terminal, and JaxPort. In the Southwest region, storm surge also has the potential to disrupt commodity flows along I-275 providing access to the Port Tampa Bay and Seaport Manatee as well as the Tampa CSXI Uceta Intermodal Terminal.

In extreme weather events, the construction materials supply chain is critical to aid in post-event recovery activities. Coastal communities impacted by storm surge rely on the availability of construction materials to rebuild damaged transportation infrastructure, to quickly restore access to local businesses and residential areas.

Inland Flooding

As shown in Figure 22, inland flooding caused by the 100-year floodplain has the potential to disrupt dense construction material employment hotspots in Tallahassee, Jacksonville, Gainesville, Orlando, St. Pete, Tampa, Bradenton, Palm Beach, and Miami. Additionally, the 100-year floodplain may disrupt construction material operations at all critical supply chain seaports and rail lines. The 500-year floodplain may cause more severe disruptions to dense inland and coastal urban areas. Flooding has the potential to cause roadway washouts, erode portions of the roadway near the coast, and cause structural damage to development near Fort Lauderdale and Tampa.

Wildfire

Wildfires may pose the greatest threat to the construction materials supply chain in the Northeast, Northwest and Southeast regions. As shown in Figure 23, wildfire risk is moderate to high in the Northeast, which may impact commodity flows traveling to JAXPORT, the Jacksonville FEC Intermodal Terminal, and the Jacksonville CSX Intermodal Terminal. Additionally, I-10, US 98 and access to Port Panama City and the Port of Pensacola may be impacted. In the Southeast, wildfire risk is the highest between Naples and Miami, which could disrupt construction employment hotspots near the Southwest Florida International Airport, the Fort Lauderdale FEC intermodal Terminal, and the Miami Hialeah FEC Intermodal Terminal.

Sinkhole

As shown in Figure 24, sinkholes are most likely to occur and cause major disruptions to the construction materials supply chain along I-75 and I-10. These interstates carry high volumes of construction material commodities and play a crucial role in connecting the Northwest region with the central and southern portions of the state. Depending on the size or severity of a sinkhole event, roadways and rail lines could be damaged, halting construction flows.

Sea Level Rise

As shown in Figure 25, sea level rise poses significant risk to all critical construction material seaports and connecting coastal roadways including I-95, I-275, I-295, and US 98. The construction materials supply chain

could be subject to increasing demands because sea level rise may cause permanent inundation. With sea level rise, businesses, residential areas, and transportation infrastructure may be forced to relocate or elevate surfaces.

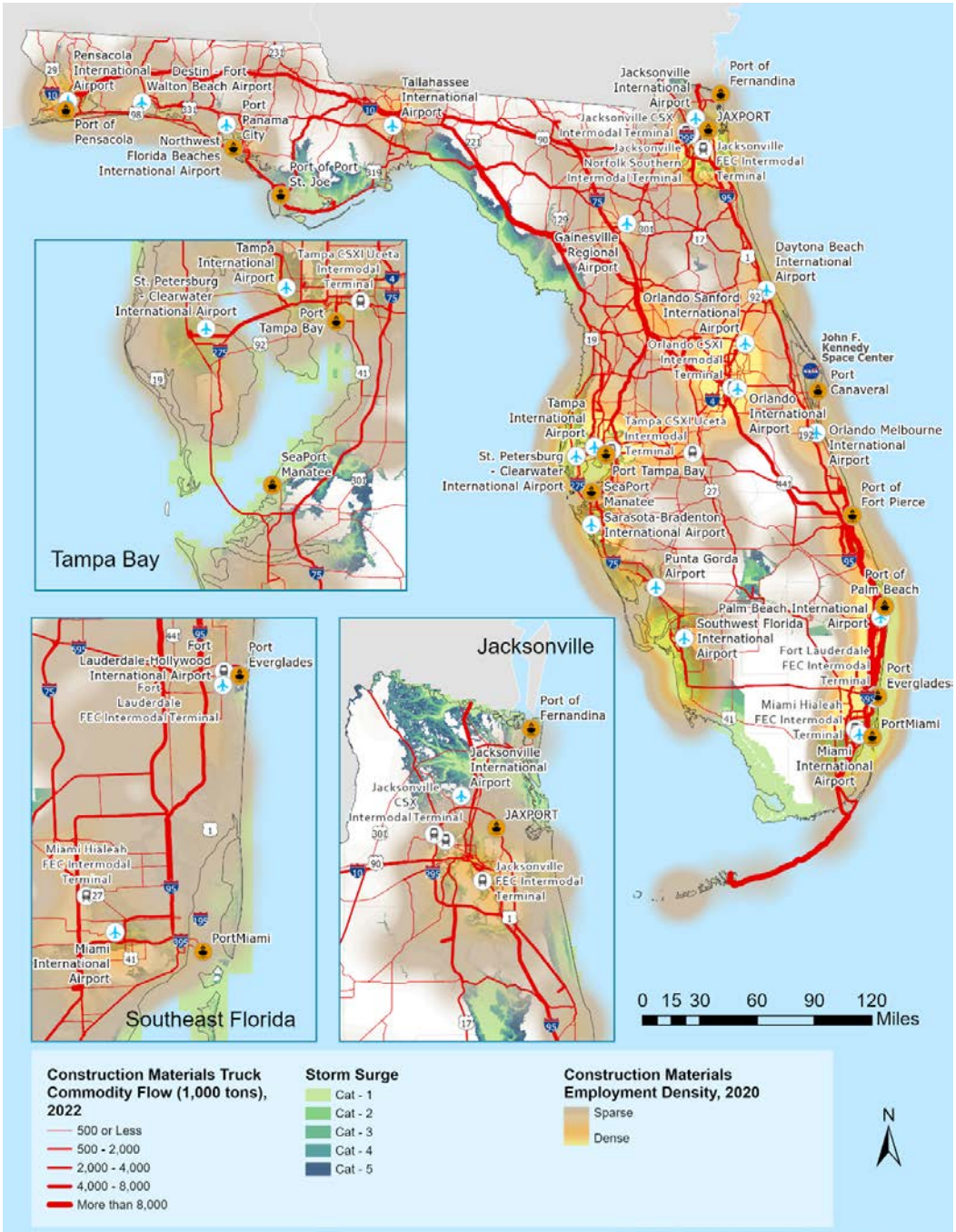
Severe Thunderstorm and Strong Winds

Severe thunderstorm has the potential for lightning and high winds. As shown in Figures 26, lightning risk is very high across all regions of the state. Figure 27 shows that strong winds are most likely to occur in the Northwest, Northwest, and Central regions. Severe thunderstorms and strong winds may delay truck travel along several critical highways supporting the construction materials supply chain, and damage or delay construction projects.

Extreme Heat

Figure 28 shows inland areas in the Central, Southwest, and Southeast regions may be subject to 31-50 days of extreme heat a year. Extreme heat may cause the most disruption to construction material employment hotspots located near Orlando and Fort Myers. While extreme temperatures have the potential to damage roadway asphalt and railroad lines, transportation infrastructure in these areas may require additional maintenance to repair deterioration and buckling. Additionally, construction projects located in these areas may be delayed due to unsafe working conditions.

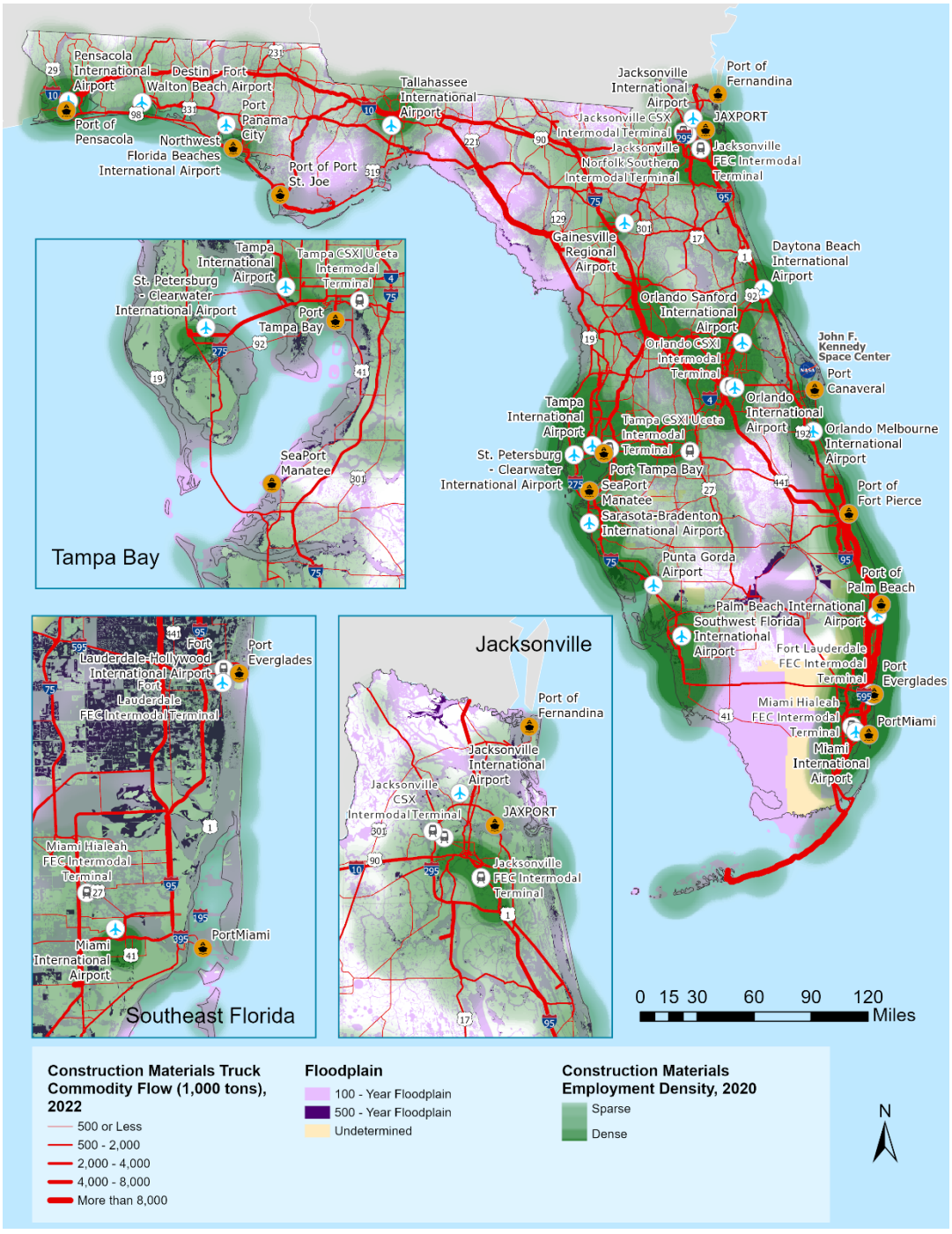
FIGURE 4. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - STORM SURGE HAZARD



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

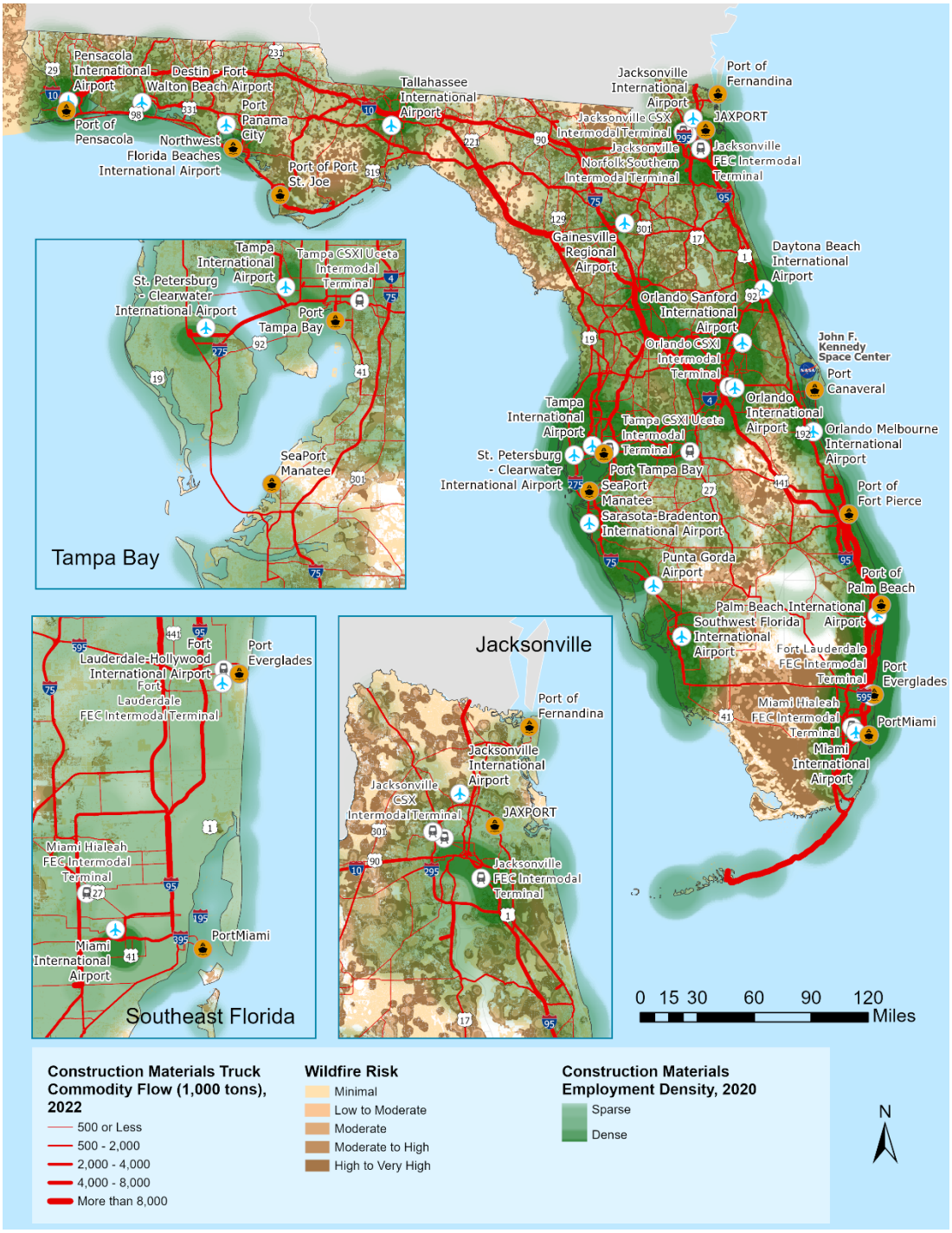
FIGURE 5. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN - INLAND FLOODING HAZARD



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

FIGURE 6. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – WILDFIRE

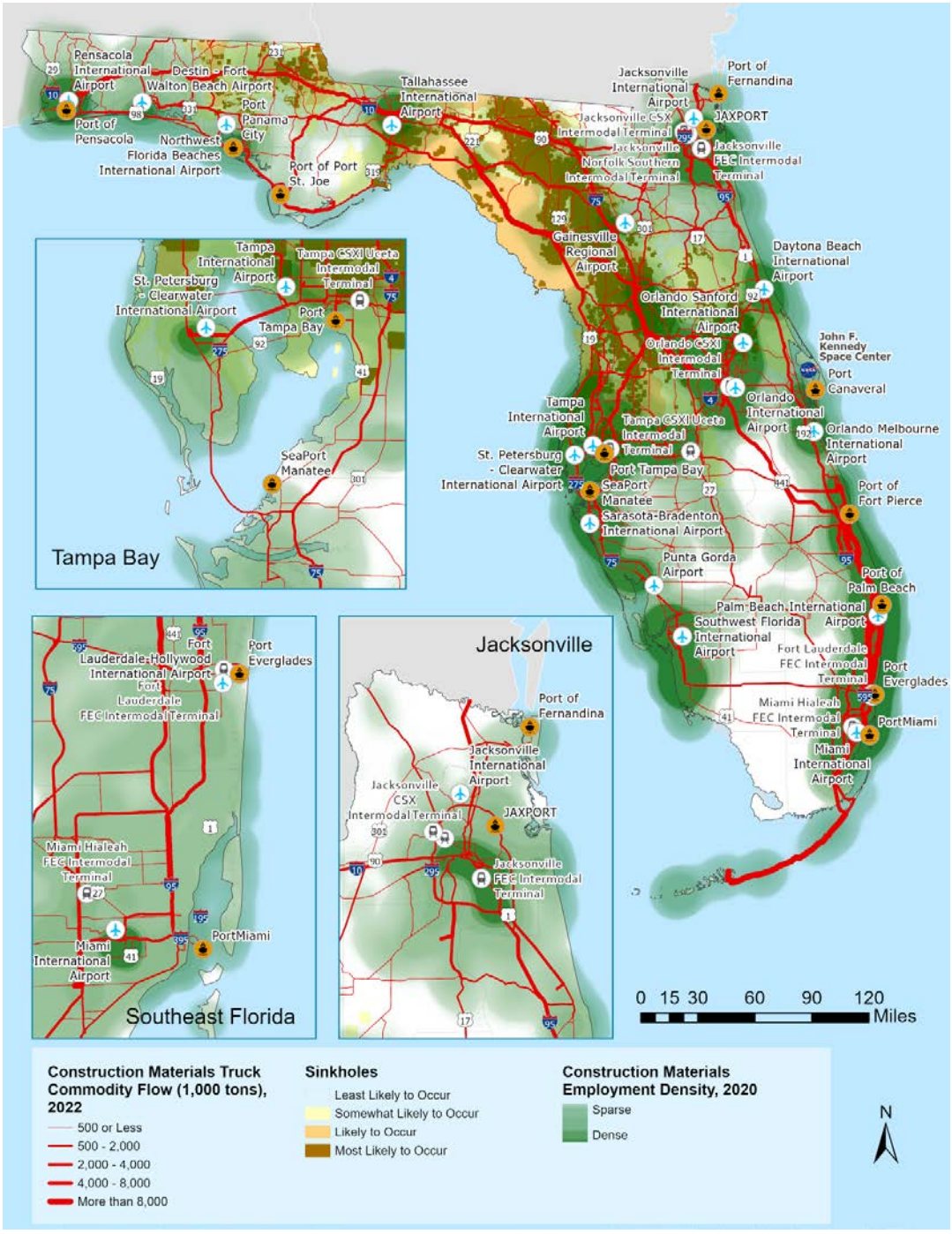


Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13),

metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

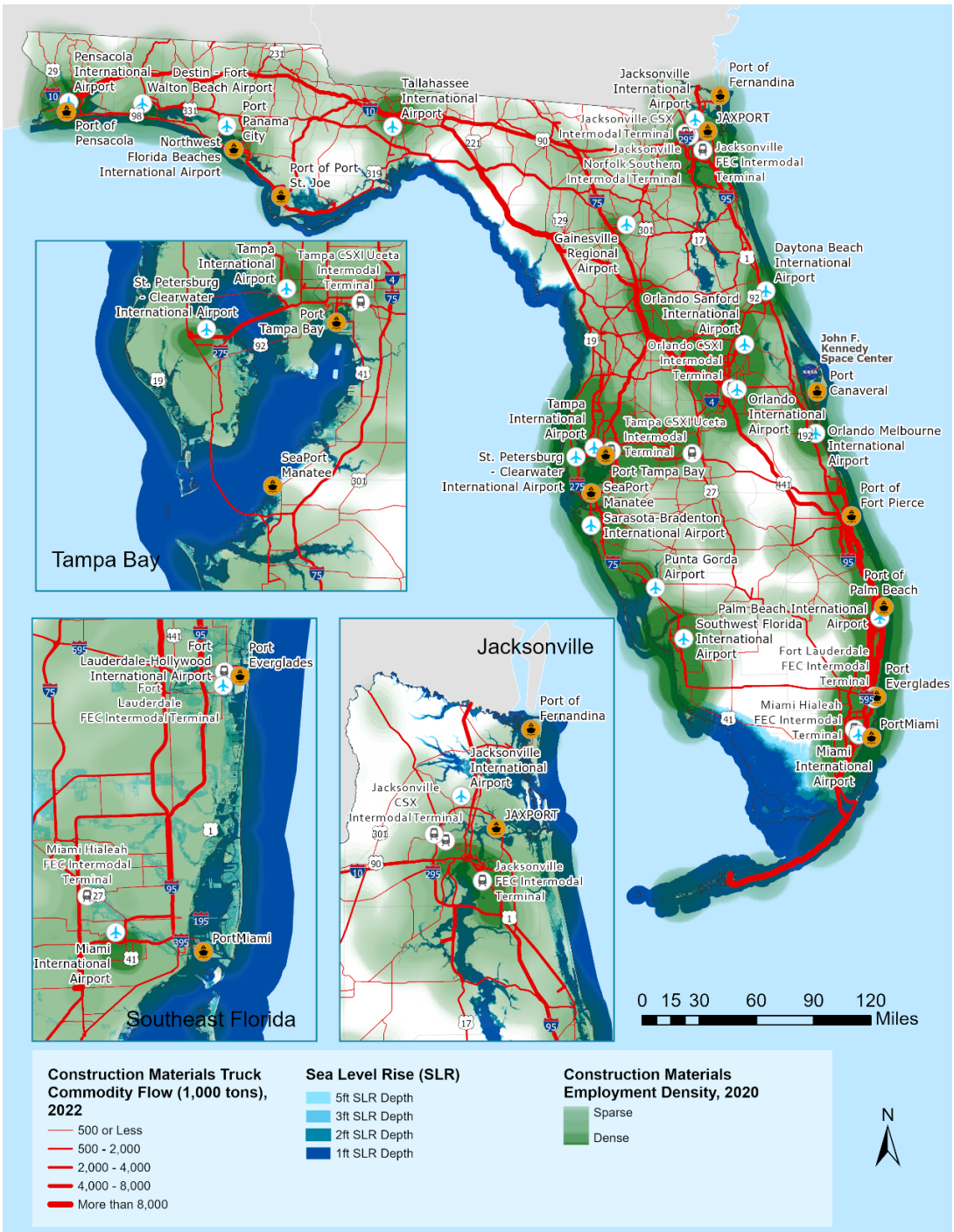
FIGURE 7. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – SINKHOLES



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

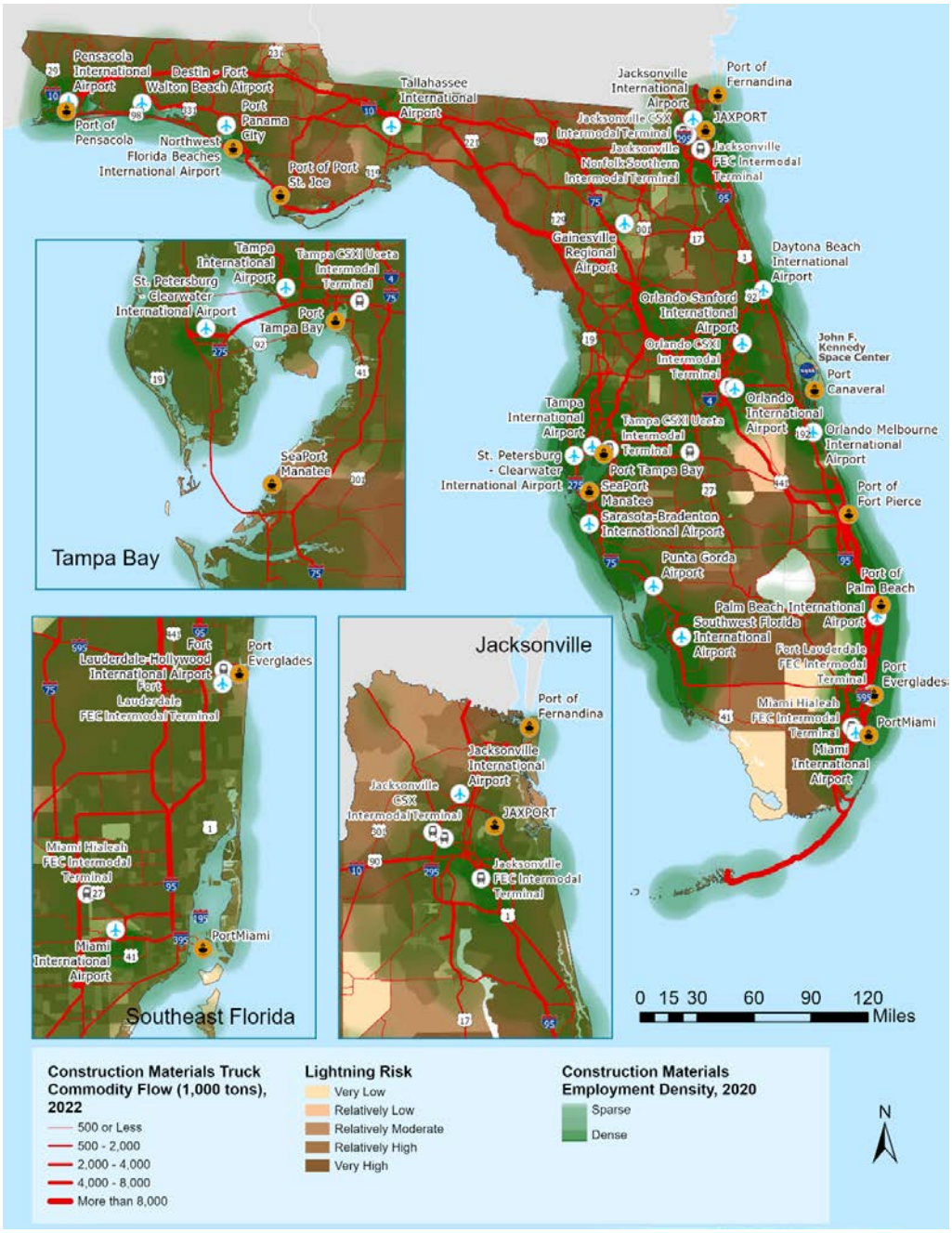
FIGURE 8. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – SEA LEVEL RISE



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

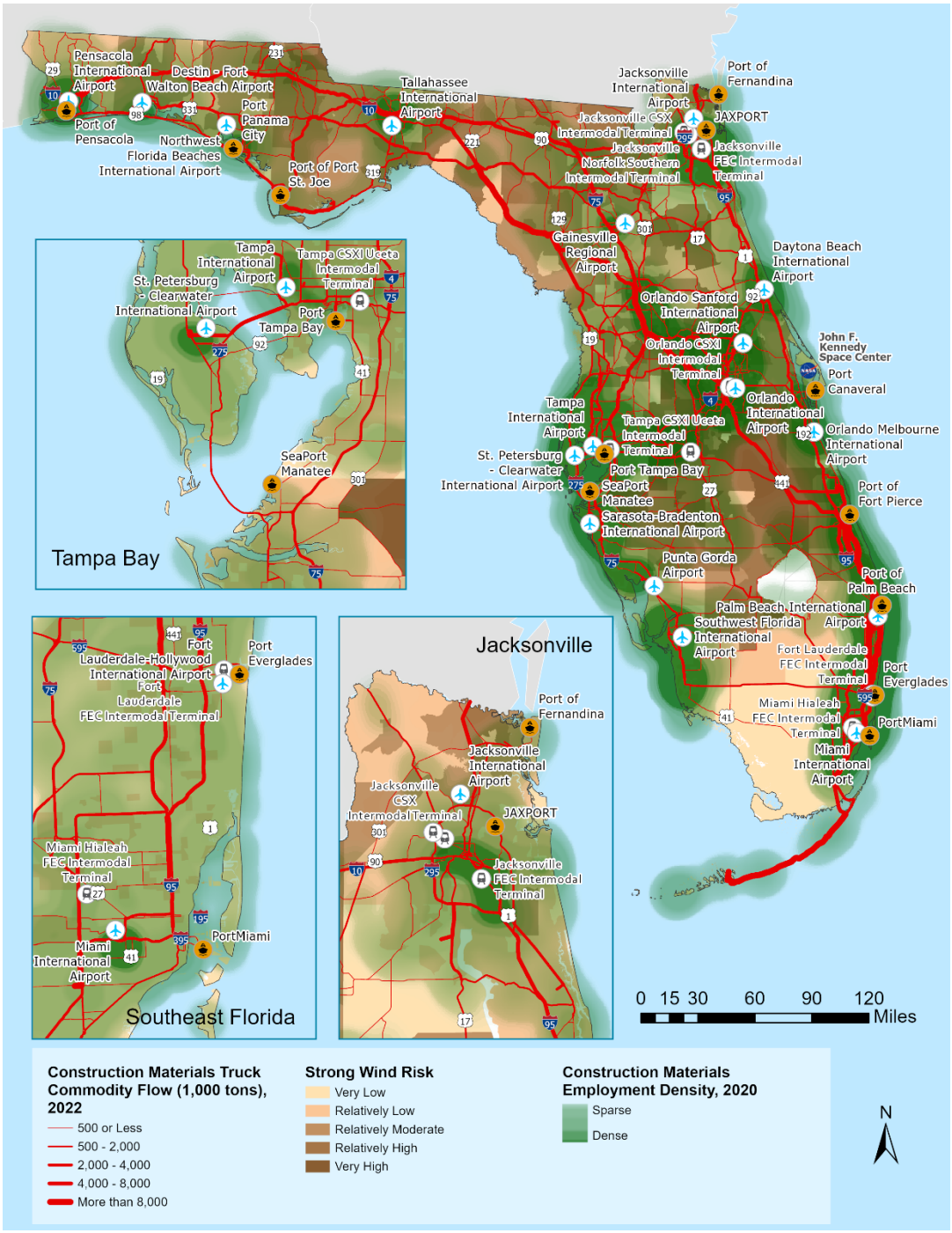
FIGURE 9. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – SEVERE THUNDERSTORM (LIGHTNING)



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

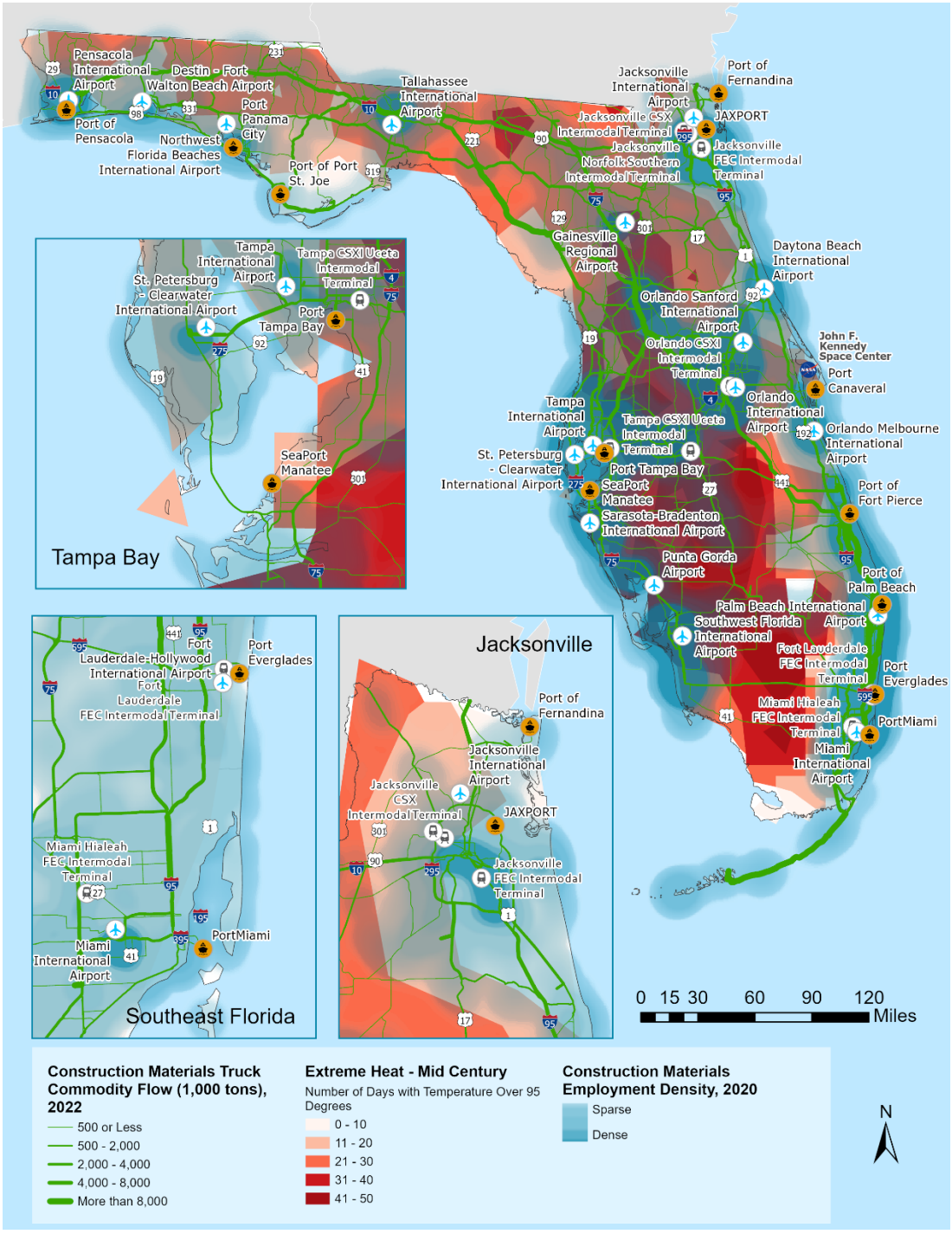
FIGURE 10. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – SEVERE THUNDERSTORM (STRONG WIND)



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

FIGURE 11. FLORIDA'S CONSTRUCTION MATERIALS SUPPLY CHAIN – EXTREME HEAT (2036 - 2065)



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

Note: Truck commodity flows include monumental or building stones (SCTG 10), natural sands (SCTG 11), gravel and crushed stone except dolomite and slate (SCTG 12), other non-metallic minerals not elsewhere classified (SCTG 13), metallic ores and concentrates (SCTG 14), and coal (SCTG 15). Construction materials employment density includes employment in the construction sector (NAICS 23).

3.5 Supply Chain Structure and Diagram

The analysis of the Florida construction supply chain focused on sand and gravel; two materials essential in construction and resilience. Figure 29 offers a graphical illustration of the supply chains. Each node in this diagram represents a key stage/facility in the supply chain lifecycle. Color-coded arrows between each node represent the modal transport that moves the commodity from one conceptual node to another, with each color representing a different modal transport as indicated in the legend. The diagram focuses on adequately capturing major commodity flows and modal usage in general and cannot fully capture all the nuances of a supply chain for a specific industry.

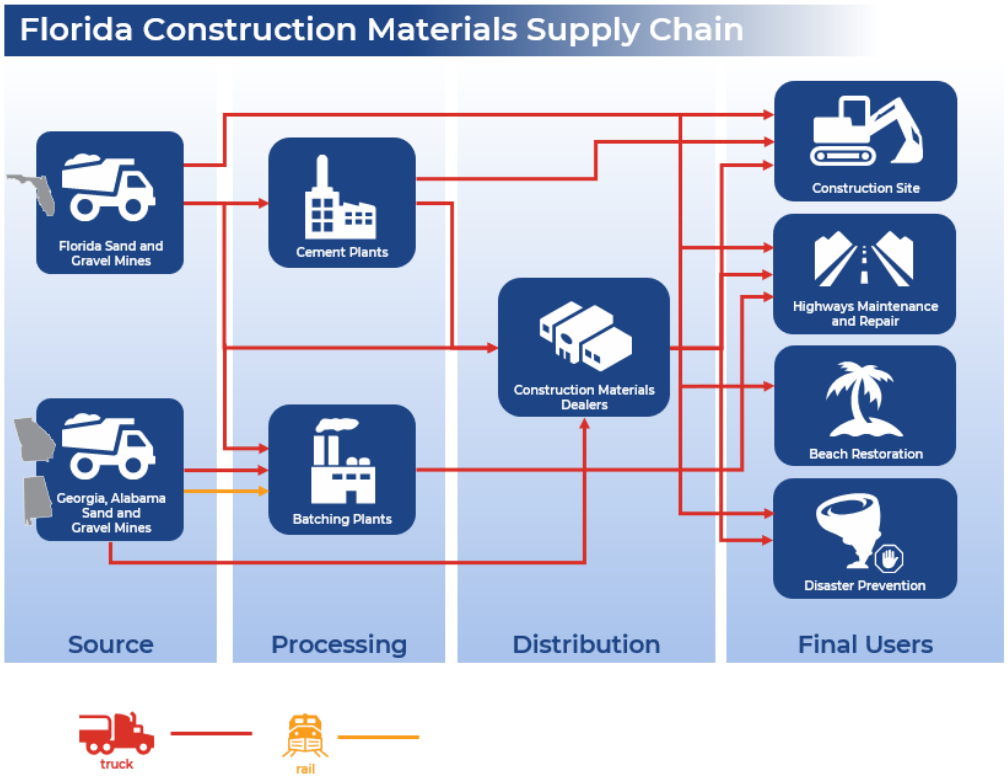
Florida is a top producer of construction sand and gravel among US,[13] with deposits found in every county.[14] Due to their weight and relatively low value, these materials are typically extracted from local mines, ensuring a short transportation distance to their final destination. As a result, over 90 percent of Florida's sand and gravel supply is sourced from within the state. Domestic trading partners, such as Georgia and Alabama, or foreign trading regions, such as the rest of the Americas, supply less than 10 percent of these materials to the construction industry in Florida.

Construction sand and gravel are inputs that can be directly transported to final users or to processing facilities and distribution centers. The dominant mode of transport for these construction materials is trucks. These commodities heavily rely on truck transportation and can be sensitive to transportation costs. Nonetheless, some of them are carried by rail, particularly inbound cargo. From mines, construction sand and gravel are shifted to cement and batching plants where they serve as inputs for concrete and cement production. Concrete is a time sensitive commodity and has to be delivered to the construction site directly. Cement, on the other hand, can be delivered to batching plants, building material dealers, or to final users by truck.

In Florida, final users of construction sand and gravel include a range of applications including construction sites, such as residential and commercial buildings, as well as beach restoration, disaster prevention, and highway maintenance and repair. Natural sand plays a vital role in disaster preparedness, serving as a critical component in flood protection kits. This enables Floridians to safeguard their properties from the impacts of hurricanes, heavy rainfall, and other extreme weather events.

[13] Mapped: Crushed Stone, Sand, and Gravel Production in the U.S.
[14] Other Resources. Mining and Mitigation Program. Florida Department of Environmental Protection.

FIGURE 12. CONSTRUCTION MATERIALS (GRAVEL AND SAND) SUPPLY CHAIN DIAGRAM



Source: Cambridge Systematics.