MISSOURI State Freight & Rail Plan

MISSOURI FREIGHT PROFILE: VOLUME 2

2022

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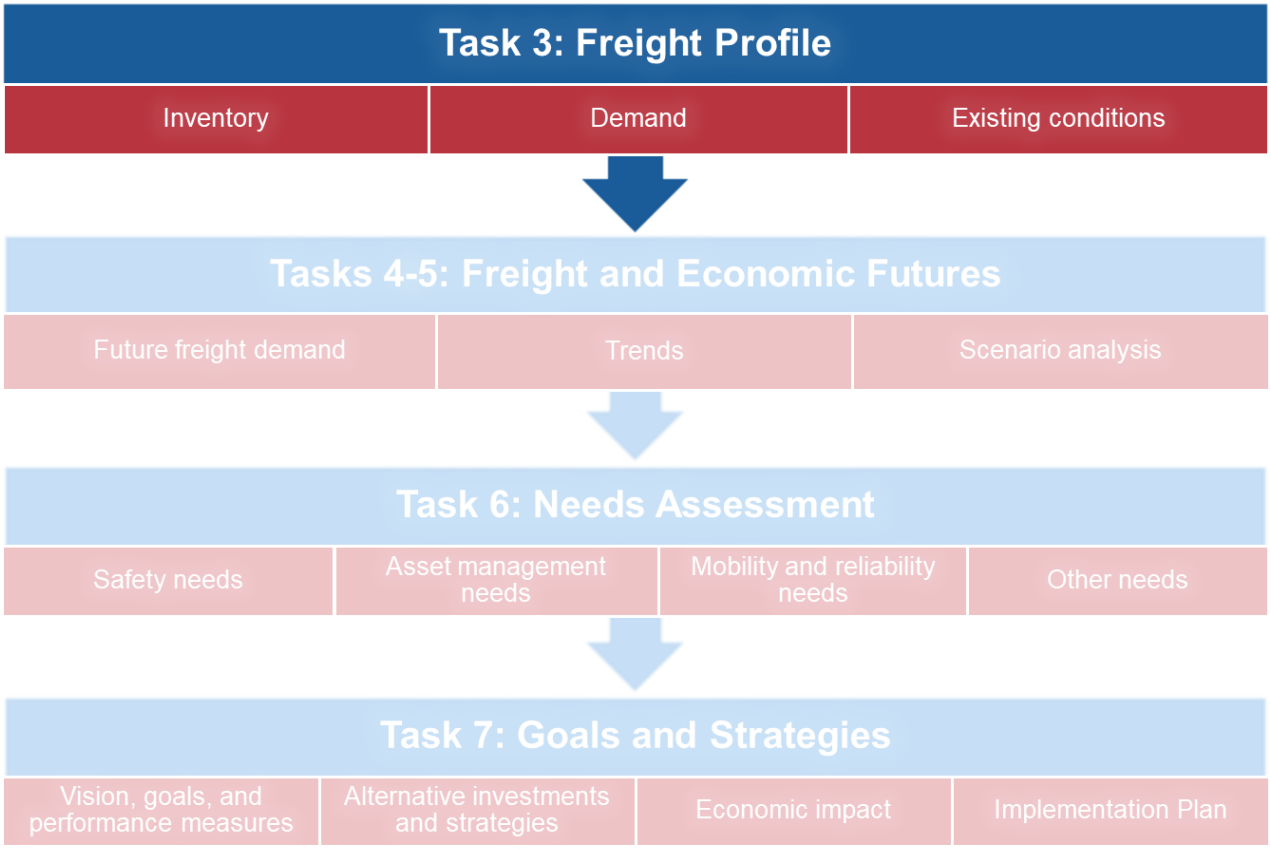
1.1 The Missouri State Freight and Rail Plan Overview

Missouri's economic vitality and quality of life are inextricably linked to the state's freight transportation network. The road, railways and other multimodal assets of this network move more than one billion tons of freight valued at more than one trillion dollars through the state each year.

This State Freight and Rail Plan was developed to provide MoDOT with a next-generation blueprint and plan for multimodal freight and passenger rail investment for the future. This plan is data driven and supported by stakeholders and is intended to help Missouri maintain its competitive advantage and economic vitality aligned with freight movement within the state. Figure 1.1 shows the overall sequence of events for the development of this plan.

FIGURE 1.1 MISSOURI STATE FREIGHT AND RAIL PLAN TASK BREAKDOWN



The Missouri Freight Profiles are a critical component to this plan as they establish the existing conditions of the State's multimodal freight network and tell the Missouri freight story. Information from the freight profiles will be combined with forecasts of future freight activity to inform the needs assessment. The profiles are split into multiple volumes and include detailed descriptions of Missouri's multimodal freight system inventory, demand and existing conditions. Volume 1 includes the Highway profile. This volume includes Rail, Air, Port, Pipeline, Intelligent

Transportation Systems and Freight Generators profiles. There are also additional chapters and technical memorandums that cover the Truck Parking, Economic Impact of Freight and Commodity Flow profiles.

Missouri's Multimodal Transportation Goals

MoDOT is built on a foundation of three primary pillars: safety, service and stability. MoDOT's mission is "to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri." Building on those pillars and its mission, MoDOT developed the 2018 Missouri's Multimodal Transportation Goals, which include:

- Take care of the transportation system and services we enjoy today
- Keep all travelers safe, no matter the mode of transportation
- Invest in projects that spur economic growth and create jobs
- Give Missourians better transportation choices
- Improve reliability and reduce congestion on Missouri's transportation system

1.2 Volume Two Overview

The remainder of this document is organized as follows:

- Chapter 2 – Rail Modal Profile
  - Section 1 examines the overall role of rail in statewide transportation
  - Section 2 describes the infrastructure of the existing rail system
  - Section 3 details demographic and economic growth factors
  - Section 4 summarizes the existing demand for rail freight
  - Section 5 analyzes the performance of the existing rail system
  - Section 6 reviews major trends across the freight and passenger rail industry
- Chapter 3 – Air Modal Profile
  - Section 1 details the inventory and supply of air cargo service in Missouri
  - Section 2 examines the network use and performance, focusing on activity and demand
  - Section 3 describes long-term trends and the outlook for future performance

- Chapter 4 – Port Modal Profile
  - Section 1 provides an inventory of port and water infrastructure
  - Section 2 explores the demand and users of the state's ports and waterways
  - Section 3 reviews the condition and performance of the ports and waterway infrastructure
  - Section 4 summarizes major trends as they relate to ports
- Chapter 5 – Pipeline Modal Profile
  - Section 1 outlines the pipeline infrastructure in Missouri
  - Section 2 briefly summarizes pipeline safety
  - Section 3 examines demand for pipeline infrastructure
- Chapter 6 – Intelligent Transportation Systems and Technology
  - Section 1 reviews the ITS architecture in Missouri
  - Section 2 provides an inventory of ITS technology in Missouri
  - Section 3 benchmarks ITS technology against the surrounding states of Illinois, Kansas, Nebraska, Arkansas and Indiana
- Chapter 7 – Freight Generators
  - Section 1 provides an overview of the freight generating industries in Missouri and the methods and data sources used in the freight generators analysis
  - Section 2 provides an inventory of the key freight generator types
  - Section 3 reviews the freight generators and freight multimodal network
  - Section 4 examines key supply chains in relation to the freight facilities that support them
  - Section 5 summarizes industry trends in freight handling and storage facilities

Freight and Passenger Rail Modal Profile

2

Freight rail is one of the primary modes of freight movement in Missouri and is used to move goods to, from, within and through the state. Detailed in this profile is the current state of rail infrastructure, including an inventory of existing operators, owners, users and generators. The section utilizes data from the Bureau of Transportation Statistics, MoDOT, stakeholder interviews and Surface Transportation Board Waybill data on rail movements to provide a comprehensive picture of freight rail in Missouri.

In addition to analyzing freight rail, this Plan also satisfies the Federal Railroad Administrations final State Rail Plan Guidance issued on September 17, 2013. Section 303 of the Passenger Rail Investment and Improvement Act of 2008 which requires states to develop FRA-accepted state rail plans. Section 11315 of the Fixing America's Surface Transportation Act of 2015 made subsequent changes to state rail plan requirements, including specifying that a state-approved rail plan be submitted every four years for acceptance by FRA, rather than the five years allowed under PRIIA. Figure 2.1 below details how those FRA requirements are met within this Plan.

FIGURE 2.1 FRA STATE RAIL PLAN REQUIREMENTS

FRA State Rail Plan Requirements	Missouri Statewide Freight & Rail Plan Location
1. Role of Rail in Statewide Transportation	Freight Profile Volume 2: 2.1 Role of Rail in Statewide Transportation
2. State's Existing Rail System	
2.1 Description and Inventory	Freight Profile Volume 2: 2.2 Infrastructure & Existing Rail System
2.2 Trends and Forecasts	Freight Profile Volume 2: 2.3 Demographic and Economic Growth Factors, 2.4 Freight Demand, 3.0 Air Freight Modal Profile; Freight Profile Volume 1: Highway; Commodity Flow Profile Technical Memorandum; Economic Impacts of Passenger Rail Technical Memorandum; Task 4: Economic Futures
2.3 Rail Service Needs and Opportunities	Freight Profile Volume 2: 2.5 Performance, 2.6 Key Performance Trends; Task 6: Needs Assessment; Task 8: Economic Impact of Passenger Rail
3. Proposed Passenger Rail Improvements	Task 6: Needs Assessment; Task 7: Goals and Strategies
4. Proposed Freight Rail Improvements	Task 6: Needs Assessment; Task 7: Goals and Strategies
5. The State's Rail Service and Investment Program	Task 7: Goals and Strategies
5.1 Vision	Task 7: Goals and Strategies
5.2 Program Coordination	Task 7: Goals and Strategies
5.3 Rail Agencies	Task 7: Goals and Strategies
5.4 Program Effects	Task 7: Goals and Strategies
5.5 Passenger Element	Task 7: Goals and Strategies
5.6 Freight Element	Task 7: Goals and Strategies
5.7 Rail Studies and Reports	Task 7: Goals and Strategies
5.8 Passenger/Freight Capital Program	Task 7: Goals and Strategies
6. Coordination and Review	Task 2: Stakeholder Outreach

2.1 Role of Rail in Statewide Transportation

This section illustrates the current and anticipated role of rail in Missouri's freight and passenger rail transportation network and the state's ability to provide political, legal and financial support to freight and passenger rail service development.

The Role of Freight Rail in Missouri

Missouri's freight railroads play a critical role in the transportation of goods within the state, throughout the country and even across North America. A substantial portion of the freight moving into, out of and through Missouri is carried on trains. In 2018 the value of rail-transported goods traveling over track in Missouri totaled approximately $552.3 billion, or 52% of the value of all freight transported to, from, or through the state.

The Association of American Railroads releases rankings of states based on key railroad metrics. A summary of the 2017 AAR rankings is provided in Table 2.1. These rankings highlight the critical role of rail in Missouri's transportation system. More detailed information about the rail system can be found in the Infrastructure & Existing Rail System.

TABLE 2.1 MISSOURI STATE RANKING, SELECT METRICS (2017)

AAR Metric	U.S. Rank
Rail Carloads Carried	3rd
Rail Tons Carried	5th
Freight Rail Employment	5th
Freight Rail Wages	5th
Total Rail Miles	9th
Terminated Rail Tons	10th
Terminated Rail Carloads	11th

Source: Association of American Railroads, Railroad Retirement Board. AAR State Rankings 2017.

The Role of Passenger Rail in Missouri

Missouri's passenger rail network is a critical component of Amtrak's Midwest operations, and by extension, the nation's passenger rail system. Passenger rail service provides important economic development benefits to Missouri communities by providing improved accessibility, connectivity and travel efficiency.

Amtrak passenger rail service in Missouri, via two Long Distance routes and the State Supported *Missouri River Runner*, connect large urban centers to outlying suburbs and smaller communities in the interior of the state. Additionally, the *Lincoln Service*, a State Supported route funded by Illinois, connects Chicago with St. Louis—the only Missouri stop. State Supported routes operated by Amtrak are made possible by local financial support subject to annual operating agreements, and in the case of Missouri, annual legislative appropriations. Amtrak ridership figures (FY 2018) show Missouri stations range from a high (St. Louis) of over 360,000 boardings and alightings—passengers getting on or off the train— to a low of 1,018 (Arcadia). The passenger rail routes servicing Missouri

cover a wide range of the state, providing a transportation option for leisure and business travelers who do not have access to an automobile or prefer train service. The passenger rail network provides a wide network of coverage, with 66% of Missourians within 30 miles of an Amtrak station and 82% living within 60 miles.[1]

Governance Structure

There are three modal agencies of the United States Department of Transportation with influence over rail: the FRA; the Federal Transit Administration; and to a lesser extent, the Federal Highway Administration. The FRA issues and enforces safety regulations in accordance with its mission to enable the safe, reliable and efficient movement of people and goods in the U.S. via rail. The FTA provides technical and financial assistance to transit authorities operating or planning for commuter rail. Coordination between the FTA and state and local transit authorities also ensures safety standards are being met. The FHWA administers the Railway-Highways Crossings Program, which provides funding for the elimination of hazards at railway-highway crossings.

At the state level, MoDOT is responsible for administering and implementing transportation projects and programs, including for rail transportation. The department operates under a decentralized organization with its principle office in Jefferson City. This central office provides staff assistance and functional control for the various departmental tasks in seven geographical districts.

MoDOT is governed by the Missouri Highways and Transportation Commission, which is a six-member, bi-partisan board appointed by the governor and confirmed by the Missouri Senate. MoDOT's director and secretary to the commission are appointed by the commission. The director is responsible for all other employee appointments and hiring. MoDOT is responsible for maintaining Missouri's highway system and bridges, as well as improving waterways, transit, aviation, railroads, freight development and bicycle and pedestrian travel. The various non-highway modes are established as sections within the Central Office and report to the Multimodal Operations Director, who reports to the Deputy Chief Engineer. These sections carry out the statewide planning for these modes; there are no counterparts in the districts.

The MoDOT Multimodal Operations Division is the administrative division responsible for supporting alternative transportation programs within the state. The division functions to continue the advancement and strategic planning for aviation, rail, transit, waterways and freight development initiatives designed to expand Missouri's infrastructure and facilitate travel and commerce. Through the integration of the various modes, the traveling public enjoys greater accessibility to the resources of the state while industry capitalizes on improved transportation efficiencies.

MoDOT coordinates with the nine Metropolitan Planning Organizations and local communities as needed through standing meetings and project-specific needs. MPOs are federally-designated regional transportation planning organizations for urbanized areas with populations over 50,000, as determined by the U.S. Census. Through the award-winning Planning Framework, MoDOT coordinates with local officials through the MPOs and Regional Planning Commissions for transportation planning, prioritization and implementation.

[1] U.S. Census Bureau, American Community Survey 2018 5-Year Estimates

This Freight and Rail plan is intended to bring Missouri in compliance with PRIIA and Title 49 United States Code Section 70202 and Chapter 227:

- Missouri has an adequate plan for rail transportation in the state and a suitable process for updating, revising and modifying the plan;
- This plan is administered or coordinated by a designated state authority and provides for a fair distribution of resources;
- MoDOT:
  - is authorized to develop, promote, supervise and support safe, adequate and efficient rail transportation;
  - employs or will employ sufficient qualified and trained personnel;
  - maintains or will maintain adequate programs of investigation, research, promotion and development with opportunity for public participation; and
  - is designated and directed to take all practicable steps (by itself or with other state authorities) to improve rail transportation safety and reduce energy use and pollution related to transportation.
- MoDOT has ensured that it maintains or will maintain adequate procedures for financial control, accounting and performance evaluation for the proper use of assistance provided by the United States Government.

State Funding Authority

This section summarizes Missouri's authority for passenger and freight railroad funding, how the state has used this authority over the past five years and revenue sources that are dedicated to rail. Rail expenditures for the past five state fiscal years are shown in Table 2.2. Missouri administers four rail-specific funding programs:

- Funding support for the Amtrak passenger rail service between St. Louis and Kansas City: Non-dedicated funding appropriated annually from the General Revenue Fund.
- Highway-Rail Crossing Safety Program: The program is funded from state motor vehicle licensing fees. Under the provisions of Section 389.612 of the Missouri Revised Statutes, each motor vehicle registration or renewal is assessed 25 cents for this purpose.
- Station Improvements Program: This funding is appropriated under Article IV, Section 30(c), of the Missouri Constitution and Section 226.225 of the Missouri Revised Statutes.
- Railroad Regulatory Activities: Railroad safety inspections and other related regulatory activities conducted by the MoDOT Railroad Section are funded in part by annual assessments of railroad companies operating in Missouri based on their gross intrastate operating revenues (Section 622.300 of the Missouri Revised Statutes).

Although MoDOT maintains and improves existing passenger rail service, there are no dedicated state funds and limited federal funds available for passenger rail operations and infrastructure improvements. Rather, funding is subject to legislative general revenue appropriation and gubernatorial approval each year. The financial support Missouri has provided for the *Missouri River Runner* since 1980 allows this transportation option to exist.

Over 20 Amtrak routes are classified as state-supported, meaning state governments provide funding for operations of the routes. Across the country these services are often shorter, regional routes. To fund these services, many states rely on annual operating and capital funding from general funds subject to annual appropriation similar to Missouri. Some states have dedicated revenue sources used to fund intercity passenger rail including fuel taxes, transportation trust funds and license plate fees. In Missouri, fuel taxes are constitutionally protected and must be used for maintenance and investment in roadways. This challenging funding environment complicates MoDOT's efforts to continue supporting the *Missouri River Runner.*

The MoDOT Railroad Section manages a small grant program which provides $25,000 annually for improvements at existing Amtrak stations. Grantees are typically local communities and/or non-profits that own and maintain stations. Grants are provided for maintenance and repair projects and related operational and safety improvements. The funding for the station improvement program is included annually in the general revenue appropriation.

There are approximately 3,800 public highway-rail crossings and an additional 2,000 private rail crossings in Missouri. MoDOT evaluates and ranks the public crossings annually according to a hazard exposure index which considers such items as train traffic and speed, vehicle traffic and speed and sight distance. The crash history of crossings, while not part of the exposure index, are also considered when prioritizing projects. On projects identified through the exposure index, the Missouri Highways and Transportation Commission normally funds 80% of each project using federal funds and the remaining 20% through the Missouri Highway-Railroad Crossing Safety Program. Missouri's Highway-Railroad Crossing Safety Program is funded by a 25-cent assessment on all Missouri vehicle registrations and renewals.

The Railroad Expense Fund is funded by assessments collected from intrastate railroads for the expenses of regulation. The fund is devoted to the payment of expenditures incurred by state agencies for the regulation of railroads. Higher expenditures for some years can happen when several projects occur in one year. When several projects occur in a fiscal year, expenditures can sometimes exceed revenue for that year, but expenditures draw from the remaining balance from prior years as is the case for the Highway/Rail Crossing Safety Program in 2015 and 2016.

Expenditures for State Supported Passenger Rail Service and Station Improvements are funded through general revenue. This means funds not used for these purposes each year revert to the state for redistribution to other programs. The Highway/Rail Crossing Safety Program, funded by an assessment on vehicle registrations and renewals, holds its dedicated funding in an account which carries over from one year to the next. In recent years funding in this account has been used as the local match to leverage federal funding.

TABLE 2.2 MISSOURI STATE RAIL EXPENDITURES

Fiscal Year	State Supported Passenger Rail Service	Station Improvements	Highway/Rail Crossing Safety	Total
2015	$10,400,000	$25,000	$4,000,000	$14,425,000
2016	$9,600,000	$25,000	$4,000,000	$13,625,000
2017	$9,100,000	$25,000	$4,350,000*	$13,975,000
2018	$9,100,000	$25,000	$3,000,000	$12,125,000
2019	$9,100,000	$25,000	$3,000,000**	$12,125,000

** $350,000 was appropriated for at-grade crossings safety for counties of the first class in addition to the $4M appropriation*

*** In addition to the $3M expenditure shown here, $1.8M from the Highway/Rail Crossing Safety account was used to leverage a federal CRISI grant (see Rail Services, Initiatives & Plans)*

Source: General Assembly of the state of Missouri, House Bill No. 4 (2015, 2017, 2019) House Bill No. 2004 (2016, 2018)

Other Missouri programs that are not specific to rail, but allow funding for some rail improvements include:

- State Transportation Assistance Revolving Fund: Provides loans to local entities for non-highway projects such as rail, waterway and air travel infrastructure
- Missouri Transportation Finance Corporation: A state infrastructure bank with the ability to make loans and provide other forms of credit assistance to public and private entities to carry out transportation projects. Eligible railroad projects include: right-of-way acquisition, development or establishment of new intermodal or railroad facilities, improvement or rehabilitation of intermodal or rail equipment or facilities and refinancing outstanding debt incurred for these purposes
- Missouri Port Capital Improvement Program: Capital improvement matching grants (20-80%) awarded for specific undertakings of port development such as land acquisitions, construction, terminal facility development, port improvement projects and other related port facilities. Program requires an annual budget appropriation from the general assembly and signature by the governor, funds come from general revenue. A summary of recent rail-related port CIP projects is shown in Table 2.3.

TABLE 2.3 RECENT RAIL-RELATED PORT CIP PROJECTS (2014-2019)

Fiscal Year	Port	CIP Funding	Project
2019	SEMO	$310,691	Expand Rail
	SEMO	$1,529,302	Expand Rail
2017	St. Louis City	$184,268	Rail Improvements
	SEMO	$41,237	Rail Improvements
2016	Kansas City	$3,597,600	Rail Improvements
	SEMO	$424,000	Rail Improvements
2015	Kansas City	$597,600	Rail Connection and Repair
	SEMO	$424,000	Rail Improvements
2014	Kansas City	$183,333	Rail Improvements
	SEMO	$435,417	Rail Improvements

Source: MoDOT, Historic Port Capital Improvement Program Projects (2019)

- Freight Enhancement Program: Funding for transportation purposes other than highways and requires a 20% local match. Only capital costs are eligible and must satisfy at least one of MoDOT's Five Goals; Safety, Connectivity and Mobility, Economic Development, Major Maintenance and Reliability. Program requires an annual budget appropriation from the general assembly and signature by the governor, funds come from the State Transportation Fund. A summary of recent rail-related FRE projects is shown in Table 2.4.

TABLE 2.4 RECENT RAIL-RELATED FRE PROJECTS (MISSOURI, 2014-2020)

Fiscal Year	Project Sponsor	FRE Funding	Project Description
2020	POET Biorefining	$463,320	New rail spur at Laddonia to increase rail capacity
2019	Progressive Rail Inc.	$139,868	Construction of a rail transload facility in Union, Mo
	Sedalia-Pettis County Community Service Corporation	$500,000	Construction of rail spur to serve current and committed tenants at the industrial park
2018	Pemiscot County Port Authority	$500,000	Complete design and construction of a rail/truck transload facility at the port
	Pettis County, City of Sedalia, Sedalia-Pettis County Community Service Corporation	$116,250 $383,750	Design and construction of loop track and spur in Sedalia to support existing and new committed customers
2016	SEMO Port	$220,600	Install rail to connect the port's West Team Tracks to the main line
2015	BNSF Railroad	$261,000	Install rail switch to increase capacity

Fiscal Year	Project Sponsor	FRE Funding	Project Description
2014	Port KC	$250,000	Rehabilitation of the existing rail yard at Woodswether Terminal. Tasks include inspection and repair of the rail track and ballast
	Pemiscot County Port Authority	$300,000	Extend port's rail spur to support committed tenant
	City of Springfield	$150,000	Relocation of West Wye rail line to increase capacity and eliminate at-grade crossings from high traffic areas.

Source: *Mo*DOT, Freight Enhancement Program Awards (2020)

Rail Services, Initiatives and Plans

Missouri's latest initiatives and plans for passenger and freight rail infrastructure are documented in the recently updated MoDOT *2018 Long Range Transportation Plan*.

In 2014, Missouri received approximately $50 million in Federal Railroad Administration funding to improve passenger rail services in the state. This funding leveraged nearly $20 million in private investment. The goal of the funding was to improve on-time performance and travel time. Completed projects included:

- Osage River Bridge
- Universal crossover near Kirkwood
- Third main line in St. Louis Terminal Railroad
- New approach to Merchant's Bridge
- Safety improvements at 15 highway-railroad crossings

These projects are all located along the State Supported *Missouri River Runner* corridor. The federal funding required a state commitment to continue operation of the *Missouri River Runner* passenger rail service.[2] Five additional improvement projects in the corridor have completed NEPA documentation and preliminary engineering. These projects, listed below, await additional capital funding to be implemented.

- Second mainline track, Lee Summit to Pleasant Hill
- Passing siding, Knob Noster
- Passing siding, Kingsville/Holden
- Universal crossover Bonnots Mill
- Universal crossover, Hermann

[2] MoDOT. *Statewide Transportation Improvement Program – Section 7 Multimodal.*

Like the projects mentioned above, these improvements are intended to improve passenger rail service on the Kansas City to St. Louis corridor. The Missouri LRTP identifies multimodal transportation improvements as an unfunded need with $80 million annually needed to improve the multimodal network, including rail transportation. The plan details "multimodal investments can improve economic development, safety and provide improved mobility and access to opportunities for all Missourians and businesses."[3]

New locomotives on the *Missouri River Runner* service were introduced in FY 2018 as part of the larger effort to improve service on the *Missouri River Runner* passenger rail route. This was accomplished through a cooperative agreement between Amtrak Midwest and the states of Illinois, Michigan, Wisconsin and Missouri. These new, more reliable locomotives are Tier IV compliant and have reduced emissions by 90% over the previous equipment. The new locomotives were obtained through a 100% federally funded grant. New train coaches will be phased in to replace the aging passenger cars on select Amtrak Midwest routes. The new coaches will offer better amenities to travelers on the *Missouri River Runner* beginning in 2021.

A $12.02 million U.S. DOT grant intended to help implement Positive Train Control in Missouri was awarded in 2017. The $197 million national program was designed to assist states in deploying PTC technology in advance of a December 31, 2018 deadline for passenger railroad implementation. The grant award was to design, install and test a fully integrated PTC system over 8.5 miles of Kansas City Terminal Railway right-of-way which carries approximately 552,000 riders per year. More about PTC can be found in Section 2.5.

MoDOT was awarded federal funding in 2019 and 2020 under the Consolidated Rail Infrastructure and Safety Improvements program. Funding under this program is intended to improve the safety, efficiency and reliability of intercity passenger and freight rail systems. Approved in February 2019 by the U.S. DOT, the MoDOT Rail Corridor Consolidation and At-Grade Crossing Safety Improvement Project proposes to close four crossings and enhance safety measures at 11 crossings along a 19-mile BNSF rail segment between Aurora and Republic. The following year CRISI funding was again awarded to a Missouri safety project. The Thayer-North Rail Corridor At-Grade Consolidation and Safety Improvement Project will close eight at-grade crossings between Fordland and Diggins and create a grade separated crossing of U.S. Highway 160 over the rail corridor. Combined grant funding for these two projects will cover up to $12,942,319. At the time of writing these projects were still in the preconstruction phase.

Project partners heard from railroads in advance of the creation of this plan. These conversations provided MoDOT with a better understanding of the challenges and priorities of railroads active within the state. Stakeholder interviews are covered in depth in Section 2.5. One such insight from these interviews is the increased focus of some railroads on developing industrial properties with rail access. By being involved with future freight shippers early in the process, railroads are able to help customize industrial development for their future customers. Economic development initiatives of Missouri's railroads in coming years also include increased focus on multimodal optimization and continued development of safety measures.

[3] MoDOT. *2018 Long Range Transportation Plan Update: Technical Memorandums*.

2.2 Infrastructure & Existing Rail System

There are more than 20 railroad owners (see Figure 2.2) in control of over 5,000 miles of railroads within Missouri. These railroad companies are vital stakeholders and participants in Missouri's existing freight rail network and will be important partners for the future of freight rail transport statewide. All major railroads that operate within Missouri are private companies; therefore, most of the capital improvements and investments made are funded by the railroads themselves. However, over recent years in Missouri there has been increasing public investment in railroads to alleviate operating constraints.

Freight Rail Network

As shown in Figure 2.2 , railroad corridors serve areas across Missouri, with Kansas City and St. Louis historically serving as major points for the interchange of rail traffic moving between the eastern and western U.S. Figure 2.3 through Figure 2.6 show details of the rail infrastructure in the Kansas City, St. Louis, Springfield and Joplin regions. State rail carriers, their abbreviations and track mileage are provided in Table 2.5 below.

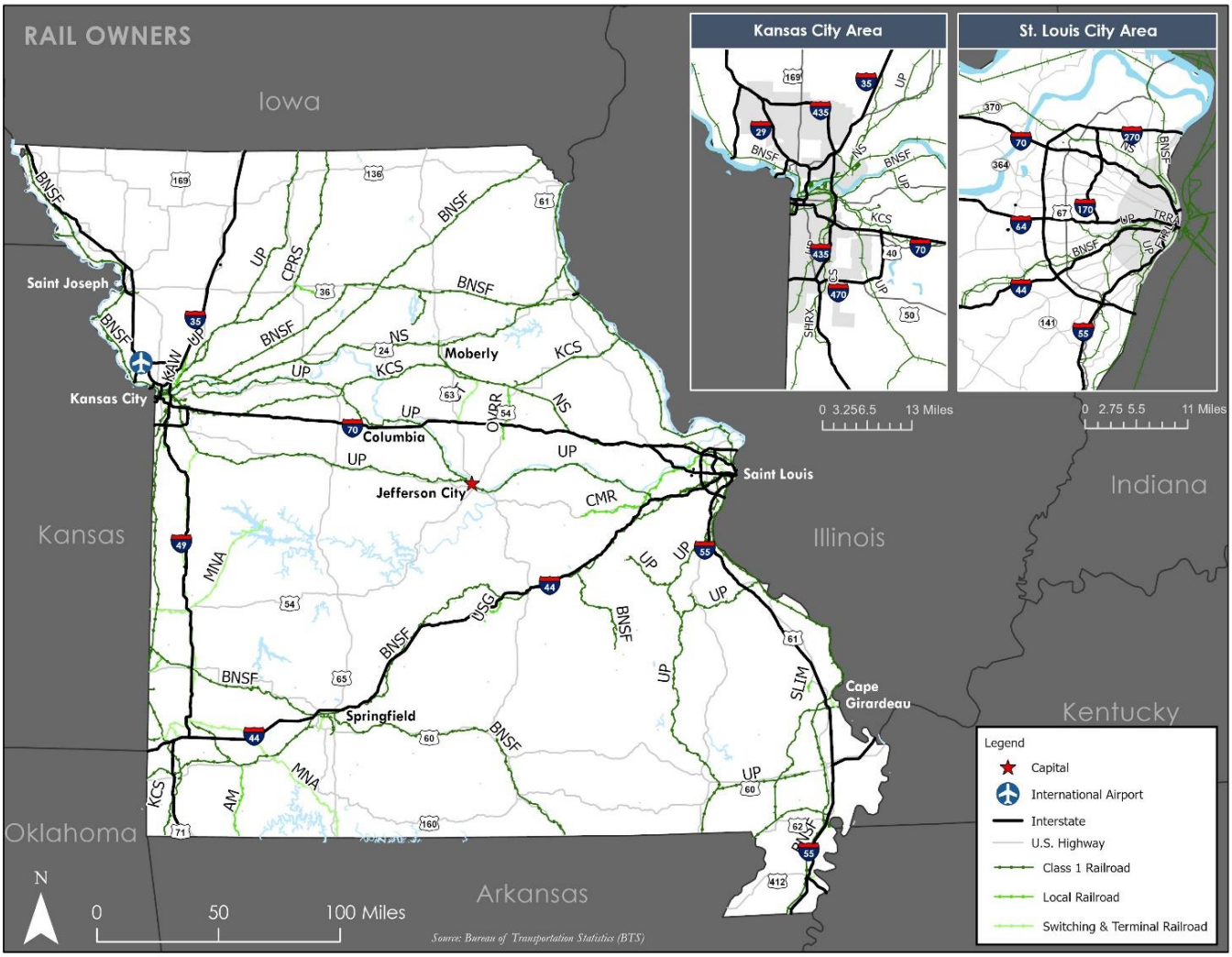
TABLE 2.5 MILEAGE OF OPERATING FREIGHT RAILROADS

Railroad	Reporting Mark	Miles Owned	Operating Rights	Total
Class I Railroads				
BNSF Railway Company	BNSF	1,777	175	1,952
Canadian Pacific	CPRS	113	20	133
Kansas City Southern Railway	KCS	453	20	473
Norfolk Southern Corp.	NS	374	205	579
Union Pacific Railroad	UP	1,031	502	1,533
CSX	CSX	0	1	1
Class I Total		**3,748**	**923**	**4,671**
Local Railroads				
Arkansas and Missouri	AM	36	0	36
Central Midland Railway	CMR	79	0	79
Kaw River Railroad	KAW	20	0	20
Missouri & Northern Arkansas Railroad	MNA	335	84	419
Ozark Valley Railroad, Inc.	OVRR	24	0	24
South Kansas & Oklahoma RR	SKOL	9	0	9
Local Railroads Total	**503**	**84**	**587**	
Switching & Terminal Railroads				
Burlington Junction Railway	BJRY	5	0	5
Bi-State Development Agency Railroad Company	BSDA	12	0	12
Columbia Terminal	CT/COLT	22	0	22
Foster Townsend Rail Logistics	FTRL	1	0	1
Kansas City Terminal Railway	KCTL	22	4	26
Missouri North Central Railroad	MNC	12	0	12
Pemiscot County Port Railroad	PCPA	5	0	5
SEMO Port Railroad, Inc.	SE	10	8	18
Terminal Railroad Assn. of St. Louis	TRRA	27	12	39
West Belt Railway	WBRW	0	10	10
Switching & Terminal Railroads Total		**111**	**24**	**135**
Total Rail Miles in Missouri		**4,362**	**1,030**	**5,392**

Note: These rail miles represent the best estimates at time of publishing. The miles do not include siding, spurs or other rail that is not shown in MoDOT's Rail Network.

Source: Bureau of Transportation Statistics, North American Rail Lines, 2020.

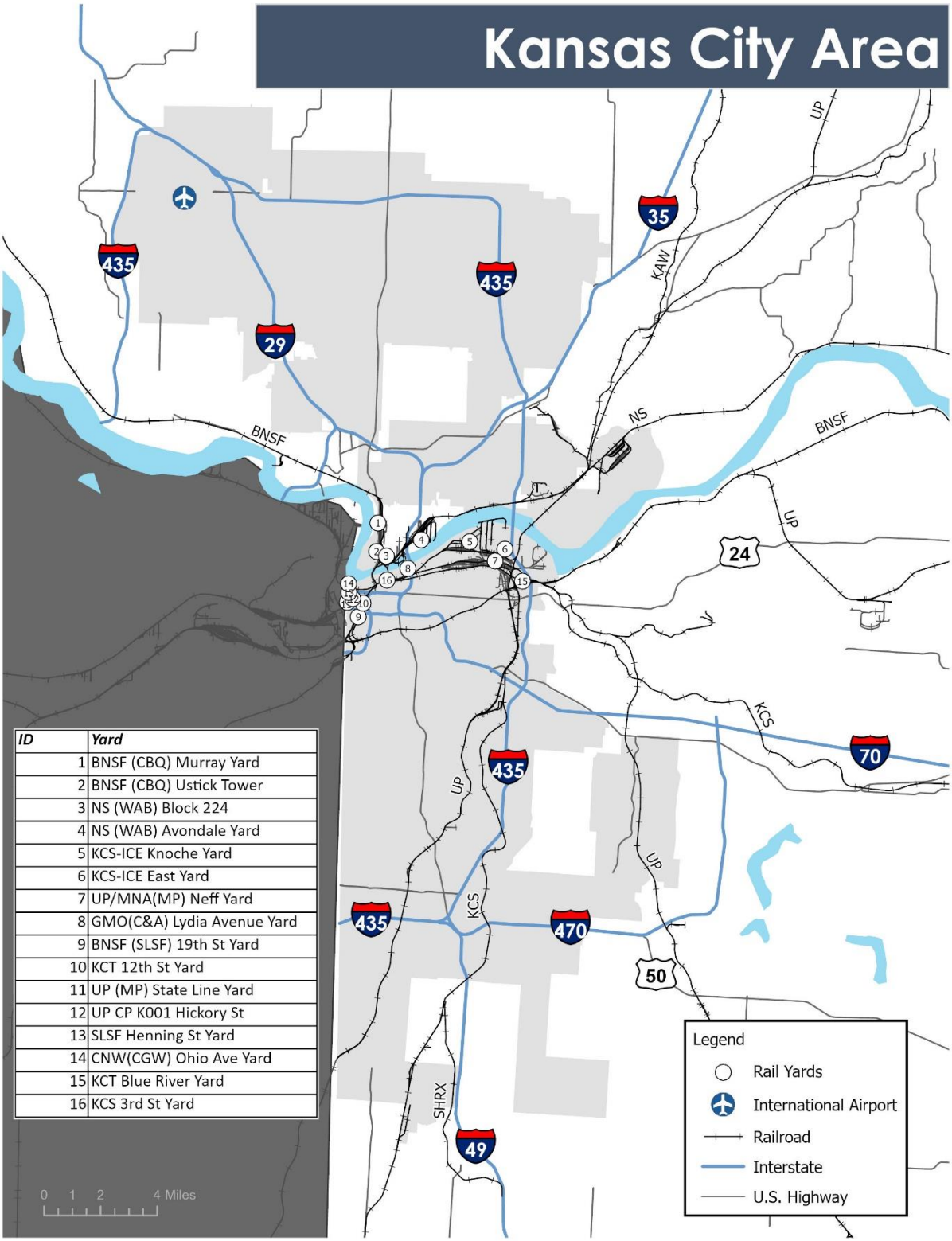
FIGURE 2.2 STATEWIDE RAILROAD OWNERS



Note: Railroad acronyms available in Table 2.5

Source: Bureau of Transportation Statistics, ESRI Living Atlas.

FIGURE 2.3 KANSAS CITY DETAIL MAP



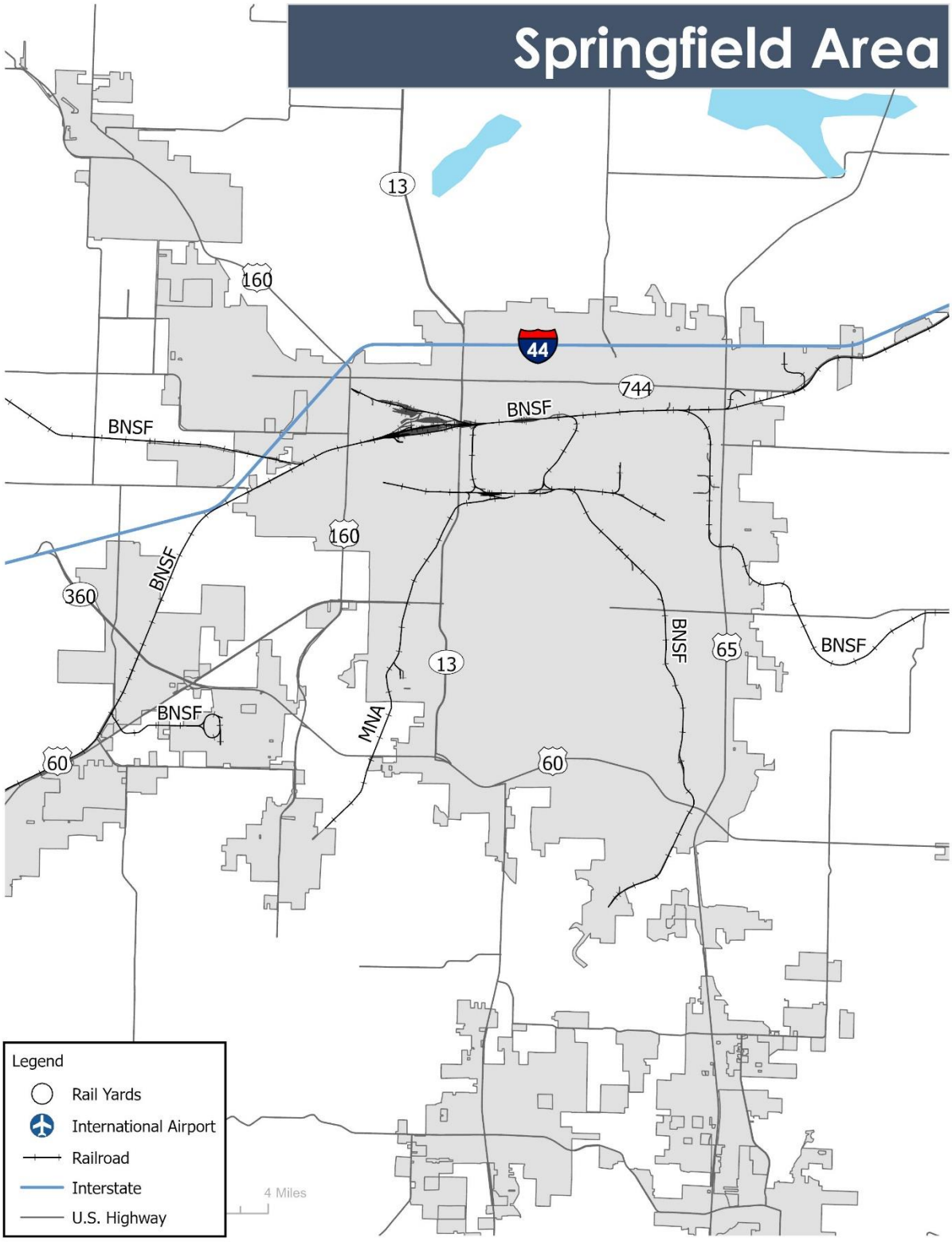
ID	Yard
1	BNSF (CBQ) Murray Yard
2	BNSF (CBQ) Ustick Tower
3	NS (WAB) Block 224
4	NS (WAB) Avondale Yard
5	KCS-ICE Knoche Yard
6	KCS-ICE East Yard
7	UP/MNA(MP) Neff Yard
8	GMO(C&A) Lydia Avenue Yard
9	BNSF (SLSF) 19th St Yard
10	KCT 12th St Yard
11	UP (MP) State Line Yard
12	UP CP K001 Hickory St
13	SLSF Henning St Yard
14	CNW(CGW) Ohio Ave Yard
15	KCT Blue River Yard
16	KCS 3rd St Yard

*Source: Bureau of Transportation Statistics, ESRI Living Atlas. *Railroad acronyms available in Table 2.5*

FIGURE 2.4 ST. LOUIS DETAIL MAP

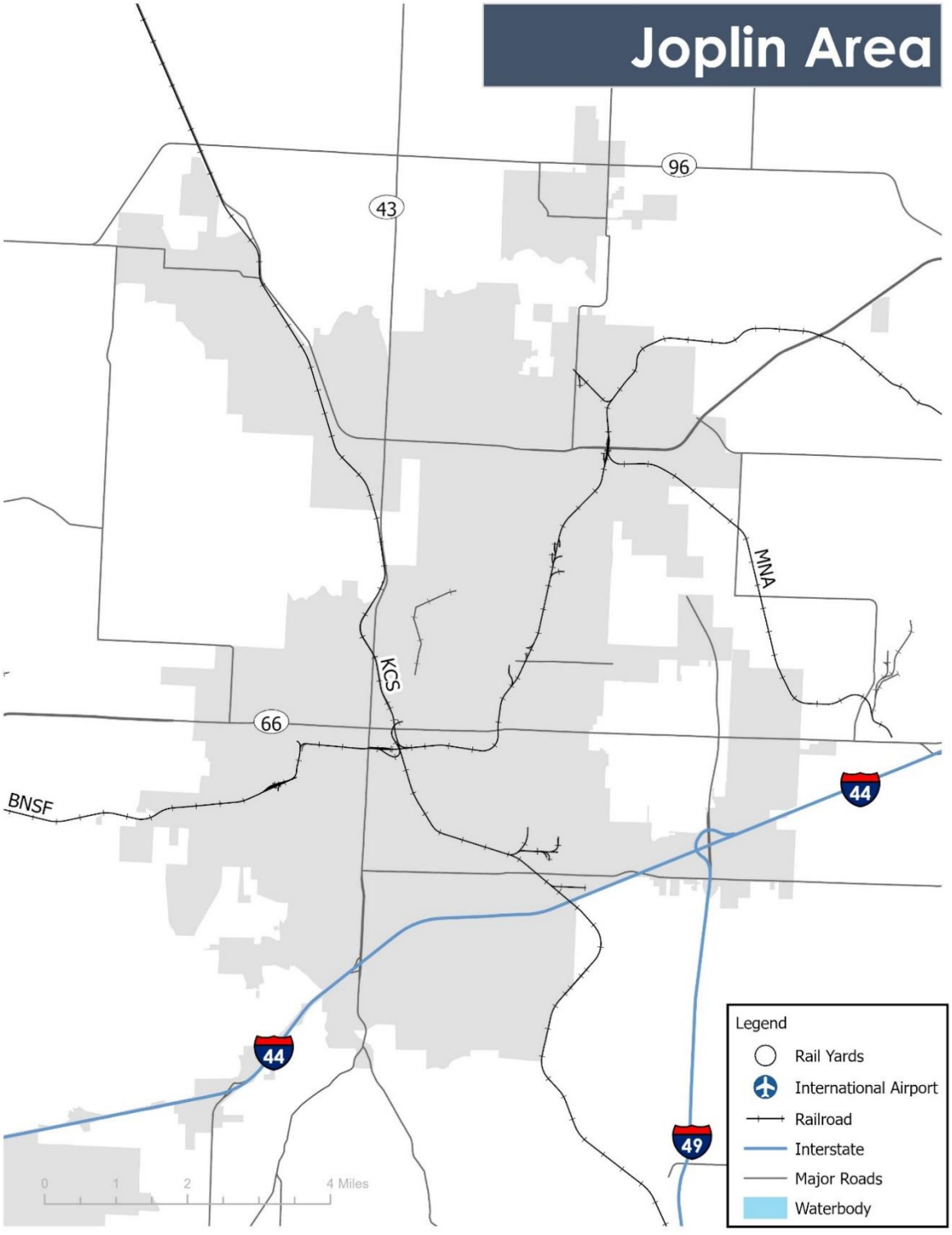
*Source: Bureau of Transportation Statistics, ESRI Living Atlas. *Railroad acronyms available in Table 2.5*

FIGURE 2.5 SPRINGFIELD DETAIL MAP



*Source: Bureau of Transportation Statistics, ESRI Living Atlas. *Railroad acronyms available in Table 2.5*

FIGURE 2.6 JOPLIN DETAIL MAP



*Source: Bureau of Transportation Statistics, ESRI Living Atlas. *Railroad acronyms available in Table 2.5*

In Missouri, railroad companies are typically described in three general categories based on their size and type of operations: 1) Class I Railroads, 2) Local Railroads and 3) Switching and Terminal Railroads. This section summarizes the different types within the state and identifies which rail carriers qualify for these categories. Missouri's rail infrastructure also includes spurs owned and operated by individual businesses used to connect industries to the larger rail network.

Class I Railroads

U.S. Class I Railroads are large line haul freight railroads with a total 2018 operating revenue of $490 million or more. There are seven Class I Railroads in the United States, five of which own tracks in Missouri with one additional Class I railroad, CSX, maintaining operating rights to roughly a mile of track within the state. The Missouri Class I Railroads are:

- Burlington Northern Santa Fe Railway Company

  BNSF Railway operates one of the largest railroad networks in North America, with roughly 32,000 miles of track. BNSF operates the largest rail network in Missouri with major rail junctions in Kansas City, Bucklin, Monroe City, St. Louis, Cape Girardeau, Springfield and Carthage.

- Canadian Pacific / Soo Line Railroad Co.

  Canadian Pacific, the owner of Soo Line, operates approximately 14,800 miles of track in six Canadian provinces and 13 U.S. states. Kansas City is the southern terminus in the CP rail network. Soo Line Railroad operates in the Kansas City area providing connections to the north central U.S. and Canada.

- Kansas City Southern Railway Co.

  KCS is a transportation holding company based out of Kansas City, Kansas, with assets across the North America. KCS operates a railway system linking commercial and industrial centers across North America. KCS serves north central and western Missouri through its Kansas City, Kan. headquarters.

- Norfolk Southern Corporation

  NS operates approximately 20,000 route miles in 22 states and the District of Columbia through its subsidiary Norfolk Southern Railway, including service to every major container port on the east coast. NS operates the most extensive intermodal network in the eastern U.S. and is a major transporter of coal and industrial products. Missouri operations include service through the north central region of the state with major rail classification yards and intermodal terminals in Kansas City, Monroe City and St. Louis.

- Union Pacific

  Union Pacific has a network of approximately 32,000 track miles covering 23 states. The UP rail network links every major West Coast and Gulf Coast port. UP operates a major freight car repair facility in DeSoto, Mo; a major freight classification yard in Kansas City and terminals in St. Louis, Sedalia, Jefferson City and Poplar

Bluff. Four Missouri short line railroads connect to the extensive UP network providing connections to freight customers across the state.

- CSX Transportation (trackage rights only)

  CSX provides rail service across 23 states, the District of Columbia and two Canadian provinces with approximately 21,000 miles of track. While CSX network's western limit is in Illinois, it operates in Missouri via trackage rights through part ownership of the St. Louis Terminal Railroad Association. CSX serves the St. Louis metropolitan area providing connections to the east coast.

Local Railroads

Missouri is home to six local railroads that provide line-haul service separate from Class I Railroads. Combined, these local railroads operate roughly 590 miles of rail throughout the state. All local railroads in Missouri are classified by the STB as Class III. There are no Class II railroads in the state. Missouri local railroads are:

- Arkansas & Missouri Railroad

  Established in 1986, operating a route between Missouri and Arkansas over 36 track-miles. A&M interchanges with BNSF, UP and KCS.

- Central Midland Railway

  Provides connections in the St. Louis area between downtown and Union, Mo on 79 miles of track. CMR has connections to BNSF, CN, CSX, KCS, NS and UP.

- Kaw River Railroad

  Established in 2004, KAW provides connections in the Kansas City area connecting downtown to eastern industrial users as well as connections between Birmingham and Kearney. KAW operates a 20-mile line with interchanges with BNSF, CP, KCS, NS and UP.

- Missouri & Northern Arkansas Railroad

  MNA serves industries statewide along 419 of its 490 miles of track. The terminals are in Kansas City and Diaz with key connections to interchange points. MNA business I driven by those interchange points, which connect to major Class I railroads.

- Ozark Valley Railroad, Inc.

  OVRR provides short line connection in mid-Missouri which operates 24 miles of track between Fulton and Arthur Spur via Kingdom City and Auxvasse with an interchange with KCS in Mexico, Mo. Similar to other local railroads, the interchanges with Class I railroads are key to OCRR's business.

- South Kansas & Oklahoma Railroad

  Operating on nine miles of track within Missouri, SKOL connects Liberal, Mo to Kansas and Oklahoma. In total, SKOL operates a 433-mile network Despite their limited track-mileage in Missouri, SKOL connects shippers to major interchanges with BNSF, KCS and UP.

Switching & Terminal Railroads

These small Class III railroads primarily perform local switching and terminal services for larger railroads. Switching and terminal railroads typically do not move freight between two geographic locations. Such movements are referred to as “line haul” moves. Rather than providing line haul service, these railroads perform support functions, including combining rail cars to form a consist, breaking down train consists and storing rail cars. A major function of switching and terminal railroads is the pickup from and/or delivery to, industry not located on Class I railroads. This vital connection provides connectivity between industry and the national rail network. In many cases rail operated by switching and terminal railroads was abandoned by larger railroads over time. Additional information about rail abandonment by railroads can be found later in this section.

Ten switching and terminal and shortline railroads operate more than 100 track-miles throughout the state. These railroads are:

- Burlington Junction Railway

  BJRY offers switching services within Iowa, Illinois and Missouri. Switching operations at Valley Park, Mo and Fenton, Mo serve several rail customers. BJRY owns approximately five miles of railroad within Missouri.

- Bi-State Development Agency Railroad Company

  BSDA is owned by the City of St. Louis and owns approximately 12 miles of railroad within the state. The line is operated by Respondek Railroad Corporation. BSDA provides switching services that connect with Class I Railroads.

- Columbia Terminal Railroad

  The COLT railroad is a full-service shortline serving mid-Missouri and is owned and operated by the City of Columbia. COLT operations include 22 miles of track between Columbia and Centralia. Shippers using the COLT system often work directly with Norfolk Southern to coordinate freight shipments intended for NS rail destinations utilizing NS connections.

- Foster Townsend Rail Logistics

  FTRL, located in St. Louis, provides rail switching near the Anheuser-Busch brewing company. The FTRL-owned one-mile line connects with the TRRA in St. Louis.

- Kansas City Terminal Railway Company

  KCT is a joint operation in the Kansas City area and is operated by Kaw River Railroad. KCT owns approximately 22 miles of track with operating rights on another four miles and leases six locomotives. KCT serves four of Missouri's Class I railroads, Missouri and Northern Arkansas Railroad, as well as Amtrak.

- Missouri North Central Railroad

  MNC operations began in 2004 from Brunswick to Chillicothe in northwest Missouri. MNC owns 12 miles of rail and interchanges with CP in Chillicothe and BNSF in Brunswick.

- Pemiscot County Port Authority

  PCPA operates approximately six miles of track via the Pemiscot County Port Railroad. This includes a rail spur that links the port with the BNSF mainline in the City of Hayti.

- SEMO Port Railroad, Inc.

  SE provides local switch service to the port facilities in Scott City and provides interchanging connections with UP and BNSF. Owned and operated by the SEMO Port, SE was initially a six-mile UP branch line. It was extended to the port's industrial area shortly after purchase and SEMO now has ownership or operating rights over 18 miles of rail. Vertical clearances allow for double-stacked container cars on this line.

- Terminal Railroad Association of St. Louis

  TRRA owns and operates 39 miles of rail, which includes the Merchants Bridge, the MacArthur Bridge and key railroad routes in St. Louis. Merchants Bridge is a railroad-only bridge over the Mississippi River just north of downtown St. Louis. The MacArthur Bridge is part of an elevated track crossing the Mississippi River in downtown St. Louis. TRRA in its current form is jointly owned by UP, BNSF, CN, CSX and NS.

- West Belt Railway

  WBRW is operated by national logistics company Patriot Rail & Ports. It is 9.6 miles of rail, all within St. Louis, were previously a branch line operated by TRRA.

Abandonments

Railroads may abandon a line with permission of the STB. Abandonments are primarily the result of burdensome maintenance costs associated with lightly trafficked or unused rail lines. While unprofitable for large rail carriers to operate, lines proposed for abandonment often serve the public's interest by connecting industries with the larger national rail network. To ensure continued rail service on unprofitable lines the Feeder Railroad Development Program enables any financially responsible person to force the sale of the line to facilitate continued service. The new ownership would assume the common carrier obligation to provide service over the line. To avoid this process, rail carriers looking to abandon lines can be offered an "Offer of Financial Assistance", which is a subsidy to allow for continued operations without sale. The STB also considers requests for trail use or public use conditions of the

abandoned line to provide public benefit and preserve rail corridors for future use. Most abandonments have occurred since the 1980 passage of the Staggers Rail Act. This federal legislation removed many regulatory restraints on the rail industry, making it easier for railroads to abandon redundant or light-density lines.

There are four ways in which rail lines can be abandoned. Class Exemptions, the most frequent case, involve the filing of a Notice of Exemption informing the STB of the rail carrier's intentions to abandon a line that has been out-of-service for at least two years. Carriers wishing to abandon a lightly trafficked line that has not been out-of-service for at least two years may Petition the Board for an exemption. Abandonment applications filed by carriers where the line is in use but unprofitable require ample evidence and documentation to receive approval for abandonment. Third party filings, known as Adverse Abandonments, are generally opposed by the carrier with ownership of the line and are rare instances.

During the abandonment process, MoDOT is afforded the opportunity to comment. A recent trend for railroads in Missouri is to retain rail infrastructure that previously would have been officially abandoned, which allows railroads to continue service if desired in the future under different circumstances. Since the 2012 Rail Plan, two abandonments in Missouri have been inventoried by the FRA and STB (See Table 2.6).

TABLE 2.6 RECENT MISSOURI RAIL ABANDONMENT (SINCE 2012 RAIL PLAN)

Docket #	Location	Railroad	Mileage in Missouri
AB 1088X	Cape Girardeau County	JGD Railroad	13.3
AB 331	City of St. Louis	Bi-State Development	1.43

Source: STB Abandonment Records

STB regulations and the National Rails to Trails Act authorize interested parties to negotiate agreements to use railroad right-of-way that otherwise would be abandoned for other public uses including highways, commuter rail service and recreational uses. When former rail right-of-way is used for trail purposes it is known as a rail-trail, denoting the transformation in the corridor's use. Missouri has 23 rail-trails which bring a productive public use to abandoned rail corridors across the state. Rail-trails in Missouri total 448 miles, with an additional 405 miles of prospective rail-trail.[4]

Intermodal Facilities

Intermodal facilities are where freight is moved between multiple modes of transportation (rail, ship/barge, truck and air) in containers or vehicles. These facilities reduce cargo-handling time, thereby increasing efficiency in transporting goods.

Missouri has 141 intermodal facilities integrating rail with other modes. A high concentration of these facilities are located in the St. Louis and Kansas City regions. Additional intermodal facilities are spread throughout the state to facilitate intermodal shipments. The primary modes of transportation for intermodal facilities across the state which feature rail are detailed in Table 2.7 and Figure 2.7 below.

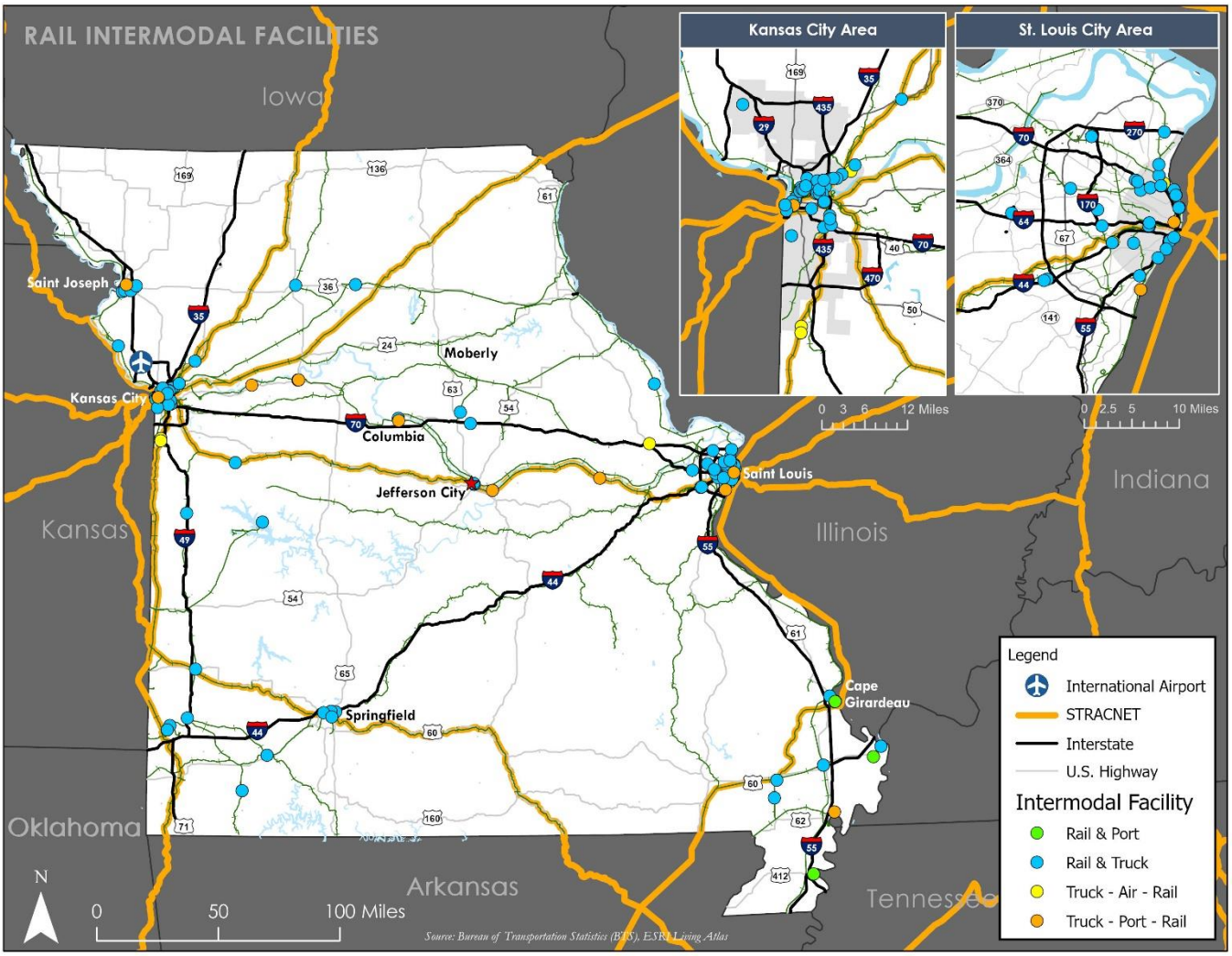
[4] Rails to Trails Conservancy https://www.railstotrails.org/our-work/united-states/missouri/

TABLE 2.7 INTERMODAL FACILITIES - PRIMARY MODE OF TRANSPORTATION

Primary Mode of Transportation	Number of Facilities
Rail & Port	1
Rail & Truck	122
Truck – Port – Rail	10
Truck – Air – Rail	8

Source: Bureau of Transportation Statistics

FIGURE 2.7 MISSOURI RAIL INTERMODAL FACILITIES



Source: Bureau of Transportation Statistics, ESRI Living Atlas

National Multimodal Freight Network

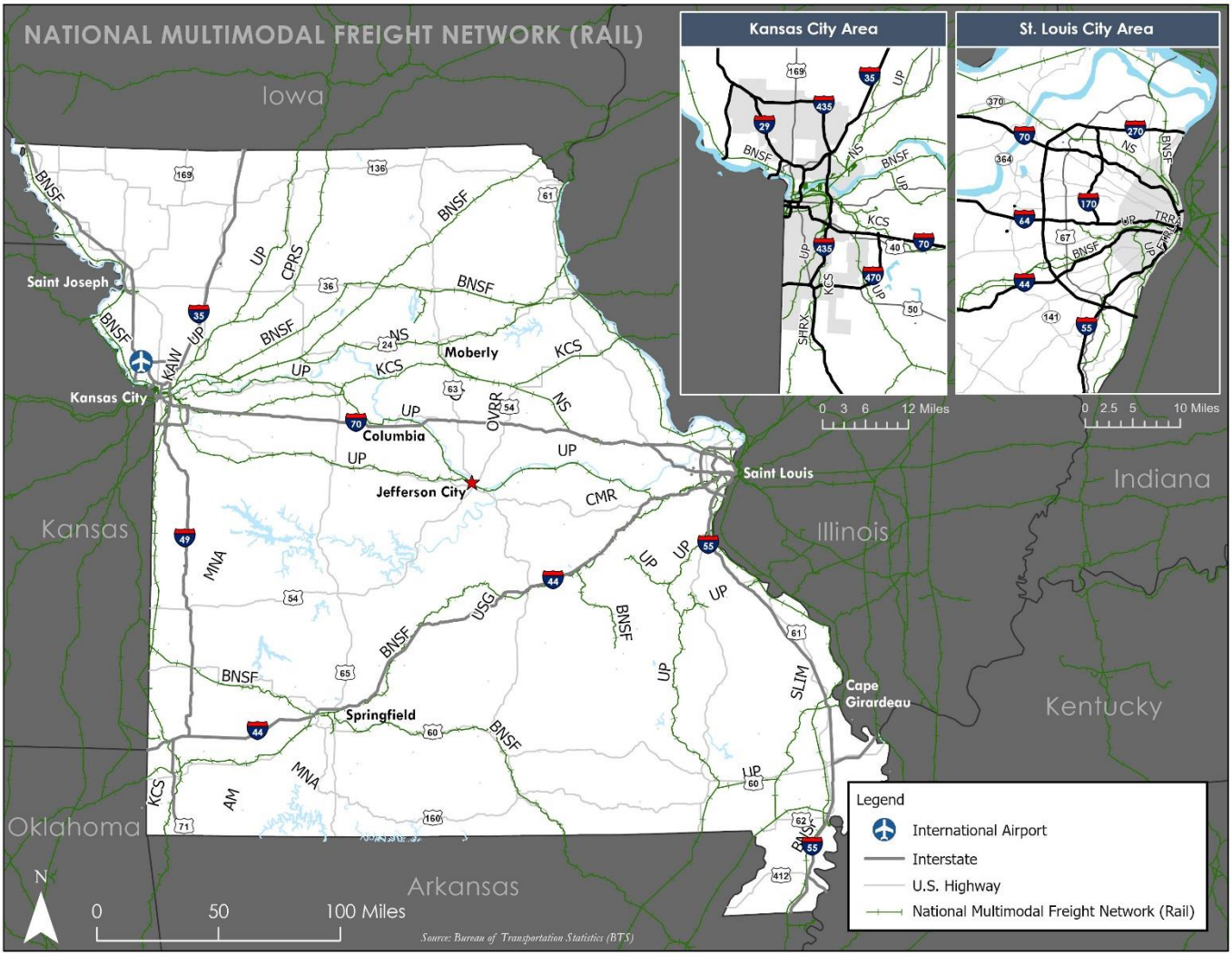
As discussed regarding other modes of freight transport, Section 70103 of title 49, United States Code established by the FAST Act requires the Under Secretary of Transportation for Policy to establish a National Multimodal Freight Network. The NMFN was established with the goal to:

- Assist states in strategically directing resources toward improved system performance for the efficient movement of freight on the network;
- Inform freight transportation planning;
- Assist in the prioritization of federal investment; and
- Assess and support federal investments to achieve the national multimodal freight policy goals and the National Highway Freight Program goals

In the interim NMFN established in 2016, Missouri contains 3,421 route miles of NMFN Rail Freight Network Routes, as shown in Figure 2.8.[5]

[5] U.S. Department of Transportation. *Interim National Multimodal Freight Network State Maps and Tables.* 2016.

FIGURE 2.8 NATIONAL MULTIMODAL FREIGHT RAIL NETWORK IN MISSOURI



Source: *Bureau of Transportation* Statistics, ESRI Living Atlas

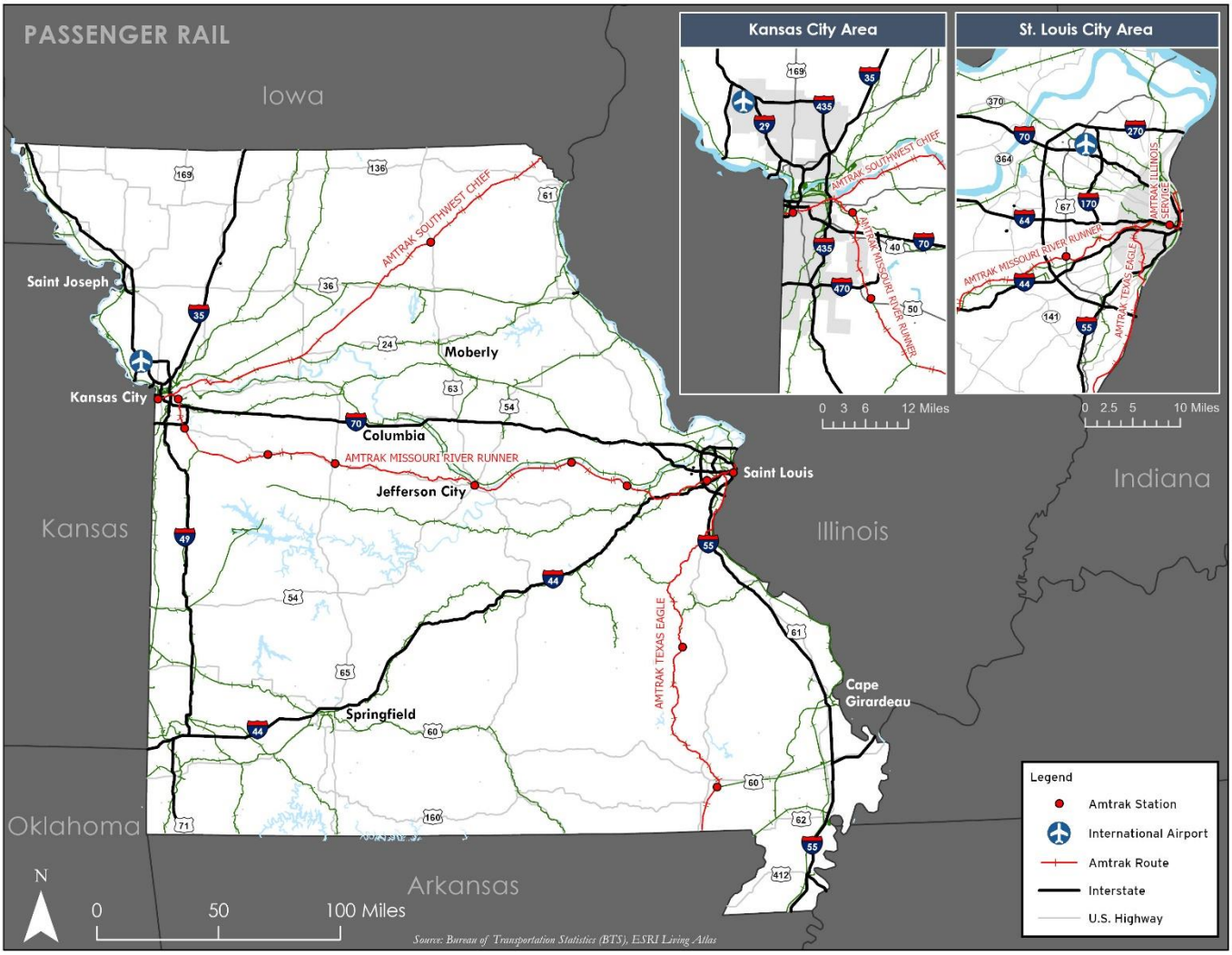
Passenger Rail Network

Intercity Passenger Rail Routes

Amtrak operates intercity passenger rail service within Missouri (see Figure 2.9). The *Southwest Chief* connects Chicago to Los Angeles with stops in Kansas City and La Plata. The *Texas Eagle* connects Chicago to San Antonio with service to three Missouri stations including St. Louis. These Long Distance routes are joined by the shorter, more reliable *Missouri River Runner*, a State Supported Amtrak route, which connects St. Louis and Kansas City with service to eight intermediate station cities along the way. The *Missouri River Runner* route operates two round trips daily across 283 miles of track between the Gateway Transportation Center in St. Louis and Union Station in Kansas City. The *Missouri River Runner* provides a connection to the *Southwest Chief* service in Kansas City and to the *Texas Eagle* and *Lincoln Service* routes in St. Louis. The Illinois-funded *Lincoln Service,* which travels almost

entirely within Illinois, provides service between Chicago and St. Louis—its only Missouri stop. The *Lincoln Service* is a state-supported, Amtrak operated route.

FIGURE 2.9 EXISTING MISSOURI PASSENGER RAIL NETWORK



Source: *Bure*au of Transportation Statistics, ESRI Living Atlas

Passenger rail service provides an option for traveling between major economic centers and promotes commerce and economic development, particularly in the areas surrounding stations. The *Missouri River Runner* provides an alternative travel mode along the heavily traveled I-70 corridor between St. Louis and Kansas City and gives rise to significant benefits in Missouri through travel/transportation, reduced energy consumption, safety and tourism/visitor spending.

TABLE 2.8 PASSENGER RAIL SERVICE DETAILS

Service	Full Route	Service Level/ Frequency	Host Railroads (Missouri)	In-state Station Cities	FY 2018 On-Time Performance
Missouri River Runner	Kansas City – St. Louis	Two daily round trips	Union Pacific	Kansas City*, Independence, Lee's Summit, Warrensburg, Sedalia, Jefferson City, Hermann, Washington, Kirkwood, St. Louis*	82.4%
Southwest Chief	Chicago – Los Angeles	One daily round trip	BNSF	La Plata, Kansas City	47.0%
Texas Eagle	Chicago – San Antonio	One daily round trip	Union Pacific	St. Louis, Arcadia, Poplar Bluff	39.7%

Note: The Lincoln Service, an Illinois State-sponsored service is not included, as it only services a small portion of downtown St. Louis and is primarily a service within Illinois.

* In Kansas City and St. Louis the Missouri River Runner connects to the Texas Eagle, Lincoln Service and Southwest Chief

Source: Amtrak. State Fact Sheets: Missouri. 2018.

Passenger Rail Stations

Missouri currently has 13 rail stations that serve the various passenger rail lines in the state. Table 2.9 details the FY 2018 ridership at each station along with station details. Ten stations are served by local or regional transit. These range from the large urban transit services of Kansas City and St. Louis, both of which serve two Amtrak stations each, to smaller, rural transit. Greyhound, Jefferson Lines, Burlington Trailways, Megabus and Amtrak Thruway operate intercity bus service across Missouri, including service to three station communities. All passenger rail stations in Missouri provide some form of onsite parking. The availability of bicycle parking at stations is detailed in Table 2.9.

TABLE 2.9 AMTRAK RIDERSHIP BY STATION

Station	FY 2018 Ridership	Routes Served	Community Type	Transit/Intercity Connections	Station Features
Arcadia	1,018	*Texas Eagle*	Rural	None	Same-day parking is available No bicycle parking
Hermann	26,037	*River Runner*	Rural	None	Same-day and overnight parking is available No bicycle parking
Independence	6,683	*River Runner*	Suburban	IndeBus	Same-day and overnight parking is available No bicycle parking
Jefferson City	39,395	*River Runner*	Urban	JEFFTRAN, Greyhound	Same-day and overnight parking is available No bicycle parking
Kansas City	154,170	*River Runner, Southwest Chief*	Urban	Kansas City Regional Transit (RideKC), Greyhound, Jefferson Lines, Megabus, Amtrak Thruway	Same-day and overnight parking is available Bicycle parking available (up to 72 hours)

Station	FY 2018 Ridership	Routes Served	Community Type	Transit/Intercity Connections	Station Features
Kirkwood	55,213	*River Runner*	Suburban	Metro Transit	Same-day and overnight parking is available Bicycle parking available
La Plata	11,124	*Southwest Chief*	Rural	None	Same-day and overnight parking is available No bicycle parking
Lee's Summit	26,811	*River Runner*	Suburban	Kansas City Regional Transit (RideKC)	Same-day and overnight parking is available Bicycle parking available
Poplar Bluff	4,640	*Texas Eagle*	Rural	Bluff Area Transit Service	Same-day and overnight parking is available No bicycle parking
Sedalia	9,289	*River Runner*	Rural	The Bus	Same-day and overnight parking is available Bicycle parking available
St. Louis	362,172	*Lincoln Service, River Runner, Texas Eagle*	Urban	Metro Transit, Greyhound Lines, Burlington Trailways, Megabus, Amtrak Thruway	Same-day and overnight parking is available Bicycle parking available
Warrensburg	12,046	*River Runner*	Rural	OATS Transit (shared-ride, demand based, door-to-door service), Greyhound, Jefferson Lines	Same-day and overnight parking is available Bicycle parking available
Washington	15,890	*River Runner*	Rural	OATS Transit (shared-ride, demand based, door-to-door service)	Same-day and overnight parking is available No bicycle parking
Total Usage	**724,488**	**N/A**	**N/A**	**N/A**	**N/A**

Source: Amtrak. State Fact Sheets: Missouri. 2018. & Great American Stations https://www.greatamericanstations.com/

Other Rail Services

Unlike longer-distance intercity passenger rail routes, commuter rail systems cater to a smaller geography, generally serving an individual urban area. The Bi-state Development Agency Railroad MetroLink provides commuter rail service within the St. Louis region.

Excursion railroads, also known as tourist railroads, provide a glimpse into the past of rail transportation. Found across the country, these railroads use vintage equipment to provide a historical experience for riders. Instead of existing to move people from one point to another, excursion railroads are purely recreation, focusing on leisurely travel. These services typically traverse scenic landscapes. Three excursion railroads operate within the state, detailed in Table 2.10.

TABLE 2.10 MISSOURI EXCURSION RAILROADS

Excursion Railroads	Reporting Mark	Operating Rights (miles)
Branson Scenic Railway	BSRX	32
St. Louis Iron Mountain Railway	SLIM	6
Belton, Grandview and Kansas City Railroad	SHRX	7
Excursion Railroads Total		**45**

Source: Bureau of Transportation Statistics, North American Rail Lines, 2020.

Ongoing Freight and Passenger Rail Projects, Financing & Challenges

Public financing for rail projects and service in the state are detailed in the state budget and Missouri State Transportation Improvement Program. Existing and historic spending is detailed in the Role of Rail in Statewide Transportation section, above. Anticipated future spending is detailed in the most recent 2020-2024 Missouri STIP. The table below details the current and prospective public capital and operating funding resources, public subsidies and state taxation relating to rail operations and infrastructure development. This funding includes the ongoing programs that fund *Missouri River Runner* service, station improvements and rail crossing safety. The STIP indicates that the state anticipates consistent continuous funding to rail-specific programs over the next five years. This funding includes the Rail Crossing Safety Program which supports the improvement of rail safety across the state. Spending appears to drastically reduce over time for the Rail Crossing Safety Program since funding reported in the STIP is tied to specific projects. This simply means there are fewer project-related funds approved for future years at the time the STIP was released. As discrete projects emerge to improve rail safety across the state, they will be added to the STIP.

TABLE 2.11 2020-2024 MISSOURI STIP RAIL FUNDING

Program	Federal/State	2020	2021	2022	2023	2024
State Supported Passenger Rail Service	Federal Costs	$-	$-	$-	$-	$-
	State Costs	$9,100,000	$9,100,000	$9,100,000	$9,100,000	$9,100,000
	Total Costs	$9,100,000	$9,100,000	$9,100,000	$9,100,000	$9,100,000
Station Improvements	Federal Costs	$-	$-	$-	$-	$-
	State Costs	$25,000	$25,000	$25,000	$25,000	$25,000
	Total Costs	$25,000	$25,000	$25,000	$25,000	$25,000
Rail Crossing Safety Program	Federal Costs	$13,071,000	$5,373,000	$5,913,000	$1,338,000	$1,898,000
	State Costs	$3,575,000	$1,467,000	$1,587,000	$302,000	$442,000
	Total Costs	$16,646,000	$6,840,000	$7,500,000	$1,640,000	$2,340,000
Total		**$25,771,000**	**$15,965,000**	**$16,625,000**	**$10,765,000**	**$11,465,000**

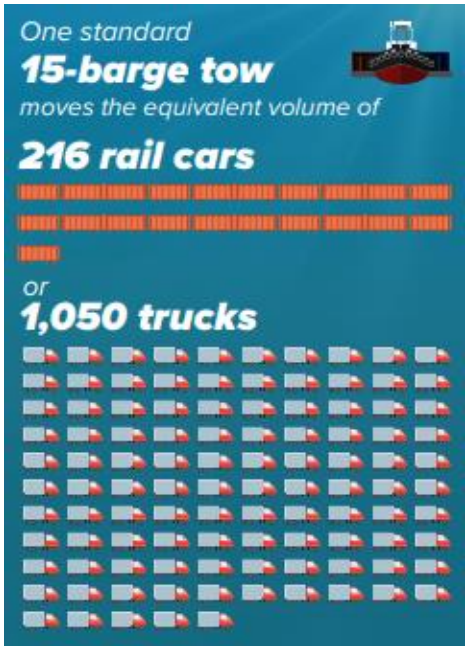
Source: MoDOT. Statewide Transportation Improvement Program – Section 7 Multimodal.

Missouri faces major challenges in funding the rail transportation network. A recent area of concern has been the funding for the *Missouri River Runner* service. Over the last decade, contributions to Amtrak from Missouri for the

service have fell short of the actual expenses. This shortfall has resulted in increased debt owed to Amtrak. This challenge is likely to remain unless additional funding is identified. The state is also limited to a single dedicated funding source for rail improvements and these funds are only available for at-grade crossing safety. Additionally, local spurs into facilities or industrial parks are owned and maintained by the business owner it serves. These spurs are a major funding gap for most states, including Missouri, because there are no mechanisms to fund improvements and these improvements are needed to attract many businesses, especially manufacturing businesses.

Economic and Environmental Impacts of Freight and Passenger Rail

The railroad industry benefits the economic and environmental well-being of Missouri. The industry employs more than 7,272 workers in Missouri with average wages and benefits per freight rail employee of $125,210. Retired railroad beneficiaries in Missouri are estimated at 18,346, with railroad retirement benefits paid estimated to be $410 million. The Association of American Railroads estimates that nationwide U.S. Railroads supported 1.1 million jobs, nearly $219.5 billion in annual economic activity, $71 billion in wages and almost $26 billion in tax revenues.



Source: National Waterways Foundation, http://www.nationalwaterwaysfoundation.org/HO_WaterwaysProfile_MO.pdf

Source: National Waterways Foundation, http://www.nationalwaterwaysfoundation.org/HO_WaterwaysProfile_MO.pdf

In 2017, America's railroads moved one ton of freight an average of 479 miles on a single gallon of fuel, which is equivalent to traveling between St. Louis and Birmingham, Ala. On average, railroads are four times more fuel efficient than trucks and one train can carry as much as several hundred trucks. The AAR estimates that it would have taken nearly 23 million additional trucks to transport the millions of tons of freight that originated in, terminated in, or moved through Missouri by rail in 2017.[6]

Missouri's passenger rail service also supports economic growth across the state. An economic impact study of the *Missouri River Runner* found the service is responsible for $208 million in annual economic activity, generating $22 million in annual tax revenue and supporting 1,250 jobs through direct, indirect and induced economic benefits.[7]

[6] Association of American Railroads. *Freight Railroads in Missouri: Rail Fast Facts For 2017.* 2019.

[7] MoDOT. *Economic Impact of the* Missouri River Runner *Passenger Rail Service*. March 2021

Amtrak's business presence in Missouri in 2019 included $28.9 million paid to in-state vendors and small businesses for construction, landscaping, engineering and business technology services. Amtrak directly employs 78 employees in a variety of roles in Missouri amounting to $7.5 million in labor income. Factoring for indirect and induced benefits, Amtrak's passenger rail services are responsible for 450 jobs across the state resulting in $35.2 million in labor income.

Additional benefits of the *Missouri River Runner* include cost savings for residents, businesses and government alike. $6.5 million in annual transportation cost savings are enjoyed by Missouri residents and visitors each year because of the *Missouri River Runner* service. Other cost savings linked to the service include $1.4 million in annual savings associated with a reduced fatality rate, and $160,000 in annual savings resulting from less wear and tear on Missouri roadways. Additionally, travelers on Missouri passenger rail services increase the economic development potential of station area land. Passenger service can also have a positive impact on the environment as moving trips from other modes to rail, emissions per passenger mile is reduced.

For more information on the benefits of the Missouri River Runner see *Economic Impact of the Missouri River Runner Passenger Rail Service*.

2.3 Freight Demand

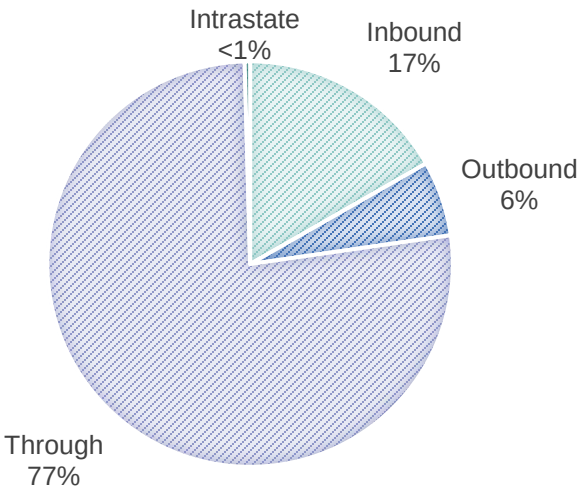
This section details the existing demand for rail freight in Missouri by examining the current movement of goods via rail to, from, within and through Missouri. Based on 2018 STB Carload Waybill data, more than 414 million tons of freight moved to, from, within or through the state in 2018 (see Table 2.12). More than 349 million of those tons were classified as carload shipments. The remainder of rail-transported freight is categorized as intermodal. Carload shipments are typical for raw materials such as coal or grain that are moved in large quantities, whereas intermodal shipments tend to be products that rely on trucks to connect freight shipments with rail facilities or final destinations. While accounting for only 15.7% of rail freight in 2018, intermodal shipments over the Missouri rail network were valued at approximately $286 million, or 51.8% of all rail freight. Carload and intermodal freight by direction for 2018 is provided in Table 2.13 and Table 2.14.

TABLE 2.12 FREIGHT TONNAGE BY FLOW DIRECTION (2012-2018)

Direction	2012 Tons	Percent of Total Tons (2012)	2018 Tons	Percent of Total Tons (2018)
Outbound	21,679,084	5%	24,833,442	6%
Inbound	89,023,110	20%	69,283,636	17%
Intrastate	2,504,270	1%	1,798,477	<1%
Through	334,872,566	75%	318,114,090	77%
Total	**448,079,030**	**100%**	**414,029,645**	**100%**

Source: STB Carload Waybill Data, 2012- 2018

FIGURE 2.10 RAIL TONNAGE BY DIRECTION, 2018



Source: STB Carload Waybill Data, 2018

TABLE 2.13 CARLOAD SHIPMENT STATISTICS, 2018

Direction	Tons	Percent of Total Tons	Value ($M)	Percent of Total Value
Outbound	21,312,242	6%	$30,784	12%
Inbound	66,234,476	19%	$35,718	13%
Intrastate	1,798,477	1%	$2,249	1%
Through	259,847,817	74%	$197,524	74%
Total	**349,193,012**	**100%**	**$266,275**	**100%**

Source: (Tonnage) STB Carload Waybill data, 2018 (Value) Transearch, 2018

TABLE 2.14 INTERMODAL SHIPMENT STATISTICS, 2018

Direction	Tons	Percent of Total Tons	Value ($M)	Percent of Total Value
Outbound	3,521,200	5%	$15,745	6%
Inbound	3,049,160	5%	$15,339	5%
Intrastate	-	0%	-	0%
Through	58,266,273	90%	$254,959	89%
Total	**64,836,633**	**100%**	**$286,043**	**100%**

Source: (Tonnage) STB Carload Waybill data, 2018 (Value) Transearch, 2018

The direction of freight movement has remained largely the same from 2012 to 2018 with through freight dominating the state's freight flows and accounting for more than 75% of freight tonnage. Intrastate shipments—those originating and terminating within Missouri—are minor compared to inbound, outbound and through shipments. Despite the drastic difference in tonnage between outbound and inbound freight in the state, the values are similar, with inbound freight values just slightly larger than outbound values, as can be seen in Table 2.15 and

Figure 2.11. This discrepancy between tonnage and value indicates that Missouri is importing more lower value, higher weight freight than it is exporting, such as coal. In recent years shipments of coal have declined significantly. This trend is discussed later in this section.

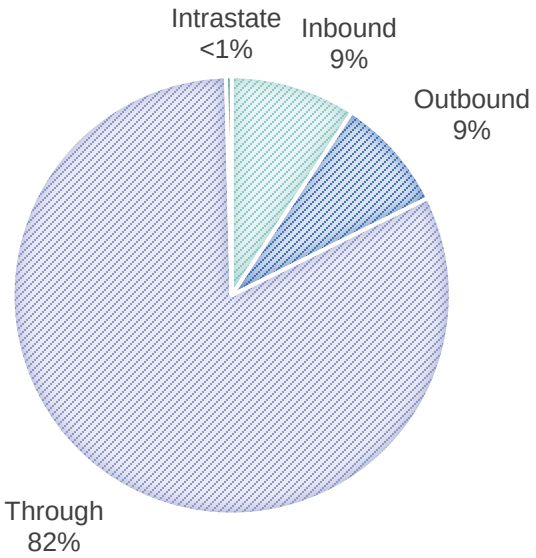
TABLE 2.15 RAIL FREIGHT VALUE BY FLOW DIRECTION (2018)

Direction	Value ($M)	Percent of Value
Outbound	$46,529	9%
Inbound	$51,057	9%
Intrastate	$2,249	<1%
Through	$452,480	82%
Total	**$99,835**	**100%**

Source: Transearch, 2018

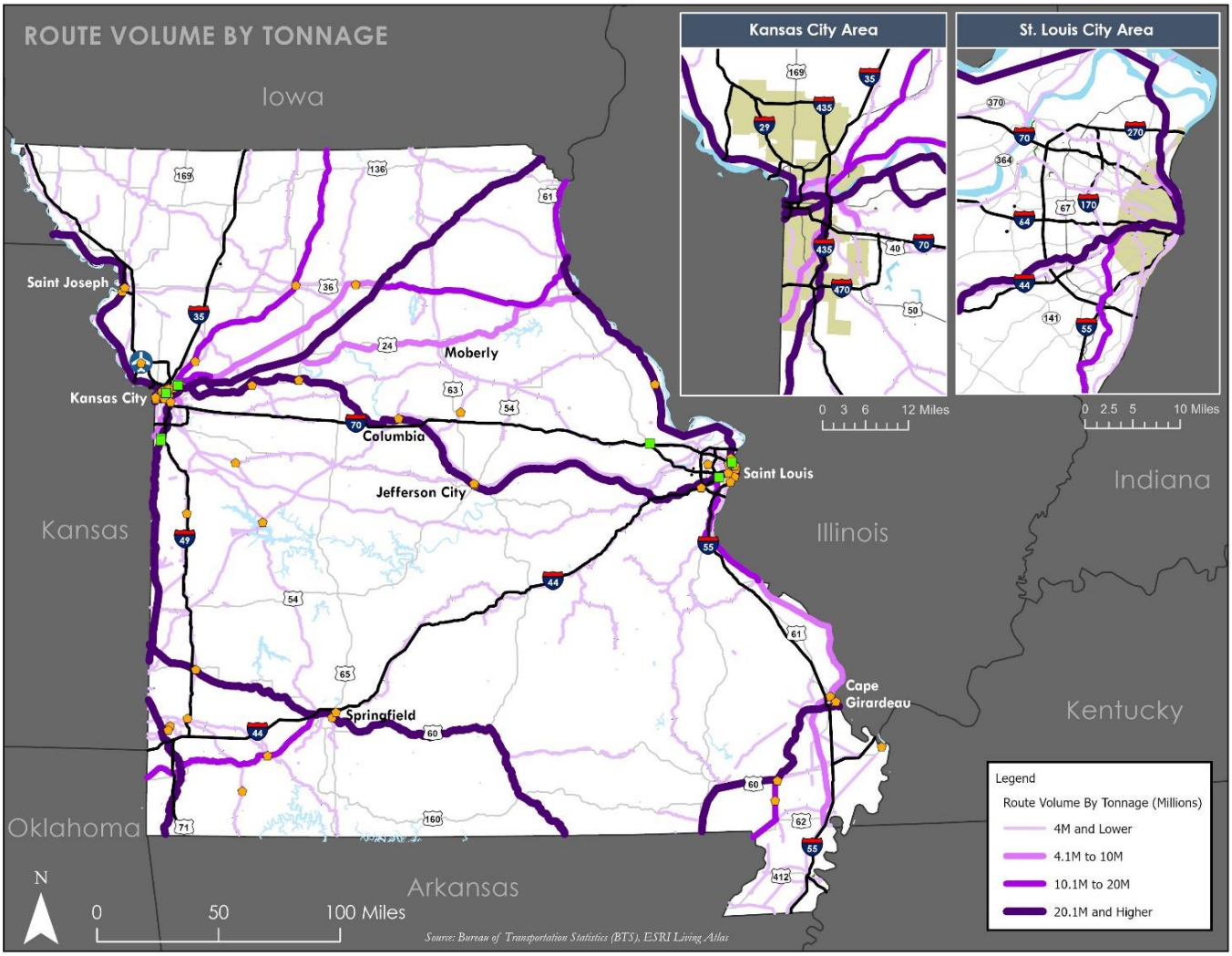
Figure 2.12 details the estimated tonnage by railroad segment. As can be seen in the map, the Union Pacific segment that travels between St. Louis and Kansas City carries large amounts of freight across the state, with more than 30 million tons on the segment between Kansas City and Jefferson City. The next route with heavy volumes is Kansas City to Napier, Mo (BNSF), which saw 28 million tons of freight. Other corridors with heavy volumes include rail lines on the eastern edge of the state and the BNSF segment between Kansas City and Burlington, Iowa.

FIGURE 2.11 VALUE BY DIRECTION, RAIL



Source: STB Carload Waybill data, 2018

FIGURE 2.12 FREIGHT MOVEMENT OVERALL – ANNUAL TONNAGE



Source: Carload Waybill data- 2018, Bureau of Transportation Statistics, ESRI Living Atlas

The demand for freight rail is driven by the efficient movement rail provides for various commodities. Bulk commodities—raw unpackaged materials—are well suited for rail travel and represent a majority of the freight rail tonnage traversing Missouri's rail network. Nearly one-third of all freight shipped by rail in Missouri was coal[8]. The remaining millions of tons of freight shipped over the state's railways was made up of varied goods, not one of which accounting for more than 10%. While coal was the top commodity based on weight shipped, its price relative to other products did not place it within the top five commodities by value. Shipments of motor vehicles and their parts constituted more than 29% of the total value of freight over Missouri's rail network in 2018. "Freight All Kinds" Shipments—a classification used for reporting and pricing purposes referring to multiple commodities—topped motor vehicle-related shipments over this time, representing more than 36% of the shipped value (see Table 2.16).

[8] By weight

This sizable classification for mixed, grouped shipments appeared in the top-five reportable commodities for all flow directions, excluding intrastate.

TABLE 2.16 TOP RAIL COMMODITIES, ALL DIRECTIONS (2018)

Commodity by Tonnage	Tons	Percent
Bituminous Coal	135,471,139	32.7%
FAK* Shipments	39,276,080	9.5%
Gravel or Sand	29,869,327	7.2%
Grain	25,597,207	6.2%
Misc. Industrial Organic Chemicals	17,881,220	4.3%
Commodity by Value	**Value ($M)**	**Percent**
FAK* Shipments	$201,226.8	36.4%
Motor Vehicle	$116,776.1	21.1%
Motor vehicle Parts or Accessories	$45,170.4	8.2%
Plastic Mater or Synth Fibers	$27,882.1	5.0%
Chemical Preparations, Nec	$12,613.4	2.3%

Source: (Tonnage) STB Carload Waybill data, 2018 (Value) Transearch, 2018

** 'Freight All Kinds'*

Imported commodities were similar to overall commodity flow in that coal accounted for a clear majority. In the case of imports, aside from coal no single commodity constituted more than 3% of overall tonnage. Missouri's top imported commodities from 2018 are provided in Table 2.17 below.

TABLE 2.17 TOP RAIL COMMODITIES, IMPORTED (2018)

Commodity by Tonnage	Tons	Percent
Bituminous Coal	46,941,962	67.8%
FAK* Shipments	1,824,560	2.6%
Oil Kernels, Nuts or Seeds	1,525,377	2.2%
Motor Vehicles	1,383,320	2.0%
Potassium or Sodium Compound	1,361,867	2.0%
Commodity by Value	**Value ($M)**	**Percent**
Motor Vehicles	$14,067.1	27.6%
Motor Vehicle Parts or Accessories	$11,295.2	22.1%
FAK* Shipments	$9,347.9	18.3%
Plastic Mater or Synth Fibers	$1,853.5	3.6%
Bituminous Coal	$1,458.3	2.9%

Source: STB Carload Waybill data, 2018

** 'Freight All Kinds'*

Rail exports represented 6% of the commodity flow in the state with a more varied distribution compared to rail imports. The state's top exported commodity, grain, accounted for only 14% of freight tons exported. While Missouri is a coal producer, it does so at a rate far lower than its top shipping partners. Missouri's 2018 coal production, 259,000 tons, is minor compared to Wyoming's 304 million tons. Top freight rail exports are presented in Table 2.18 below.

Vehicles and their parts accounted for over half of the freight value exported by Missouri via its rail network in 2018 while making up a small share of freight tonnage (see Table 2.18). The value of finished products such as motor vehicles and the volume of bulk freight illustrates the diversity of rail shipments in Missouri and the ability of the state's railroads to handle raw material and finished products alike.

TABLE 2.18 TOP RAIL COMMODITIES, EXPORTED (2018)

Commodity by Tonnage	Tons	Percent
Grain	3,543,960	14.3%
Soybean Oil or By-products	2,423,328	9.8%
Motor Vehicles	2,251,160	9.1%
FAK* Shipments	1,999,360	8.1%
Portland Cement	1,836,508	7.4%
Commodity by Value	**Value ($M)**	**Percent**
Motor Vehicles	$22,892.3	49.2%
FAK Shipments	$10,243.5	22.0%
Motor Vehicle Parts or Accessories	$2,758.8	5.9%
Chemical Preparations, Nec	$2,182.2	4.7%
Misc. Fabricated Textile Products	$922.0	2.0%

Source: STB Carload Waybill data, 2018

** 'Freight All Kinds'*

Intrastate freight movements were by far the smallest flow direction with only 2% of rail freight by weight originating and terminating within the state. While a small percentage of overall freight movement, nearly 1.8 million tons of freight were classified as traveling exclusively within Missouri in 2018. Top intrastate commodities are shown in Table 2.19 below.

TABLE 2.19 TOP RAIL COMMODITIES, INTRASTATE (2018)

Commodity by Tonnage	Tons	Percent
Broken or Crushed Stone or Riprap, NEC	631,108	35.1%
Hydraulic Cement, Natural, Portland or Masonry	243,464	13.5%
Motor Trucks or Truck Tractors	161,000	9.0%
Lime or Lime Plaster	144,000	8.0%
Nonmetallic Minerals or Earths, Ground or in any other manner	74,520	4.1%
Commodity by Value	**Value ($M)**	**Percent**
Motor Vehicle	$1,841.8	81.9%
Misc Industrial Inorganic Chemicals	$48.4	2.2%
Plastic Mater or Synth Fibres	$46.9	2.1%
Railroad Cars	$43.3	1.9%
Flour or Other Grain Mill Products	$37.5	1.7%

Source: STB Carload Waybill Data, 2018

Close to 77% of freight movement via Missouri's rail network—totaling more than 300 million tons—are through movements. These shipments originate and terminate outside of the state. Due to its centralized location and robust rail network and facilities, Missouri plays a key role in connecting varied regions of the United States. Missouri's central location in the country places it between the coal producing west and eastern recipient states. While roughly 47 million tons of coal were delivered to locations within Missouri in 2018, an additional 88.5 million tons traveled through the state making coal, at 28%, the top through commodity (see Table 2.20).

TABLE 2.20 TOP RAIL COMMODITIES, THROUGH (2018)

Commodity by Tonnage	Tons	Percent
Bituminous Coal	88,503,380	27.8%
FAK* Shipments	35,452,160	11.1%
Gravel or Sand	27,784,899	8.7%
Grain	20,764,561	6.5%
Misc Industrial Organic Chemicals	16,577,981	5.2%

Source: STB Carload Waybill data, 2018

** 'Freight All Kinds'*

Trading Partners

The top domestic freight rail trading partner for shipments terminating in Missouri is the nation's leading coal producer, Wyoming. In 2018 Wyoming produced more than 304 million tons of coal which was more than 40% of national production. Freight originating in Wyoming and terminating in Missouri constituted nearly 69% of Missouri's freight rail imports in 2018. Top trading partners for shipments terminating in Missouri and those originating in the

state are presented in Table 2.21 and Table 2.22 below. The states identified below do not necessarily represent the beginning or ending location of shipment, but where products begin or end rail transportation.

TABLE 2.21 TOP RAIL TRADING PARTNER STATES, TO MISSOURI (2018)

Top States by Weight	Tons	Percent
Wyoming	47,722,116	68.9%
Illinois	2,310,263	3.3%
Iowa	2,077,876	3.0%
California	1,259,280	1.8%
North Dakota	1,205,658	1.7%

Source: STB Carload Waybill Data, 2018

Recipients of freight rail shipments originating in Missouri are more varied than the top trading partners shown above. This is partially due to the smaller role exported goods play in the statewide rail network when compared to freight rail imports—58% and 21%, respectively. The automobile industry is a major employer within Missouri as can be seen in the commodity data throughout this section. These vehicles are often shipped to other states for eventual export to international destinations. Top trading partners receiving freight rail shipments from Missouri are shown in Table 2.22 below.

TABLE 2.22 TOP RAIL TRADING PARTNER STATES, FROM MISSOURI (2018)

Top States by Weight	Tons	Percent
Texas	4,381,154	17.6%
California	2,632,050	10.6%
Illinois	2,433,079	9.8%
Oklahoma	1,416,936	5.7%
Kansas	1,312,689	5.3%

Source: STB Carload Waybill Data, 2018

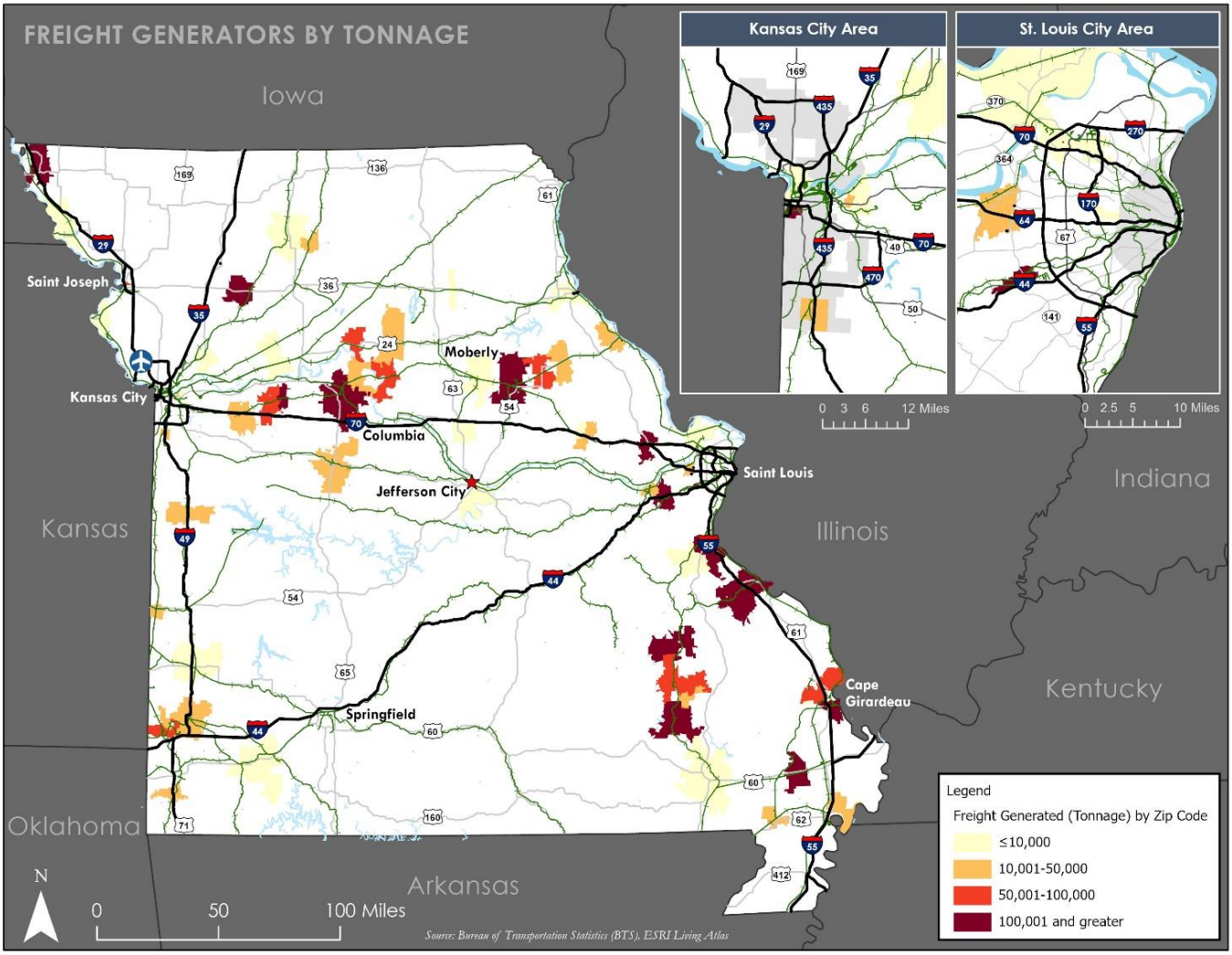
Freight Generators

Freight within Missouri is generated throughout the state within various industries. Figure 2.13 details the freight rail tonnage generated by zip code within Missouri. As shown in the map, major freight generators exist across the state, with major generation in the central part of the state between St. Louis and Kansas City and along the eastern portion of the state south of St. Louis.

Major freight generators are present across the state. Two notable freight producers are located in Ste. Genevieve County at the crossroads of the Mississippi River, I-55 and two Class I railroads. These major freight generators are St. Louis-based Mississippi Lime Company and international construction material firm LafargeHolcim. Excavation and treatment of natural resources drives freight volumes to the southwest in the communities along the Union Pacific De Soto subdivision. Mining operations in this area known as the Lead Belt, which includes portions of the counties surrounding the St. Francois Mountains in southeastern Missouri, extract large quantities of lead as well

as other metals and valuable minerals. Other areas across the state such as the cities of Mexico and Marshall have a larger share of their economies dedicated to agriculture and manufacturing than the state average distribution of these industries—which require considerable inbound and outbound freight shipments.

FIGURE 2.13 FREIGHT RAIL GENERATORS



Source: Bureau of Transportation Statistics, ESRI Living Atlas

Coal Trends

Missouri's freight rail network is critical in transporting coal from western states to the eastern portion of the country and for supplying the state's coal burning power plants. Coal has been the number one commodity by weight shipped over the state's rail system consistently year-after-year. Nearly 47 million tons of coal were imported in 2018 alone, constituting 67.8% of all rail-transported imports by weight. Coal also accounted for nearly 33% of all freight to use the state's rail network in 2018 (by weight) when accounting for all flow directions (see Table 2.23).

TABLE 2.23 MISSOURI COAL FREIGHT RAIL TRAFFIC (2018)

Direction	Tons	Percent of Total Directional Tons
Inbound	46,941,962	67.8%
Through	88,503,380	27.8%
All	135,471,139	32.7%

Source: STB Carload Waybill Data, 2018

Imports of coal have been trending downward since 2012 (see Table 2.24 and Figure 2.14). The most notable year-to-year reduction of freight rail imports happened from 2015 to 2016. Nationally, 2016 marked the lowest level of annual tonnage of coal transported by rail since 1979 and the first time natural gas accounted for more electricity generation than coal[9]. However, Missouri is still dependent on imported coal to produce power at the state's 11 coal-fueled power plants, all of which receiving coal shipments via the freight rail network. Accounting for 78.6% of freight in 2012 by weight, coal dropped to 67.8% in 2018, fluctuating year-to-year but generally trending downward. The reduction in coal moving across Missouri's rail network is not being replaced by other freight shipments. As a result of this, overall freight tonnage has dropped similarly with coal (see Figure 2.14).

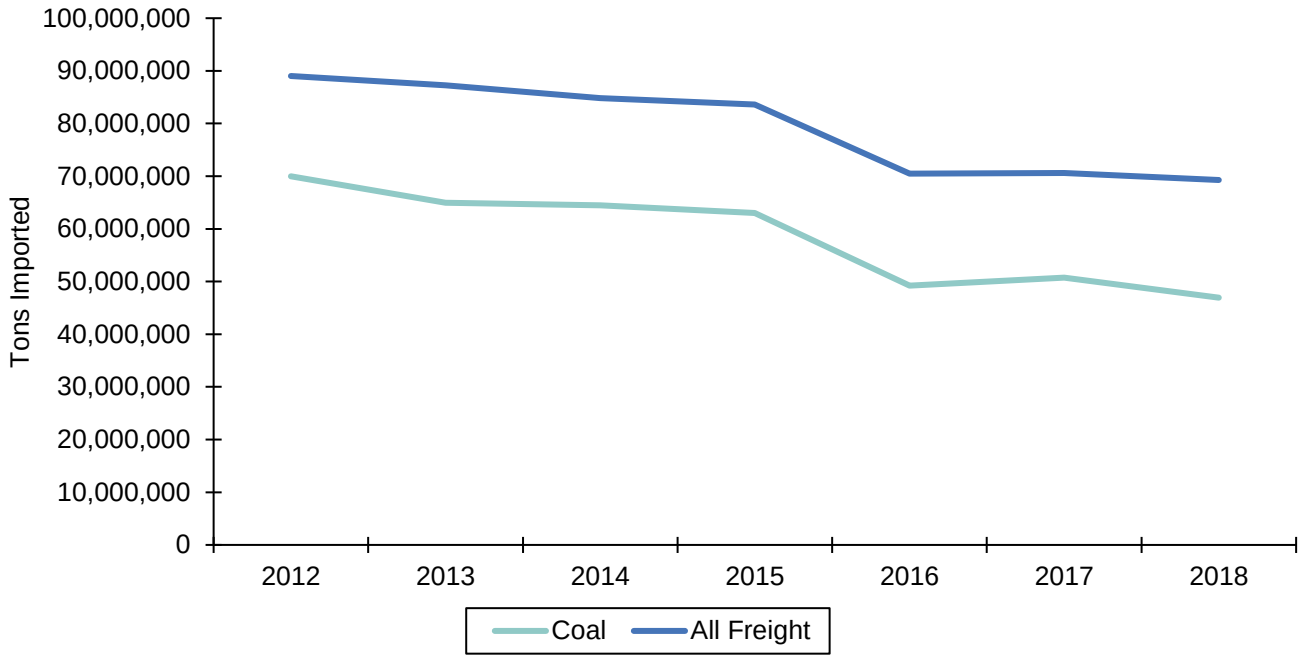
TABLE 2.24 COAL AND TOTAL FREIGHT IMPORTS OVER TIME (2012-2018)

Year	Tons	Percent of Imported Tonnage	Percent Change from 2012	Tons	Percent Change from 2012
	Coal			All Freight	
2012	69,981,939	78.6%	--	89,023,110	--
2013	64,974,304	74.5%	-7.16%	87,254,548	-1.99%
2014	64,493,256	76.0%	-7.84%	84,856,312	-4.68%
2015	63,011,804	75.4%	-9.96%	83,613,415	-6.08%
2016	49,206,348	69.8%	-29.69%	70,481,128	-20.83%
2017	50,774,916	71.9%	-27.45%	70,620,383	-20.67%
2018	46,941,962	67.8%	-32.92%	69,279,796	-22.18%

Source: STB Carload Waybill Data, 2012-2018

[9] Association of American Railroads. *Railroads and Coal.* May 2019 https://www.aar.org/wp-content/uploads/2018/05/AAR-Railroads-Coal.pdf

FIGURE 2.14 COAL AND FREIGHT IMPORTS BY RAIL OVER TIME (2012-2018)



Source: STB Carload Waybill Data, 2012-2018

2.4 Performance

Freight Rail Performance

This section analyzes the performance of the existing freight rail system by examining the existing level of service for freight rail corridors. The National Rail Freight Infrastructure Capacity and Investment Study prepared by the AAR establishes a methodology for determining the level of service for specific freight rail corridors. The basis of LOS and congestion on freight rail corridors is a calculated volume-to-capacity ratio. Considerations such as the number of tracks, yard capacity, siding length, track speed, locomotive type and terrain are factored into the ratio. Rail segments with a V/C ratio in the range of 0.8 to 1.0 are identified as at capacity while a V/C ≥ 1.0 exceeds current capacity (see Table 2.25).

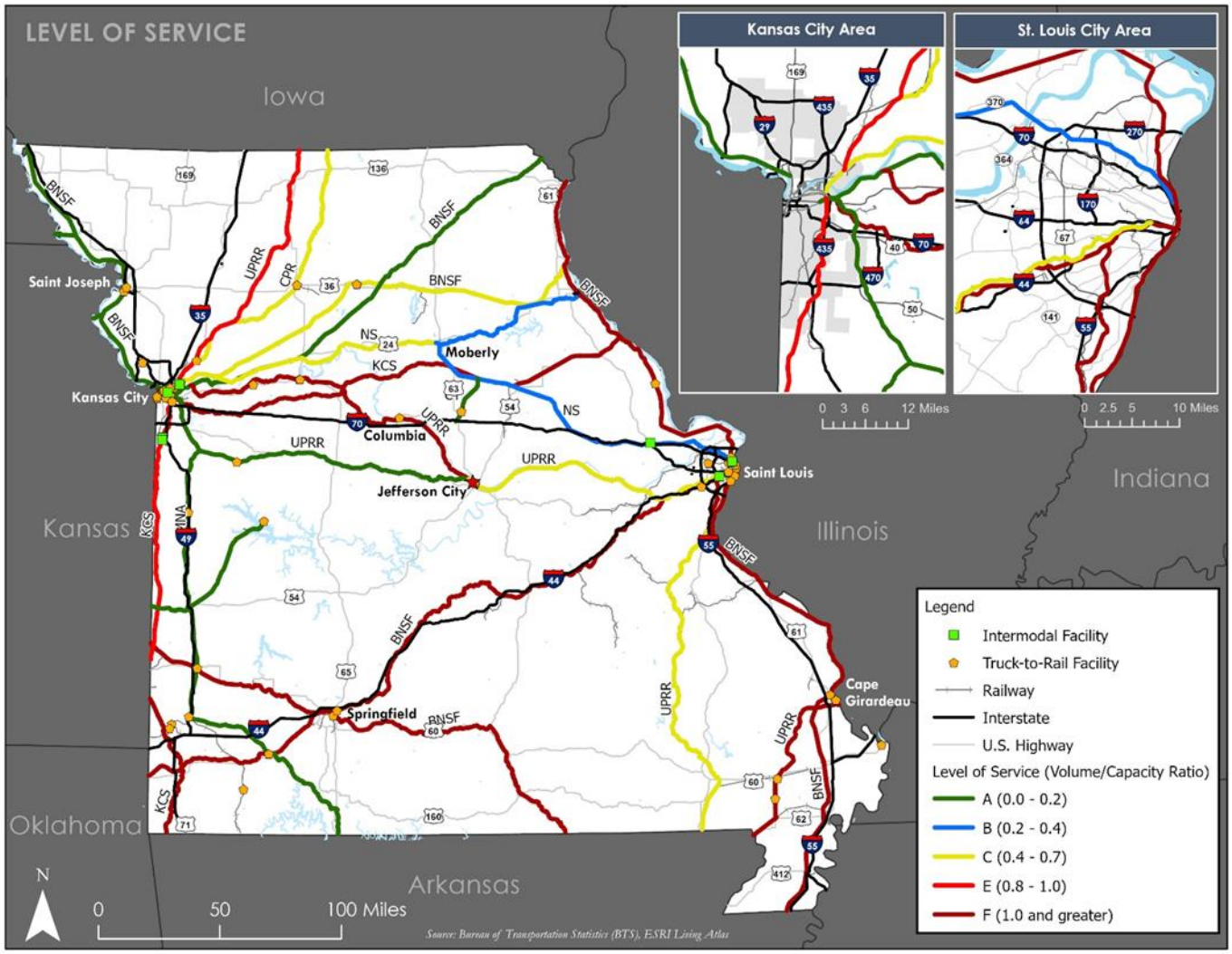
This methodology was utilized across the Missouri freight rail network to determine the LOS for each corridor to identify areas that are performing poorly. The level of service for Missouri's freight rail corridors are detailed in Figure 2.15.

TABLE 2.25 VOLUME/CAPACITY RATIO AND LEVEL OF SERVICE GRADES

LOS Grade	Capacity Level	Description	Volume/Capacity Ratio
A	Below Capacity	Low to moderate train flows with capacity to accommodate maintenance and recover from incidents	0.0 to 0.2
B			0.2 to 0.4
C			0.4 to 0.7
D	Near Capacity	Heavy train flow with moderate capacity to accommodate maintenance and recover from incidents	0.7 to 0.8
E	At Capacity	Very heavy train flow with very limited capacity to accommodate maintenance and recover from incidents	0.8 to 1.0
F	Above Capacity	Unstable flows; service breakdown conditions	≥ 1.0

Source: National Rail Freight Infrastructure Capacity and Investment Study

FIGURE 2.15 RAILROAD EXISTING LEVEL OF SERVICE (CORRIDOR VOLUME TO CAPACITY)



Source: STB Carload Waybill Data, 2012-2018, AAR.

As shown in Figure 2.15, several of Missouri's railroad corridors are close to or are exceeding capacity. Table 2.26 details the corridors that have a level of service E or F. These corridors represent segments that currently exceed capacity (F) or that may exceed capacity in the future if trends continue (E). All other corridors in Missouri are operating at an LOS of C or better with additional capacity available for freight.

TABLE 2.26 FREIGHT RAIL CORRIDORS APPROACHING CAPACITY

Owner	Rail Segment	LOS
KCS	Kansas City - South	E
UPRR	Kansas City - Iowa	E
NS	Hannibal - St Louis	F
BNSF	Tulsa - Springfield - St Louis	F
BNSF	Kansas - Springfield - Jonesburg, AR	F
KCS	Kansas City - Iowa	F
BNSF	Burlington, IA - St Louis - Arkansas	F
UPRR	Kansas City - Jefferson City	F
BNSF	Cape Girardeau - Arkansas	F
UPRR	St Louis - Ste. Genevieve	F
UPRR	Cape Girardeau - Arkansas	F

Source: STB Carload Waybill Data, 2012-2018

Passenger Rail Performance

Passenger Rail Service Objectives

In 2012, MoDOT developed passenger rail service objectives and strategies to improve the system. MoDOT has worked and continues to work towards these objectives. Passenger rail service objectives detailed in the previous state rail plan include:

- Maintain Existing *Missouri River Runner* Service: The *Missouri River Runner* is a key service that connects Missouri's two largest cities. To maintain the service, MoDOT aims to continue to support the service operations funding, build public understanding and support and fund necessary capital improvements.

- Expand Existing *Missouri River Runner* Service: MoDOT aims to expand the state-supported service both in frequency, travel time and infrastructure improvements. Long term the objective aims to support six or more round trips on the service. Additional, objectives include travel time below four hours and speeds of 90 mph or higher.

- Enhance Passenger Rail Service to New Corridors: Missouri aims to expand passenger service by conducting feasibility studies on a number of potential corridors. Once a suitable corridor for service is identified, funding opportunities and alignment geometry will be analyzed to determine an implementation plan.

Passenger Rail Evaluation

This section of the rail and freight profile evaluates the performance of the existing passenger rail services within Missouri.

On-time performance is a key metric for evaluating the operation of a passenger rail service. “On-time performance” represents the percentage of trains to arrive at a route’s terminus within 15 minutes of the scheduled arrival time. Fiscal Year 2018 on-time performance is detailed below in Table 2.27 for the three Amtrak Services in Missouri. Amtrak OTP targets are 85% on the Northeast Corridor; 82% on State Supported routes and 50% on Long Distance routes. Of the three passenger rail routes serving more than one Missouri station only the *Missouri River Runner* met Amtrak targets for OTP in FY18.

To achieve on-time performance, Amtrak relies on the cooperation and coordination of railroads to operate routes using tracks that are not owned or controlled by Amtrak. Host railroads are statutorily required to provide Amtrak “preference” over freight transportation. However, on time performance on host railroads remains below targets due in part to preference not consistently being given to passenger trains.

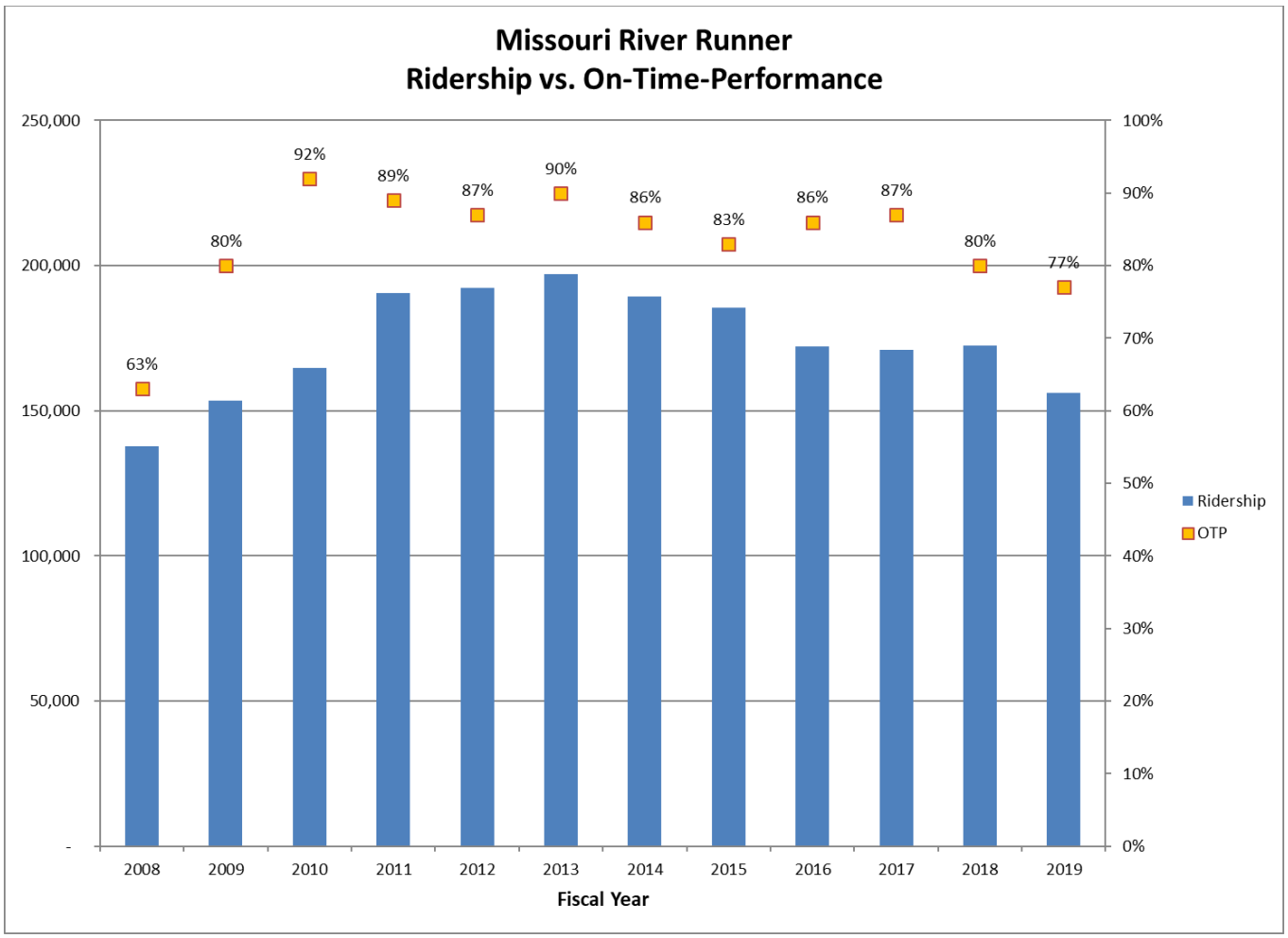
TABLE 2.27 ON-TIME PERFORMANCE

Service	FY 2018 OTP	Service Type	Amtrak Target	Target Performance
River Runner	82.4%	State Supported	82%	Achieved
Southwest Chief	47.0%	Long Distance	50%	Not achieved
Texas Eagle	39.7%	Long Distance	50%	Not achieved

Source: Amtrak. State Fact Sheets: Missouri. 2018.

On-time performance remains a key objective to continue monitoring into the future. Over recent years the *Missouri River Runner* data shows ridership levels have risen and fallen in direct correlation with on-time performance (see Figure 2.16).

FIGURE 2.16 MISSOURI RIVER RUNNER RIDERSHIP AND OTP (2008 TO 2019)



Source: Amtrak

In addition to on-time performance, another important measure of evaluation for passenger rail service is the cost per rider. The *Missouri River Runner* is the only state-supported passenger service in Missouri. Over the past three years (2017-2019), the DOT has contributed $9.1 million annually to support the service equating to a cost per rider of between $53 and $58.

Condition

Bottlenecks

Bottlenecks in a rail network are caused by underperforming components of the system which detrimentally effect capacity or performance at a systemwide level. Causes of bottlenecks to a rail system include congestion caused by having a single track where a double track configuration is necessary, a stalled train on a single-track corridor, broken traffic signals, or a lack of proper equipment at intermodal facilities. The weakest link of a freight rail system can cause a bottleneck in service which in turn impacts freight shippers, their clients and to a certain degree, the state's economic vitality.

Missouri railroads shared certain areas of concern during stakeholder interviews with project staff. One such bottleneck location is on the BNSF Fayetteville subdivision near Thayer. Here, geography is the major factor inhibiting the smooth movement of freight through the area. Bottlenecks can also be created by the built environment, with limiting factors such as rail corridors unable to expand in dense urban areas or roadway infrastructure which interferes with rail operations. UPRR expressed the challenges to their service created by low bridges that do not allow double-stacked containers or specialty automotive racks.

Constraints

Missouri railroads are limited by the capacity of their networks (discussed earlier in this section), demand for freight shipments and aging infrastructure. Possibly the largest constraint to railroads is the fixed nature of their infrastructure. However, this limitation is not of major concern to the state's rail carriers who instead focus resources on upgrading existing equipment and enhancing safety and efficiency.

Missouri railroads are constrained by the willingness of customers to use their services over other options and even by the general state of the economy. Freight volumes dropped during the Great Recession as is expected during an economic downturn. On the other hand, a booming economy facilitates robust commercial activity and results in high demand for freight shipments. Railroads in Missouri and around the country, are challenged by their need to meet demand while not over-investing in infrastructure made redundant by competing modes (highways, ports, airports). Focus is instead placed on working more efficiently with other modes.

Constraints to Missouri freight operations are not limited to factors within the state. Rail conditions in neighboring states—particularly Kansas and Illinois—affect freight operations in Missouri. The limited capacity of certain rail lines is a major constraint to interstate freight movement. However, due to increased investment in freight transportation at the federal level dating back to the early 2010s and the multi-state operations of major rail carriers, access to funding to fix these capacity issues is available. Project stakeholders have expressed the importance of pursuing and securing federal funding when available to improve system-wide operations by addressing substandard, or otherwise inadequate infrastructure. One way in which Missouri railroads leverage federal investment is through the CRISI grant program which supports capital projects addressing the safety, efficiency, or reliability of passenger or freight rail.

Rail Safety

This section evaluates existing safety related to freight rail corridors in Missouri based on 2019 FRA Safety data.

Rail Incidents

This analysis utilizes FRA's Office of Safety Analysis Ten Year Accident Overview data to examine the existing safety of the rail network. As summarized in Table 2.28, Missouri has seen similar levels of train incidents and fatalities between 2010 and 2019. In 2019, the state saw 201 total railroad incidents[10], where 16 resulted in fatalities. Between 2010 and 2019 the highest level of fatalities, injuries and total incidents occurred in 2010, indicating an overall improvement over the past nine years.

[10] Incident totals include all incident types which fall under three groupings: Highway-Rail Incidents, Train Accidents, and Other Accidents/Incidents.

TABLE 2.28 TOTAL TRAIN INCIDENTS (2010-2019)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Total Incidents	256	252	203	223	213	226	212	190	217	201	**2,054**
Fatalities	20	19	14	8	9	15	13	12	18	16	**144**
Non-Fatal Injuries	192	153	136	161	124	151	144	132	127	106	**1,426**

Source: FRA Office of Safety Analysis

At-grade Roadway/Rail Crossing Incidents in Missouri

Of the incidents detailed above, a portion occurred at the 5,550 at-grade highway-rail crossings in Missouri, 60.3% of which are public vehicle highway-rail crossings[11]. In 2019, there were 39 incidents across the active at-grade public and private crossings in the state. As shown in Table 2.29, five fatalities resulted from those incidents. Between 2010 and 2019, total incidents at at-grade crossings ranged between 39 and 53 with fatalities peaking in 2011 with 13.

TABLE 2.29 TABLE AT-GRADE ROADWAY-RAIL CROSSING INCIDENTS (2010-2019)

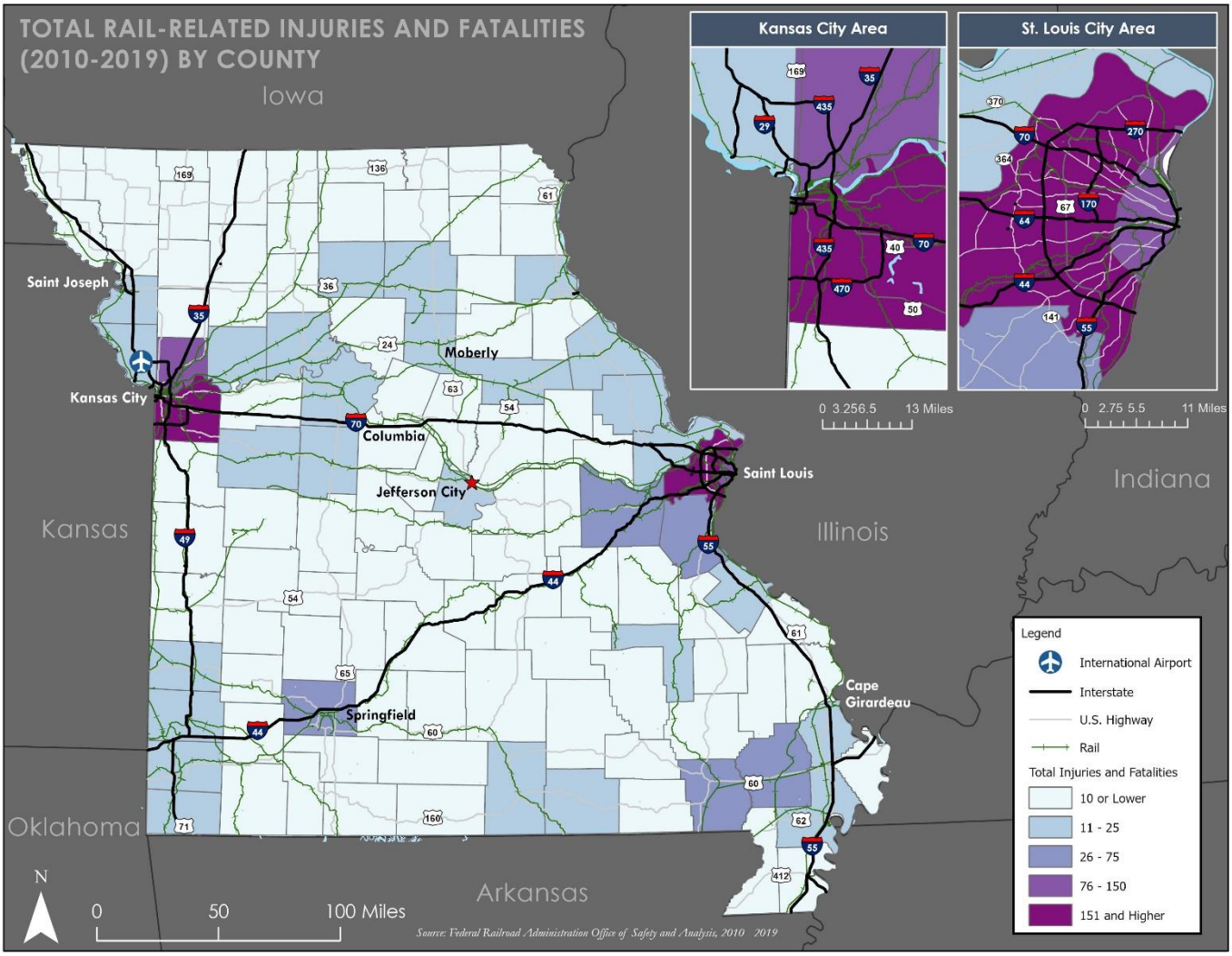
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Total Incidents	52	50	50	53	43	49	39	35	53	39	**463**
Fatalities	11	13	7	2	1	8	8	6	9	5	**70**
Injuries	25	22	24	31	14	23	17	18	22	14	**210**

Source: FRA Office of Safety Analysis

The St. Louis and Kansas City metro regions experienced the most railroad injuries and fatalities between 2010 and 2019. This can be explained by their high populations and robust railroad infrastructure. Missouri counties with the most total railroad injuries and fatalities over this time are visualized in Figure 2.17.

[11] https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/query/invtab.aspx

FIGURE 2.17 TOTAL RAILROAD INJURIES AND FATALITIES BY COUNTY (2010-2019)



Source: Amtrak

2.5 Key Performance Trends

Stakeholder Outreach

Key stakeholders were identified in advance of this update to the State Freight & Rail Plan to inform MoDOT with technical knowledge and in-the-field conditions of the state's freight rail network. Stakeholder participation plays an important role in Missouri's efforts to plan for the future of freight rail in the state. An extensive list of stakeholders was compiled including trucking companies, ports, airports, transloads and intermodal facilities. Stakeholders included rail carriers, shippers and industry associations. In total, 22 rail-specific stakeholders were identified and contacted to be included in the planning process for the freight rail portion of this plan.

Stakeholder Interviews

Project partners conducted stakeholder interviews in fall 2020 to inform them of this Plan's objective and gather their input. Interviews were conducted with three of the five Class I railroads owning track in the state: BNSF, NS and UP. An interview was also conducted with the Missouri Farm Bureau, an organization representing the state's agricultural industry—a major user of the freight rail network. Interviews were followed up with information requests to build on topics discussed during the stakeholder interviews.

Interview Findings

Rail carriers noted in interviews that their focus is primarily on making improvements to existing infrastructure over expanding the state's already robust rail network. Improvements are directed to locations that improve efficiency and safety and reduce operational delays. Project stakeholders offered insights into what they move, where they move it and which recent tools and technologies are helping them deliver shipments on time. Through these interviews, rail carriers also shared recent advances for the state and regional rail system as Missouri moves to build the freight rail network of the future. Areas of concern expressed by project stakeholders include:

- Service disruptions and infrastructure damage caused by flooding
- Physical impediments to operations including the built and natural environment alike
- Decreasing shipments of coal in recent years

While robust, the network of more than 5,300 miles of rail in the state has limitations that act as chokepoints for service. Most notable are the hinderance caused by overhead bridges that are too low and siding tracks that are too short for modern train lengths. Even where rail capacity is not otherwise an issue, rail carriers are limited by the height of bridges in some areas that do not allow for the deployment of current standard and oversized operating clearances. This includes the stacking of intermodal containers and the specialty cars used to transport automobiles, both of which being critical to the state, regional and national economies. Advances in railroad safety allow for the safe operation of trains of longer lengths. The prior standard of 8,000 ft siding track does not allow for new, longer consists. As a result, the rail industry is moving to a 10,000 ft standard for siding track to accommodate modern trains, with even 15,000 ft sidings being implemented in key areas allowing better overall operations and network capacity. Alternately, some shipments are time-sensitive, requiring swift movement between modes, and are not conducive to longer consists which take time to switch. Precision Scheduled Railroading is a recent approach which shifts focus away from train length and places greater importance on the needs of customers and timely deliveries. PSR is discussed further in the following section.

Railroad interviewees mentioned the importance of strong public-private partnerships and access to federal and state support to maintain safety and efficiency of the network. One such success was the collaboration between government and private entities to construct Logistics Park Kansas City. This massive development just across the Kansas border in Edgerton, KS was made possible in part due to the exceptional cooperation and coordination between the disparate groups involved according to representatives of BNSF. Interviewees also shared of the importance of state and federal funding to assist in the improvement of rail infrastructure. Recent federal funding through the U.S. DOT CRISI program has been awarded for up to $12,942,319 to be used for safety improvements

at two Missouri locations (Section 2.1). Railroad interviewees note the importance of leveraging federal funding and the availability of programs designed to facilitate rail or intermodal improvements.

Stakeholders also identified the diminishing volumes of bituminous coal; the top commodity by weight moved over the state's rail network in 2018. Used to fuel powerplants in Missouri and points east, coal using the Missouri rail network largely originates in Wyoming. Coal is also the top commodity, by weight, to be imported to and to pass through Missouri. Rail carriers noted the reduced tonnage of coal in recent years, partially explained by the emergence of fracking technology to capture natural gas used in the production of energy. Their observations are supported by the commodity flow data, as there was a nearly 33% drop in the gross weight of coal shipped via Missouri rail lines between 2012 and 2018. This sharp drop in coal production— 69.1 million fewer tons in 2018 compared to 2012—is a major factor in declining freight tonnage. Annual freight rail weight dropped by approximately 34.0 million tons from 2012 to 2018. This illustrates the impact of reduced coal shipped via rail on overall freight rail volumes.

Rail Industry Trends

Major trends across the freight and passenger rail industry will help shape the next era of rail in Missouri. Two key emerging trends in rail are Positive Train Control and Precision Scheduled Railroading.

Positive Train Control

Positive Train Control is a "a safety system that tracks the location, speed and movement of trains and can automatically stop a train to prevent specific human-error accidents."[12] PTC has been an emerging industry trend for some time and its implementation has increased since 2008 when legislation was enacted requiring PTC installation on track that carry passengers and certain hazardous materials. The 2008 legislation followed public outcry and elected official concerns when a commuter rail line crash killed 25 people. Following that crash, a federal safety panel found that PTC likely could have prevented the crash. The 2008 legislation mandates PTC on Class I railroads' main lines that transport poison or toxic-by-inhalation hazardous materials and any main lines with regularly scheduled intercity or commuter rail passenger service. The legislation originally required full implementation by December 31, 2015, but since that time Congress has extended the deadline and the final deadline was December 31, 2020. The legislation highlights four specific types of errors that PTC prevents:

- Train-to-train collisions.
- Derailments caused by excessive speed.
- Incidents that can occur if trains are routed down the incorrect track.
- Unauthorized train movements on tracks undergoing maintenance.

PTC implementation has been completed to varying degrees across the country as summarized in Table 2.30.

[12] AAR. PTC Fact Sheet. https://www.aar.org/wp-content/uploads/2020/01/AAR-PTC-Fact-Sheet-2020.pdf

TABLE 2.30 PTC IMPLEMENTATION STATUS (NATIONWIDE)

Railroad	PTC Implementation Status
BNSF Railway Company	Complete
Canadian Pacific	Complete
Kansas City Southern Railway	Complete, interoperability testing underway
Norfolk Southern Corp.	Complete, interoperability testing underway
Union Pacific Railroad	Complete
CSX	Complete, interoperability testing underway
Burlington Junction Railway	N/A
Bi-State Development Agency Railroad Company	N/A
Columbia Terminal	N/A
Foster Townsend Rail Logistics	N/A
Kansas City Terminal Railway	Complete, interoperability testing underway
Missouri North Central Railroad	N/A
SEMO Port Railroad, Inc.	N/A
Terminal Railroad Assn. of St. Louis	Complete, interoperability testing underway
Arkansas and Missouri	N/A
Central Midland Railway	N/A
Kaw River Railroad	N/A
Missouri & Northern Arkansas Railroad	N/A
Ozark Valley Railroad, Inc.	N/A
South Kansas & Oklahoma RR	N/A

Source: FRA. 2020 Quarterly Progress Report Forms – Positive Train Control Implementation.

Implementing PTC over the past several years has been a massive endeavor by railroads carriers. The outcomes and results from the implementation of PTC for the industry will start to be understood in the years to come. In addition to enhancing the safety for railroad employees, passengers and communities, PTC will generate a large, new set of data for the rail industry. Implementation of the technology allows for the tracking of locomotives in real-time throughout the network, which can help identify where and why network constraints and conflicts are experienced during rail operations. The implementation of PTC will also help to identify redundancy in workforce and provide the ability to implement efficiencies related to engine crews and maintenance of wayside and cab signals.

Precision Scheduled Railroading

Precision Scheduled Railroading is a new scheduling and service approach being adopted by most Class I carriers in the United States. Prior to PSR, freight rail focused on moving long trains faster. This focus on long trains meant

freight movement was often focused on the train rather than the customers. PSR changes that approach and instead "trains are always moving and cars are picked up on schedule, regardless of train length."[13]

PSR is already in-process or implemented at most Class I railroads across North America, including Missouri Class Is Canadian Pacific, CSX, Norfolk Southern, Union Pacific and Kansas City Southern. The only major Class I rail line that has not fully adopted PSR is BNSF Railway.

Several Class I railroads are currently revising or have already revised their operating plans to implement PSR. Due to changed operating schedule, businesses are adapting to new railroad operating schedules and modifications to their business operations that had previously been tailored to existing operating approaches, plans and schedules. Additionally, the overall supply chain will need to adapt to how the new operating plans move and distribute commodities throughout the network.

Railroad carriers describe the benefits of PSR to shippers and receivers as more reliable, consistent and faster rail service that will in turn help them strengthen their overall supply chain and reduce costs. In the long-term, according to carriers, these benefits outweigh rail customers having to adjust their business operations.

A primary goal of PSR is to drive down the operating ratio by keeping trains and equipment moving on schedules within a carrier's network. This may result in consolidating train routing within a specific carrier's network and negatively impacting existing service to customers. Another potential outcome is the closing of existing railroad facilities such as rail yards, which may result in job losses for the surrounding communities that provide workers and services to those facilities. The implementation of PSR may present other negative impacts beyond the rail industry and its customers. New PSR operating models may shift more rail traffic to other corridors and generate longer trains. Increased rail traffic and longer trains can result in safety concerns related to inadequate at-grade warning devices and more frequent or blocked at-grade crossings due to railroad operations. MoDOT will need to continue to analyze the impacts of PSR and address at-grade safety concerns, trespassing and additional grade separations, and seek funding to limit any detrimental effects.

Trends on the Horizon

Stakeholders shared several items that they are monitoring, which could have significant impact on the future of freight rail. One such issue is the consistent push by over-the-road freight carriers to allow trucks to operate at higher weights. Rail carriers fear that allowing trucks to carry more freight per vehicle could diminish freight rail volumes and cause increased wear on public roadways. The recent introduction of legislation mandating a minimum of two crew members per train could similarly influence the industry. If passed, "two-man crew" legislation will change staffing for operators currently using single-person crews.

Stakeholders also expressed the importance of other technological advances on the future of rail freight. Technology deployed at intermodal facilities coordinating truck pickups and drop-offs is currently in use to facilitate multimodal efficiency. Missouri's large agricultural industry, a major shipper of freight, is similarly poised to implement emerging technology. Precision farming, a data- and technology-based approach to farming, matched

[13] Union Pacific. *What Is Precision Scheduled Railroading? 2020.* https://www.up.com/customers/track-record/tr091019-precision-scheduled-railroading.htm

with the possibility of automated combines and tractors harvesting crops would change the ways in which crops are moved to market.

Performance Objectives

This section tracks the performance on key performance measures and findings from both the 2012 Rail Plan and the Missouri State Freight Plan (2017). Table 2.31 provides a summary of performance on 2012 Missouri State Rail Plan measures and strategies.

TABLE 2.31 STATE RAIL PLAN OBJECTIVES

Missouri State Rail Plan (2012) Policy	Performance since 2012
Stabilize State Operating Support for the *Missouri River Runner* Service	State operating support has continued at similar levels since 2012 resulting in insufficient funding.
Secure Funding for Service Development Planning and Environmental Review to Enhance Passenger Service in Missouri	Funding for these studies has not been secured.
Initiate a Targeted Marketing and Advertising Program for the Missouri River Runner Service	Marketing of specific trips on the *Missouri River Runner* has been implemented to enhance tourism along the corridor.
Establish State Funding Source to Leverage Federal Funds for Passenger Rail Development	No additional state funding sources have been established
Expand the State Transportation Assistance Revolving Fund	STAR program has remained at stagnant funding levels over past five years and is expected to remain the same.
Develop a State Freight Rail Economic Development Grant Program	The MoDOT Freight Enhancement Program which dedicates funds to transportation purposes other than highways was established in 2012.[14]
Expand the MoDOT Port Capital Improvement Program	The program has varied in size from year to year, but generally has increased since 2012.
Assess MoDOT Railroad Section Organization and Staffing Needs	MoDOT evaluates organizational and staffing needs on an ongoing basis.
Develop a Rail Asset Management Program	Improvements have been made to MoDOT's rail inventory system.

Source: Missouri State Rail Plan, 2012

MoDOT tracks progress toward its long-range statewide transportation goals through the tracker quarterly performance measure publication. Tracker allows users to view data supporting trends over time and progress in achieving the state's transportation goals. Key performance measures from the Missouri State Freight Plan (2017) applicable to freight rail are provided below.

[14] Multiple rail projects have been funded by the FRE program but there remains a need for a more robust and/or rail-specific program.

TABLE 2.32 KEY PERFORMANCE MEASURES, MISSOURI STATE FREIGHT PLAN

Missouri State Freight Plan 2017 Goals	Performance Measure	Performance since 2017
Safety	Rail crossing crashes or fatalities	As noted in the Safety section above, rail crossing crashes and fatalities are similar to levels in 2017. In 2019 and 2020, nearly $13M was awarded to two rail safety improvements in Missouri through the federal CRISI grant program (See page 14).
Connectivity & Mobility	Freight tonnage by mode	Freight tonnage by mode remains similar to data presented in the 2017 plan. Pipeline freight has increased significantly with all other modes remaining relatively similar. See *Commodity Flow Profile* for more details.

** These represent goals that specifically relate to freight rail and were measurable with obtainable data*

Source: Missouri State Rail Plan, 2017

Air Freight Modal Profile

3

Air cargo is vital to Missouri's freight network, allowing for freight to be moved over long distances in a short amount of time, and for the state to compete with other air-served freight markets. With major national and international airports that distribute cargo (freight and mail) located in Kansas City, St. Louis, Springfield, Columbia and Joplin, Missouri is an air cargo origin and destination point of freight shipments for national and international locations. The largest air cargo facilities and distributors in Missouri are Kansas City International (MCI), St. Louis Lambert International (STL) and Springfield-Branson National (SGF). These three key airport hubs transport 99.9% of total air cargo tonnage in the state.

This profile of Missouri's air cargo system describes the assets currently in use, the type of cargo that uses air transport, air freight demand, short and long -term trends and future needs. Section 3.1 lays out the background of Missouri's air cargo system: where major airports and facilities are located, the interstates, highways, rail lines and waterways servicing the airports and the freight origins and destinations passing through MCI, STL and SGF. Section 3.2 analyzes which carriers utilize MCI, STL and SGF and how much cargo by tonnage passes through these facilities. Finally, Section 3.3 describes future activity and demand of the three major air cargo facilities in Missouri.

The information in this section is a critical element of the Missouri Freight Plan, particularly in light of the strong and consistent growth of e-commerce activity over the past decade, which has only intensified during the COVID-19 global pandemic. Air cargo data helps inform where these high-value, low-weight goods enter the state and where they are destined, but it also helps inform which companies are distributing air cargo and where these major air cargo facilities are located. Expedited carriers are critical linkages in the transport of e-commerce goods. These are smaller companies contracting with FedEx Corporation, UPS and Amazon at MCI, STL and SGF to transport air cargo statewide with ground and air modes. These companies are particularly important to rural areas, using primarily small planes to deliver letters and packages to/from the metro hubs. For e-commerce, expedited carriers contract with the Amazon/Prime supply, for example, to ensure delivery of goods. Data, knowledge and understanding about this type of air cargo activity will help inform the Missouri Freight Plan and impact future plans and policies that will be derived from this plan.

The information from this section was leveraged from a number of sources, including: the 2017 Missouri Freight Plan[15], Bureau of Transportation Statistics TranStats Database T-100 Market[16], IHS Markit Transearch database, MCI[17], STL[18] and SGF[19] airport websites and Airport Council International[20]. These sources informed air cargo

[15] "Freight Plan". Missouri Department of Transportation. Accessed June 2020. Available from: https://www.modot.org/freight-plan

[16] "TranStats". Bureau of Transportation Statistics. Accessed June 2020. Available from: https://www.transtats.bts.gov/DatabaseInfo.asp?DB_ID=111

[17] "Kansas City International Airport". Kansas City International Airport. Accessed May 2020. Available from: https://www.flykci.com/about-us/kci-airport/

[18] 'St. Louis Lambert International Airport". St. Louis Lambert International Airport. Accessed May 2020. Available from: https://www.flystl.com/

[19] "Springfield-Branson National Airport". Springfield-Branson International Airport. Accessed May 2020. Available from: http://www.sgf-branson-airport.com/

[20] "Airports Council International". Airports Council International. Accessed May 2020. Available from: https://aci.aero/

origin/destination flows, annual tonnage, carriers servicing Missouri via freight and mail and other annual air cargo statistics.

3.1 Infrastructure and Facilities

Missouri Airport Facilities

The Missouri aviation system includes 121 public and 250 private use airports.[21] Of that, five airports have reported cargo activity (freight or mail). STL and MCI are the most significant freight distributors, collectively handling 90% of cargo tonnage in the state. SGF handles nearly all of the remaining 10% of the cargo, with Columbia and Joplin Regional airports handling less than 1%. All of the air cargo-handling airports are located near large- or medium-sized metro areas. Facilities located near major metropolitan areas are generally larger in size and capacity and are proximate to population centers, which enables them to support greater volumes of freight and mail. By contrast, airports located within medium-sized metropolitan areas are generally able to accommodate smaller volumes of freight and mail distribution. Table 3.1 shows the five largest airports in Missouri and how many tons of air cargo are transferred through each facility in 2019.

Figure 3.1 shows the location of the three major air cargo facilities (MCI, STL and SGF), two minor air cargo facilities (COU and JLN), and the interstates, U.S. highways, rail lines and waterways that surround and serve the aforementioned airports.

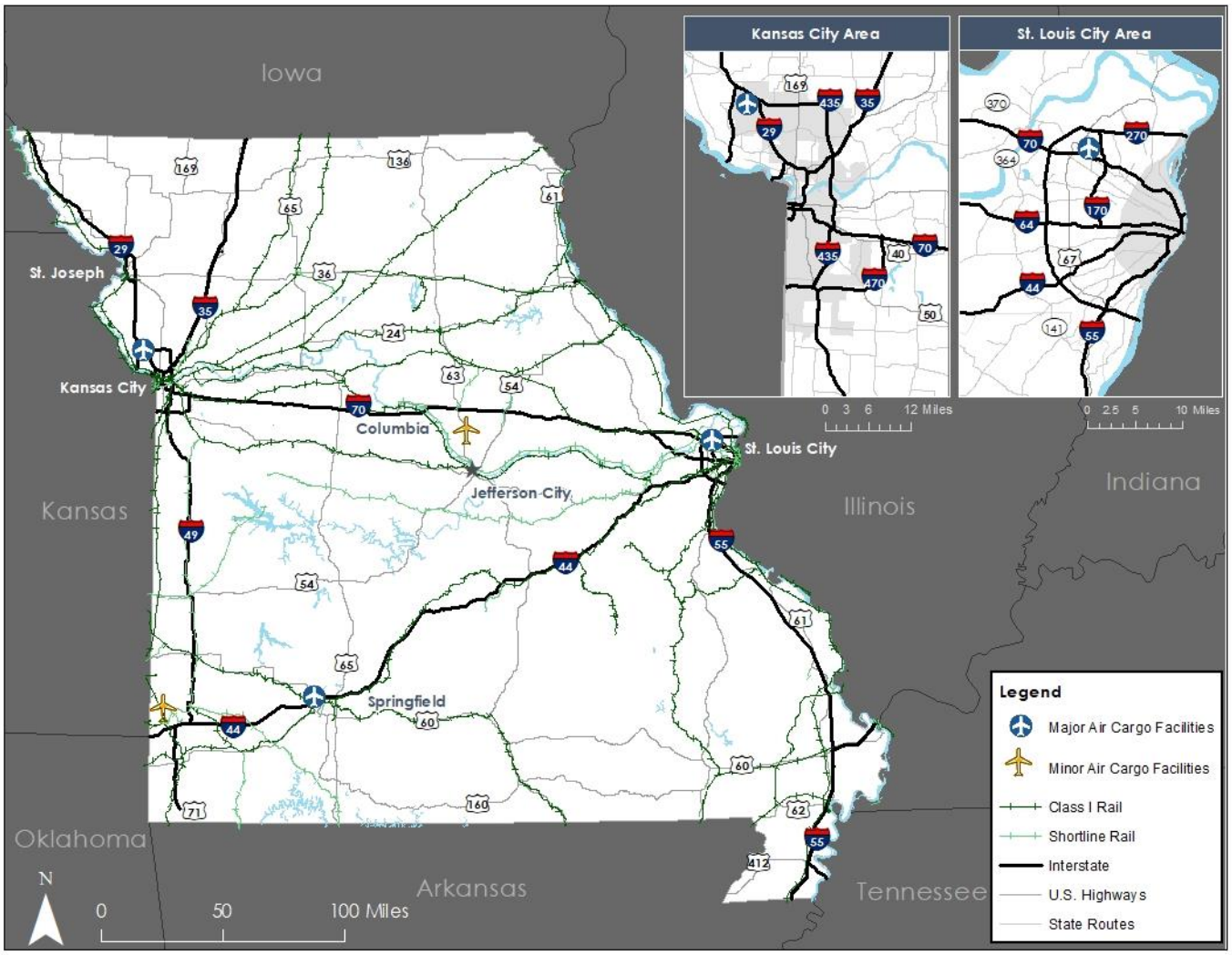
TABLE 3.1 AIRPORTS WITH FREIGHT CARGO ACTIVITY

Abb.	City	Facility	Freight (Lbs.)	Mail (Lbs.)	Total (Lbs.)	Total (Tons)	Percent
MCI	Kansas City	Kansas City International	182.6 million	5.9 million	188.5 million	94,258	49.6%
STL	St. Louis	St. Louis Lambert International	147.2 million	5.4 million	152.6 million	76,321	40.2%
SGF	Springfield	Springfield-Branson National	38.7 million	<100	38.7 million	19,329	10.2%
COU	Columbia	Columbia Regional	13,722	-	13,722	<100	0.00%
JLN	Joplin	Joplin Regional	651	<100	667	0	0.00%

Source: BTS T-100 Market, 2019

[21] FAA Airport Statistics: https://www.faa.gov/airports/airport_safety/airportdata_5010/menu/#reports

FIGURE 3.1 AIRPORTS SERVICING AIR CARGO IN MISSOURI



Sources: BTS T-100 Market, 2019 and ESRI

Kansas City International Airport

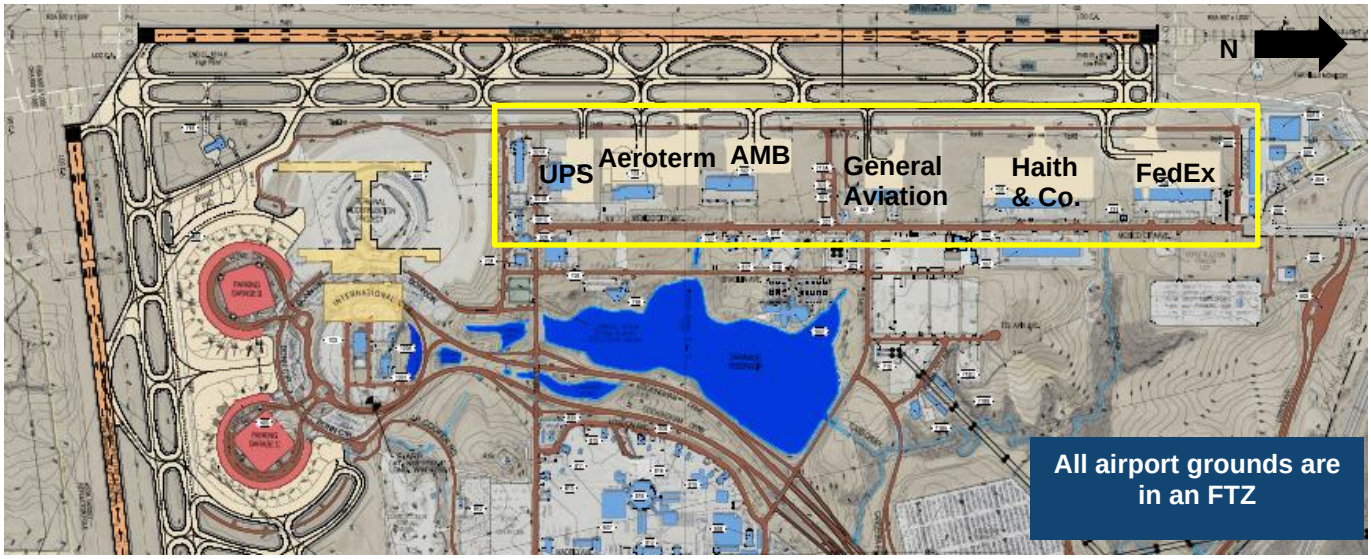
MCI is the busiest airport in Missouri in terms of air cargo weight. In 2019, the airport handled more than 94 million tons of commodity imports and exports. The design of the facilities and runways is primarily geared toward transporting passengers, but many of the passenger airlines are also capable of transporting cargo in the belly of the plane. The airport services seven major commercial airlines (10 total) and provides flights to 46 non-stop destinations. [22] 12 million passengers moved through the airport in 2019. According to MCI 2019 statistics, of the 10 airlines that use MCI for operations, three service approximately 81% of the total passenger traffic.[23]

[22] Fly KCI website. Accessed on August 4, 2020. Available from: https://www.flykci.com/flight-information/nonstop-destinations/

[23] "Kansas City International Airport Traffic and Operations Dec-19". Kansas City International Airport. Accessed on August 4, 2020. Available from: https://www.flykci.com/media/7943/stats-2019-december.pdf

MCI has three runways and covers 10,000 acres of land. The airport has approximately 252,000 square feet[24] of warehouse space for cargo storage and more than 1.3 million square feet of apron area. Figure 3.2 illustrates the location of the air cargo storage facilities at MCI as well as the layout of the new single terminal, parking garage and terminal apron being constructed at the airport. The entire MCI airport land and facilities are designated as a Foreign Trade Zone. FTZs are approved by the U.S. Customs and Border Protection and are designed to provide security and tax benefits on foreign and domestic merchandise moved within the zone.

FIGURE 3.2 KANSAS CITY INTERNATIONAL AIRPORT CARGO FACILITIES



Source: MCI Master Plan, 2009

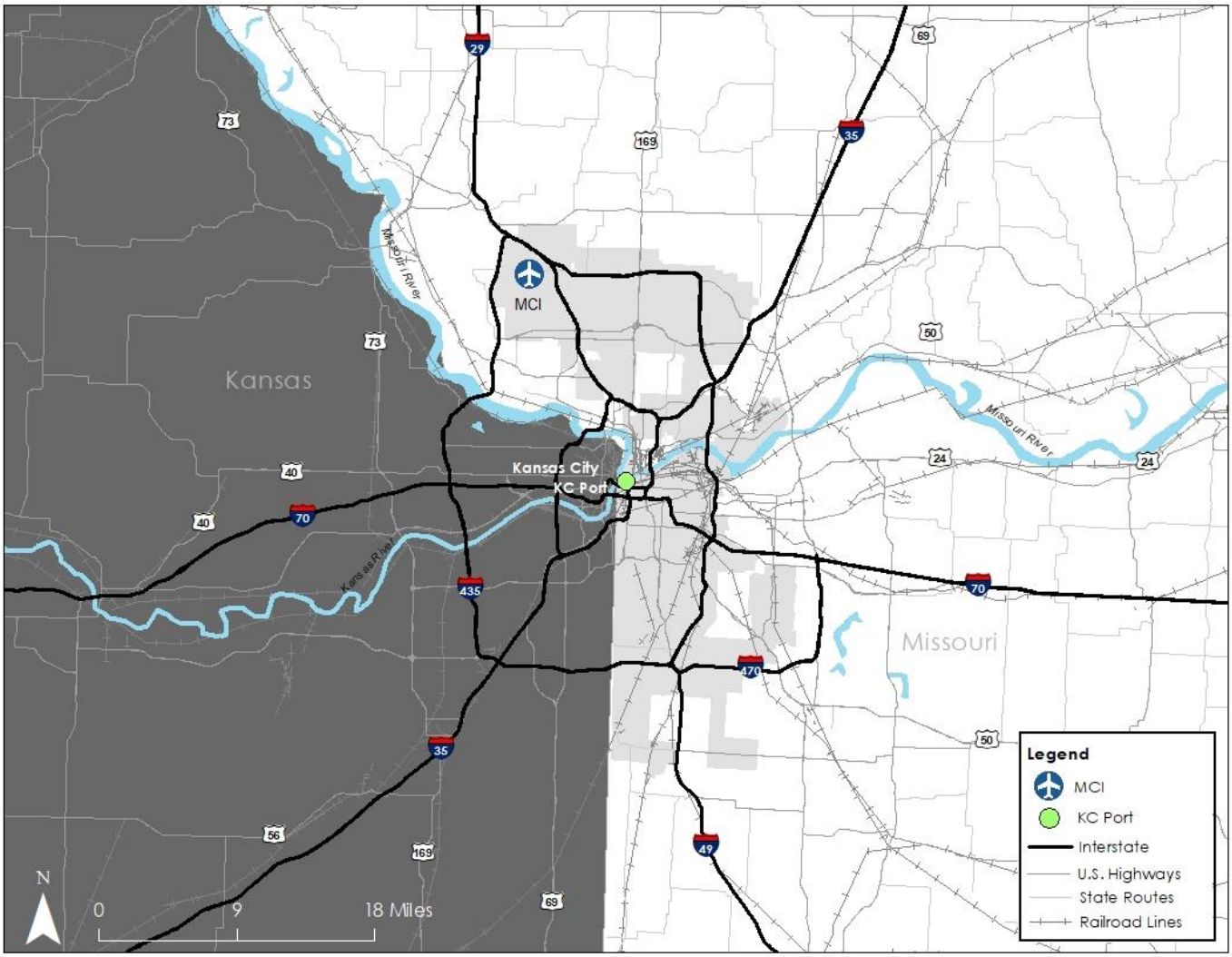
Most of the air cargo facilities are located north of the MCI airport terminals and major runways. All four commercial cargo facilities are managed by private developers: Aeroterm, AMB, Haith & Co. and FedEx. The third-party company, Aeroterm, leases its facilities at the airport to UPS. Aeroterm has 46,347 square feet of cargo warehouse space, AMB has 50,000 square feet, Haith & Co. has 70,000 square feet and FedEx has 85,000 square feet of warehouse space[25]. These air cargo operators complete all operations at night and outside of regularly scheduled passenger airport hours. Seasonal inbound and outbound cargo activity increases from November to January every year during the holiday season, and is steady throughout the rest of the year.

Figure 3.3 identifies the various freight networks surrounding MCI. The airport is in proximity to major highway, rail and port operations in the Kansas City region, allowing for efficient multimodal connectivity. Interstate connections in conjunction with MCI include I-29, I-35, I-49, I-70 and I-435 with the airport having direct access to I-29 and I-435. The airport includes a private four-lane arterial roadway which provides trucking companies with separate access to and from airport cargo distribution centers and I-29.

[24] "Appendix A- Assets and Freight Flow Technical Memo". Assets and Freight Flow. Accessed June 18, 2020. Available from: https://www.modot.org/sites/default/files/documents/Missouri-Freight-Plan-Appendices-Small-FINAL2%5B1%5D_0.pdf

[25] "Kansas City International Airport Master Plan, 2009". Kansas City International Airport. Accessed on October 16, 2020. Available from: https://www.flykci.com/media/1316/mci_master_plan_update_technical_report_12-2009.pdf

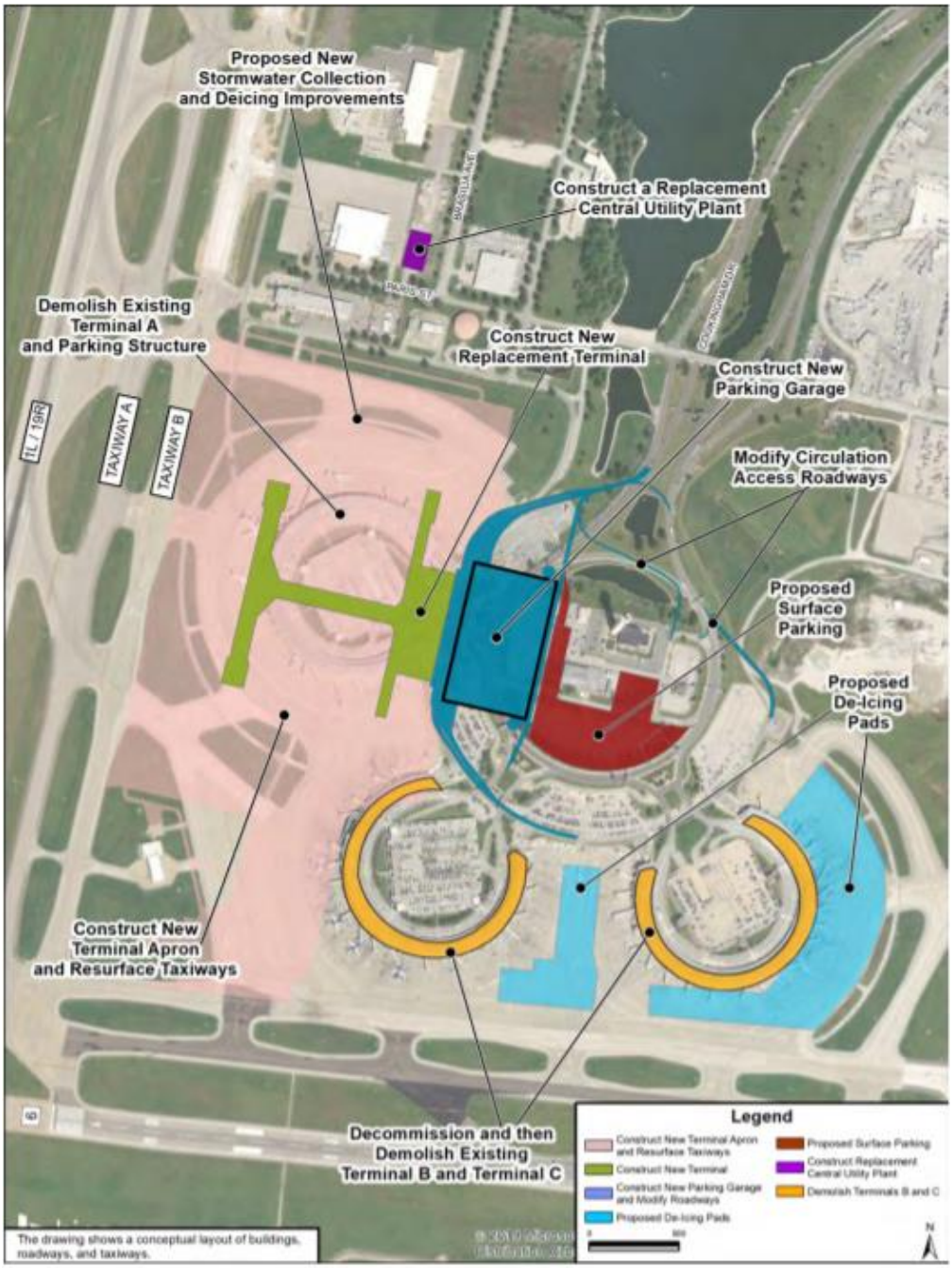
FIGURE 3.3 REGIONAL FREIGHT NETWORKS SURROUNDING MCI AIRPORT



Source: ESRI

MCI is in the process of constructing a new single terminal for airport passengers along with a parking garage to accommodate for the growing passenger demand, which will also have some impact on air cargo operations. Figure 3.4 shows the layout of the new single terminal, parking garage and terminal apron being constructed at the airport. The figure also illustrates where services such as de-icing will be moved to but does not include relocating air cargo facilities.

FIGURE 3.4 NEW MCI AIRPORT SINGLE TERMINAL LAYOUT



Source: KCI Terminal EA https://www.flykci.com/media/7778/redacted_signed-2-21-19_final_kci-terminal-ea_february-2019-reduced.pdf

The new single terminal will be located where the existing Terminal A once stood. Estimated to be completed by 2023, the new single terminal MCI will encompass one million square feet of additional space and have 39 gates with the ability to expand to 50, if needed. Terminals B and C will be repurposed and then demolished after construction and opening of the new terminal. This strategy allows the airport to operate at normal capacity during

the four-year construction phase. During construction, Terminals B and C will be open for passengers and air cargo. This will increase the distance between the warehouse space to the north for air cargo and the runways and active terminals in use during the construction phase. However, the distance between the new terminal and the warehouse facilities will decrease with the addition of the new single terminal.

The most recent KCI[26] Master Plan was completed in 2009. However, the KCI Terminal Environmental Assessment[27], completed in 2019, states that the addition of the new single terminal "does not include any specific facilities designed to induce or increase the capacity for air freight or cargo operations." Efficiency of moving the cargo to storage facilities and to the runways could increase but storage space and the capacity of cargo coming and going to MCI will remain the same.

The runway environment and cargo facilities are not changing with the new construction, but the distance traveled between the aircraft and the cargo facility will decrease in most cases, thus increasing efficiency. The air cargo facilities will remain in their existing location to the north of the terminals. Aeroterm, in conjunction with UPS, is doubling its air cargo capacity, adding 70 employees and spending $22 million in capital investment. According to airport officials, discussions have occurred regarding Amazon renting air cargo space and storage facilities at the airport. Due to the new single terminal having a larger footprint than the previous terminal, the air cargo storage facilities will be closer in distance to the new terminal and runway space. With the new airport terminal and reconfiguration, air cargo congestion, system delays and service disruption are expected to improve. The largest hurdle when constructing new buildings at MCI is providing electrical power to the facilities. MCI has space to expand cargo facilities to the west with new infrastructure and distribution centers.

St. Louis Lambert International Airport

According to BTS, STL is the 34th busiest airport in the United States in terms of passengers moving through the airport. Traffic at the airport has increased in recent years since 2001, when STL and many other airports experienced a sharp decline in passengers following the September 11 terrorist attacks. By the end of that year, American Airlines had dramatically reduced the number of flights out of STL, removing its hub status for the airline. The loss of the American hub status from STL left the airport on the decline for several years; in July 2001 STL operated more than 500 daily flights whereas today's average number of flights departing is 255 planes per day. [28]

In recent years, the airport has seen increases in flights per day, annual cargo tonnage and total number of passengers per year as compared to the airport's lowest point of flights per day. As of September 2019, the airport had recorded a record increase of passengers in the preceding 49 months[29]. In 2018, the airport serviced more

[26] Note: For the purpose of this profile, KCI and MCI are interchangeable terms. KCI was originally called Mid-Continent International Airport or MCI, and the International Air Transportation Association (IATA) adopted MCI as the airport's designator code. U.S. airports cannot use codes beginning with N, K or W as the first letter of the prefix. More information available from: https://www.flykci.com/about-us/kci-airport/

[27] "Table H-1 Responses to Comments". KCI Terminal Environmental Assessment, Section 106 Evaluation, and Section 4(f) Statement. Accessed July 23, 2020. Available from: https://www.flykci.com/media/7778/redacted_signed-2-21-19_final_kci-terminal-ea_february-2019-reduced.pdf

[28] "The Near Death and Resurgence of St. Louis International Airport". Airline Geeks. Accessed on July 23, 2020. Available from: https://airlinegeeks.com/2017/08/07/the-near-death-and-resurgence-of-st-louis-international-airport/

[29] "New Cargo Flights Gives STL Major Boost in Q3 Activity". Accessed on July 23, 2020. Available from: https://www.flystl.com/newsroom/stl-news/2019/new-cargo-flights-gives-stl-major-boost-in-q3-activity

than 15.8 million passengers, representing an increase of 1.6% from the previous year. In March 2021, the airport services 70 non-stop destinations with five major commercial airlines servicing approximately 97% of the total passenger traffic.[30] STL handled more than 76,000 tons of cargo in 2019, making it the second busiest air cargo airport in the state servicing 40% of the total air cargo enplaned and deplaned in Missouri. Air cargo increased by 25.3% during FY 2020 from FY 2019 with most of the air cargo being domestic. During the months of November and December, UPS and FedEx increase their number of flights in and out of the airport to accommodate air cargo demand tied to the busy holiday season, which has become busier each year as more consumers turn to online retailers for shopping.

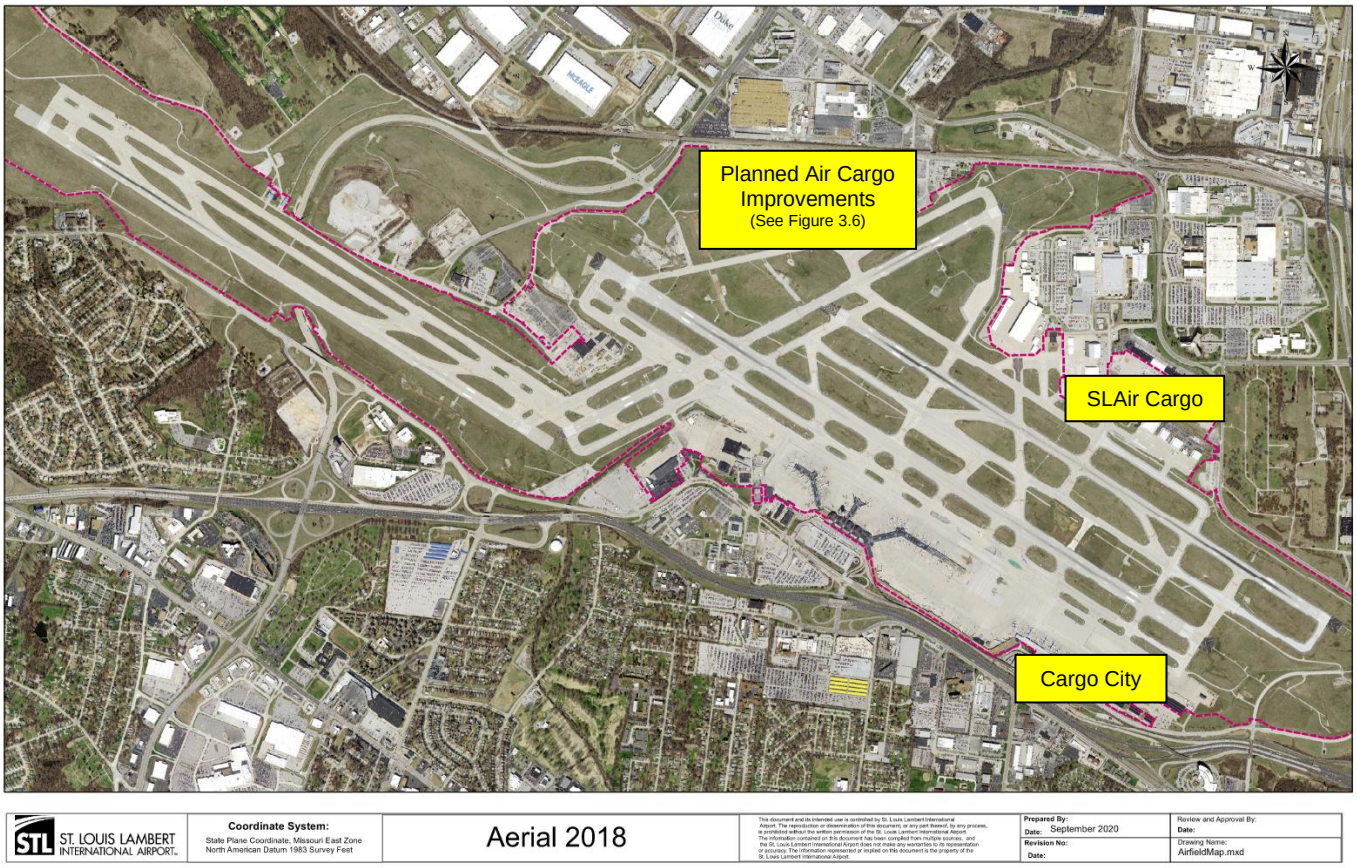
The airport has four runways and covers 2,800 acres of land. STL has two designated cargo areas, one on each side of the airport runways, with multiple warehousing facilities and sheds totaling approximately 231,500 square feet[31]. Three express carriers and eight air carriers move cargo in and out of the airport. The three express carriers at STL are DHL, FedEx and UPS. More recently, Amazon has also signed on as an express carrier flown by other partners. Amazon recently added cargo flights to STL which has helped increase cargo departures in September 2019 by 6.5% compared to the previous year. STL also services 31 freight forwarders, four dedicated air cargo trucking companies and 47 general trucking companies. The airport is located within Foreign-Trade Zone (FTZ) No. 102.

Figure 3.5 shows the layout of the grounds of STL Airport. The air cargo facilities are located to the north and south of the terminal and are outlined in red on the right-hand side on the map. Cargo City is where all airlines handle belly cargo. The USDA embarkation facility is also located at this site. SLAir Cargo is where FedEx, UPS, DHL and Amazon are all located. The facility had approximately 40,000 sq. ft. of vacancy in 2019 but Amazon recently acquired that space.

[30] "CY 2019 Passenger & Operation Statistics". St. Louis Lambert International Airport. Accessed April 14, 2020. Available from: https://www.flystl.com/uploads/documents/stl-airport-records-5th-straight-year-of-passenger-growth/STL_CY2019_Passenger_Operations_Statistics.pdf

[31] "Appendix A- Assets and Freight Flow Technical Memo". Accessed June 18, 2020. Available from: https://www.modot.org/sites/default/files/documents/Missouri-Freight-Plan-Appendices-Small-FINAL2%5B1%5D_0.pdf

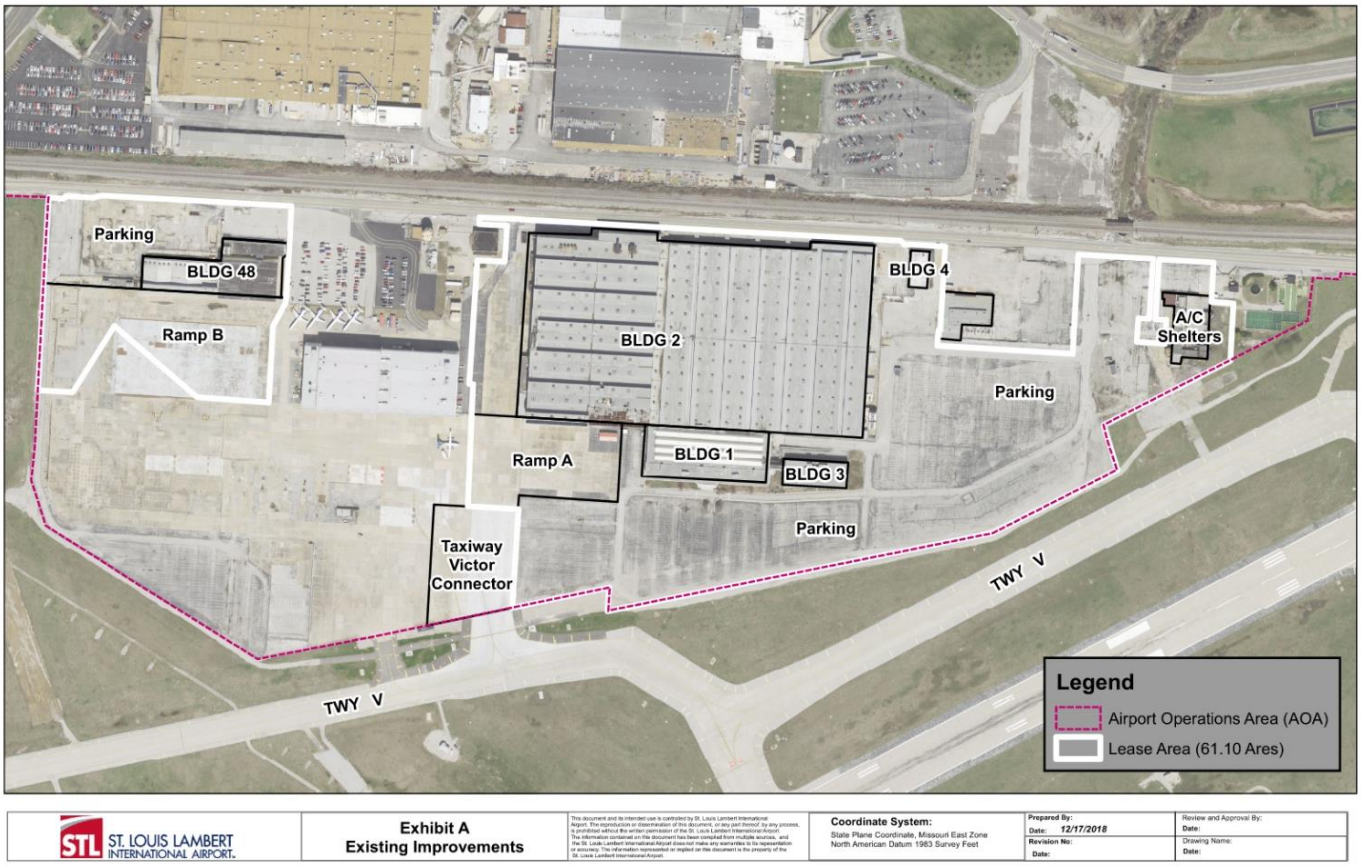
FIGURE 3.5 ST. LOUIS LAMBERT INTERNATIONAL AIRPORT CARGO FACILITIES



Source: STL Airport

St. Louis Airport is planning to develop the “northern tract” cargo area shown in Figure 3.6. Currently, Building 2 is a vacant facility spanning 1 million square feet. West of that facility is a hangar occupied by Trans States Holding, and there are two buildings further west that are also vacant.

FIGURE 3.6 PLANNED AIR CARGO IMPROVEMENTS



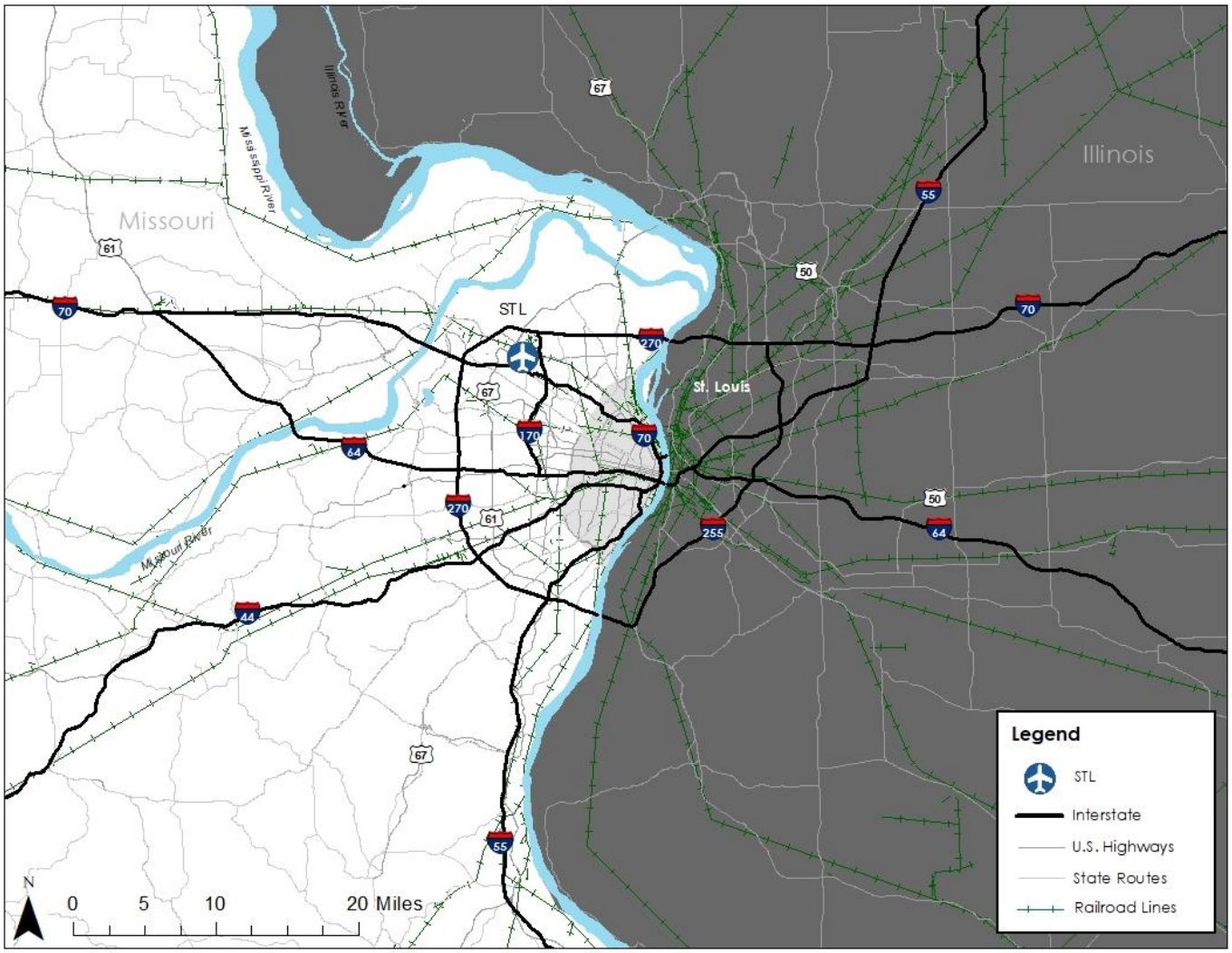
Source: STL Airport

Figure 3.7 identifies the freight networks surrounding the STL airport. Interstates that service the St. Louis area include I-44, I-55, I-64, I-70, I-170, I-255 and I-270. Air cargo is offloaded to trucks every night during the overnight hours of 6 p.m. to 9 a.m., with Amazon permitted to have one truck departing in the afternoon with packages delivered via air. There is significant truck traffic between STL and Chicago every night as well. During the months of November and December, UPS and FedEx increase their number of flights in and out of the airport to accommodate air cargo demand. Roughly 75% of trucks that drive freight to and from the facilities are single unit while the other 25% are tractor trailers.

There is significant congestion on several highway corridors near STL that impacts truck access at the airport. The I-70 corridor entering and exiting the airport is often congested, which impacts trucks getting to and from the airport facilities. The airport indicated that improvements identified in a study of the I-70 corridor would be helpful to improve traffic and bottlenecking near the airport. [32] n addition, traffic on I-44 can cause delays for trucks traveling to and from the Springfield/Joplin area. On weekday mornings and evening peak hours, the bridges across the river on I-55 and I-70 are often congested, which is sometimes due to bridge closures over the river.

[32] I-70 PEL Final Report, 2018. MoDOT. Accessed 4/16/2021. Available from: https://www.modot.org/i-70-pel-final-report

FIGURE 3.7 REGIONAL FREIGHT NETWORKS SURROUNDING STL AIRPORT



Source: ESRI

According to STL's Airport Director, the airport's strategic location to highways, rail lines and ports provides an opportunity for STL to thrive in the future. Currently, STL has been working on the construction of a new jet fuel storage facility and maintaining taxiways but has no immediate renovation or construction updates to the storage facilities or terminals. Over the past few years, the airport has seen the importance of air cargo at STL with planned air cargo investment of facilities as shown in Figure 3.5 and 3.6. There are currently no roadblocks from the legislation standpoint on air cargo or expanding air cargo facilities in the future. The last STL Master Plan was completed in 2012 and the airport is currently in the process of completing a new Master Plan. This plan is set to be completed by the end of 2021.

Springfield-Branson National Airport (SGF)

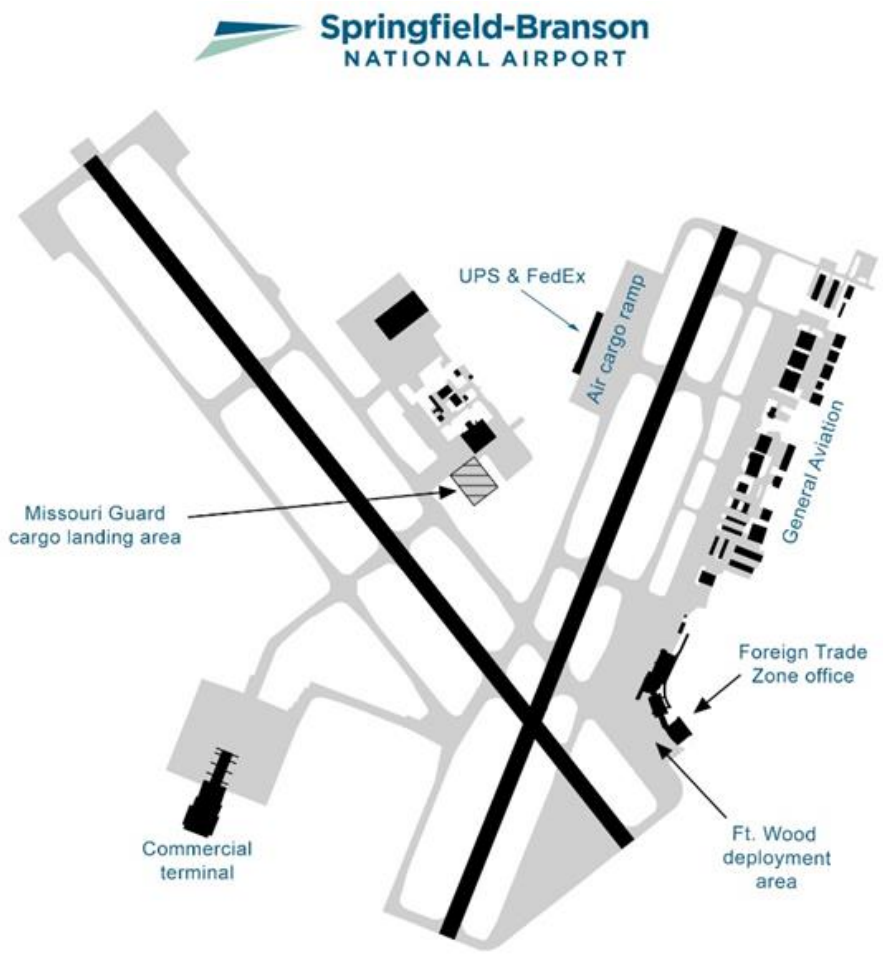
SGF is the third-busiest airport in Missouri in terms of air cargo tonnage and passenger traffic. As of March 2021, the four airlines in operation service 13 non-stop destinations around the country year-round.[33] According to the BTS, SGF handled more than 19,000 tons of cargo in 2019. SGF services approximately 10% of Missouri's enplaned and deplaned air cargo tonnage, which includes troop and cargo deployments in and out of Ft. Leonard Wood. Similar to MCI and STL, the airport is located within an FTZ, which enables the airport to trade and distribute foreign goods. This FTZ is the largest in the state of Missouri covering 23 counties in southwest Missouri. The FTZ is used for truck and rail in relation to air cargo.

UPS and FedEx are the major air cargo handlers at SGF, and both conduct nightly operations during times when the airport is closed for passenger flights. Over 2019, the volume of air cargo enplaned and deplaned at SGF grew steadily at 8% for the year.

Figure 3.8 shows the layout of the airport's terminal, runways and air cargo facility. The air cargo storage facilities are located toward the northeast corner of the complex.

[33] Fly Springfield website. Accessed 4/16/2021. Available from: https://www.flyspringfield.com/airlines.

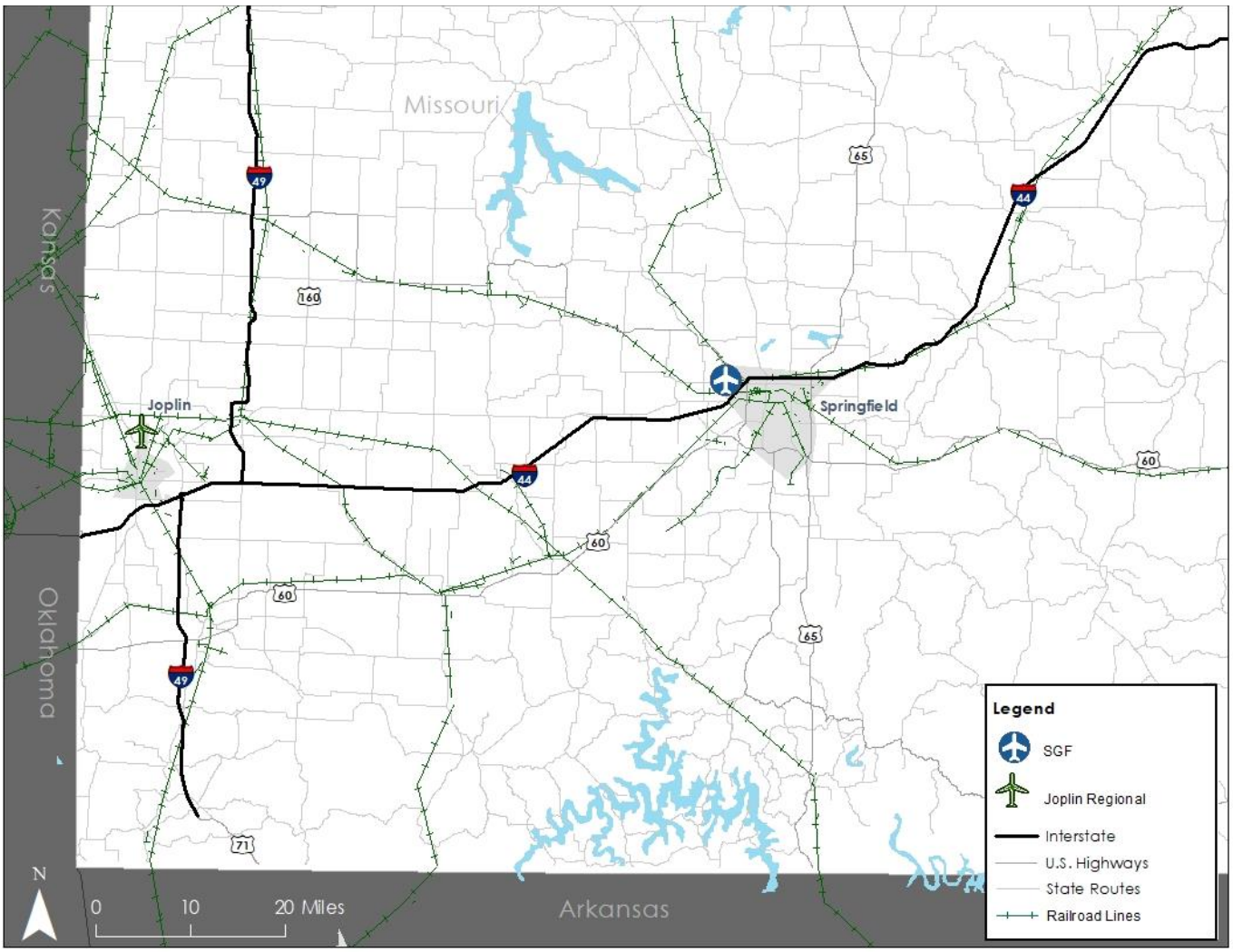
FIGURE 3.8 SGF AIRPORT LAYOUT



Source: SGF Master Plan

SGF facilitates multimodal freight connectivity via highway systems or rail. Figure 3.9 illustrates the supporting freight infrastructure surrounding the Springfield-Branson Airport. The airport is in proximity to highways and rail lines. The nearest interstate to the airport is I-44 and the nearest rail lines are in the city of Springfield. There is a BNSF main rail line to the south of the airport though it is not connected directly to the airport. When compared to MCI and STL airports, SGF does not have as much of a diverse freight network surrounding the airport and does not have the nearby amenity of major waterways and ports.

FIGURE 3.9 REGIONAL FREIGHT NETWORKS SURROUNDING SGF AIRPORT



Source: ESRI

The current SGF airport terminal opened in 2009 with no future construction plans to the terminal in development at this time. Air cargo facilities currently meet the needs of the airport and level of operations. The current building will be maintained as needed. Future Master Plans will address a potential new air cargo facility as the current warehouse is an older building.[34]

Missouri Air Cargo Service Providers

According to the Bureau of Transportation Statistics, there are two types of air cargo services being used in Missouri:

[34] "Springfield-Branson National Airport Master Plan". Springfield-Branson National Airport. Accessed on July 23, 2020. Available from: http://www.sgf-branson-airport.com/sites/default/files/files/SGF%20Working%20Paper%2008_02_2012.pdf

- **Service Class F**: Scheduled passenger/cargo service (includes freight/mail belly cargo) –constituting 97% of the total air freight in Missouri.

- **Service Class L**: Non-scheduled civilian passenger/cargo service (includes freight/mail belly cargo) – constituting 3% of the total air freight in Missouri.

Table 3.2 summarizes the market share for the top air cargo carriers in Missouri. FedEx is responsible for importing and exporting more than half of the cargo tonnage. UPS also handles a significant amount of cargo in the state, 27%. Delta Airlines and American Airlines, while not as substantial freight movers as FedEx and UPS, are the primary U.S. mail carriers for the state, both carrying more than 2,000 tons of U.S. mail in 2019.

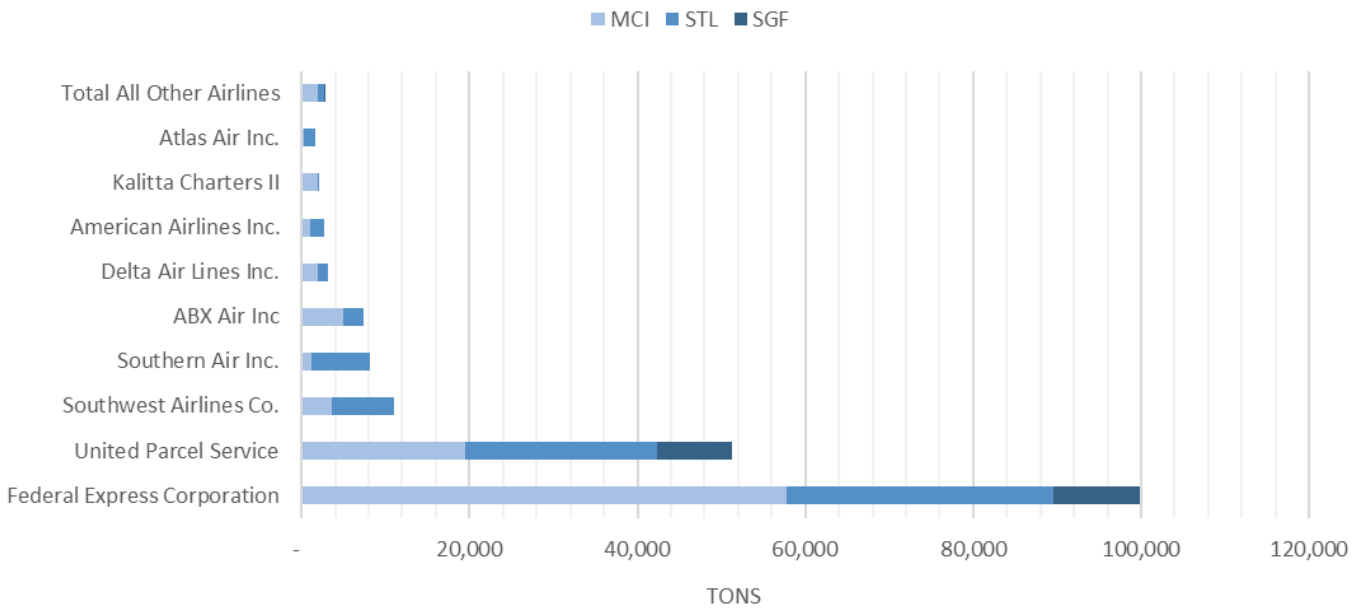
TABLE 3.2 TOP AIR CARGO CARRIERS AT MISSOURI AIRPORTS BY TONNAGE, 2019

Carrier Name	Freight (Tons)	Mail (Tons)	Total (Tons)	Percent Total	Operating at MCI	Operating at STL	Operating at SGF
Federal Express Corporation	99,915	-	99,915	53%	x	x	x
United Parcel Service	51,283	40	51,322	27%	x	x	x
Southwest Airlines Co.	11,035	-	11,035	6%	x	x	
Southern Air Inc.	8,083	-	8,083	4%	x	x	
ABX Air Inc	7,352	-	7,352	4%	x	x	
Delta Air Lines Inc.	883	2,240	3,123	2%	x	x	
American Airlines Inc.	590	2,044	2,633	1%	x	x	
Kalitta Charters II	1,971	-	1,971	1%	x	x	
Atlas Air Inc.	1,709	-	1,709	1%	x	x	
All Other Airlines	1,798	1,336	3,135	2%	x	x	x
Total	184,620	5,659	190,279	100%	-	-	-

Source: BTS T-100 Market, 2019

The same top air cargo carriers that service and operate at MCI also service and operate at STL. SGF has fewer air cargo carriers since it is smaller in size compared to MCI and STL, and is in a medium-sized metropolitan area for Missouri. Figure 3.10 shows the distribution of tonnage for air carriers at the three primary freight airports in Missouri. FedEx is the primary carrier at MCI, whereas UPS is the primary carrier at STL. FedEx and UPS were the primary distributors at SGF in 2019, both having a similar market share. The top 10 exporting cargo carriers at MCI, STL and SGF show the variety in carrier companies that use air cargo in Missouri.

FIGURE 3.10 CARGO CARRIERS AT TOP 3 MISSOURI AIRPORTS, IN TONS, 2019



Source: BTS T-100 Market, 2019

3.2 Demand and Performance

This section details the statewide demand for air cargo in Missouri and highlights air cargo activity at the three primary airports: MCI, STL and SGF. The analysis then examines each airport's demand within the state. Data used to summarize usage and performance includes air cargo trade partners, tonnage, value and top commodities.

Missouri Air Cargo Activity

Table 3.3 shows air cargo trends for the three major airports (MCI, STL and SGF) in Missouri. Air cargo tonnage at each of these primary airports has increased since 2013.

TABLE 3.3 MISSOURI CARGO AIRPORT VOLUMES AND RANKINGS

Airport Name	2013 Air Cargo Tonnage	2013 North American Rank	2013 Global Rank	2018 Air Cargo Tonnage	2018 North American Rank	2018 Global Rank	% Change (2013 – 2018)
Kansas City International	99,354	37th	152nd	106,211	47th	181st	1.34%
St. Louis Lambert International	64,557	56th	N/A	74,270	62nd	222nd	2.84%
Springfield – Branson National	12,693	106th	N/A	15,307	111th	436th	3.82%

Source: Airports Council International, Economic Affairs 2019 Traffic Report

In terms of freight distribution (Table 3.4), more than 50% of Missouri air cargo tonnage is exported and more than 48% is imported. Similarly, 50% of Missouri air commodity value is exported and 49% is imported. About 1% of air cargo by value remains within the state. Missouri's air cargo movements in 2018 totaled more than 201,000 tons and were valued at $22 billion, which equates to a value of nearly $109,000 per ton.

TABLE 3.4 MISSOURI WEIGHT AND VALUE OF AIR COMMODITIES, 2018

Direction	Tons (Thousands)		Value (Millions)		Average Value/ Ton
	Amount	Percent	Amount	Percent	
Outbound	101.87	50.5%	$10,992	50.1%	$107.90
Inbound	98.02	48.6%	$10,726	48.9%	$109.43
Intrastate	1.90	0.9%	$210	1.0%	$110.53
Total	**201.79**	**100%**	**$21,927**	**100%**	**$108.66**

Source: Transearch

The outbound cargo value to Missouri is slightly less than the inbound cargo value. The similarity between import and export volumes shows that the amount of goods entering and exiting the state are roughly valued at the same price. Intrastate goods and commodities make up a small percentage of commodities entering and leaving Missouri via air cargo at MCI, STL and SGF.

Air cargo services are most frequently used to move high-value, low-weight commodities and time-sensitive goods. Table 3.5 and Table 3.6 provide a breakdown of the top import and export commodities in Missouri in 2018. Small Packaged Freight Shipments was the number one commodity type shipped by air in terms of tonnage for both imported (38%) and exported (43%) air cargo. FedEx and UPS are major air cargo carriers of packages at MCI, STL and SGF. It is important to note that although these packaged shipments account for the most tonnage, they are not quantified in terms of value within the Transearch data product used for this study, and therefore no value for packaged shipments is available.

Miscellaneous Manufacturing Products was the top commodity group in terms of value. The top five exported commodities in terms of value make up 85% of the total value of commodities shipped via air. The top five imports make up 83% of the total value. These commodities are shown in Table 5 and Table 6. In 2018, all exported air commodities totaled 101,900 tons and were valued at nearly $11 billion. All imported commodities totaled 98,000 tons and were valued at over $11 billion.

TABLE 3.5 TOP AIR COMMODITIES IN MISSOURI, 2018 (EXPORTED)

Commodity by Tonnage	Tons (Thousands)	Percent of all Commodities
Small Packaged Freight Shipments*	43.40	43%
Electrical Equipment	9.82	10%
Printed Matter	7.25	7%
Transportation Equipment	5.97	6%
Instrum, Phot Equipment, Optical EQ	4.60	5%
Commodity by Value	**Value (Millions)**	**Percent of all Commodities**
Misc. Manufacturing Products	$3,555	32%
Electrical Equipment	$2,277	21%
Transport Equipment	$1,814	17%
Instrum, Phot Equipment, Optical EQ	$1,006	9%
Drugs	$669	6%

Source: Transearch

*Note: Intrastate trips not included. *No value is available for Small Packaged Freight Shipments*

TABLE 3.6 TOP AIR COMMODITIES IN MISSOURI, 2018 (IMPORTED)

Commodity by Tonnage	Tons (Thousands)	Percent of all Commodities
Small Packaged Freight Shipments*	37.70	38%
Transportation Equipment	10.11	10%
Meat or Poultry, Fresh or Chilled	6.07	6%
Machinery	5.75	6%
Instrum, Photo Equipment, Optical EQ	5.71	6%
Commodity by Value	**Value (Millions)**	**Percent of all Commodities**
Transportation Equipment	$3,071	29%
Misc. Manufacturing Products	$2,526	24%
Instrum, Photo Equipment, Optical EQ	$1,249	12%
Electrical Equipment	$1,220	11%
Machinery	$731	7%

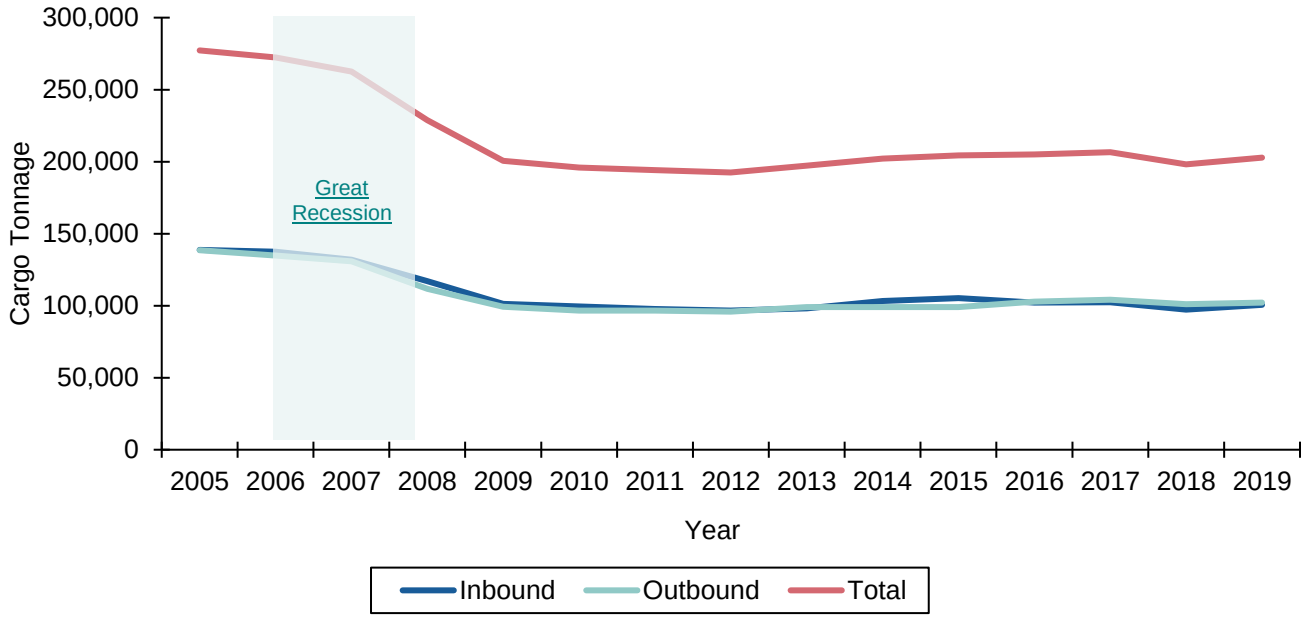
Source: Transearch

*Note: Intrastate trips not included. *No value is available for Small Packaged Freight Shipments*

Figure 3.11 and Figure 3.12 show air cargo trends over the last 15 years. The overall inbound and outbound air tonnage in Missouri has followed a relatively similar trend line. The Great Recession had a major impact on the air cargo tonnage flowing in and out of Missouri between 2007 and 2009. Since that time, cargo tonnage has remained relatively stable over the last 10 years. One reason for the lack of resurgence could be the abundance and cost-effectiveness of interstate and rail line shipping in the state of Missouri. Due to Missouri's central location, most

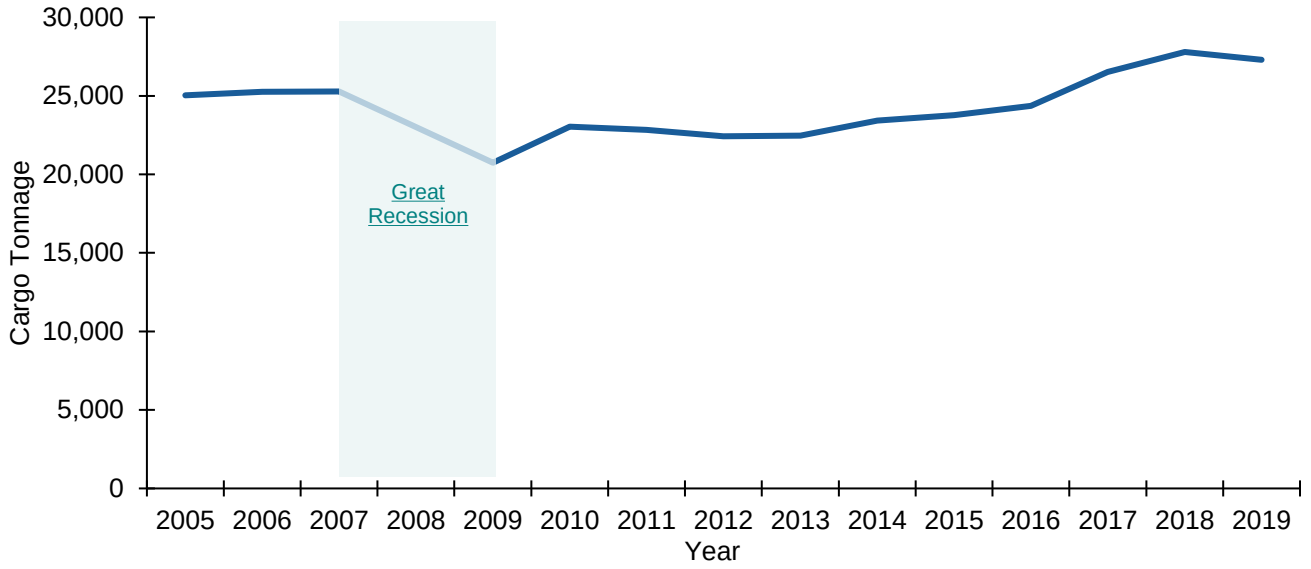
highway and rail shipments can reach their destination within two days, lessening the need for air freight. This relatively flat trend is not a reflection of the overall United States. After the initial downturn between 2007 and 2009, air cargo tonnage in the U.S. has been rising since 2012 (Figure 3.12). It is still unknown what the impacts of the COVID-19 pandemic will play on air cargo transport in the future.

FIGURE 3.11 MISSOURI INBOUND AND OUTBOUND AIR CARGO, IN TONS (2005 - 2019)



Source: BTS T-100 Market

FIGURE 3.12 U.S. AIR CARGO REVENUE TONS ENPLANED, IN THOUSAND (2005 - 2019)



Source: BTS T-100 Market

Table 3.7 and Table 3.8 show the top air cargo import and export cities for the state of Missouri. Memphis, Louisville, Indianapolis and Rockford are the top origins and destinations of air cargo. From there freight volumes begin to differ in terms of tonnage moving in or out of Missouri. The locations of top origin and destination airports are due in part to being close to other FedEx or UPS hubs. Rockford is close to Chicago which is home to one of 14 North American distribution facilities for FedEx. Locations of other FedEx hubs include[35]:

- Atlanta, GA
- Blaine, WA
- Buffalo, NY
- Champlain, NY
- Toronto, ON
- Dallas, TX
- Detroit, MI
- El Paso, TX
- Laredo, TX
- Los Angeles, CA
- Port Huron, MI
- San Diego, CA
- Seattle, WA

Indianapolis is accessible to the FedEx hubs located in Chicago, Detroit and Point Huron. Memphis and Louisville, although not located close to major North American distribution centers, are closer to other large metropolitan areas. UPS has many cargo distribution hubs located in North America including Louisville, KY; Philadelphia, PA; Dallas, TX; and Hamilton, ON[36]. The airports located in Louisville, KY and Memphis, TN are a top air cargo import and export destination for the state of Missouri.

TABLE 3.7 STATEWIDE TOP 10 FREIGHT + MAIL DESTINATION AIRPORTS IN 2019

Destination	Freight	Mail	Total (Tons)
Memphis, TN	33,183	-	33,183
Louisville, KY	18,706	-	18,706
Indianapolis, IN	9,381	-	9,381
Rockford, IL	7,500	-	7,500
Dallas/Fort Worth, TX	2,482	83	2,564
Cincinnati, OH	2,081	-	2,081
Cedar Rapids/Iowa City, IA	1,738	-	1,738
Charlotte, NC	1,127	355	1,482
Ontario, CA	1,458	-	1,458
Omaha, NE	1,411	-	1,411

Source: BTS T-100 Market, 2019

TABLE 3.8 STATEWIDE TOP 10 FREIGHT + MAIL ORIGIN AIRPORTS IN 2019

Origin	Freight	Mail	Total (Tons)
Memphis, TN	31,459	-	31,459
Louisville, KY	20,780	40	20,820
Indianapolis, IN	8,087	-	8,087
Rockford, IL	6,300	-	6,300
Cincinnati, OH	3,876	-	3,876
Dallas/Fort Worth, TX	2,638	197	2,835
Cedar Rapids/Iowa City, IA	1,954	-	1,954
Los Angeles, CA	906	536	1,442
Houston, TX	1,210	31	1,241
Boston, MA	1,204	-	1,204

Source: BTS T-100 Market, 2019

[35] "North American Distribution Facilities". FedEx Trade Networks. Accessed on July 24, 2020. Available from: http://ftn.fedex.com/us/services/distribution_locations.shtml

[36] "Worldwide UPS Fact Sheet". UPS. Accessed on July 24, 2020. Available from: https://www.ups.com/ca/en/about/facts/worldwide.page

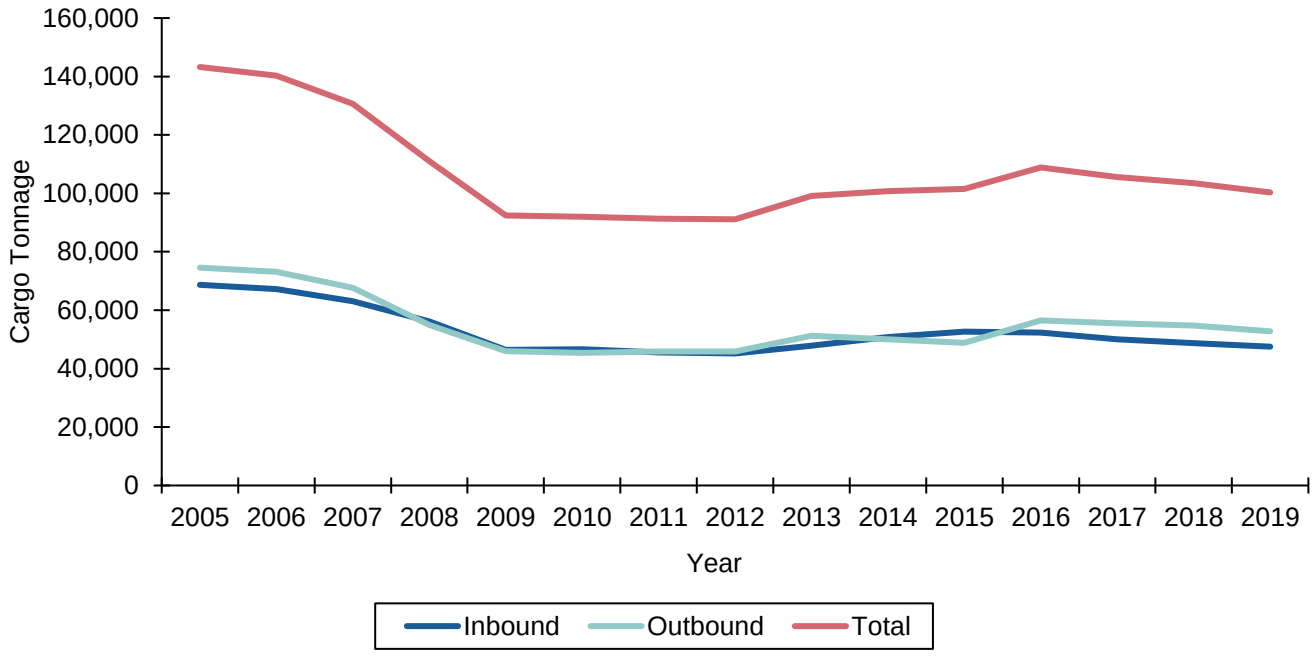
MCI Airport Demand

At its peak in 2005, MCI handled more than 143,000 tons of cargo; however, the airport saw a sharp decline in freight tonnage between 2005 and 2009. Between 2009 and 2016, MCI inbound and outbound air cargo tonnage increased overall, but has since declined, ending 2019 with more than 100,000 tons. However, Kansas City is continuing to grow as a major e-commerce hub. According to airport officials, discussions have occurred regarding Amazon renting air cargo space and storage facilities at the airport.

Air cargo is frequently sent to airport hubs prior to distribution to other smaller, regional destinations. Table 3.9 and Table 3.10 show the top origin and destination cities for MCI airport. Memphis International Airport accounts for 46% of the total tonnage that is imported or exported from the top 10 airports. The top six origin and destination airports with nearby cities are ranked in the same order.

Figure 3.14 and Figure 3.15 show the location of MCI and its top 10 origin and destinations of air cargo. The air cargo is flown to the airports in the associated cities. Cargo can then be transported to other nearby cities or redistributed elsewhere.

FIGURE 3.13 MCI AIRPORT INBOUND AND OUTBOUND CARGO, IN TONS (2005 – 2019)



Source: BTS T-100 Market

TABLE 3.9 MCI AIRPORT TOP 10 FREIGHT + MAIL DESTINATION AIRPORTS IN 2019

Destination	Freight	Mail	Total (Tons)
Memphis, TN	21,970	-	21,970
Louisville, KY	8,187	-	8,187
Rockford, IL	4,428	-	4,428
Indianapolis, IN	3,227	-	3,227
Dallas/Fort Worth, TX	2,442	20	2,462
Cedar Rapids/Iowa City, IA	1,738	-	1,738
Charlotte, NC	1,117	208	1,326
Seattle, WA	925	11	937
Sioux Falls, SD	767	-	767
Colorado Springs, CO	675	-	675

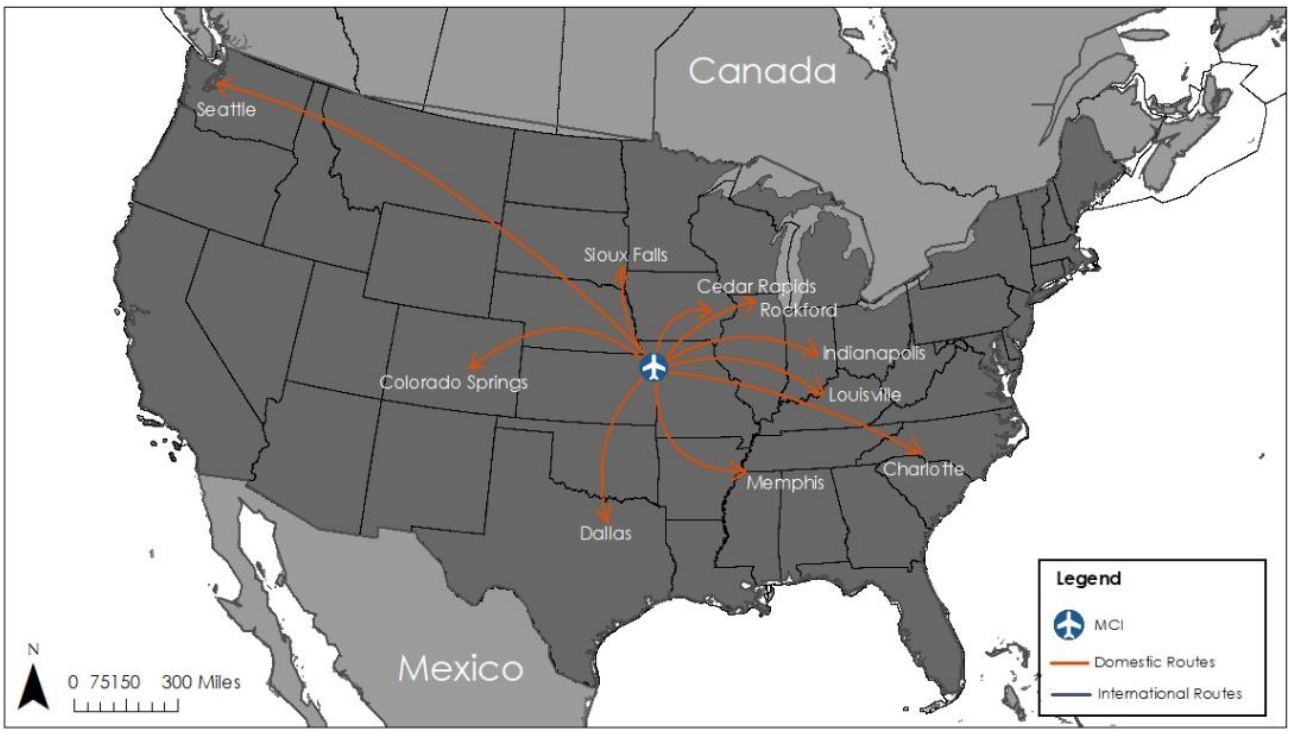
Source: BTS T-100 Market, 2019

TABLE 3.10 MCI AIRPORT TOP 10 FREIGHT + MAIL ORIGIN AIRPORTS IN 2019

Origin	Freight	Mail	Total (Tons)
Memphis, TN	17,686	-	17,686
Louisville, KY	8,269	-	8,269
Rockford, IL	3,284	-	3,284
Indianapolis, IN	2,711	-	2,711
Dallas/Fort Worth, TX	2,536	106	2,642
Cedar Rapids/Iowa City, IA	1,954	-	1,954
Houston, TX	992	29	1,021
Charlotte, NC	790	110	899
Boston, MA	828	-	828
Los Angeles, CA	436	303	739

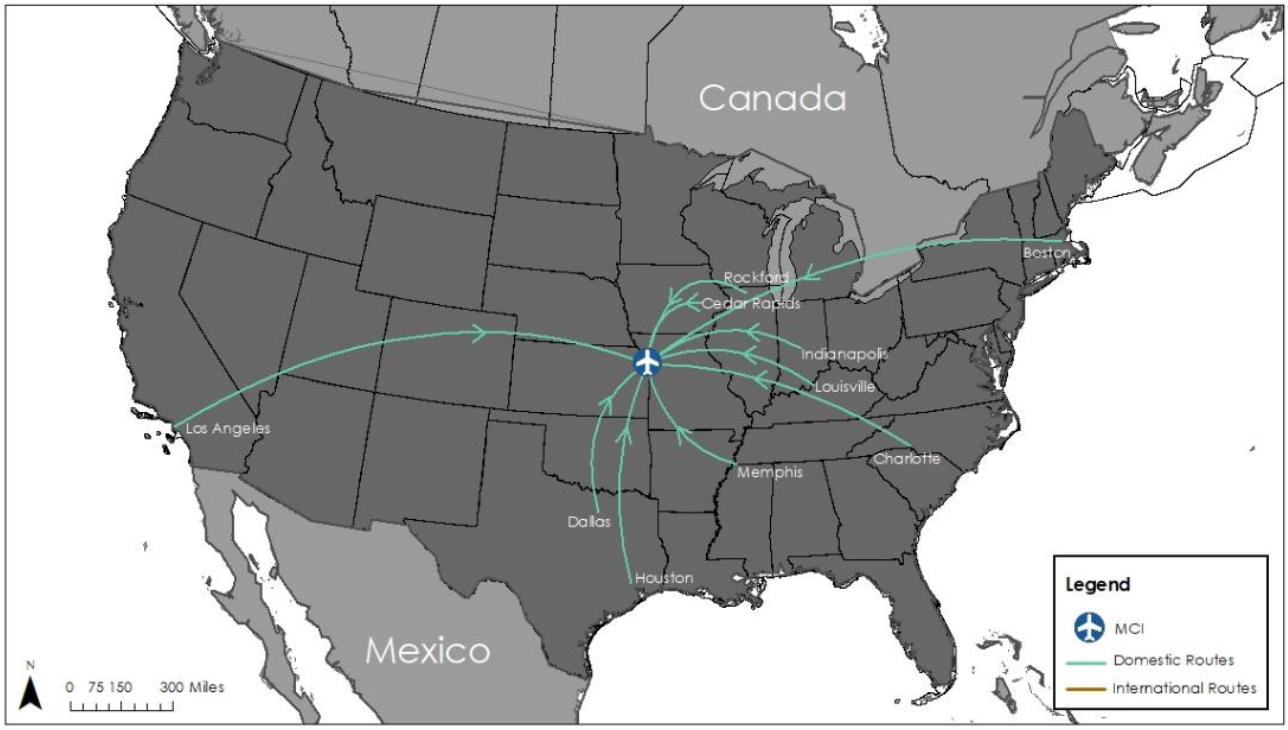
Source: BTS T-100 Market, 2019

FIGURE 3.14 MCI TOP 10 CARGO DESTINATION AIRPORTS



Source: BTS T-100 Market, 2019

FIGURE 3.15 MCI TOP 10 CARGO ORIGIN AIRPORTS

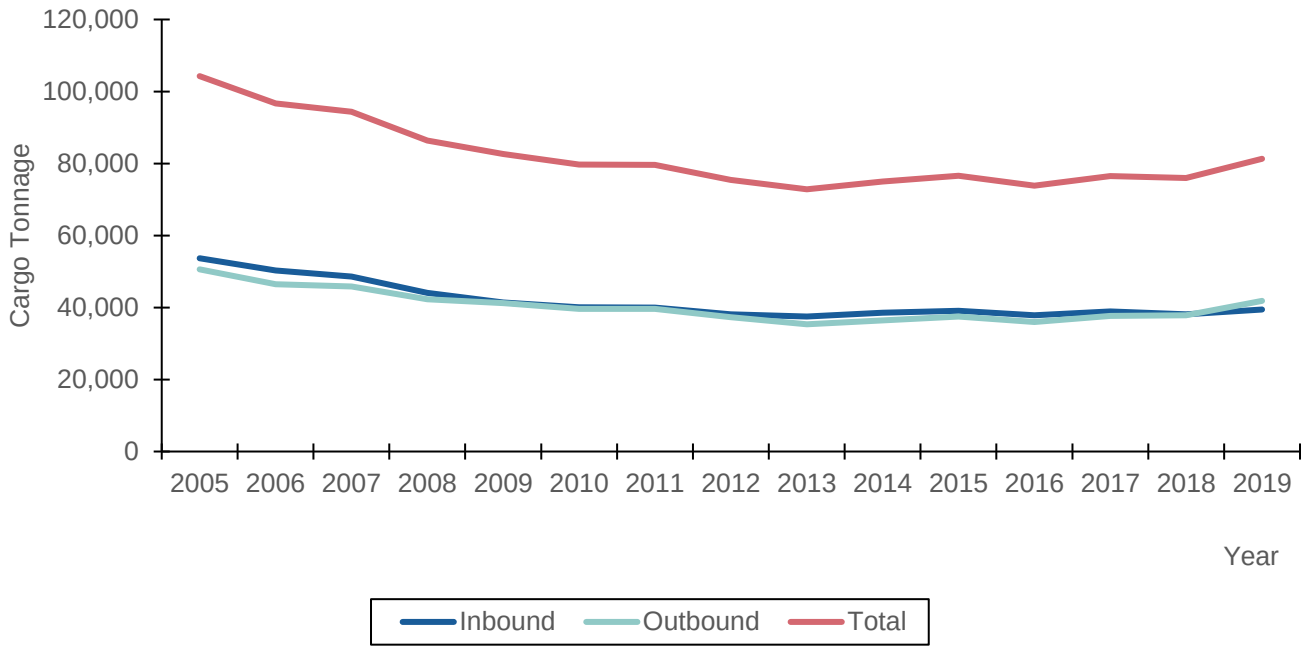


Source: BTS T-100 Market, 2019

STL Airport Demand

For STL, air cargo tonnage decreased between 2005 to 2011, leveled off until 2012, and then slowly increased through 2019. At its peak in 2005, STL carried more than 104,000 tons of air cargo, but until 2013 that number was on a steady decline. Since then, the amount of air cargo has remained relatively steady, except for 2019 when there was a noticeable increase in air cargo tonnage. Table 3.11 and Table 3.12 show the top origin and destination cities for the STL airport. Memphis, Louisville, Indianapolis, Rockford and Cincinnati all rank at the top for air commodity imports and exports for STL. Maps are also provided in Figure 3.17 and Figure 3.18. As discussed in the statewide demand section, the locations of top origin and destination airports are due in part to being close to other FedEx or UPS hubs.

FIGURE 3.16 STL AIRPORT INBOUND AND OUTBOUND CARGO, IN TONS (2005 – 2019)



Source: BTS T-100 Market

TABLE 3.11. STL AIRPORT TOP 10 FREIGHT + MAIL DESTINATION AIRPORTS IN 2019

Destination	Freight	Mail	Total (Tons)
Memphis, TN	8,350	-	8,350
Louisville, KY	7,190	-	7,190
Indianapolis, IN	6,152	-	6,152
Rockford, IL	3,072	-	3,072
Cincinnati, OH	1,976	-	1,976
Ontario, CA	1,452	-	1,452
Omaha, NE	1,395	-	1,395
Detroit, MI	995	4	999
Casper, WY	792	-	792
Toronto, Canada	771	-	771

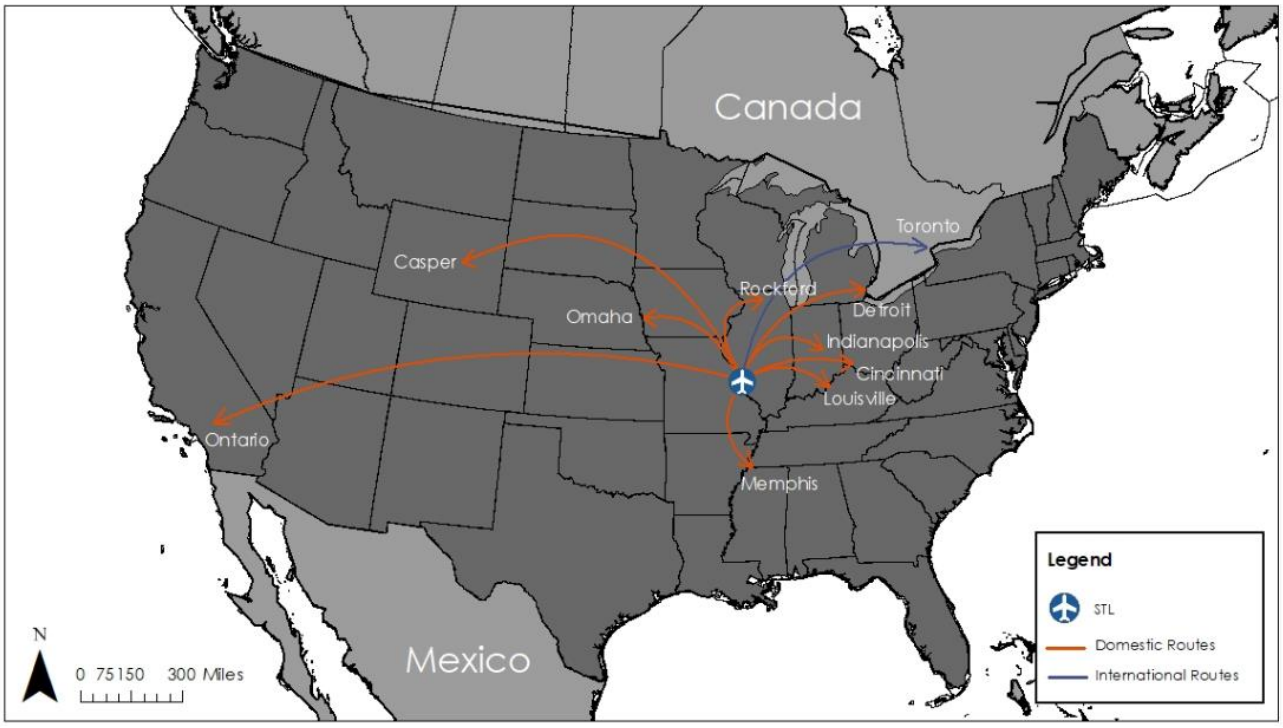
Source: BTS T-100 Market, 2019

TABLE 3.12. STL AIRPORT TOP 10 FREIGHT + MAIL ORIGIN AIRPORTS IN 2019

Origin	Freight	Mail	Total (Tons)
Louisville, KY	8,084	40	8,124
Memphis, TN	7,656	-	7,656
Indianapolis, IN	5,376	-	5,376
Cincinnati, OH	3,742	-	3,742
Rockford, IL	3,015	-	3,015
Baltimore, MD	982	-	982
Los Angeles, CA	470	234	703
Omaha, NE	595	-	595
Newark, NJ	582	-	582
Boise, ID	549	-	549

Source: BTS T-100 Market, 2019

FIGURE 3.17 STL AIRPORT TOP 10 CARGO DESTINATION AIRPORTS



Source: BTS T-100 Market, 2019

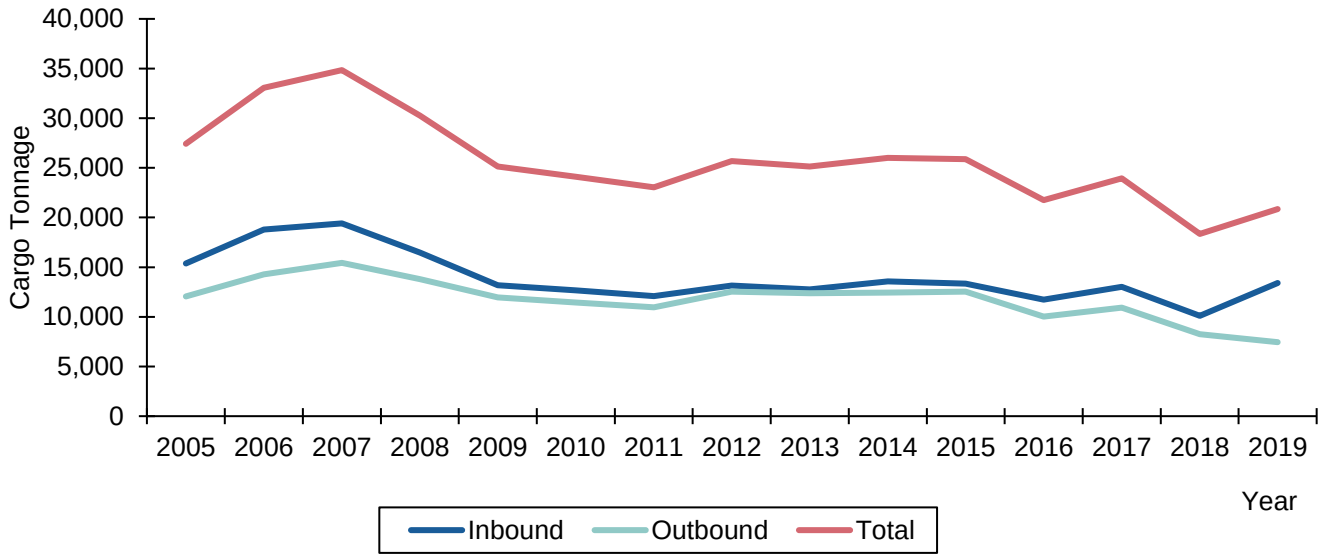
FIGURE 3.18 STL AIRPORT TOP 10 CARGO ORIGIN AIRPORTS

Source: BTS T-100 Market, 2019

SGF Airport Demand

Air cargo tonnage at SGF has been somewhat volatile since 2005. Unlike MCI and STL, SGF saw its peak in air cargo tonnage in 2007 with nearly 35,000 tons of air cargo carried. Since the Great Recession, total air cargo tonnage has experienced a net decrease while remaining relatively flat between 2009 and 2016. Overall, the amount of inbound cargo has been higher than outbound. Table 3.13 and Table 3.14 show the top origin and destination cities for the SGF airport. Memphis and Louisville represent 87% of the total imports and exports for SGF. Maps are provided in Figure 3.20 and Figure 3.21.

FIGURE 3.19 SGF AIRPORT INBOUND AND OUTBOUND CARGO, IN TONS (2005 – 2019)



Source: BTS T-100 Market

TABLE 3.13 SGF AIRPORT TOP 9 FREIGHT + MAIL DESTINATION AIRPORTS IN 2019

Destination	Freight	Mail	Total (Tons)
Louisville, KY	3,329	-	3,329
Memphis, TN	2,863	-	2,863
Newburgh/Poughkeepsie, NY	290	-	290
Wichita, KS	239	-	239
Mission/McAllen/Edinburg, TX	101	-	101
Fresno, CA	3	-	3
Indianapolis, IN	3	-	3
Chicago, IL	2	-	2
Dallas/Fort Worth, TX	2	0	2

Source: BTS T-100 Market, 2019
Note: Freight delivered to nine destinations in 2019

TABLE 3.14 SGF AIRPORT TOP 10 FREIGHT + MAIL ORIGIN AIRPORTS IN 2019

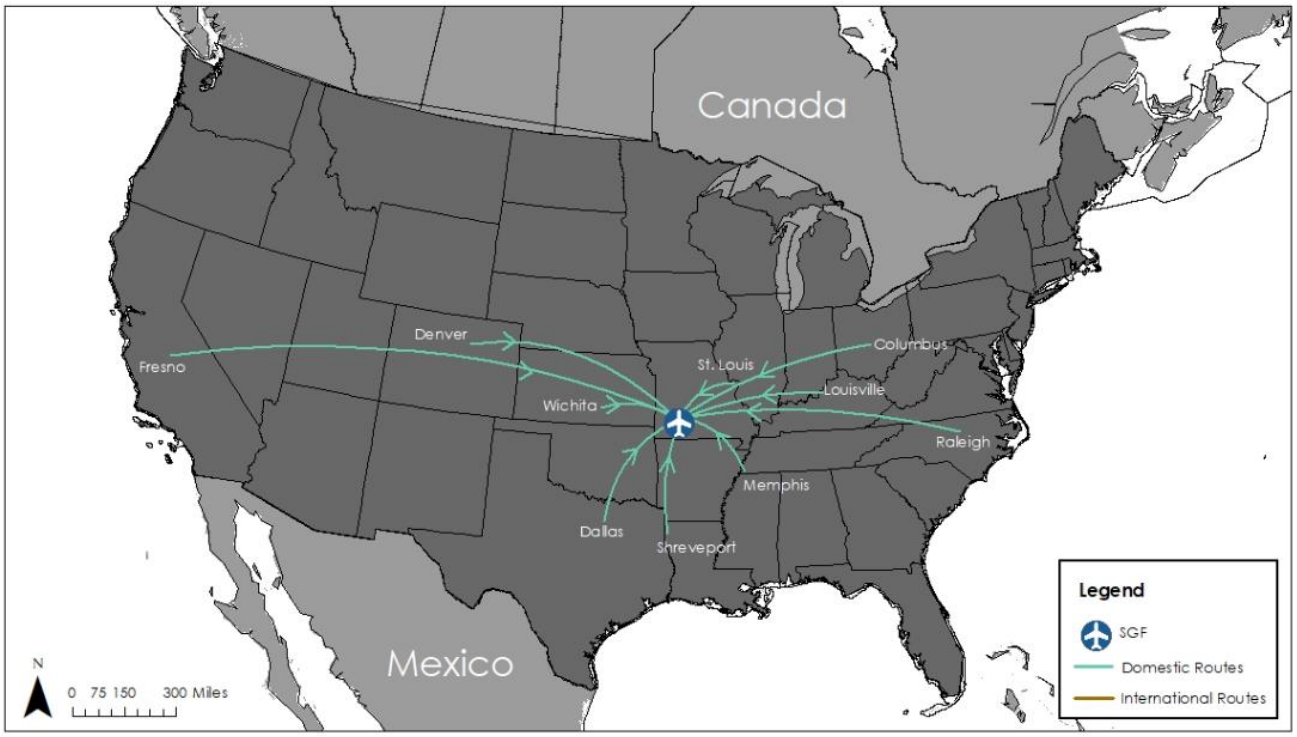
Origin	Freight	Mail	Total (Tons)
Memphis, TN	6,116	-	6,116
Louisville, KY	4,427	-	4,427
Raleigh/Durham, NC	661	-	661
St. Louis, MO	459	-	459
Wichita, KS	459	-	459
Columbus, OH	192	-	192
Denver, CO	154	-	154
Fresno, CA	13	-	13
Shreveport, LA	7	-	7
Dallas/Fort Worth, TX	4	-	4

Source: BTS T-100 Market, 2019

FIGURE 3.20 SGF AIRPORT TOP 9 CARGO DESTINATION AIRPORTS

Source: BTS T-100 Market, 2019

FIGURE 3.21 SGF AIRPORT TOP 10 CARGO ORIGIN CITIES



Source: BTS T-100 Market, 2019

Statewide Air Cargo Safety

National Transportation Safety Board records confirm that there were no fatal accidents involving air cargo carriers over the last 10 years in the state of Missouri. There were also no reported fatal crashes involving commercial passenger carriers at MCI, STL or SGF in that period.

3.3 Future Performance and Trends

Future Activity and Demand Statewide

Air cargo is projected to see a steady increase in volume and value between now and 2045. According to Transearch (Table 3.15), overall air freight tonnage for Missouri will experience a 2.9% growth through 2030. The value of commodities between 2018 and 2030 are forecasted to also grow by 2.5%. From 2030 to 2045, air freight tonnage and value are expected to have an annual increase of 2.6% and 3.1%, respectively.

TABLE 3.15 MISSOURI AIR CARGO TRENDS AND 2045 OUTLOOK

	2018	2030	2045	Projected Annual Growth 2018-2030	Projected Annual Growth 2030-2045
Import					
Tons (Thousands)	98.02	124.56	179.35	2.3%	2.9%
Value (Millions)	$10,726	$13,929	$20,043	2.5%	2.9%
Export					
Tons (Thousands)	101.87	120.76	161.46	1.5%	2.2%
Value (Millions)	$10,992	$14,270	$21,253	2.5%	3.3%
Intra					
Tons (Thousands)	1.90	2.67	3.82	3.4%	2.8%
Value (Millions)	$210	$292	$426	3.3%	3.1%
Overall					
Tons (Thousands)	201.79	248.00	344.63	2.9%	2.6%
Value (Millions)	$21,927	$28,492	$41,722	2.5%	3.1%

Source: Transearch

Freight tonnage is projected to grow in value and in tons overall for the state of Missouri. This means the tonnage and value of the goods will increase for imports, exports and intra freight. In 2045, air cargo is projected to nearly double for exports and more than double for imports and intra goods from 2018.

Future Activity and Demand at Top Airports

This section discusses projected future activity and demand at Missouri's top three airports. Table 3.16 and Table 3.17 display the air cargo import and export projections of the MCI, STL and SGF airports for the years 2030 and 2045 using the Transearch database.

TABLE 3.16 AIR CARGO TRENDS AND 2045 OUTLOOK BY MISSOURI AIRPORT – TONNAGE (THOUSANDS)

	2018	2030	2045	Projected Annual Growth 2018-2030	Projected Annual Growth 2030-2045
Import					
MCI	49.62	66.16	97.03	2.8%	3.1%
STL	39.10	46.64	65.30	1.6%	2.7%
SGF	9.11	11.48	16.56	2.2%	2.9%
Export					
MCI	55.55	61.58	80.02	0.9%	2.0%
STL	37.88	49.46	69.40	2.5%	2.7%
SGF	8.20	9.45	11.65	1.3%	1.5%

Source: Transearch

TABLE 3.17 AIR CARGO TRENDS AND 2045 OUTLOOK BY MISSOURI AIRPORT – VALUE (MILLIONS)

	2018	2030	2045	Projected Annual Growth 2018-2030	Projected Annual Growth 2030-2045
Import					
MCI	$4,648	$6,368	$9,271	3.1%	3.0%
STL	$4,888	$6,008	$8,584	1.9%	2.9%
SGF	$1,126	$1,457	$2,026	2.5%	2.6%
Export					
MCI	$5,874	$8,171	$12,903	3.3%	3.9%
STL	$4,442	$5,322	$7,340	1.7%	2.5%
SGF	$647	$742	$964	1.2%	2.0%

Source: Transearch

Kansas City International

MCI is expected to have the highest tonnage of air cargo by 2045 at 177,000 tons of imports and exports. Freight tonnage for imports is expected to grow at a higher rate than exports. Although the reported tonnage of exports in the year 2018 was higher than the weight of imports, projections show that the tonnage of imports will eclipse exports between 2018 and 2030. Between 2018 and 2030, exports are projected to grow at a rate of less than 1%, whereas imports are expected to grow at a rate of 2.8%.

The combined value of imports and exports in the year 2045 is forecasted to be $22.1 billion. This is more than twice the value for imports and exports in 2018. In 2045, the value of exports is expected to be $161,000 per ton compared to imports where the value is expected to be $96,000 per ton. The sizable margin for exports is due to value of the cargo being higher and tonnage being lower, whereas for imports the value is lower and the tonnage is higher. The value of exports is also forecasted to grow at a higher rate than imports from 2018 to 2030 as well as 2030 to 2045.

St. Louis Lambert International

STL is expected to have the second largest tonnage of air cargo in Missouri in the future at 135,000 tons of imports and exports anticipated to flow through STL by the year 2045. Freight tonnage for exports is expected to grow at a rate of 2.5% compared to 1.6% for imports between 2018 and 2030. Between 2030 and 2045, the growth rates are expected to both be 2.7%. The difference in growth rates between 2018 and 2030 means that exports will have a higher tonnage than imports by 2030, even though in 2018 imports had the higher tonnage.

The combined value of imports and exports in the year 2045 is forecasted to be $15.9 billion. In 2045, the value of imports is expected to be $131,000 per ton, compared to exports, where the value is expected to be $106,000 per ton. The growth rates between 2018 and 2030 are projected to be less than 2% for imports and exports, but between 2030 and 2045 the growth rates are forecasted to be 2.9% for imports and 2.5% for exports.

Springfield-Branson National

Finally, SGF is expected to have the lowest total air cargo imports and exports of the three primary airports in Missouri. Forecasts indicate that SGF is expected to have 28,000 tons of imports and exports flowing through SGF by the year 2045. Imported air cargo is expected to grow by 2.9% compared to only 1.5% for exports from 2030 to 2045.

The combined value of imports and exports in the year 2045 is forecasted to be nearly $3 billion. In 2045, the value of imports is expected to be $122,000 per ton, compared to exports, where the value is expected to be $83,000 per ton. Compared to MCI and STL, there is a noticeable difference in the proportional value of imports compared to exports. In the years 2018, 2030 and 2045, the values of imports are nearly double that of exports. This is likely a function of geographic location within the state and availability of other modes. Products manufactured in Missouri can likely arrive to MCI or STL airports for export more efficiently than SGF.

Port Freight Modal Profile

4

Ports that provide access to navigable waters allow freight to be transported by barge or ship. This method of transportation has low emission levels and comparatively low costs. Additionally, because it has a dedicated throughway, water transportation is an attractive alternative for the movement of goods compared with highways and rail for many commodities. Missouri, in particular, is located along two major navigable waterways (the Mississippi and Missouri Rivers) that places it in a central position along the nation's inland waterways. As of 2018, Missouri's waterways transported just less than 40 million tons of commodities valued at $7.6 billion to and from the state; however, there were over 630 million tons of through traffic on the Mississippi River in 2019, making Missouri's waterways an essential part of Missouri's freight economy and connection to domestic and global markets.

This section provides an overview of Missouri's waterway freight transportation system through the lenses of supply, demand and performance. It starts with an inventory of the port and water infrastructure, including public port authorities and navigable waterways. It will then examine the users of the state's ports and waterways, examining the industries and commodities that use this infrastructure the most. Finally, it will review how this infrastructure is maintained and what issues may affect the long-term operation of the state's ports and waterways.

The information in this section builds off of the Economic Impact of Public Ports Study that was published in February 2018.[37] It makes clear the essential role that ports play in the state's economy and therefore in the overall *Missouri Freight Plan*. Understanding the role of the ports and waterways is critical to inform the needs, issues, policies and projects that will result from this plan.

4.1 Infrastructure

Missouri's waterways make up a distinct and often dedicated path of goods movement that supports a significant amount of freight movement. There are approximately 2,500 square miles of major bodies of water in Missouri, including major rivers, lakes and reservoirs. Within this, there are 1,050 miles of inland navigable waterways, defined by the U.S. Army Corps of Engineers as those that may be used to transport interstate or foreign commerce. These waterways form the basis of the state's marine freight infrastructure, which includes the ports and vessels that transport cargo into, within and out of Missouri.

Ports and private docks are the facilities that interface with vessels that are traveling on the navigable waterways. These facilities are classified in two different ways. First, public port facilities are run by public port authorities, which cities or counties can form and which are approved by the Missouri Highways and Transportation Commission.[38] Not all public port authorities have port facilities and some port authorities only promote economic development within their jurisdiction. Second, port facilities can be grouped together into Port Statistical Areas, which are used by the USACE to monitor port and waterway activities and track commodity movement. PSAs can span multiple states and can include public and private port facilities.

[37] https://www.modot.org/economic-impact-public-ports-study

[38] Section 68.010 of the Revised Statutes of Missouri

Overview of Marine Highways and Public Port Authorities

From a national perspective, the most significant routes of waterway freight movement happen on the marine highways designated by the U.S. Department of Transportation. Set up in 2007, they are a network of maritime expressways that provide an alternative to the highway and rail networks. They add another layer of redundancy to America's freight network and allow movement by vessels that use less energy and reduced air emissions (including greenhouse gases) per ton-mile of freight moved than by other modes. Figure 4.1 shows the full marine highway system in across the United States.

FIGURE 4.1 MARINE HIGHWAYS IN THE UNITED STATES

Source: U.S. Department of Transportation, Maritime Administration

Missouri occupies a central location in the inland waterways of the marine highway system. The major rivers that are involved include the Mississippi River, Missouri River, Illinois River and Ohio River. They are classified by the Marine Highway System as follows:

- **M-29 –** This highway includes the Missouri River west of Kansas City that runs northwest to Omaha, Nebraska.[39]

- **M-35** – This highway consists of the Mississippi River north of the confluence with the Illinois River and connects St. Louis with Iowa and Minnesota with a northern terminus in Minneapolis-St. Paul.

- **M-55** – This highway encompasses the Great Lakes, the Illinois River and the Mississippi River south of M-35. It makes up much of the eastern border of the state. Further south of Missouri, it forms the western border of Tennessee and Mississippi and the eastern border of Arkansas, and flows through Louisiana and New Orleans into the Gulf of Mexico. It is one of the busiest inland waterways in the country.

- **M-70** – This highway is made up of the portion of the Missouri River that runs between Kansas City and St. Louis and the Ohio River with its southwestern terminus in Cairo, Illinois (which sits on the border with Missouri). The confluence of the Ohio River with the Mississippi river also defines the distinction between the "Upper Mississippi" and "Lower Mississippi."

There are 16 active public port authorities along the marine highways in Missouri, including the following:

- **Upper Mississippi:** Lewis County, Marion-Ralls Regional Port Authority (formerly Marion County), Pike/Lincoln County, St. Charles County, St. Louis City, St. Louis County, Jefferson County, New Bourbon and Southeast Missouri

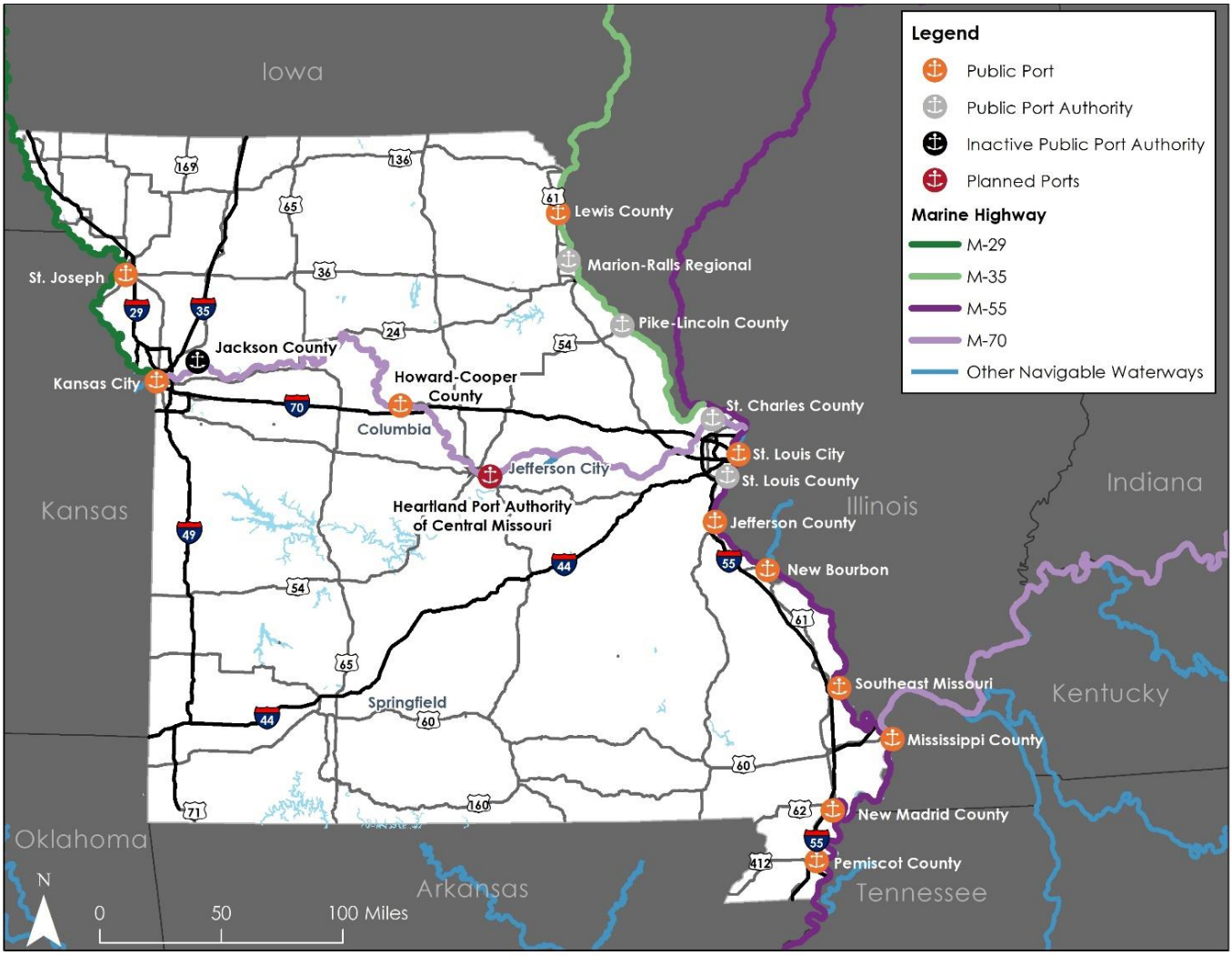
- **Lower Mississippi:** Mississippi County, New Madrid County and Pemiscot Count

- **Missouri River:** St. Joseph, Kansas City, Howard-Cooper County and the Heartland Port Authority of Central Missouri

There is one additional inactive public port authority, the Jackson County Port Authority, located west of Kansas City on the Missouri River. The public port authorities and marine highways are mapped out in Figure 4.2. Additional details about each of the public port authorities and the port facilities they operate (where applicable) are included below.

[39] The portion of the Missouri River connecting St. Louis with Kansas City used to be classified as part of the M-70 highway, but that has changed in recent years. As of January 2020, that stretch of river is now classified as part of M-29, according to the Bureau of Transportation Statistics: https://data-usdot.opendata.arcgis.com/datasets/marine-highways

FIGURE 4.2 PORTS AND MARINE HIGHWAYS IN MISSOURI

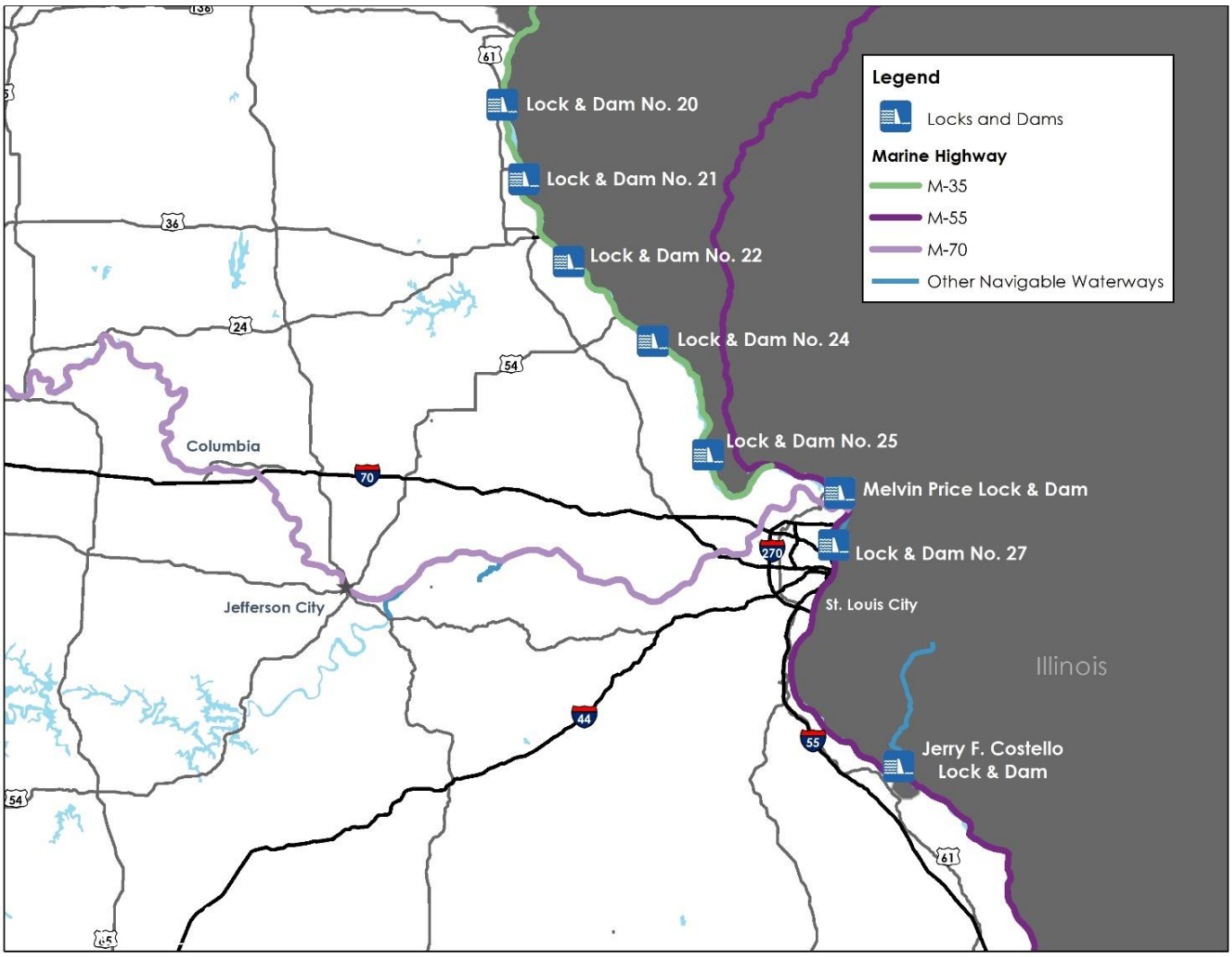


Source: MoDOT; U.S. Department of Transportation/Bureau of Transportation Statistics; Analysis by Cambridge Systematics, 2020

Lock & Dam Infrastructure

The USACE maintains multiple locks and dams along the Mississippi River to control the passage of barge traffic as well as the river levels. There are seven locks along the Mississippi River in Missouri, including Lock & Dam 20, 21, 22, 24, 25, 26 (also called the Melvin Price Lock & Dam) and 27. There is also one lock (the Jerry F. Costello Lock and Dam) that is located where the Kaskaskia River intersects with the Mississippi River. These locks are mapped out in Figure 4.3.

FIGURE 4.3 LOCKS AND DAMS ON THE MISSISSIPPI RIVER



Source: US Army Corps of Engineers; Analysis by Cambridge Systematics, 2020

Public Port Authority Facilities

Port of Metropolitan St. Louis

By far the largest Port Statistical Area in Missouri is the Port of Metropolitan St. Louis. This PSA stretches 70 miles and spans both sides of the Mississippi River and includes America's Central Port, St. Charles, St. Louis City and Jefferson County and numerous private docks in the region. The Port of Metropolitan St. Louis is the third-largest inland water port by tonnage in the United States, moving over 37 million tons of cargo through the port as of 2018. The port moves a significant amount of energy-related commodities such as coal and crude petroleum. Other significant categories of freight moved through the port include farm commodities, such as soybeans and corn and construction-related material such as cement, sand, gravel and asphalt.

Within it is the City of St. Louis Port District, located on the Mississippi River on the eastern border of Missouri with its main terminal, the Municipal River Terminal, located just north of the Stan Musial Veterans Memorial Bridge and I-70. The port offers central access to intermodal connectors within St. Louis and includes a rail spur from a local switching line, the Terminal Railroad Association of St. Louis, which facilitates access to six Class I railroads. The port has a variety of support facilities, such as storage tanks and warehouses, which are leased by a variety of users of both the river infrastructure and connecting modes. In September 2020, the St. Louis Port Authority was awarded U.S. DOT funding, along with America's Central Port in Granite City, Ill., to support the construction of 7,300 linear feet of new railroad track, barge loading equipment modernization, conveyor replacement, loading shed updates and flood mitigation work in and around the Municipal River Terminal.[40]

Port of Jefferson County

The Port of Jefferson County is located approximately 30 miles south of the City of St. Louis's Municipal River Terminal and is also part of the Port of Metropolitan St. Louis PSA. It has been in development by the Jefferson County Port Authority for about a decade, making it one of the newer public ports in Missouri. Past development efforts included a review of three development sites, the construction of a corrosive material dock and the development of a new rail track loop to link with UP and BNSF trains. In January 2018, The Port of Jefferson County signed a memorandum of understanding with Plaquemines Port Harbor and Terminal District in Louisiana. Under this agreement, the two ports will be sister ports, using American Patriot Holdings container transport vessels to move freight between them. This agreement is expected to lead to the Port of Jefferson County being a hub for container vessel service as early as 2023. In the future, there are also hopes that locating additional docks south of St. Louis can avoid issues with bridge clearance that arise as vessels travel further north on the Mississippi River.[41] As of December 2020, these plans are still under development.

Port of New Bourbon

The Port of New Bourbon is located 30 miles further south of the Port of Jefferson County and about 50 miles south of the St. Louis metropolitan area. It is located near U.S. Highway 61, giving it good access to the highway system, and 1 mile from a BNSF main line, so it has the potential for improved connectivity with rail service. It was operated by Beelman River Terminals until 2017; in 2021, Missouri River Terminals, Inc. entered into a new lease with the New Bourbon Regional Port Authority and is the port's current operator.

One of the main users of the Port of New Bourbon is the Mississippi Lime Company, which used the port as an alternative site for when water levels were high. However, the Port was damaged during flooding in 2019 and that facility was taken out of service in May 2019.[42] Additionally, the roads leading to the Port of New Bourbon were also damaged by the flooding.[43] Repairs have since been completed and the port is installing new components at the dock.

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[40] https://www.transportation.gov/sites/dot.gov/files/2020-09/BUILD%202020%20Fact%20Sheets.pdf

[41] https://www.stltoday.com/business/local/jefferson-county-s-port-eyed-for-regional-container-cargo-hub/article_9fe7bb3e-d275-5d56-902d-59132df3f30c.html

[42] https://mississippilime.com/2019/06/mlc-announces-temporary-barging-facility-expected-to-be-in-use-for-several-weeks-in-ste-genevieve/

[43] https://www.mymoinfo.com/update-on-port-road-in-ste-genevieve-county-a-history-lesson-behind-the-name-new-bourbon/

There is also a ferry operated at the port, the St. Genevieve-Modoc Ferry, which is owned by the New Bourbon Regional Port Authority. Though the ferry mainly serves visitors to the historic sites of French Colonial Sainte Genevieve, it also provides a crossing route for area truckers, farmers and industries.

Port of Lewis County

The Port of Lewis County is the northernmost port on the Mississippi River in Missouri. It has several points of connectivity to local highways, through Highway 61 (one of the highest volume non-interstates for freight traffic in the state), as well as rail service provided by BNSF. As of 2015, this port handled approximately 581,000 tons of commodities, including corn, soy, wheat, liquid products and ethanol by-products. In 2019, the port issued a bid for the addition of a transloading facility to further improve its ability to accommodate the movement of commodities between different modes of transport.[44] The port is also currently exploring plans for a secondary dock in Lewis County; however, as of December 2020, a second site has not yet been chosen.

Southeast Missouri Regional Port

The Southeast Missouri Regional Port is located just under 50 miles north of the confluence of the Mississippi River and Ohio River. It is located close to I-55 and is serviced by a short line railroad, the SEMO Port Railroad, that operates between Scott City and Cape Girardeau and connects with BSNF and UP rail lines. These facilities allow for continuous intermodal transport of freight. There are also three pipelines within one mile of the port which handle a variety of petroleum and natural gas products. In addition to these commodities, the port also moves agricultural products like corn, wheat and soybeans and bulk commodities like sand and mulch.

One of the major initiatives that the port has been pursuing has been an increase in its capacity to connect rail vehicles with waterway vessels. In December 2018, the U.S. Department of Transportation awarded the SEMO Port Authority a $19.8 million grant to construct two 12,000 foot long loops of rail track for just such a purpose.[45] The construction of these loop tracks will allow the port to handle unit trains without disrupting the daily freight service provided by BNSF and UP.

Port of Mississippi County

The Port of Mississippi County is small port located approximately four miles south of the confluence of the Ohio and Mississippi River. It is a 19-acre parcel that includes the operation of the Dorena-Hickman Ferry, which transports passengers and freight between Missouri and Kentucky. Currently, the only freight movement happens through trucks traveling on this ferry service. The port also has a barge repair facility available and a dry dock repair facility in place.

Port of New Madrid County

The Port of New Madrid County is located in Missouri near the tri-border area where Missouri, Kentucky and Tennessee meet. According to the data tracked by the USACE, it is the second-busiest port in Missouri by volume, moving 2.2 million tons of commodities in 2018. It provides multi-modal access to freight transit, including a rail spur

[44] https://midamericaport.com/lewis-county-port-authority-announces-the-addition-of-a-transloading-facility/

[45] https://www.kfvs12.com/2018/12/07/m-grant-semo-regional-port-authority-announced-by-lawmakers/

served by UP and close access to I-55. It is dependent on significant maintenance dredging provided by the USACE, without which the port could not operate, as happened in 2013. Its tenants specialize in commodities such as rice, fertilizers, corn, soybeans, aluminum ore and rock/gravel, among others. Just under 1 million tons of commodities move through the port annually. Beginning in December 2019, construction work began on expanding the port to allow over 80 acres of area north of the current facilities to be developed.[46]

Port of Pemiscot County

The Port of Pemiscot County is the southernmost port in Missouri. It has direct access to BNSF railways through a five-mile spur that also includes access to a storage yard and four sidings. The port's location is advantageous because it allows for reliable operation even in low water. Its facilities include a general cargo dock and barge loading areas, and it leases facilities out to several tenants who use the port for storage and movement of goods. The port is expanding rapidly and has increased its rail facilities, and in recent years multiple new tenants have moved on site. The commodities that are moved most frequently through the port include soybeans, distillate fuel oil, fertilizer, corn and wheat. As of 2018, just over half a million tons of commodities moved through the port.

Port of Kansas City

The Port of Kansas City is located on the Missouri River just south of the confluence with the Kansas River. Its operations have been dependent on one primary lessee of its facilities, Kaw Valley Companies, which is capable of handling fertilizer, coal, scrap steel, finished steel products, sand and other bulk commodities. There have been interruptions with port services in the past, most notably with a pause in operations between 2007 and 2015. Operations have been hampered by old infrastructure in the terminal that was in subpar condition. However, since resuming operations, infrastructure investment has improved the condition of the port and it has become one of the fastest growing ports in the Midwest. As of 2018, the port moved over 1.3 million tons of commodities. In April 2020, the Port of Kansas City announced an initiative to fast-track e-commerce and warehousing and distribution facilities to spur construction and capital investment as part of a plan to support recovery from the economic crisis brought on by the COVID-19 pandemic.[47] Additionally, the port is currently developing its Municipal River Terminal, which is slated to become a major warehousing and multimodal port. It is scheduled to open in two years and will include containerized vessel capabilities.

Port of Howard-Cooper County

The Port of Howard-Cooper County is located in the middle of Missouri, near I-70 and Boonville, Missouri. Historically, it has been a very small operation and the Port Authority employed one part-time employee to oversee operations. However, in recent years, there have been plans to expand port operations. There is ample land available for development of facilities and there are opportunities to connect service with several major highways (including I-70) as well as the UP rail service in Boonville. Currently, the port is contracted with MFA Incorporated as its main operator. The port is also rehabbing its dock and constructing additional grain elevators.

[46] https://standard-democrat.com/story/2657691.html

[47] https://portkc.com/port-kc-to-fast-track-ecommerce-and-manufacturing-projects-in-kansas-city-missouri/

Port of St. Joseph

The Port of St. Joseph is located on the Missouri River in St. Joseph, approximately 50 miles north of Kansas City. The port is currently operated by Transport 360. It has access to highways through I-229 and I-29 and railways through a rail spur that serves UP freight lines. In the past, the port had been hindered by high barge rates and delays that can arise during periods of drought or flooding. Because of this, no barges operated at the port between 2011 and 2018. However, in recent years, the port has increased the amount of storage space on-site, leading to the resumption of barge traffic in 2018 and increased traffic in 2019.[48] Commodities that are moved through the port include crops such as soybeans and grain and bulk commodities like fertilizer and steel. Additionally, starting in 2020, the port began moving wind turbine components through its facilities.

Heartland Port Authority of Central Missouri

There is one planned public port under development on the Missouri River in the state's capital of Jefferson City. It will be constructed and operated by the Heartland Port Authority of Central Missouri, which was newly created and approved in September 2018. The port's construction is being planned to have two sites, one on the south side of the Missouri River adjacent to the Missouri National Guard and the other on the north side of the river approximately 1.5 miles west of the south site. This location will give the port easy access to a UP rail line as well as access to the highway system through U.S. Routes 50, 54 and 63.

Prior to the port authority's creation, the Jefferson City Chamber of Commerce, Callaway County and Cole County sponsored and completed a port feasibility study.[49] This study found a favorable result from a benefit-cost analysis of the port's development, strong interest in the port from the private sector and a strong manufacturing industry near where the port will be constructed. In particular, the report noted that the port could be used to boost the economy in an area in the center of the state where there is lower commodity movement by truck traffic.

Following up on this feasibility study, the Jefferson County Chamber of Commerce also released a comprehensive market study that went further into detail about how the port's business model might work, including specific sectors and industries that might realize potential cost savings from this port.[50] This market study also suggested that, if funding assistance can be secured, it may be possible to build the port using a public-private partnership (P3) for construction and operation.

Other Public Missouri Port Authorities

There are five additional public port authorities (one of which is inactive) that lead economic development initiatives but do not presently operate port facilities. They are listed below:

- **St. Louis County Port Authority** – The St. Louis County Port Authority is a branch of the St. Louis Economic Development Partnership, an economic development organization for St. Louis City and County. It promotes

[48] https://www.newspressnow.com/news/local_news/with-increased-port-traffic-is-st-joseph-a-river-town-once-again/article_68ef13aa-b53f-11e9-b60c-2b41da1adb43.html

[49] https://asoft9103.accrisoft.com/jcchamber/clientuploads/Economic_Development/Port%20Authority/Central_Missouri_Multimodal_Port_Feasibility_Study.pdf

[50] https://www.jcchamber.org/clientuploads/Economic_Development/Port%20Authority/200506_HPACM_Comprehensive_Market_Study,_Final_Report.pdf

regional welfare and direct investment opportunities, including assisting with site selection and attracting foreign trade. It also provides grants and financial assistance to community organizations and non-profits. Additionally, in response to the COVID-19 economic crisis, the port authority contributed to the Small Business Resource Program to offer financial assistance to small businesses.

- **Marion-Ralls Regional Port Authority** – Located in the northeastern part of the state and centered in Hannibal, Missouri, the Marion County Port Authority was created to encourage economic development in the region. Though it has been dormant for several years, in March 2020 the Marion County Commission approved a new board of commissioners for the port authority who have started work on establishing a regional effort to create a port.[51] Since then, it has combined with Ralls County to become the Marion-Ralls Regional Port Authority and is planning to apply for FTZ status. Additionally, it is working with an engineering firm to assess potential sites for development and identify potential market strategies.

- **Pike-Lincoln County Port Authority** – The Pike-Lincoln County Port Authority was established in February 2011 and purchased property in 2017 to develop a port in Louisiana, Missouri, located on the upper Mississippi River in the northeast part of the state. It has received funding from MoDOT for general administrative expenses as well as for the development of two industrial parks on the east and west side of the purchased site. Development efforts are ongoing to construct port and other supportive facilities in this area.

- **St. Charles County Port Authority** – The St. Charles County Port Authority was created in January 2020 after the St. Charles County Council submitted an application to the Missouri Highway and Transportation Committee in September 2019. Located northwest of St. Louis, St. Charles County is in proximity with the Mississippi, Illinois and Missouri rivers. The creation of the port authority is the first step in establishing a port somewhere near the confluence of these three rivers. Though a site has not yet been chosen, the St. Charles area offers a strategic location to support barge traffic on the Missouri River, including the potential development of a facility to provide operational support, fueling services and fleeting.[52]

- **Jackson County Port Authority** – The Jackson County Port Authority is located east of Kansas City along the Missouri River. Established in the mid-1980s, it has been inactive since 2015.

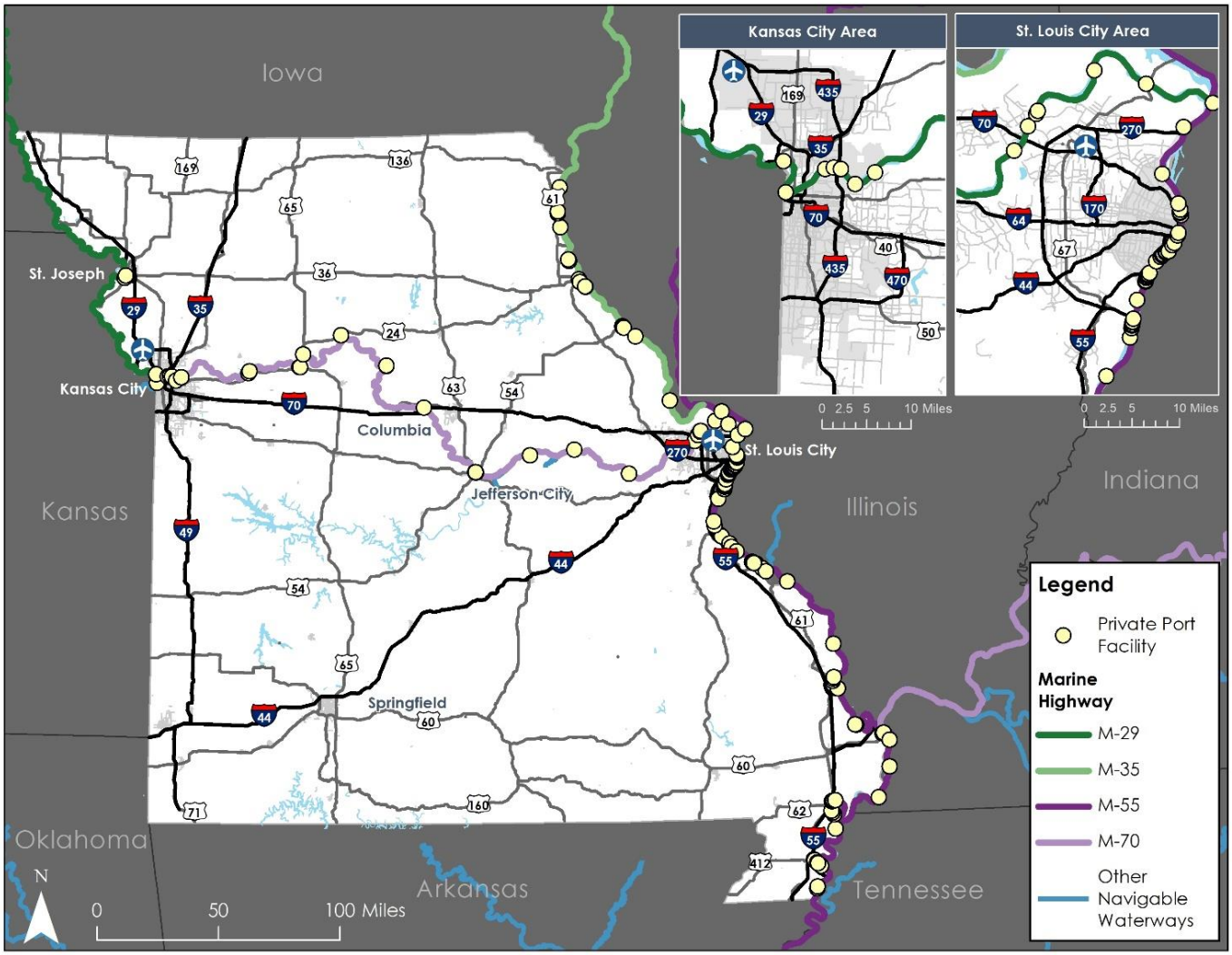
Private Docks and Facilities

In addition to the facilities controlled by public ports authorities in Missouri, there are hundreds of private facilities along the navigable waterways. According to the USACE's Waterborne Commerce Statistics Center, there are over 150 docks maintained along the Mississippi and Missouri Rivers that are not associated with one of the public ports listed above. This can include facilities like grain elevators, storage centers and pipeline infrastructure. These facilities, along with those that are associated with one of the public ports authorities, are mapped out in Figure 4.4. A substantial amount of waterborne freight is moved via the private port facilities, and that data is captured by the USACE as being within the PSA that the private port is associated with.

[51] https://www.hannibal.net/Marion-commission-seats-new-port-authority-board

[52] https://www.sccmo.org/DocumentCenter/View/15537/20-052-Addendum-2-Port-Authority-Strategic-Planning-Process?bidId=

FIGURE 4.4 PRIVATE PORT FACILITIES IN MISSOURI



Source: US Army Corps of Engineers; Analysis by Cambridge Systematics, 2020.

Because these docks are privately owned and operated, there is less information publicly available about their impact on freight services. However, below is a list of notable private port facilities that operate along the navigable waterways in Missouri:

- **Bunge North America** – They are a national agribusiness located in St. Louis. They handle several agricultural and other commodities such as soybeans, canola, oilseeds, grain and food and have a variety of facilities along the Mississippi River.

- **Bussen Quarries** – They are a mining company that move commodities like riprap stone, crushed stone and river sand. They have three plant locations in south St. Louis that supply crushed limestone. They also operate a barge and rail facility near the Jefferson Barracks Bridge.

- **Capital Sand Company –** They specialize in producing and shipping sand and gravel and have various facilities along the Missouri River. The largest facility is the Jefferson City River Terminal.
- **AgriServices of Brunswick –** They are an agricultural and fertilizer company in north-central Missouri. They have a main location in Brunswick, Missouri that has access to rail, barge and highway modes.
- **Holcim** – They are a supplier of cement, crushed stone, gravel, sand and other aggregates. They have a significant production plant in Bloomsdale, Missouri and they also operate two facilities in St. Louis.
- **MFA Incorporated** – They are a farm supply and marketing cooperative who work with farmers in Missouri providing agricultural services and wholesale products. They own private port facilities along the Missouri and Mississippi Rivers that transport dry-bulk fertilizer, liquid fertilizer and grain.

Mid-America Port Commission

The state of Missouri is a member of the Mid-America Port Commission, a partnership of 26 counties from Illinois, Iowa and Missouri. Figure 4.5 shows the counties that make up this commission. The Mid-America Port Commission was established in 1999 to coordinate the logistics of the movement of freight along these rivers and to link the waterways with other modes such as rail, highway and air. In October 2020, the USACE announced that the Mid-America Port Commission was approved as a PSA. It is the largest port district on the Upper Mississippi river and the Illinois river. It is comprised of 59 public and private terminals and oversees the annual movement of 14 million tons of commodities. In Missouri, it will encompass the Pike-Lincoln County Port Authority, the Marion-Ralls Regional Port Authority and the Port of Lewis County.

FIGURE 4.5 DISTRICT MAP OF THE MID-AMERICA PORT COMMISSION

Source: Mid-America Port Commission

4.2 Demand

Users of Ports

This section summarizes the direct and indirect users of ports and provide context for the scale of their activities. Ports serve as an access point for industries and freight producers to move their commodities to and from waterborne transportation. The users of ports therefore start with the transportation providers and port employees who interact directly with ports in this manner. In a broader sense, these actions are reliant first on *port-dependent users*, typically industries who produce various commodities and use marine transportation as one mode to bring their products to markets. Additionally, port activity affects *port-benefitted users*, who use ports and marine transportation to receive commodities that are necessary inputs in their businesses.

More than 40 million tons of freight were moved through the state's ports in 2018, which supported a variety of industries. Table 4.1 provides a breakdown the volume of commodities moved through individual ports tracked by the USACE, which includes the Port of Metropolitan St. Louis, Port of Kansas City, SEMO, Port of New Madrid County and Port of Pemiscot County. The Port of St. Louis handled the highest volume of commodities at over 37 million tons. Note that USACE has a broad definition of the port of St. Louis, and this captures the movement of goods around the central port facilities at both public and private port facilities on both sides of the Mississippi River. Note also that the USACE includes freight moved at private facilities as part of the PSA that that facility is associated, so Table 4.1 includes volumes for both public and private facilities associated with each port.

TABLE 4.1 2018 VOLUMES AND TOP COMMODITIES AT FIVE MISSOURI PORTS

Port	2018 Commodity Volumes (Tons)	2018 Top 5 Commodities (By Tons in All Traffic Directions)
Port of Metropolitan St. Louis		Corn
	Intraport: 1,142,550	Soybeans
	Receipts: 6,632,533	Cement & Concrete
	Shipments: 29,651,627	Coal & Lignite
	All Traffic Directions: 37,426,710	Crude Petroleum
Port of Kansas City		Sand & Gravel
	Intraport: 425,928	Cement & Concrete
	Receipts:773,068	Asphalt, Tar & Pitch
	Shipments:174,288	Soybeans
	All Traffic Directions: 1,374,284	Fertilizer & Mixes Not Elsewhere Classified
Southeast Missouri Regional Port (SEMO)		Sand & Gravel
	Intraport: 0	Wood Chips
	Receipts:136,677	Soybeans
	Shipments: 917,451	Corn
	All Traffic Directions: 1,054,128	Wheat
Port of New Madrid County		Nitrogenous Fertilizer
	Intraport: 0	Soybeans
	Receipts: 791,929	Corn
	Shipments:1,467,619	Rice
	All Traffic Directions: 2,259,548	Aluminum Ore
Port of Pemiscot County		Soybeans
	Intraport: 0	Distillate Fuel Oil
	Receipts: 219,531	Nitrogenous Fertilizer
	Shipments: 300,425	Corn
	All Traffic Directions: 519,956	Potassic Fertilizer

Source: US Army Corps of Engineers; Analysis by Cambridge Systematics, 2020

Table 4.1 also summarizes the most commonly shipped goods at Missouri's ports, with commodities such as corn, soybeans, other agricultural products, energy products, fertilizers and manufacturing materials as the top commodities at Missouri ports. The value of these materials was substantial, estimated to be nearly $8 billion in 2018. According to the National Waterways Foundation, the top three commodities by value in 2018 were basic chemicals used in consumer products (valued at $4.1 billion), cereal grains (valued at $2.4 billion) and agricultural and food products (valued at $536 million).[53] Table 4.1 does not include the substantial amount of freight passing along the marine highways in Missouri without stopping (aside from brief stops for fuel or other supplies).

MoDOT's 2018 Economic Impact Study for Public Ports Study[54] conducted a thorough analysis of levels of individuals supported by this activity. First, at the level of direct employment, it found that just over 1,000 people were employed directly by the ports working in Inland Water Transportation or Water Transportation Support

[53] http://www.nationalwaterwaysfoundation.org/HO_WaterwaysProfile_MO.pdf

[54] https://www.modot.org/economic-impact-public-ports-study

Activities. At port-dependent businesses and port-benefitted businesses, ports support over 200,000 jobs. Additionally, these jobs induce approximately 80,000 through the income being spent by these employees or through other indirect activities supported by the ports.

To identify port-dependent users, the 2018 study focused on those industries that had higher-than-average freight marine modal share. For production and shipments, it found that crop production, nonmetallic mineral products manufacturing, transportation equipment management and mining (except oil & gas) industries all had a higher marine mode share compared to the national average. For freight attraction and receipts, it found that chemical manufacturing, primary metal manufacturing and nondurable manufacturing industries all had a higher marine mode share compared to the national average and crop production, construction and food manufacturing industries had roughly equivalent marine mode share to the national average. All told, the study found that the top 5 freight-producing industries by marine freight modal share were: chemical manufacturing, crop production, primary metal manufacturing, mining (except oil & gas) and nonmetallic mineral product manufacturing. All these industries had at least an 8% marine modal share in Missouri.

In addition to analyzing industries that rely heavily on waterborne transportation to move their commodities, the 2018 study also interviewed shippers, receivers and economic developers to further identify port-dependent industries. These interviews found that fabricated metal product manufacturing and transportation equipment manufacturing industries are also port-dependent. To summarize the economic impact of port-dependent industries, Table 4.2 shows their employment, labor income, location quotient and real economic output that was calculated during the 2018 study. All told, as of 2016, these industries employed just under 110,000 people in Missouri and produced over $20 billion in real economic output as of 2015.

TABLE 4.2 SUMMARY OF DIRECT IMPACTS OF PORT-DEPENDENT INDUSTRIES

Industry Description	Employment (2016)	Labor Income (2016)	Location Quotient (2016)	Real Economic Output (2015)
Chemical manufacturing	19,130	$1.05 billion	1.22	$7.8 billion
Fabricated metal product manufacturing	24,390	$1.05 billion	1.05	$2.5 billion
Crop Production	2,600	$79.2 million	0.44	$3.0 billion
Mining (except oil & gas)	2,770	$114.2 million	1.05	$930 million
Nonmetallic mineral product manufacturing	7,300	$292.2 million	0.96	$776 million
Transportation equipment manufacturing	46,190	$2.9 billion	1.46	$4.9 billion
Primary metal manufacturing	7,030	$296.2 million	0.94	$730 million
Total	**109,410**	**$5.8 billion**		**$20.6 billion**

Source: 2018 Economic Impact Study for Public Ports, using the IMPLAN economic model and data from the U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis

Port-benefitted users are those that benefit from the reduced freight costs that result from marine transportation. The five largest sectors that benefit from port activity are construction of buildings, heavy and civil engineering construction, plastics and rubber products manufacturing, machinery manufacturing and computer and electronic

product manufacturing. All told, these industries support nearly 100,000 jobs in Missouri and have almost $5 billion in annual income impact. Table 4.3 summarizes these benefits.

TABLE 4.3 EMPLOYMENT AND INCOME AT PORT-BENEFITTED BUSINESSES IN MISSOURI

Industry Description	Employment	% of Total	Average Weekly Wage	Average Annual Income Impact
Construction of Buildings	26,480	27%	$1,030	$1.42 billion
Heavy and Civil Engineering Construction	19,690	20%	$1,004	$1.02 billion
Plastics and Rubber Products Manufacturing	16,250	17%	$807	$0.68 billion
Machinery Manufacturing	25,560	26%	$932	$1.29 billion
Computer and Electronic Product Manufacturing	9,530	10%	$1,121	$0.56 billion
Total	**97,510**	**100%**	**$979**	**$4.97 billion**

Source: 2018 Economic Impact Study for Public Ports, using data from the U.S. Bureau of Labor Statistics (2016)

The location of port-dependent and port-benefitted users is concentrated in the urban areas of the state and near the ports, but their impact is not limited to these areas. There are port-dependent or port-benefited users in nearly every county of Missouri, especially crop production, machinery manufacturing and mining businesses. Other industries are more concentrated around the ports and the urban areas, such as chemical manufacturing firms that are frequently located on or near port sites.

Commodity Flow Analysis

In 2018, according to IHS Markit's Transearch data, there was just under 40 million tons of commodities worth $7.6 billion transported into, out of and within Missouri's ports and waterways. Table 4.4 summarizes this trade by direction. Outbound trade made up the majority of trade both in terms of tonnage (73%) and value (54%). Behind that is inbound trade, which makes up 16% of tonnage yet 44% of value of all trade on Missouri's waterways. Intrastate trade made up the smallest component of trade, at 11% of tonnage and 2% of value.

TABLE 4.4 SUMMARY OF FREIGHT TRANSPORTED BY TRUCKS ON MISSOURI HIGHWAYS

Direction	Tonnage (millions)	Percent of Total Tons	Value ($ millions)	Percent of Total Value
Inbound	6.2	16%	3,324.8	44%
Intrastate	4.5	11%	176.3	2%
Outbound	29.1	73%	4,126.9	54%
Total	**39.9**	**100%**	**7,628.0**	**100%**

Source: Transearch, 2018; analysis by Cambridge Systematics, 2020

Note: Data is not available for through flows for ports and waterways.

Table 4.5 summarizes the top commodities transported on Missouri's ports and waterways based on tonnage and Table 4.6 summarizes the top commodities based on value. Three significant agriculture commodities, oil kernels, grain and fertilizer, appear in both tables. This reflects the significant role that agriculture plays in Missouri's economy, especially the parts that use ports and waterways to transport their commodities. Crude petroleum, an energy commodity, also appears on both tables. For the top commodities by tonnage, there are several construction-related commodities, such as gravel or sand and broken stone or riprap. For the top commodities by value, there are also commodities related to chemical engineering and metal mining.

TABLE 4.5 TOP 10 COMMODITIES BY TONNAGE TRANSPORTED ON MISSOURI WATERWAYS

Rank	Commodity (STCC 4)	Tonnage (millions)	Percent of Total Tons	Value ($ millions)	Percent of Total Value
1	Gravel or sand	12.1	30.3%	101.0	1.3%
2	Oil kernels, nuts or seeds	10.9	27.3%	3,742.3	49.1%
3	Grain	10.8	27.1%	1,194.5	15.7%
4	Bituminous coal	5.2	13.1%	162.6	2.1%
5	Concrete products	4.4	11.0%	759.5	10.0%
6	Fertilizers	3.1	7.8%	985.5	12.9%
7	Crude petroleum	2.8	7.1%	1,253.0	16.4%
8	Broken stone or riprap	2.3	5.9%	25.3	0.3%
9	Petroleum refining products	2.3	5.7%	1,738.2	22.8%
10	Portland cement	2.1	5.2%	238.1	3.1%

Source: Transearch, 2018; analysis by Cambridge Systematics, 2020

TABLE 4.6 TOP 10 COMMODITIES BY VALUE TRANSPORTED ON MISSOURI WATERWAYS

Rank	Commodity (STCC 4)	Value ($ millions)	Percent of Total Value	Tonnage (millions)	Percent of Total Tons
1	Oil kernels, nuts or seeds	3,742.3	49.1%	10.9	27.3%
2	Petroleum refining products	1,738.2	22.8%	2.3	5.7%
3	Crude petroleum	1,253.0	16.4%	2.8	7.1%
4	Chemical preparations	1,248.7	16.4%	0.3	0.9%
5	Grain	1,194.5	15.7%	10.8	27.1%
6	Fertilizers	985.5	12.9%	3.1	7.8%
7	Concrete products	759.5	10.0%	4.4	11.0%
8	Blast furnace or coke	668.8	8.8%	0.7	1.7%
9	Primary iron or steel products	538.3	7.1%	0.4	1.1%
10	Misc. industrial inorganic chemicals	416.4	5.5%	0.2	0.6%

Source: Transearch, 2018; analysis by Cambridge Systematics, 2020

More information about the commodities that are transported in Missouri can be found in the Commodity Flow Technical Memo of the Missouri State Freight and Rail Plan.

4.3 Condition & Performance

The condition and performance of ports in Missouri is largely context-dependent at the individual port level. It can be influenced by a combination of the port's scope of services, user base and weather conditions. Information about port-specific condition and performance is detailed in the Infrastructure section (Section 4.1) of this report. To maintain and improve the condition and performance, ports rely on the port Capital Improvement Program (CIP) to assist with expenditures such as dock construction, mooring, site development, access improvements and other capital needs.[55] As of the 2020-2024 planned CIP, Missouri's ports have identified more than $100 million in current port capital improvement needs.

Examples of currently funded capital improvement projects greater than $500,000 include:

- SEMO – raise rail to eliminate flooding as part of a loop track project receiving Better Utilizing Investments to Leverage Development grant funds;
- SEMO – install harbor lead track;
- SEMO – Install west rail tracks #4 and #5;
- Port of Jefferson County – complete dock and passenger ramp to serve cruise passengers in Kimmswick;
- Port of St. Louis – upgrade the existing rail facilities at the Municipal River Terminal to allow large trains;
- Port of New Madrid County – Site preparation for customers, including fill and utilities, to newly acquired port property;
- Pike-Lincoln County Port Authority – West Site Industrial Park initial site preparations of newly acquired property including utility connections.

[55] https://www.modot.org/sites/default/files/documents/Sec07Multimodal_2.pdf

Aging Infrastructure and Flooding Events

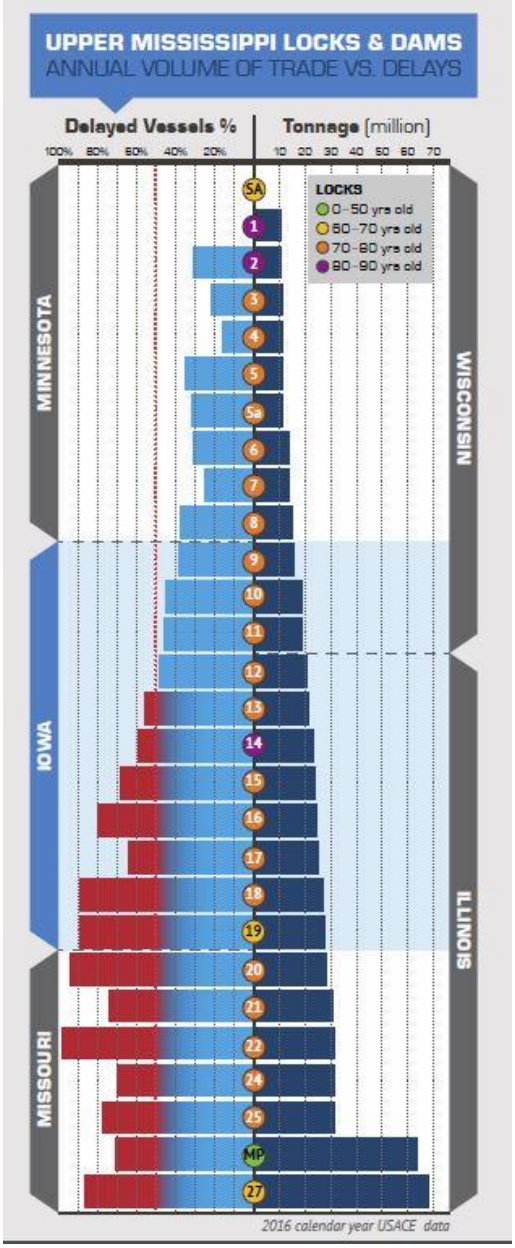
One of the longstanding issues for condition and performance on Missouri's waterways is aging lock and dam infrastructure. Missouri's location along the Mississippi River is at a particularly critical part of the river. In the northern half of the state, the upper Mississippi River is maintained using locks and dams to control the depth of water and allow barge traffic through. The focus of the infrastructure is on maintaining the water depth at a level that is sufficient for safe passage of barges yet not too high to flood the surrounding areas. In the southern half of the state, there is the confluence with the Illinois and Ohio Rivers. The nature of the river changes drastically from there until it reaches the Gulf of Mexico and the water flow is less predictable and requires more control through levees.

There has been uncertainty for years about how to maintain the aging infrastructure that is used to manage these different river conditions. This is the result of the gradual shift in long-established programs for preventative maintenance to a strategy where major lock components are fixed as they fail. This has led to a backlog in maintenance along the entire Mississippi and Illinois Rivers to be estimated at over $1 billion as of FY 2019.[56]

These locks and dams were built in the 1930s and have gradually outlived their useful life. One of the notable issues with their design is that many of them are undersized at 600 feet long and cannot accommodate a standard 15-barge tow configuration, which is 1,200 feet. This requires barge operators to run smaller configurations or break down the barges transport them through the locks. This can lengthen delays that accumulate along the Upper Mississippi River. Figure 4.6 shows the annual trade and the percentage of delayed vessels at each of the locks and dams along the Upper Mississippi River.

In 2018, there were debates at the federal level about the extent to which it, through the USACE, should maintain

FIGURE 4.6 VOLUME OF TRADE VERSUS DELAYS FOR UPPER MISSISSIPPI RIVER LOCKS AND DAMS



Source: Iowa Department of Transportation, "Don't Call These Lazy Rivers," https://www.transportationmatters.iowadot.gov/2018/07/dont-call-these-rivers-lazy.html

[56] https://www.mvr.usace.army.mil/About/Offices/Programs-and-Project-Management/District-Projects/Projects/Article/1164618/backlog-of-maintenance-major-rehabilitation-and-major-maintenance-mississippi-r/

authority along the river.[57] There have been proposals to reduce the role of the federal government in several aspects of this infrastructure's maintenance. One proposal would reduce the federal share of repair projects. Another would transfer the authority from the USACE to state and local officials to control the height of levees along the river. A third example would lead to the use of public-private partnerships to maintain locks and levees, which may lead to barge companies and other users of the river having to pay user fees (such as tolls).

However, these proposals were introduced before many inland waterways experienced unprecedented flooding. In 2019, between January and July, flooding was so widespread that at least 11 states had sought federal disaster funds across more than 400 counties.[58] A picture from flooding experienced in Jefferson City in Missouri is included in Figure 4.7. In Missouri, flooding affected 95 counties, leading to 470 state highways being closed, rail and Amtrak service being suspended, river navigation being suspended and numerous airport closures. MoDOT estimated the total economic cost of delays, closures and damage along highway, rail, air and water transportation routes at over $383 million.[59]

FIGURE 4.7 MISSOURI RIVER FLOODING IN JEFFERSON CITY, MISSOURI IN 2019

Source: MoDOT

This flooding lead to Governor Parson appointing the Flood Recovery Advisory Working Group. Comprised of a variety of organizations and members from state, local and federal governmental organizations, the working group released a list of recommendations in May 2020.[60] It recommended more investment in flood control and navigation infrastructure and to conduct a study to come up with a modern design of levees and other flood control infrastructure. It also recommended that the USACE have more control over the repairs and maintenance of river infrastructure along with authorization to fund repairs at 100% of federal expense. Furthermore, it recommended that Congress funds the USACE to dredge the Upper Mississippi River and modernize the Mississippi River lock and dam system. As of this plan, these debates are still ongoing and the USACE maintains authority for the maintenance and operation of lock and dam infrastructure along the Mississippi River.

[57] https://www.washingtonpost.com/graphics/2018/national/mississippi-river-infrastructure/

[58] https://www.nytimes.com/interactive/2019/09/11/us/midwest-flooding.html

[59] https://dnr.mo.gov/floodrecovery/docs/2019-10-17-frawg-ppt.pdf

[60] https://dnr.mo.gov/floodrecovery/docs/2020-05-31-2019-flood-recovery-advisory-working-group-final-report.pdf

4.4 Key Trends

The 2017 Missouri State Freight Plan focused on measuring trends and prioritizing projects under four goal areas: maintenance, safety, economy and connectivity and mobility. The plan identified multimodal performance metrics within each goal area both for the purpose of screening projects and to track plan implementation (Table 4.7). These metrics were chosen based on both MoDOT's rich history of using performance measurement, exemplified by the MoDOT Tracker,[61] and in consultation with stakeholder groups. Note that only the economy and connectivity and mobility goal areas have performance measures applicable to ports.

TABLE 4.7 GOALS AND PERFORMANCE MEASURES FROM THE 2017 MISSOURI STATE FREIGHT PLAN

Freight Plan Goal	Performance Measure
Maintenance Maintain the freight system in good condition	• *Percent of the major highways in good condition* • *Percent of structurally deficient deck area on National Highway System bridges*
Safety Improve safety on the freight system	• *Number of commercial vehicle crashes resulting in fatalities or serious injuries* • *Rail crossing crashes or fatalities*
Economy Support economic growth and competitiveness	• **Goods movement competitiveness** • **Job and economic growth by key sector, including:** – **Agriculture** – **Manufacturing** – **Transportation/Logistics**
Connectivity and Mobility Improve the connectivity and mobility of the freight system	• **Freight tonnage by mode** • *Annual hours of truck delay* • *Truck reliability index*

Source: MoDOT

Note: Bold text indicates performance measures applicable to ports.

Port Economy

The 2017 Missouri State Freight Plan tracked the annual trends in the cost of transporting three key commodities in Missouri as compared to other midwestern states. Those three commodities are: the cost of shipping one ton of soybeans to New Orleans (largely by barge), the cost of shipping one ton of crop protection to Mexico (largely by rail), and the cost of shipping one motor vehicle to Toronto (by truck) or Los Angeles (by rail). Among these, the metric that applies to ports is the cost of shipping one ton of soybeans by barge. This data was tracked by the MoDOT Tracker through 2017, at which time it cost $10 per ton to ship soybeans, representing a decrease in cost

[61] https://www.modot.org/tracker-measures-departmental-performance

as compared with the 2017 plan (which included data on costs in 2014). However, this metric is no longer tracked by MoDOT.

Additionally, the 2017 plan tracked jobs and economic growth in agriculture, manufacturing and transportation/logistics. This metric was developed in partnership with the Missouri Department of Economic Development. This metric is not specific to any particular mode of freight transport; however, the 2018 Economic Impact of Public Ports Study expanded on the economics of port-dependent and port-benefited industries. In summary, that study has the following conclusions about the key industries of agriculture, manufacturing and transportation/logistics:

- In Missouri, manufacturing is an important port-dependent industry, specifically chemical manufacturing, fabricated metal product manufacturing, nonmetallic mineral product manufacturing, transportation equipment manufacturing and primary metal manufacturing. Together, those industries support over 104,000 jobs in Missouri (as of 2016) with a labor income of nearly $5.6 billion (as of 2016) and real economic outcome of over $16.7 billion (as of 2015).

- Additionally, manufacturing is an important port-benefitted industry in Missouri, specifically plastics and rubber products manufacturing, machinery manufacturing and computer and electronic product manufacturing. Together, in 2016, these industries employed 51,340 people with an average annual income impact of just under $2.5 billion.

- Crop production is another important port-dependent industry. It supported 2,600 jobs in Missouri (as of 2016) with a labor income of $79.2 million (as of 2016) and real economic output of $3.0 billion (as of 2015).

Port Connectivity and Mobility

The performance metric for connectivity and mobility relevant to ports is the freight tonnage by mode. This was tracked by the MoDOT Tracker up through October 2019. As discussed in Section 4.2, in 2018, just under 40 million tons of commodities worth $7.6 billion transported into, out of and within Missouri's ports and waterways. This represents a slight increase in tonnage as compared with past years tracked in the MoDOT Tracker.[62]

[62] https://www.modot.org/sites/default/files/documents/October2019Tracker.pdf

Pipeline Freight Modal Profile

5

Pipelines allow for the efficient transport of many liquid commodities that used in the energy industry, such as oil and liquified natural gas. Their movement can be more complicated on other modes (such as highway or rail) because they are liquid, and thus comparatively heavy. Additionally, these materials are often flammable and toxic, and the use of dedicated infrastructure can help mitigate the potential harm from their hazardous release.

This section provides an overview of the pipeline infrastructure in Missouri, focusing on its location in the Midwest region's pipeline network. It also provides an overview of the organizations and entities responsible for the safe transport of the hazardous materials within the pipelines. Finally, this section examines the quantity and value of commodities that move through Missouri.

Pipelines have a far-reaching impact on the movement of certain goods that are critical to the economy as a whole Therefore, understanding the infrastructure that transports these commodities is an important component of the overall Missouri State Freight and Rail Plan.

5.1 Infrastructure

Pipelines are primarily used for the transportation of energy materials, including raw materials, like crude oil and liquified natural gas and refined products, like gasoline, heating oil, diesel fuel, aviation gasoline, jet fuels and kerosene. A lot of these products are liquid, meaning they would be very difficult to transport through other modes because of their weight, potentially hazardous nature and the quantity in which they are used at their destinations.

Inventory

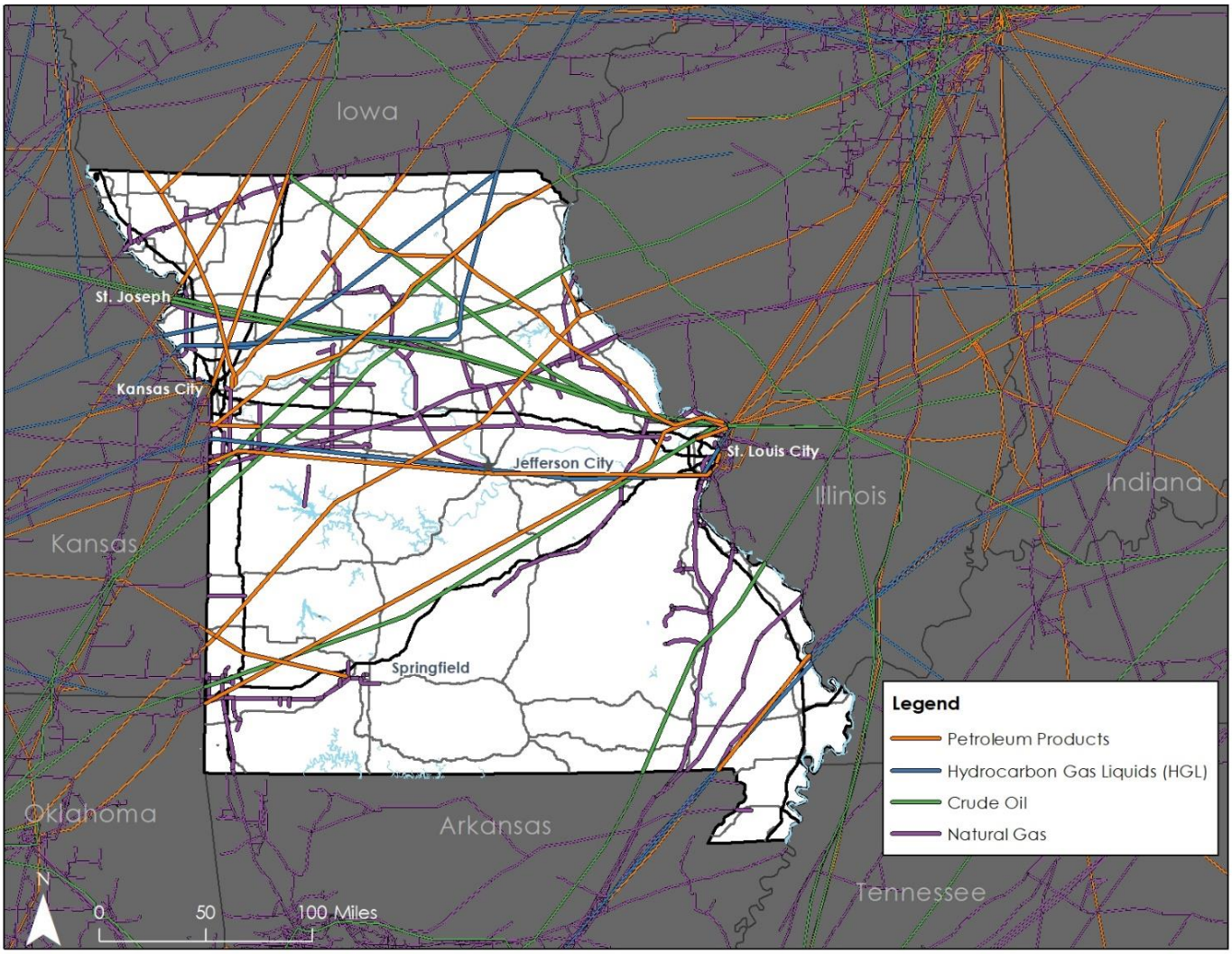
The major types of pipelines in Missouri, as defined by the U.S. Energy Information Administration, are as follows:

- **Crude Oil** – Mixtures of hydrocarbons that formed from the remains of animals and plants that lived missions of years ago and turned to petroleum by heat and pressure.
- **Natural Gas** – An energy source found deep beneath the earth's surface that contains many different compounds, with the largest component being methane.
- **Petroleum Products** – Fuels made primarily from crude oil but also from hydrocarbons contained in natural gas, coal and biomass. The most common products include motor gasoline, jet fuel, distillates such as diesel fuel and heating oil, petrochemical feedstocks, waxes, lubricating oils and asphalt.
- **Hydrocarbon Gas Liquids** – Hydrocarbons that typically occur as gasses at atmospheric pressure and liquids under higher pressure. They are found in raw natural gas and crude oil and are extracted when those raw materials are refined into petroleum products. Examples include ethane, propane, butanes, ethylene, propylene and others.

Figure 5.1 shows a map of the pipelines that run through Missouri in the context of the pipeline network of the surrounding area. Pipelines in general carry materials across a vast distance, first from a source of where the raw materials are collected, then to plants where they are refined and then to their destination where they are used. This means that many of the pipelines in Missouri cross through the state as they move materials between their

origin and destination. However, there are many pipeline destinations in industrial areas of Kansas City and in East St. Louis, Illinois, where several pipelines converge. There are also many destinations for natural gas pipelines within the state, including producing and processing areas and storage and distribution centers. Table 5.1 lists the major pipelines that run through Missouri.

FIGURE 5.1 MISSOURI PIPELINES CARRYING PETROLEUM PRODUCTS, HYDROCARBON GAS LIQUIDS, CRUDE OIL AND NATURAL GAS



Source: U.S. Energy Information Administration

TABLE 5.1 MAJOR PIPELINES IN MISSOURI

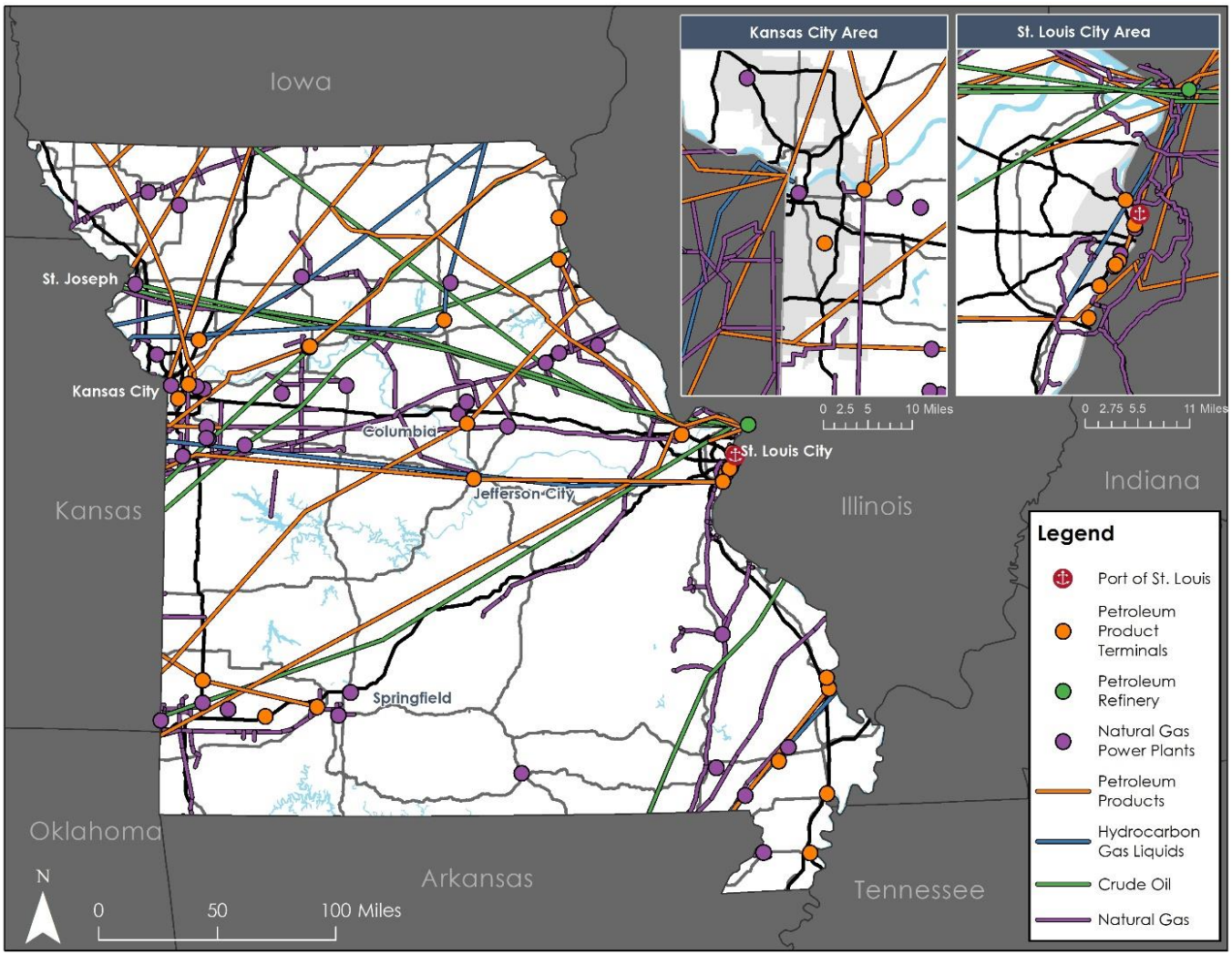
Pipeline Type	Pipeline Name	Operator
Crude Oil	Midcontinent (Ozark)	Enbridge
	Spearhead	Enbridge
	Platte Pipeline	Spectra Energy
	Keystone	Transcanada
	Pakota, IL – Corsicana, Tx	Permian Express Partners
	Minncan Pipeline System	Koch Pipeline
	Cushing – Whiting	BP
Natural Gas	Mississippi River Transmission	Enable Midstream Partners
	MoGas Pipeline	MoGas Co.
	Spire STL Pipeline	Spire
	Natural Gas Pipeline Company of America	KinderMorgan
	Texas Eastern Transmission	Spectra Energy
	Southern Star Central Gas	Southern Star, Inc.
	ANR Pipeline	TransCanada
	Rockies Express Pipeline	Tallgrass Energy
	Panhandle Eastern	Panhandle Eastern Pipeline Company
Petroleum Products	TEPPCO	Enterprise Products
	Houston – Woodriver	Explorer Pipeline
	Magellan	Midstream Partners
	Goldline	Phillips 66 Pipeline
	Buckeye	Buckeye Partners
	Milan - Woodriver	BP
	Oalthe-Carrollton-Gibbs-Ft.Madison	Sinclair Transportation
HGL Pipelines	Mid-America Pipeline	Enterprise Products
	Blue Line	Phillips 66
	North System	OneOK
	Paola-Kansas City	Philips 66
	TEPPCO	Enterprise Products
	ATEX	Enterprise Products

Source: *https://www.modot.org/sites/default/files/documents/MoVehRouteMap-Statewide%5B1%5D.pdf*

Another significant component of pipeline infrastructure is the network of terminals where the liquids carried through the pipeline are either loaded into the pipeline or unloaded for storage or use. Depending on the pipeline material being carried, this can include outlet terminals, refineries, chemical plants, gas plants or power plants. Information about the location and purpose of these terminals is not always publicly available, but facilities for which public information is available are mapped out in Figure 5.2. This includes:

- **The Port of St. Louis** – Contains several petroleum product terminals which can be used to transfer modes between pipelines and barges.
- **Petroleum Product Terminals** - Defined as a terminal which can store 50,000 or more barrels of petroleum or interact with other modes such as tankers, barges and pipelines.
- **Petroleum Refinery** – Industrial plants that transform crude oil into a variety of petroleum products. Of note, the Wood River Refinery, operated by Phillips 66, is in Roxana, Illinois, just to the northwest of St. Louis.
- **Natural Gas Power Plants** - Power plants that use natural gas as a main fuel source for the generation of electrical power. Though they do not connect with natural gas pipeline terminals directly, they are often located near terminals.

FIGURE 5.2 TERMINALS ALONG MISSOURI PIPELINES



Source: U.S. Energy Information Administration

5.2 Safety

Safety is one of the primary concerns for pipelines. This infrastructure transports liquid materials that are often hazardous and flammable, meaning that incidents involving damage to pipelines can rapidly progress to disaster if proper precautions and plans are not in place. At the federal level, pipeline safety is the responsibility of the Pipeline and Hazardous Materials Safety Administration, an agency of the U.S. DOT. It develops, oversees and enforces regulations for the safe, reliable and environmentally sound operation of the nation's pipeline infrastructure. This includes analyzing pipeline safety and accident data, working with state pipeline inspectors and coordinating with the Transportation Security Administration, Department of Energy and Federal Energy Regulatory Commission. It has jurisdiction over pipelines crossing state boundaries (i.e. *inter*state pipelines). In Missouri, at the state level, several commissions oversee pipeline safety. This first includes the Missouri Pipeline Safety Authority, a division of the Missouri Public Service Commission, which has jurisdiction over natural gas pipelines that do not cross state lines (i.e. *intra*state pipelines). Second, the Missouri Propane Safety Commission has jurisdiction over liquified petroleum gas (e.g. propane), one type of HGL. Finally, the Missouri Emergency Response Commission, a division of the Missouri State Emergency Management Agency, is responsible for the statewide hazardous material safety program that oversees county-level emergency response plans for hazardous material emergencies. Together, these agencies work with pipeline operators to ensure the safe operation of pipelines and create plans to respond to any incidents that cause damage to or breaches of pipelines in Missouri.

5.3 Demand

In 2018, according to IHS Markit's Transearch data, more than 89 million tons of commodities worth $26.9 billion were carried into or through Missouri. There were no outbound commodities transported through Missouri's pipelines. The commodities carried were comprised almost entirely of crude petroleum, which made up 99.9% of the total commodities based on both tonnage and value. Liquified gases, coal or petroleum and petroleum refining products were the other two commodities transported through Missouri's pipelines, at least among those that are tracked by Transearch. These two commodities accounted for less than 10,000 tons combined. Approximately 4.9 million tons of crude petroleum worth $1.3 billion was brought into the state of Missouri in 2018. The remaining flows were considered through flows, though some did originate in Kansas City, Kansas.

More information about the commodities that are transported in Missouri can be found in the Commodity Flow Technical Memo of the Missouri State Freight and Rail Plan.

Intelligent Transportation Systems and Technology

6

State DOTs across the United States are continuing to turn to Intelligent Transportation System solutions to solve complex challenges with sometimes limited budgets. ITS technologies advance transportation safety, mobility and productivity by integrated advanced communication technologies into transportation infrastructure and into vehicles. ITS includes a wide variety of technologies that help all road users, many of which are familiar to Missouri's residents including red light cameras and traffic signal coordination.[63] For example, Operation Green Light is a cooperative effort to improve coordination of traffic signals and emergency response on major routes throughout the Kansas City area in both Missouri and Kansas. Reducing delay (both recurring and incident-based) will help speed delivery times and help truck drivers meet pickup and delivery appointments, improving the freight system in the region.[64] The Heartland Freight Technology Plan is another example of regional cooperation to identify, prioritize and recommend critical freight technology.[65]

6.1 ITS Architecture

At the state level, MoDOT maintains documentation about their ITS architecture as part of the Engineering Policy Guide.[66] This architecture divides the ITS architecture into six core ITS programs:

- Commercial Vehicle Operations – oversees the clearance, weigh-in-motion and administrative processing of trucks.
- Incident Management – oversees predicted and unexpected incidents in relation to traffic management and emergency vehicles response.
- Traffic control and monitoring – oversees freeway, surface street and network surveillance for state traffic.
- Traveler and Weather Information – Oversees the broadcasting and information dissemination related to traffic and weather.
- Transit management – tracks the location and operations of transit vehicles
- Maintenance and construction operations – monitors information related to maintenance and construction services.

At the regional level, the East-West Gateway Council of Government completed a comprehensive update of its ITS architecture for the St. Louis Metropolitan Region in 2015. This region is one of the busiest metropolitan areas in Missouri and one that has significant truck traffic.[67] This plan sought to improve mobility and safety by standardizing and improving information collection and dispersion among various stakeholders. It included updates to numerous

[63] https://www.its.dot.gov/factsheets/benefits_factsheet.htm

[64] https://www.marc.org/Transportation/Programs/Operation-Green-Light/About-OGL

[65] https://www.marc.org/Transportation/Plans-Studies/pdfs/HFTP_FinalPlan_508Certified.aspx

[66] https://epg.modot.org/index.php/910.4_ITS_Achitecture

[67] https://www.ewgateway.org/transportation-planning/transportation-systems-management-operations/intelligent-transportation-system/

technical systems and required extensive coordination among state and local agencies to streamline the flow of data among those entities and allow external platforms to use that data for web and phone applications. Specific to freight, it also improved the ability of agencies to administer freight services, communicate with trucks and monitor cargo such as hazardous materials.

6.2 ITS Inventory

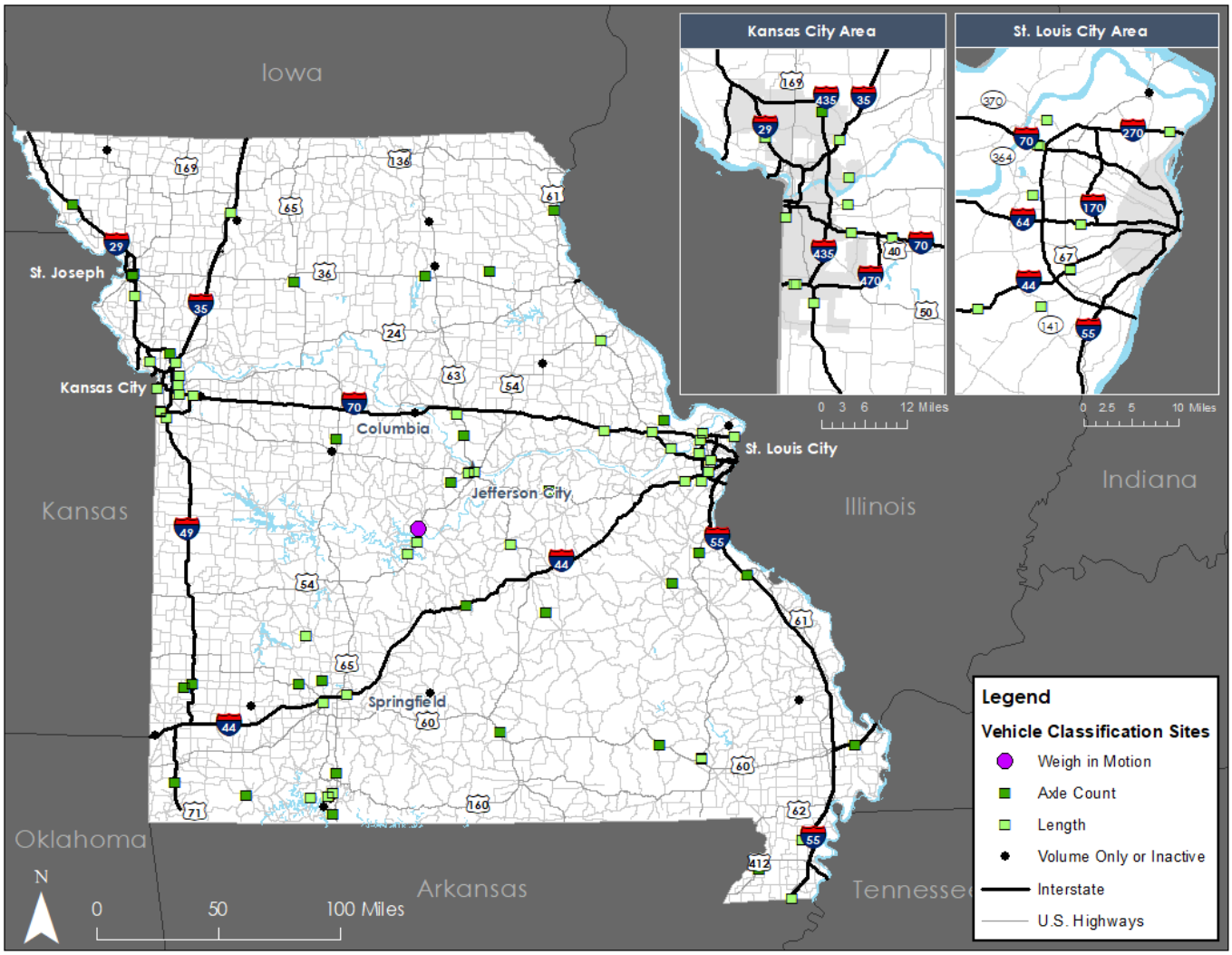
This section inventories ITS technology in Missouri. The first two categories include data collecting and distribution methods that target a wider audience. The last set of technologies are those that are specific to freight movement.

Vehicle Classification Counters

MoDOT operates 170 vehicle counter locations across the state covering a wide range of interstate, U.S. and state highways, shown in Figure 6.1 below. Of these, approximately 137 are able to distinguish truck traffic from automobile traffic and provide truck counts. These include:

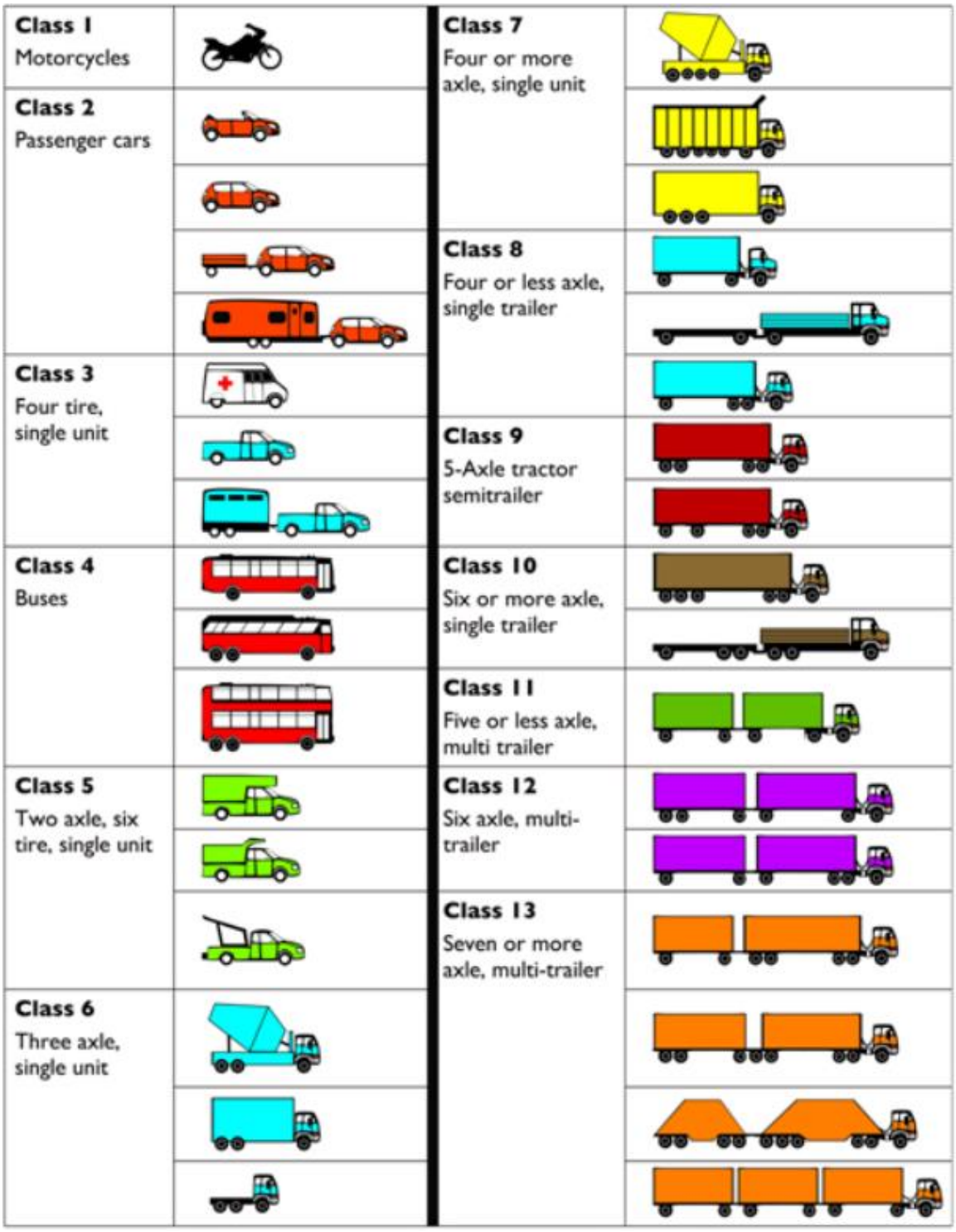
- 2 weigh in motion sites which collect vehicle weight information;
- 57 axle count sites which determine vehicle type based on the number of axles (see Figure 6.2 below);
- 78 length count sites which determine vehicle type based on overall vehicle length; and
- 33 sites which only collect total volume data or are inactive as of April 2020.

FIGURE 6.1 MODOT VEHICLE CLASSIFICATION COUNT SITES



Source: MoDOT, Analysis by Cambridge Systematics (2020).

FIGURE 6.2 FHWA VEHICLE CATEGORY CLASSIFICATION



Source: FHWA

Freight-Related ITS

Within the freight world, some specific technologies are becoming more common as a way to improve freight safety, mobility and compliance. These freight-specific ITS deployments in Missouri are discussed in the following sections.

Commercial Vehicle Operations

MoDOT's Commercial Vehicle Operations program also relies on ITS to help keep freight moving safely. There are three relevant pieces including:

1. An administrative processes package for applications, processing, fee collection, credential issuance and tax filings to help increase efficiency and accuracy of data;
2. An electronic clearance package to help enforcement target riskier vehicles for roadside safety checks and
3. A weigh-in-motion package to help enforcement identify overweight vehicles.

The first piece of ITS is public-facing through the MoDOT Carrier Express portal and aids businesses in Missouri by reducing time and costs associated with registering and operating trucks.[68]

The other two pieces are used by Missouri's Commercial Vehicle Enforcement Division of the Missouri State Highway Patrol to screen trucks on the road and focus their time on high-risk vehicles and drivers while allowing safe and legal drivers and trucks to bypass enforcement. This saves compliant drivers time and improves safety and infrastructure preservation efforts by removing oversize/overweight or unsafe vehicles and drivers from the highway.

As discussed in the Highway modal profile of this plan, the Missouri State Highway Patrol operates 21 weigh stations throughout the state to enforce vehicle weight laws. Of these, 19 are equipped with additional technology to improve site efficiency and help officers focus their efforts on vehicles most likely in violation of size, weight or safety regulations. This technology includes:

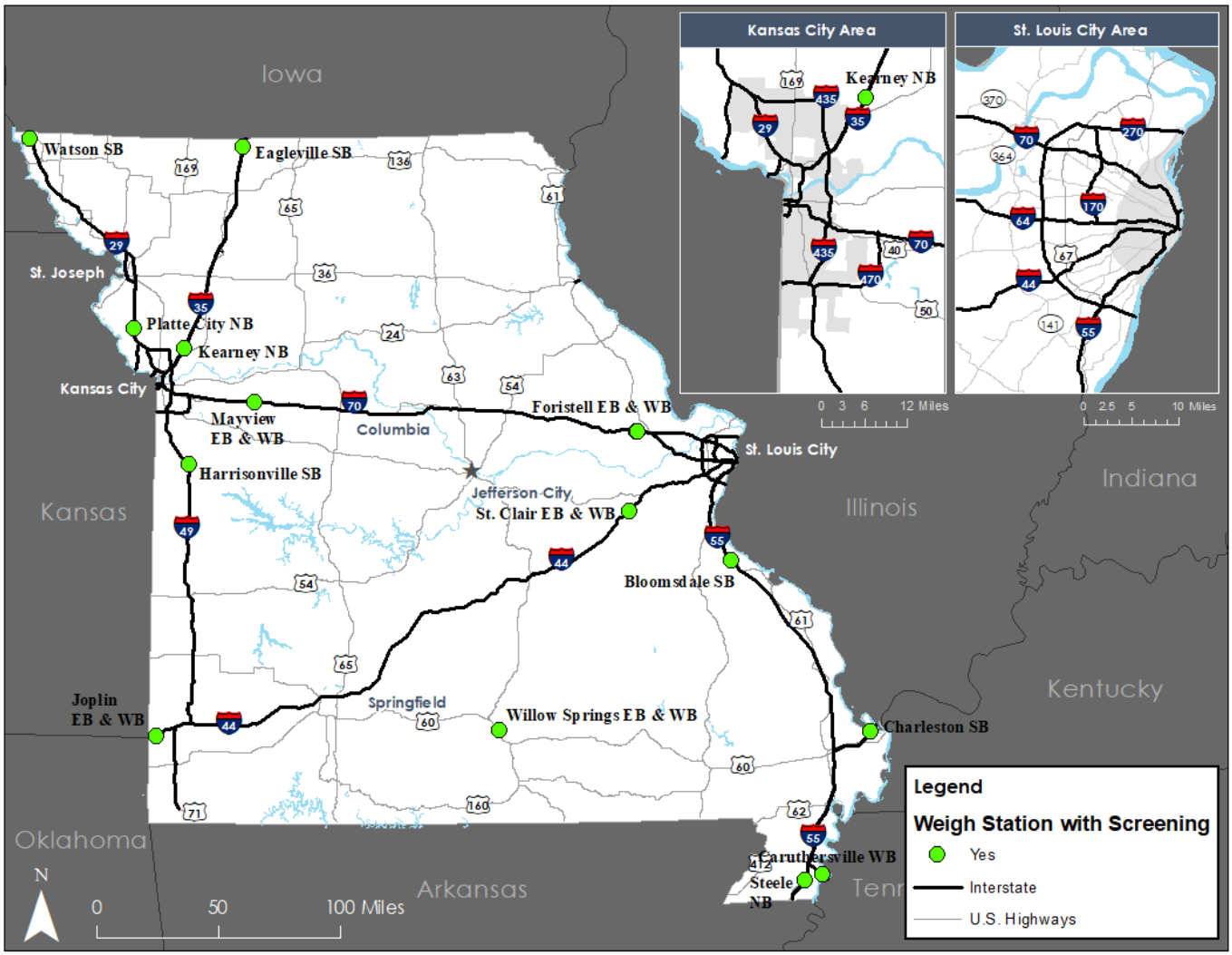
- 19 sites with PrePass and Drivewyze. These companies offer subscribers the possibility of bypassing sites and staying on the highway if enrolled companies are of legal weight (measured using a WIM on the highway) and have current credentials and a good safety rating;
- 3 sites with license plate and U.S. DOT number readers. These technologies can identify any truck entering the site, allowing enforcement to check credentials, safety and other data while the vehicle is moving;
- 1 site with a radiological detector which can detect radiation emitted from nuclear devices; and

[68] https://mcs.modot.mo.gov/mce/login.htm

- 4 sites with additional WIM on the entrance ramp to the site. Trucks go over these at lower speeds than WIM on the highway, providing a better weight estimate and allowing enforcement to better target potential violations that must be verified on a site's static scale.

These 19 locations are shown in Figure 6.3. Note that some locations are paired (located across from each other on opposite sides of a divided highway) and appear as a single location in the map. Labels identify these locations with direction of enforcement (e.g., "Joplin EB & WB" is two locations).

FIGURE 6.3 ELECTRONIC SCREENING LOCATIONS IN MISSOURI



Source: MoDOT, 2020.

These locations play a critical role in safety, infrastructure preservation and economic competitiveness for the state. Enforcing safety regulations protects both the trucks and the motoring public by removing unsafe drivers and vehicles from the road and preventing incidents. Enforcing weight limits helps preserve Missouri's highway infrastructure as overweight vehicles or axles can damage pavement and bridges. Both weight and safety enforcement help ensure a level playing field for companies operating in the state, making sure that everyone is

"playing by the rules." Using screening technology makes enforcement more efficient, allowing them to target the highest risk vehicles out of the thousands that pass these locations each day.

In addition to approximately 1.1 million weighings on static scales, MSHP officers performed 75,027 commercial vehicle inspections and detected 137,863 violations and 30,295 out-of-service violations which are infractions which prevent the vehicle/driver from returning to the road until the issue is addressed.[69]

Truck Parking

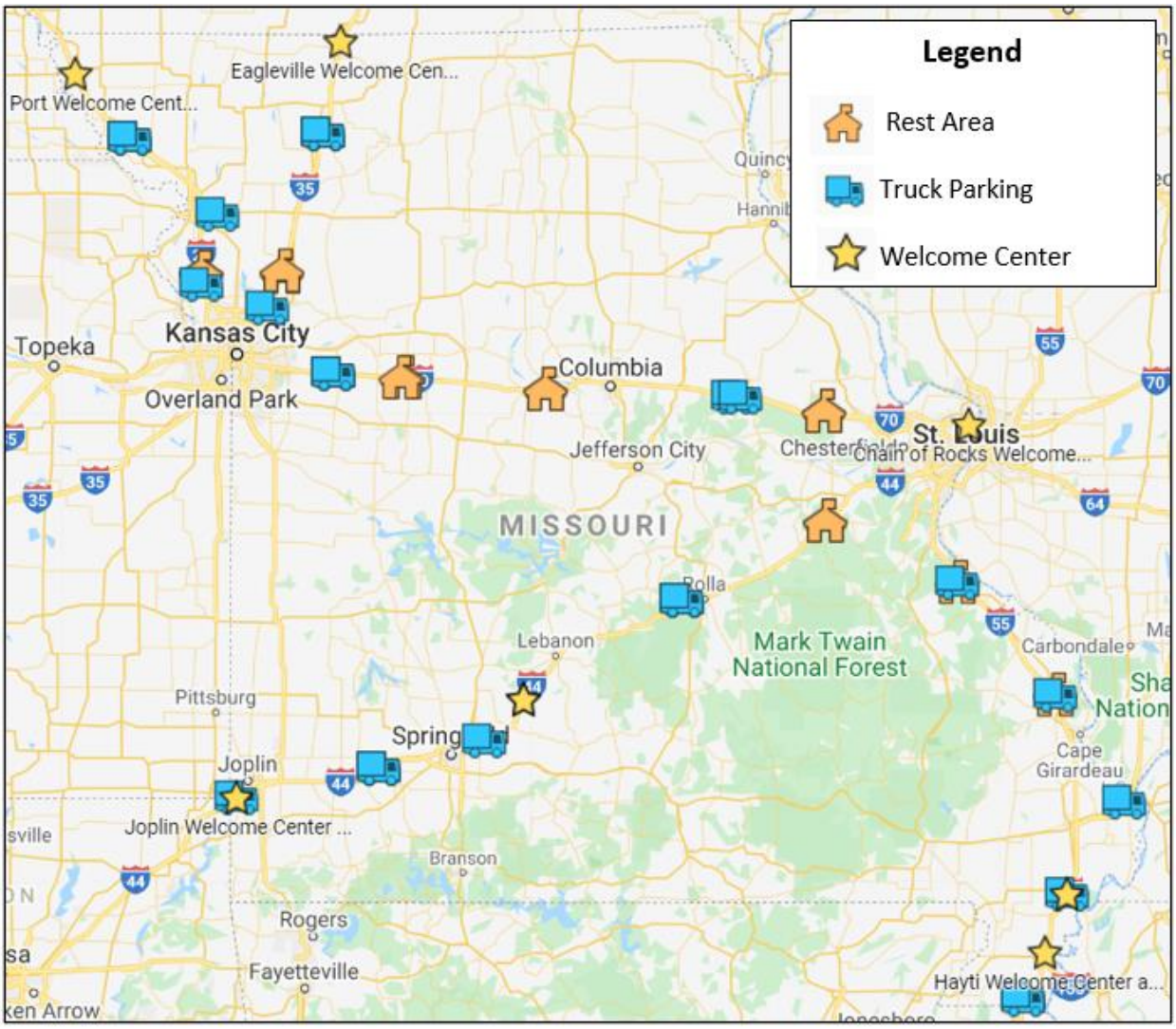
As discussed in detail in the Truck Parking chapter, Missouri has several publicly operated truck parking options statewide, including eight welcome centers, 14 rest areas and 24 truck-only parking sites. The locations of these facilities are available on MoDOT's website (see Figure 6.4).[70] Missouri is not a participant in the Mid America Association of State Transportation Officials truck parking information and management system deployment, which encompasses eight states in the mid-west (see Figure 6.5) and the state is not currently collecting real-time truck parking availability information.

Although information about the number of occupied or available spaces is not available in real-time, MoDOT's online map does include information about the total number of spaces at each location as well as amenities, hours and contact information.

[69] http://www.mshp.dps.missouri.gov/MSHPWeb/Publications/OtherPublications/documents/2018AnnualReport.pdf

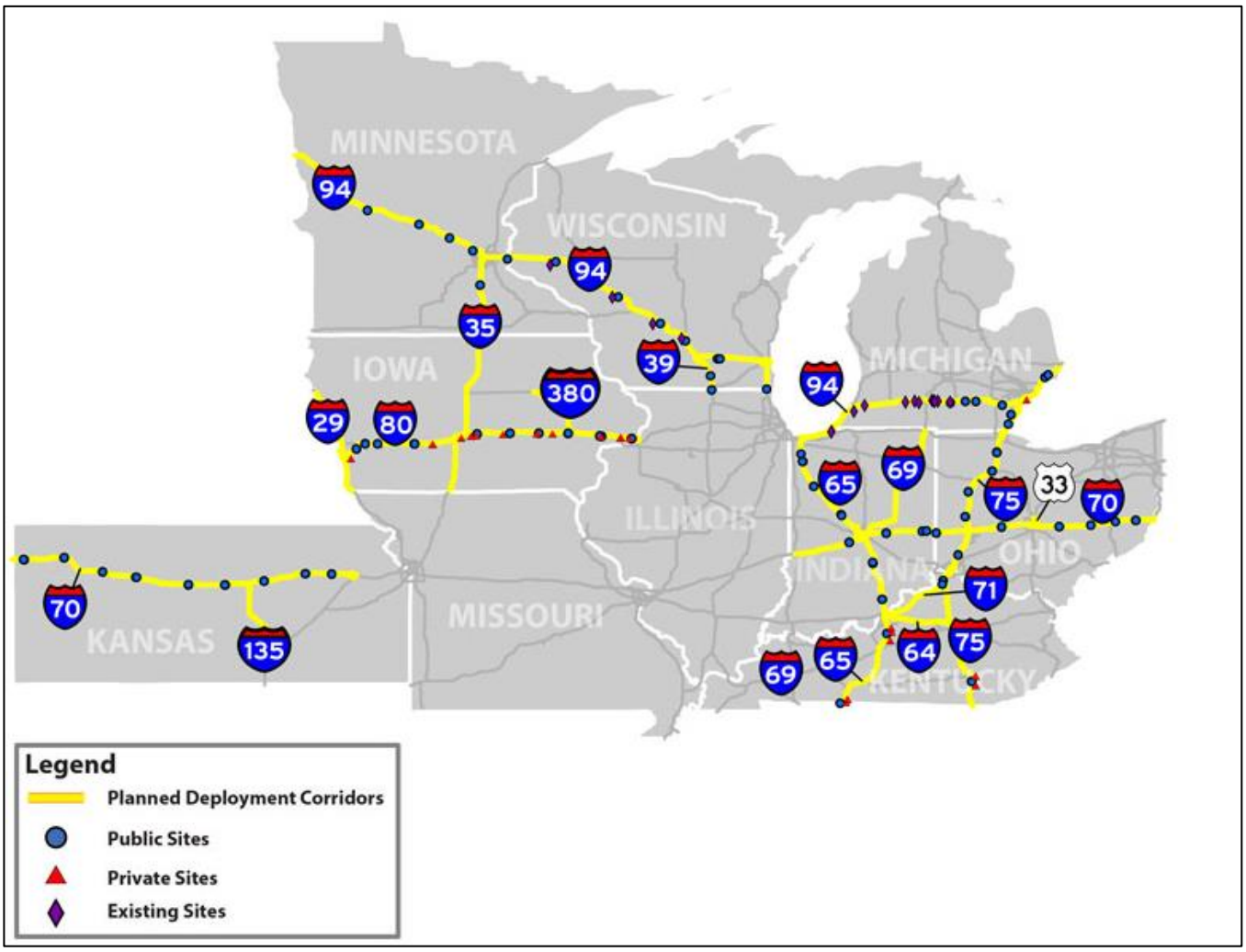
[70] https://www.modot.org/missouri-rest-area-guide

FIGURE 6.4 PUBLICLY OWNED TRUCK PARKING LOCATIONS IN MISSOURI



Source: https://www.modot.org/missouri-rest-area-guide

FIGURE 6.5 MAASTO TRUCK PARKING INFORMATION DEPLOYMENT CORRIDORS



Source: *https://trucksparkhere.com/projectdetails/*

Port/Intermodal Facility Data

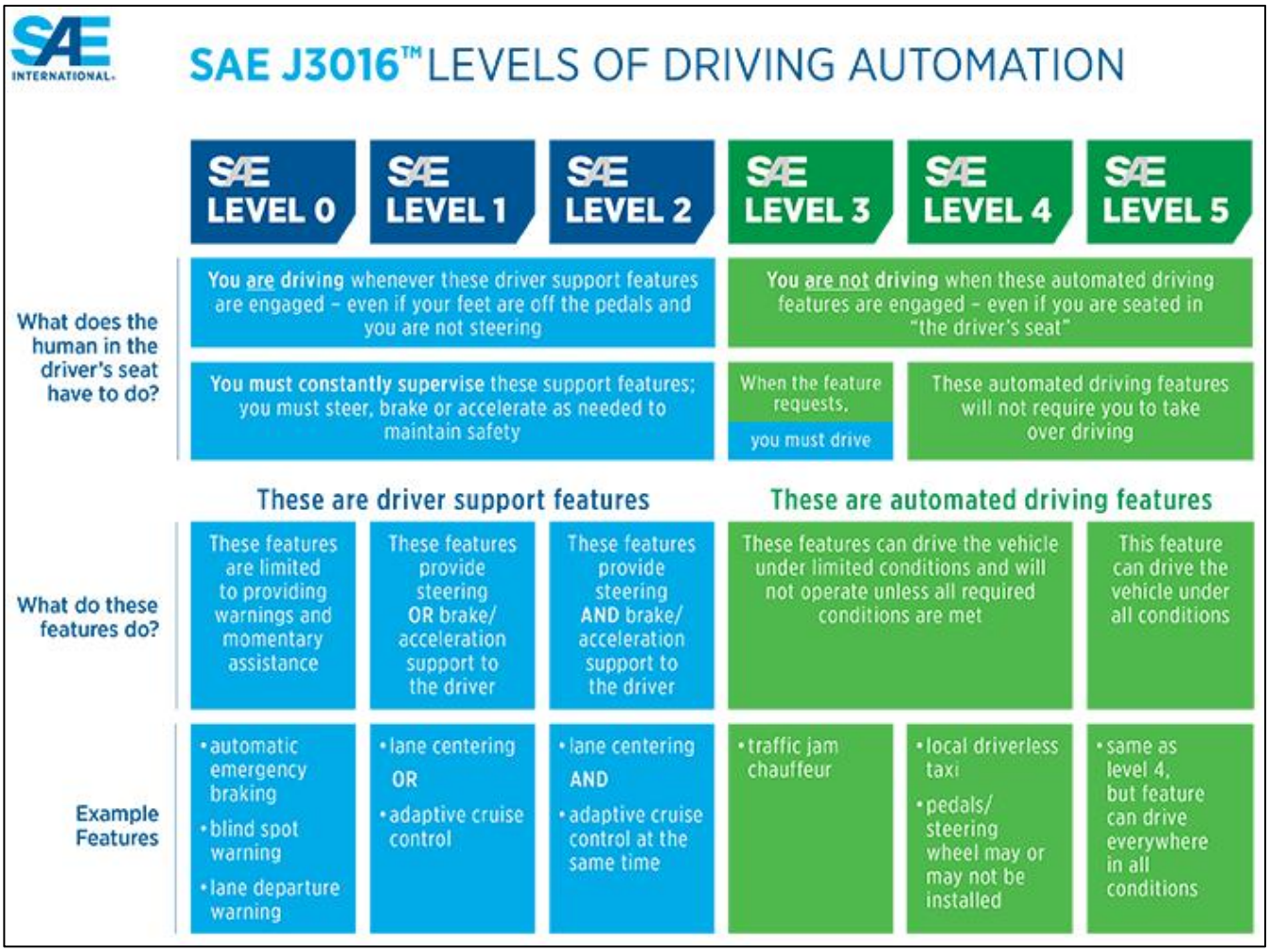
Missouri currently has 16 active public port authorities located throughout the state, primarily clustered on the east side of the state along the Mississippi River. This includes larger ports located in major cities like St. Louis or Kansas City as well as developing ports located in other parts of the state. Ports are covered in detail in Section 4.0. There is limited real-time information available detailing activity at these ports. The Inland Rivers Ports & Terminals association offers a mobile app that provides notification for any navigation notices issued by the U.S. Coast Guard and USACE.[71] However, there is presently no system or application providing real-time information about port activity or delays that may impact land-based freight movement.

[71] https://www.irpt.net/introducing-irpts-mobile-app/

Connected and Automated Vehicle Testing

A notable emerging technology is the use of connected and automated vehicles systems that either assist the driver while operating a vehicle or control the vehicle outright. The degree of automation has been classified by the Society of Automotive Engineers between Level 0 (no automation) and Level 5 (complete automation) as shown in Figure 6.6 below.

FIGURE 6.6 SOCIETY OF AUTOMOTIVE ENGINEERS LEVELS OF DRIVING AUTONOMY—UPDATED INFOGRAPHIC

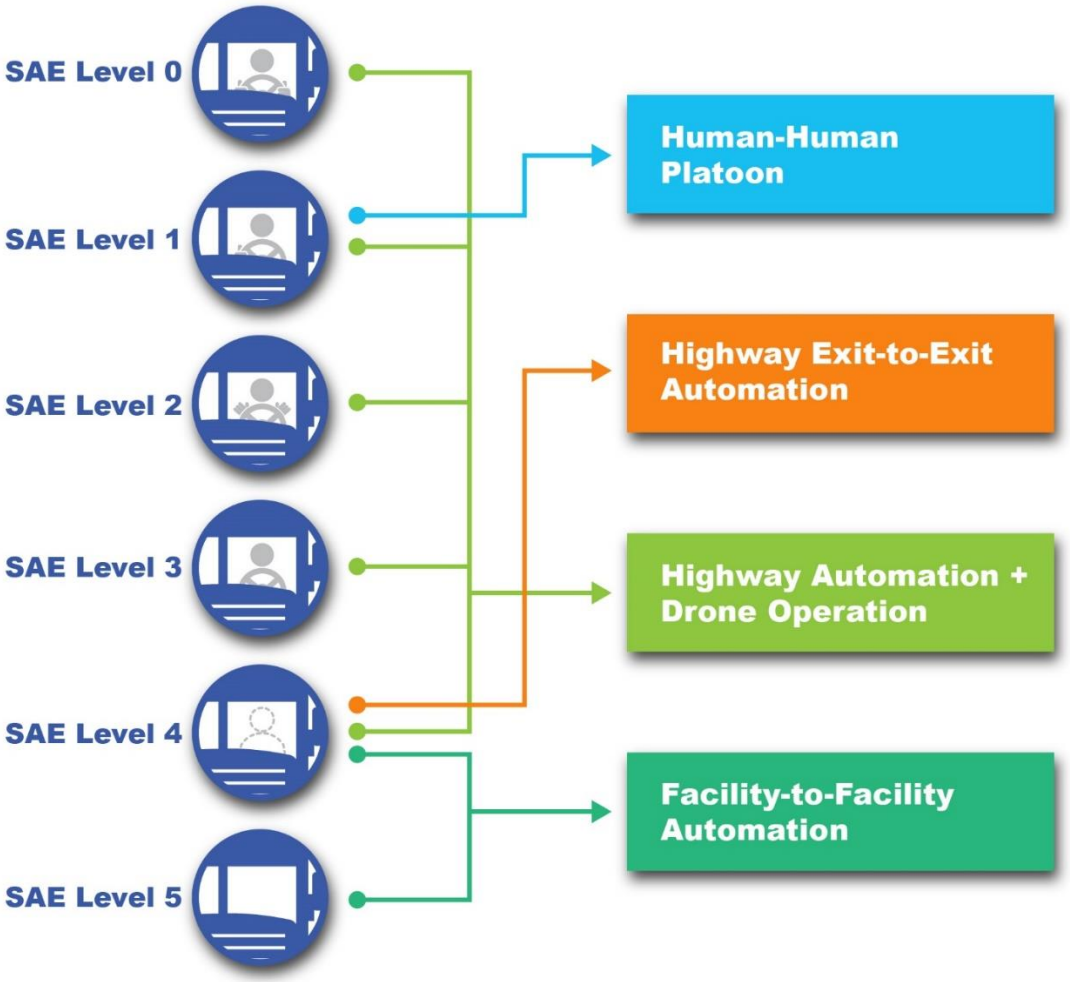


Source: https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic

Recent work for the Commercial Vehicle Safety Alliance revealed that companies are developing SAE Level 1, Level 2 and Level 4 vehicles at this time, with Level 1 and Level 2 vehicles already operating in the United States. SAE Level 4 commercial motor vehicles are still in development and testing phases, but some are carrying commercial loads with a safety driver onboard and ready to take control of the vehicle. More recently, stakeholders have indicated some exploration of SAE Level 3 deployment as an interim step towards SAE Level 4 although the blending of responsibility between human and machine is a key challenge for developing SAE Level 3 vehicles.

Within these broadly defined SAE categories, there are different use-scenarios, including platooning, highway exit-to-exit automation, highway automation with remote (drone) access and facility-to-facility automation (when facilities are located close to a highway interchange). The interaction between SAE levels and potential use-scenarios is shown in Figure 6.7 below.

FIGURE 6.7 INTERACTION OF SAE LEVEL AND CURRENT/ANTICIPATED USE-SCENARIOS



Source: *https://www.cvsa.org/inspections/inspections/resources/cvsa-fmcsa-ads-report/*

MoDOT has experimented with autonomous trucking in an effort to improve the safety of its work zones (Figure 6.8). This includes using autonomous trucks that block lanes and have rear attenuators attached to reduce the damage to drivers and vehicles in the event of a collision. In 2019, MoDOT partnered with the Colorado Department of Transportation to submit a pilot proposal for a U.S. DOT Automated Driving Systems Demonstration

grant to test this technology at larger scale;[72] however, they were not among the grants that were awarded in September 2019.[73]

FIGURE 6.8 AUTONOMOUS TRUCKS IN MISSOURI WORK ZONES

Source: *https://www.modot.org/autonomous-truck-mounted-attenuators-and-flagger-vehicles*

The private sector has also been experimenting with a variety of ways to incorporate autonomous trucking into its operations. For instance, a Springfield, Mo.-based trucking company, Wilson Logistics, recently launched a three-year pilot program to use platooning in two-truck convoys, where the driver in the lead truck controls the truck that is following.[74]

Though there are numerous firms expanding the use of CAV technologies, challenges remain. One of the factors that makes the adoption of CAV more complicated is that there is limited federal legislative or policy framework in place to guide consistent practices and govern the standards of this technology. As of March 2020, according to the National Conference of State Legislatures, 30 states have enacted legislation regarding CAVs, 6 states have executive orders in effect and 5 states have both (see Figure 6.9). Missouri presently has neither legislation nor an executive order related to CAVs,[75] and is one of 13 states that does not allow truck platooning (SAE Level 1).[76] Work continues at the federal level and within organizations such as CVSA and the American Association of State Highway and Transportation Officials to develop guidance/best practices and harmonize state and federal regulations and laws on this topic. The recently completed Heartland Freight Technology Plan notes that while public agencies will not directly invest in CAV, they can help support implementation by harmonizing regulations

[72] https://cms8.dot.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/351311/25-colorado-dot.pdf

[73] https://www.transportation.gov/av/grants

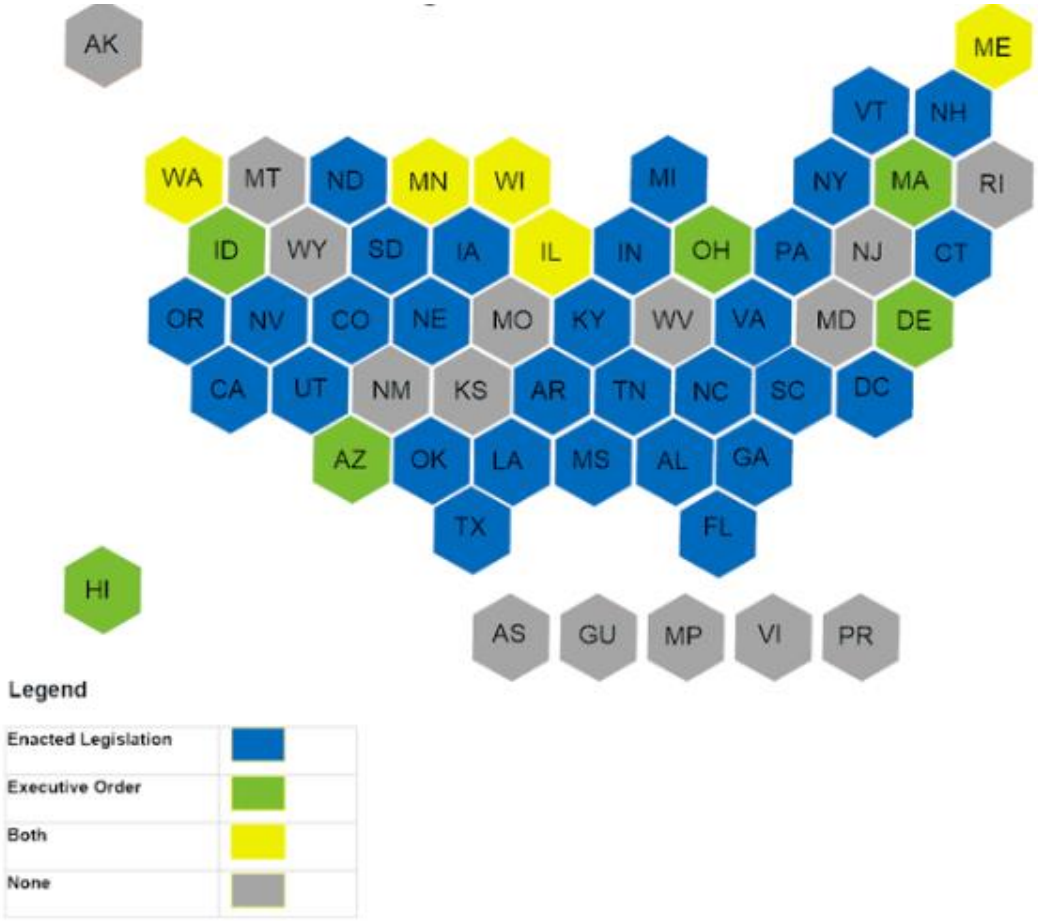
[74] https://www.ttnews.com/articles/autonomous-tech-company-locomation-signs-deal-wilson-logistics?utm_source=technology&utm_medium=newsletter&utm_campaign=newsletter&mkt_tok=eyJpIjoiWTJJM1lqSTNObUk1WlRrdyIsInQiOiJXeVhiMG01Q3N4VURtM1NnNk8zUHdTZUE0bndMOVlDaXRMRmJRUUtzdlI1R01VbUZmUFlOTklwVXZUS3ZGS3Zhck12XC9XbE82SzFnTnJyMFluR2dUTkdua0dvRGJVVVp6cHBqbEdjRmRZUE1iYmZxXC9hV05xZWxndVd3TzFQWEJrIn0%3D

[75] https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx

[76] https://peloton-tech.com/platooning-regulatory-status/

and ensuring that infrastructure such as road signage and markings and work zone information is up-to-date. The Technology Plan encompasses southwestern Illinois, Iowa, Kansas, Missouri and Nebraska. Working together to address CAV issues as well as broader ITS issues such as big data, communications and information exchange and enforcement and inspection approaches will help the entire region be more economically competitive.[77]

FIGURE 6.9 STATES WITH AUTONOMOUS VEHICLE ENACTED LEGISLATION AND EXECUTIVE ORDERS (MARCH 2020)



Source: https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx

Dedicated Truck Lanes

Dedicated truck lanes are separate highway lanes intended to carry only trucks as a way to improve freight mobility, increase regional economic competitiveness and reduce safety issues for all users by eliminating the mix of trucks with passenger vehicles. MoDOT has been one of the leaders in studying this approach through two key efforts:

[77] https://www.marc.org/Transportation/Plans-Studies/pdfs/HFTP_FinalPlan_508Certified.aspx

- The Interstate 70 Corridor Environmental Impact Statement and Record of Decision (2009) which recommended DTLs;[78]

- The I-70 Corridors of the Future planning effort in coordination with Illinois DOT, Indiana DOT and Ohio DOT (2011). This study examined the construction of DTLs along an 800-mile corridor between Kansas City, Missouri and the Ohio border with West Virginia.[79]

While this approach has been studied, at this time MoDOT does not have plans to implement dedicated truck lanes.

Drones

Unmanned aircraft systems, also known as unmanned aerial systems or colloquially as "drones" are a growing area of research for freight movement. In early 2018, Boeing began testing an "unmanned electric vertical-takeoff-and-landing cargo air vehicle" at its research lab in St. Louis, Missouri. The CAV is capable of lifting a 500 pound payload and is another step towards automated delivery of goods and packages via drone.[80] Drones offer an interesting approach to solving last-mile delivery needs, especially for smaller packages. Currently Alphabet, Inc. offers commercial service in limited parts of the U.S. (rural Virginia) and around the world through its company Wing,[81] and other companies, including UPS and Amazon (Prime Air), are conducting tests.[82]

Manufacturing Trends

Manufacturing is a major part of Missouri's economy, making up 9.44% of the Missouri workforce and 12.82% of the total economic output of the state in 2019, according to the National Association of Manufacturers.[83] Manufacturing output has grown considerably in the state in the past decade, from approximately $32 billion in 2008 to just under $41 billion in 2018. The top three categories of manufacturing that experienced the most growth in 2018 were pharmaceuticals and medicine; aerospace products and parts; and navigational, measuring, electromedical and control instruments (see Figure 6.10).

All three of these categories are potential growth sectors for a sub-category of manufacturing called additive manufacturing, colloquially known as 3D printing. This approach uses computers, modeling software and specialized printers using liquid, powder or sheet material to "print" three-dimensional objects.

AM has the potential to disrupt the traditional supply chain by removing the need to have specific parts made in one location and shipped to another. Instead, the design of that part can be digitally transmitted and printed at a location closer to where the part will be used while at the same time reducing the need for sourcing material from around the globe. This shortening of supply chains on both the inbound and outbound sides could have a significant impact

[78] http://www.improvei70.org/pdf/FinalI70SEIS.pdf

[79] http://www.maasto.net/2011presentations/024.I70MAASTO.pdf

[80] https://www.theverge.com/2018/1/10/16875382/boeing-drone-evtol-cav-500-pounds

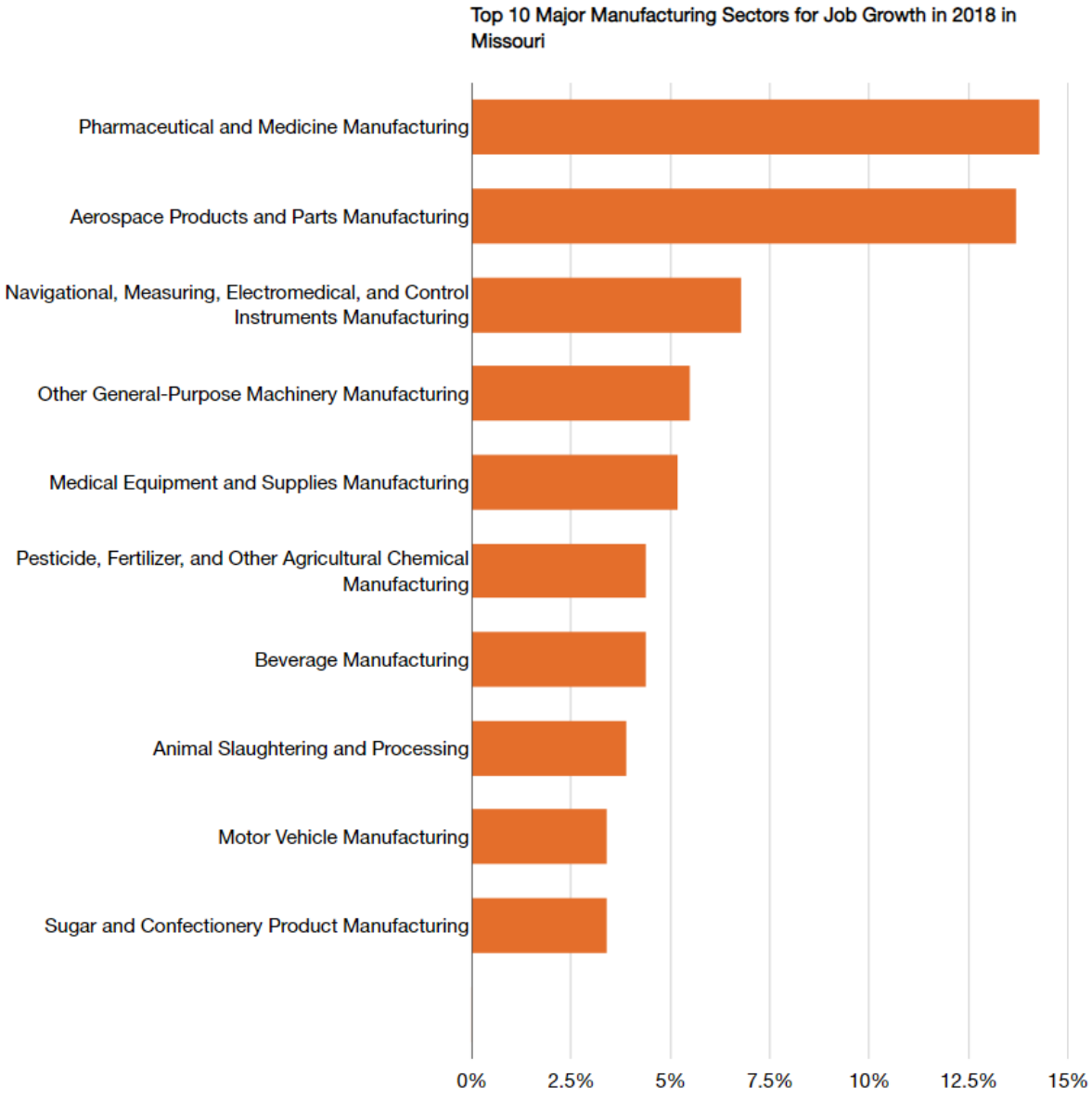
[81] https://www.bloomberg.com/news/articles/2020-04-08/alphabet-s-delivery-by-drone-surge-to-stay-at-home-customers?sref=ExbtjcSG

[82] https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011

[83] https://www.nam.org/state-manufacturing-data/2019-missouri-manufacturing-facts/

across all transportation sectors, with a particular impact on trucking which could see up to 25% of the current demand impacted by AM.[84] Aerospace and motor vehicle manufacturing are two industries expected to be heavily affected by AM which could be of particularly importance to Missouri's manufacturing sector.

FIGURE 6.10 TOP 10 MAJOR MANUFACTURING SECTORS FOR JOB GROWTH IN 2018 IN MISSOURI



Source: *http://am.org/state-manufacturing-data/2019-missouri-manufacturing-facts/*

[84] https://cait.rutgers.edu/wp-content/uploads/2018/05/cait-utc-nc19-final.pdf

6.3 Benchmarking

Table 6.1 provides a comparison of key ITS technologies in Missouri and a number of surrounding states including Illinois, Kansas, Nebraska, Arkansas and Indiana.

TABLE 6.1 FREIGHT-RELATED ITS BENCHMARK

Topic	Missouri	Illinois	Kansas	Nebraska	Arkansas	Indiana
Number of truck enforcement sites with electronic screening	19	20	8	19	13	8
Publicly-provided truck parking availability information	Inventory online, no availability	None, IDOT conducting a Truck Parking Study (2020)[85]	MAASTO TPIMS - 22 locations	None	Rest area locations only (no inventory, no availability)	MAASTO TPIMS – 19 locations
Automated/Connected vehicle regulations (testing, allowing operation, etc.)	No	Yes	No, platooning working group formed[86]	Yes	Yes	Yes
Truck restrictions (weight limits, vertical clearances, etc.) on 511 website or similar?	No	Yes (Getting Around Illinois)	No	Yes (construction related only)[87]	Yes (weight restricted bridges and highways)	Yes (construction related only)[88]

Source: FMCSA ITD Program, NCSL, applicable state traveler information websites.

[85] https://idot.illinois.gov/Assets/uploads/files/Transportation-System/Pamphlets-&-Brochures/Freight-Council/013020/IDOT%20TP%20ISFAC%20Meeting%201%20Draft%20_2.pdf

[86] See Slide 4: https://wisconsindot.gov/Documents/about-wisdot/who-we-are/comm-couns/maasto-presentation.pdf

[87] Posted bridges are available on a separate website, see: https://prodmaps2.ne.gov/Html5NDOT/index.html?viewer=WeightRestrictedBridges

[88] Vertical clearance restrictions available on a separate website, see: https://www.in.gov/indot/2416.htm

Freight Generators

7

7.1 Introduction

Freight movements are a derived activity based on the location of the sources of production for raw materials and intermediate goods and the consumption of those goods within an economy. Businesses within the Agriculture, Forestry, Fishing and Hunting; Mining, Quarrying and Oil and Gas Extraction; or the Manufacturing industry sectors are generally considered to be producers of freight. As producers of freight, they are primarily engaged in growing crops, raising animals, harvesting timber, fish or other animals, extracting mineral solids, liquids and gases from the earth or the transformation or assembling of materials into something else. These producers of freight account for roughly 16% of Missouri's employment with manufacturing responsible for the majority of those employees (Table 7.1).

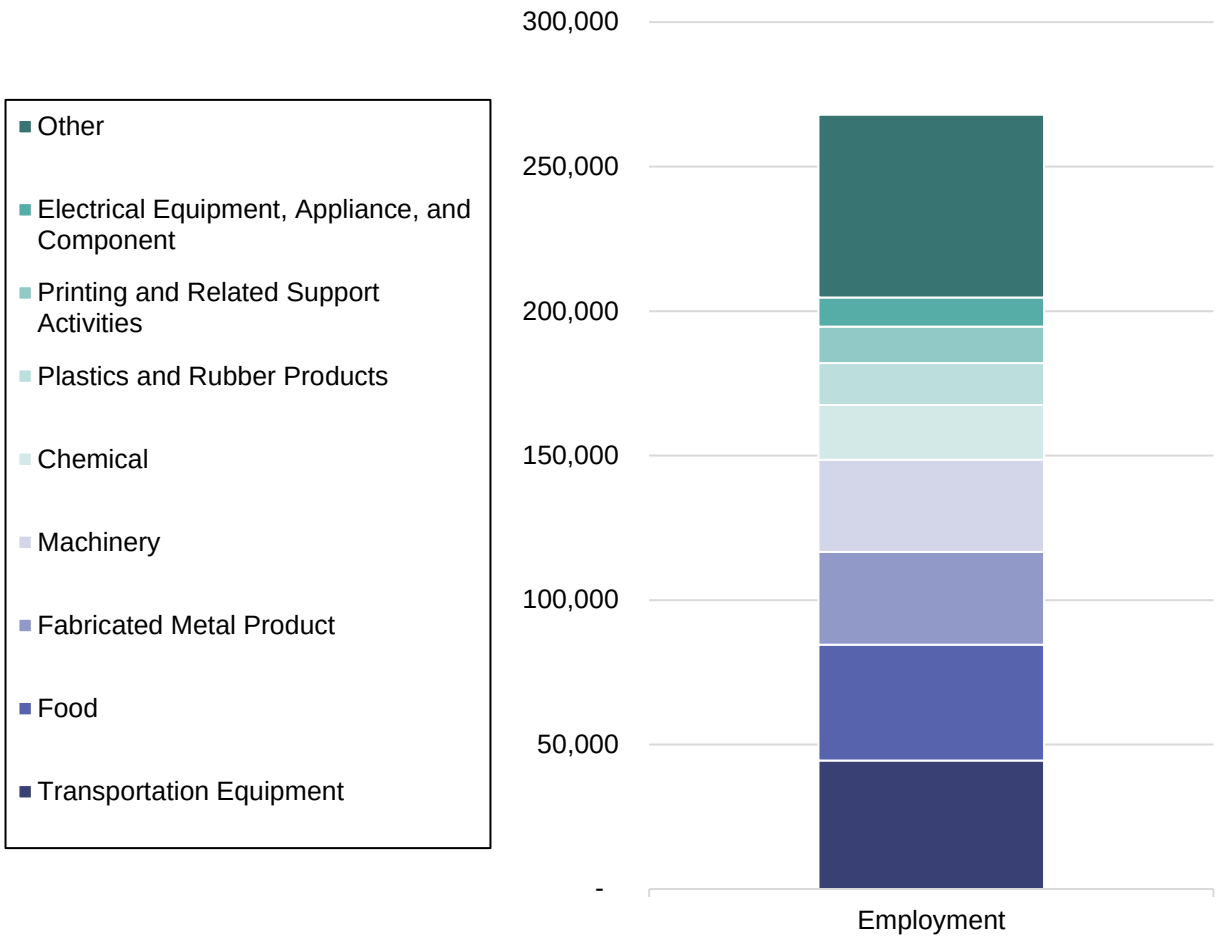
TABLE 7.1 MISSOURI EMPLOYMENT BY FREIGHT GENERATION TYPE[89]

	Industry Sector	Employment
Producers	Agriculture, Forestry, Fishing & Hunting	156,634
	Mining, Quarrying and Oil & Gas Extraction	3,633
	Manufacturing	267,907
Services	Transportation & Warehousing	97,053
	Waste Management & Remediation	7,046
	Utilities	15,587
Attractors	Construction	129,188
	Wholesale Trade	130,913
	Retail Trade	307,751
	Food Services & Drinking Places	237,073
	Non-Freight	1,342,383

Transportation equipment manufacturers represent the top manufacturing subsector in the state by employment comprising roughly 17% of all manufacturing employees (Figure 7.1). Companies within this subsector include all of those manufacturing motor vehicles and motor vehicle bodies, trailers and parts that make up a finished motor vehicle as well as manufacturers of equipment for other modes including aerospace products and parts, railroad rolling stock, ships and boats and other transportation equipment. The food manufacturing subsector was a close second with 15% of the state's manufacturing employment. Food manufacturers include those companies producing dairy, meat, fruit, vegetables, bakery, grains and cereal products. Both the fabricated metal products and machinery subsectors accounted for about 12% of the manufacturing employment.

[89] Based on 2018 CBP data and 2017 AAR and 2017 USDA census of agriculture data updated using the agriculture support services growth factor from 2017-2018.

FIGURE 7.1 MISSOURI'S TOP MANUFACTURING SUBSECTORS BY EMPLOYMENT



According to the 2017 USDA Census of Agriculture, the state was home to 95,320 farms covering a total of 27.7 million acres. Missouri livestock and poultry farms sold more than 286 million broilers, 13 million hogs and pigs and 45,000 cattle and calves. Statewide, farms harvested nearly 13.5 million acres producing 563 million bushels of corn for grain and 37 million bushels of winter wheat. Missouri farm employment was more than 156 thousand in 2018. While mining activity employment in the state only totaled more than 3,600, the industry produces large volumes of raw materials.

Companies in the Transportation and Warehousing industry sector and those in the Waste Management & Remediation subsector account for about 4% of the state's employment. These companies do not produce or attract freight, but rather leverage equipment and facilities to provide carry and storage services as it moves within supply chains. In 2018, trucking companies alone employed more than 40,000 people. Warehouses employed more than 14,000, while companies providing transportation related support activities to the various modes including couriers and messengers employed more than 10,000 each. The Association of American Railroads reported railroad employment to be 7,272 in 2017.

A number of industry sectors are generally considered to be attractors of freight as they bring in inputs to produce energy, construct buildings and engineering projects such as new roads and bridges or bring in goods and finished

products to sell to other businesses and consumers. These attractors of freight account for three of out every ten Missouri employees. The other half of Missouri's businesses can generally be thought of as being 'Non-Freight' related.

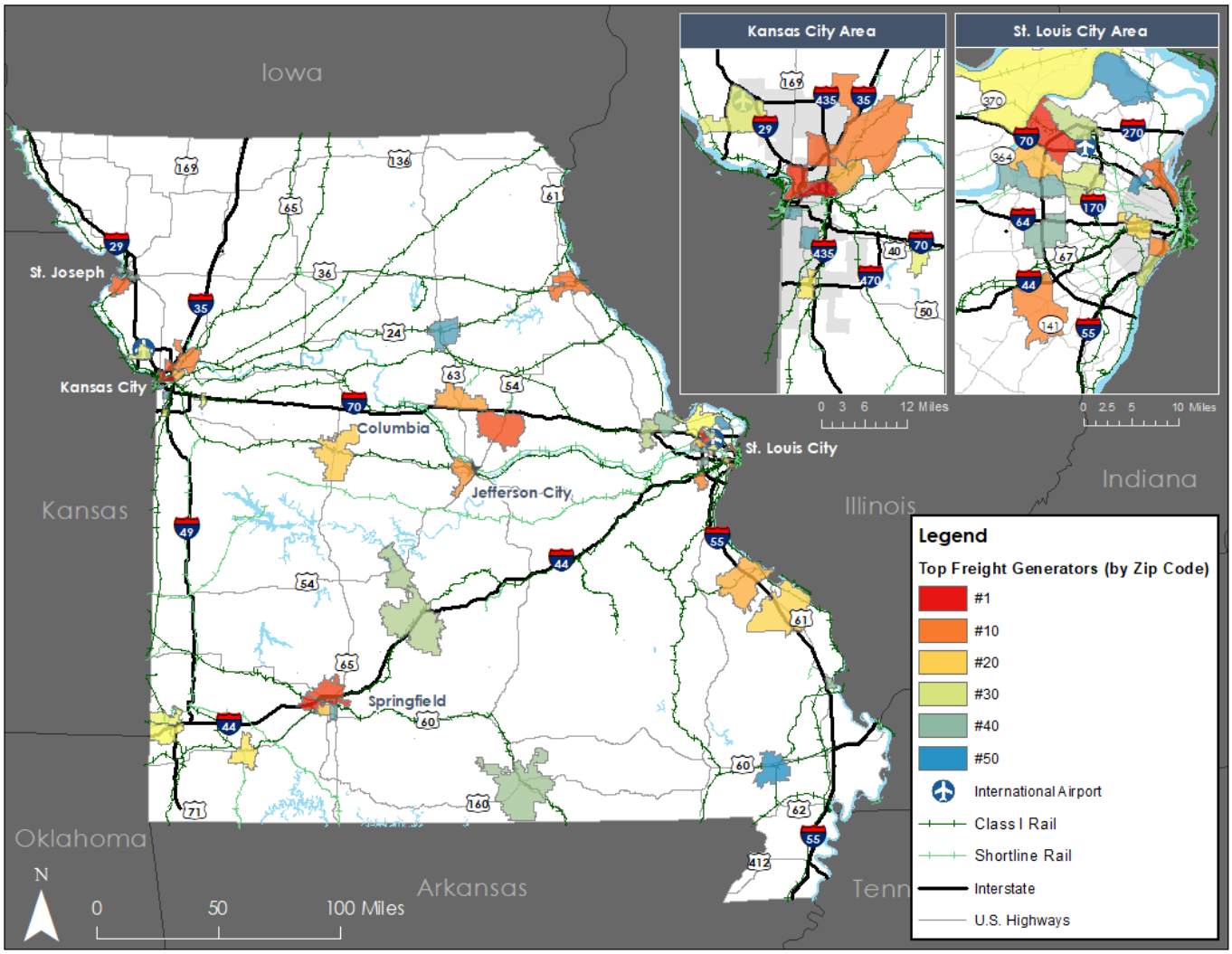
IHS Freight Finder and private sector bill of lading data are two sample-based datasets that allow for the estimation of freight at a more granular level than statewide or county. IHS uses known business locations along with estimated employment, sales and size of facility footprint to estimate the annual inbound and outbound flows of up to five commodities per business. The BOL data is comprised of actual bill of lading records, which is a required document to move a freight shipment, working as a receipt of freight services and a contract between a freight carrier and a shipper. The records include information related to the shipment's origin and destination, weight, mode, equipment type used to carry the shipment and associated costs. Both samples provide industry classification information and can be aggregated to a larger geographical area such as ZIP codes.

The Missouri IHS data sample includes roughly 135 million tons from more than 5,400 freight generating businesses across 497 of Missouri's 1,024 5-digit ZIP codes. The subsectors with the highest coverage include merchant wholesalers of both durable and non-durable goods, manufacturers of fabricated metal products, miscellaneous manufacturers, specialty trade contractors, manufacturers of machinery products and building material and garden equipment supply retailers. The Missouri BOL shipments included nearly 6,900 distinct Missouri addresses in 729 ZIP codes totaling approximately 10 million tons. The BOL sample included the highest coverage of shipments by transportation equipment manufacturers, food manufacturers, durable and non-durable goods wholesalers, manufacturers of electrical equipment, appliances and components, machinery manufacturers, miscellaneous products, chemicals and plastics and rubber.

The IHS Freight Finder and private sector BOL data were utilized to identify freight activity throughout the state at the 5-digit ZIP code level. The goal of the analysis was to identify the locations where freight activity is the highest based on the volumes of freight movements. The analysis used a weighted-ranking scheme to combine the IHS and the BOL data samples into a single ranking of ZIP code freight generation. Figure 7.2 presents the results of the analysis, showing the top 50 freight generating zip codes in the state. IHS data contains annual inbound and outbound freight volume estimates for individual business locations while the BOL data contains freight volumes for individual shipments between an origin and destination.

The majority of the top freight generators are located alongside major roadway corridors such as interstates. The metropolitan areas of Kansas City and St. Louis encompass the largest share of the top 50 ZIP codes with other urban areas such as Springfield, St. Joseph, Columbia, Joplin also showing high levels of freight generation. Top rural areas for freight generation in Missouri include Hannibal, Perryville, Ste. Genevieve, Sedalia and Monett.

FIGURE 7.2 TOP 50 MISSOURI FREIGHT GENERATORS



Source: IHS Freight Finder and Bill of Lading Data.

7.2 Key Freight Generator Types

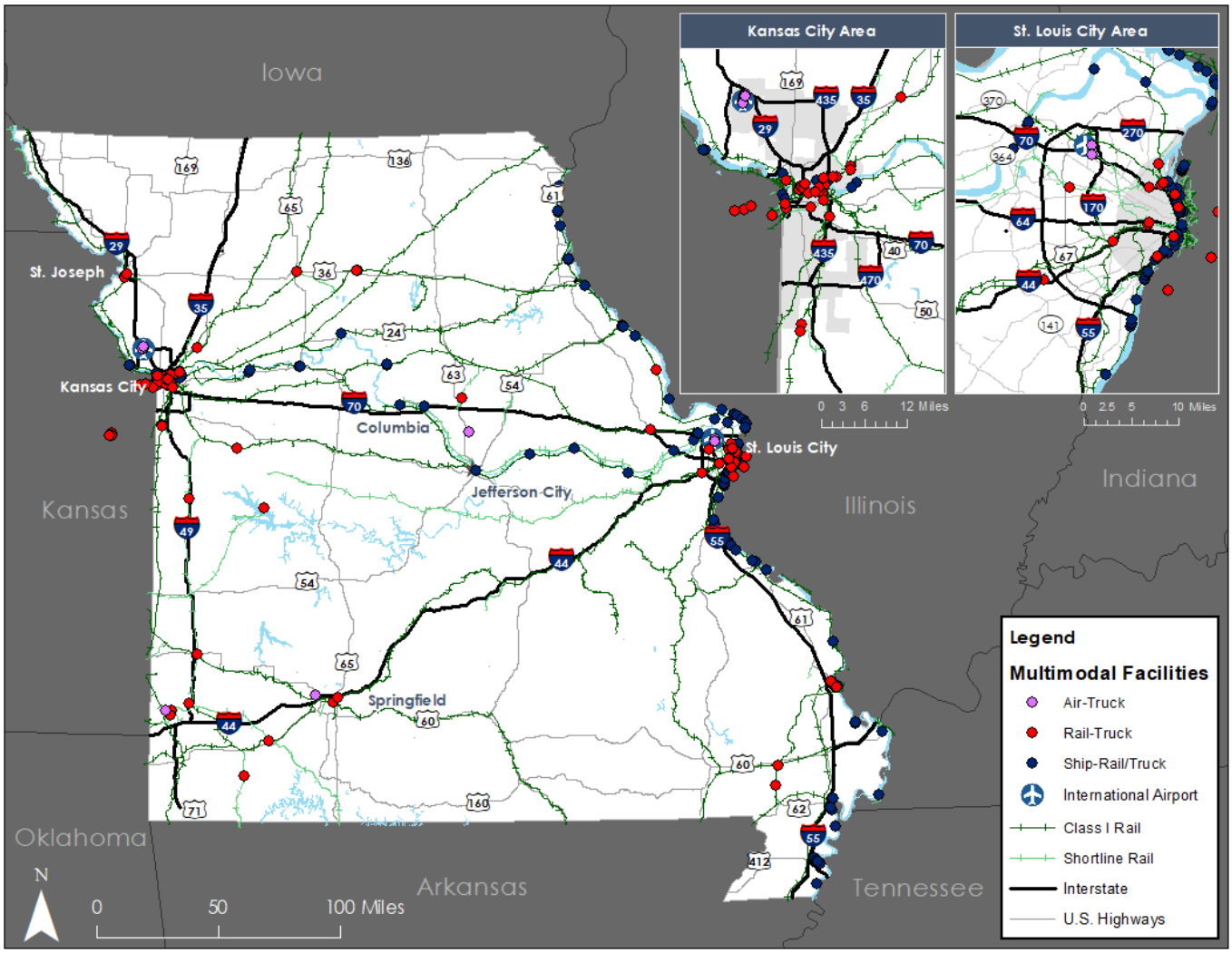
Multimodal nodes are the locations within the transportation network where freight can be transferred from one mode to another. Leveraging multiple modes for a single shipment allows shippers to take advantage of the rail and river networks' economies of scale or air's speed and security while leveraging trucking's ability to cover the first and last miles and make door-to-door deliveries. A well-connected multimodal transportation network improves Missouri shippers' efficiency and cost competitiveness.

As part of the MoDOT's State Freight and Rail Plan, an inventorying process was undertaken to identify the various freight generators within the state. Multiple sources were used to create the MoDOT State Freight and Rail Plan Freight Generator Dataset beginning with the Bureau of Transportation Statistics' National Transportation Atlas Database. The NTAD was then modified by incorporating information gathered via Google Maps and company

websites such as Class 1 and shortline railroad operators, river terminal operators, warehouse providers and others. The dataset also includes information from the Missouri Department of Natural Resources to identify active mining operations. The Missouri Department of Agriculture and USDA's Farm Services Agency were used to locate state and federally licensed grain elevators. IHS Freight Finder provided the locations of major manufacturing and other freight producing businesses. Missouri's major multimodal nodes can be seen in Figure 7.3. These consist of various terminals transferring freight between the highway and rail networks, the river and the highway or rail networks and from air cargo facilities to the highway network.

Missouri's truck-to-rail transload facilities are heavily concentrated in the Kansas City and St. Louis regions, including rail terminals located in the Kansas and Illinois portions of those urban areas. There is also a number of facilities in the southwest and southeast portions of the state. A large number of the public and private river terminals offering access between the road, rail and river networks are concentrated in the St. Louis region and include Missouri and Illinois based terminals such as America's Central Port in Granite City, Illinois. Other concentrations of river terminals are located in Kansas City, Marston and New Madrid, Scott City and Cape Girardeau and in Caruthersville. A string of terminals can also be seen north of St. Louis along the Upper Mississippi and throughout the Missouri River. Missouri's largest air cargo facilities are located at Kansas City International Airport, Lambert International Airport in St. Louis and at Springfield-Branson National Airport.

FIGURE 7.3 MAJOR MULTIMODAL NODES



Source: MoDOT SFRP Freight Generator Dataset

Included in the truck-to-rail nodes discussed above, are eight intermodal rail terminals in close proximity to Missouri shippers including five within the state, two in Illinois and one in Kansas (Table 7.2). Rail intermodal service involves moving freight within containers or trailers using rail networks to cover the long-haul portion of the delivery and trucks and the road network to travel the first and last mile of the delivery. Premium intermodal services utilize well cars that allow for containers to be double stacked. Intermodal containers/trailers can be carried in trainload quantities (unit trains) as well as alongside other rail traffic in manifest trains.

TABLE 7.2 INTERMODAL TERMINALS

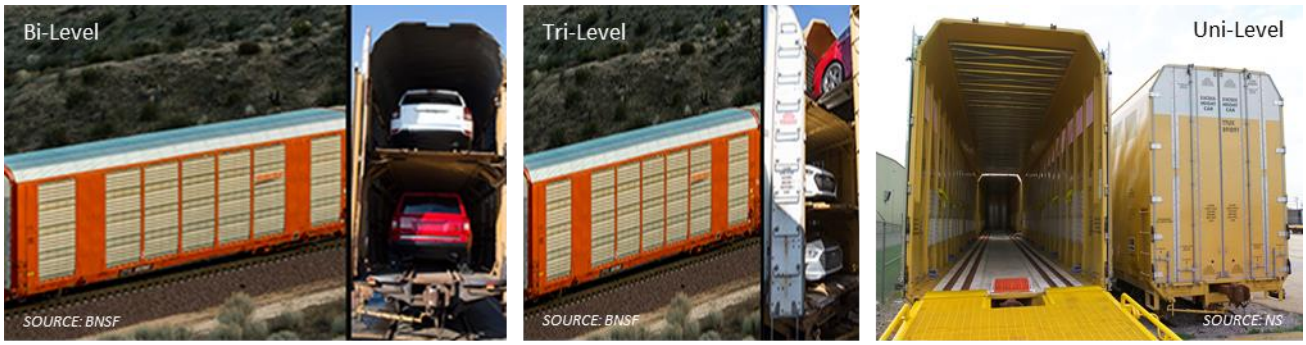
Rail Carrier	Facility	Street Address	City	State
BNSF	Logistics Park Kansas City	32880 W. 191st St	Edgerton	KS
BNSF	St. Louis	3500 Wellington Ave	St. Louis	MO
CSX	East St. Louis	3900 Rose Lake Rd	East St. Louis	IL
KCS	International Freight Gateway	3001 East 150 Hwy	Kansas City	MO
NS	St. Louis	333 East Carrie Ave	St. Louis	MO
NS	Kansas City	4800 N. Kimball Dr	Kansas City	MO
UP	Dupo	Hwy 3 & State St	Dupo	IL
UP	Kansas City	4801 Gardner Ave	Kansas City	MO

Source: Class I Railroads

Missouri is also home to a number of Class I automotive facilities responsible for the loading and unloading of finished motor vehicles to the rail network. KCS operates a loading facility for Ford in Kansas City. NS operates a Ford loading facility in Kansas City that also unloads for both Ford and Chrysler. The NS automotive facility in St. Louis loads for GM and unloads for GM, Ford and Chrysler. Nearby facilities include UP in Centreville, Illinois and UP and BNSF in Kansas City, KS. Auto auctions, such as the St. Louis Auto Auction and the Adesa and Manheim auctions in Kansas City, are located in close proximity to these rail facilities.

Rail carriers utilize four railcar types to safely and securely move finished motor vehicles from origin to destination while ensuring the quality of the product by minimizing damage. An auto-max railcar utilizes adjustable deck heights (allowing for two or three levels), is articulated to a second auto-max railcar and can haul between 18 and 26 automobiles, trucks, SUVs or minivans. A bi-level railcar can move 8-10 trucks, SUV and mini-vans while tri-level railcars can move 14-15 automobiles (Figure 7.4). Uni-level railcars are used to two to four large vehicles such as a truck tractor, farm implements, buses and others.

FIGURE 7.4 AUTOMOTIVE RAILCARS: BI-, TRI AND UNI-LEVEL



Transload terminals allow for the transfer of bulk goods between two modes. Transloading is a popular supply chain solution for shippers who lack direct access to the nation's rail and waterway networks, but want to benefit from the economies of scale and efficiencies afforded to those modes. Transload terminals tend to be commodity specific in that they require specialized equipment to make the transfer between modes. For example, a transload terminal designed to move grains between the highway, rail and waterway networks would not be able to make the transfer of aggregate materials such as stone, sand and gravel or liquid commodities like fertilizer. Examples of various Missouri transloads can be seen in Figure 7.5.

FIGURE 7.5 TRANSLOAD EXAMPLES

Commodities conducive to transloading can be dry or liquid and are bulk and dimensional in nature, including: grains and soybeans and their by-products; seeds; fertilizers; animal feed; aggregates, concrete and cement; frac sand; steel and other metal products; machinery; forest products such as lumber and paper; crude petroleum and petroleum-based products; chemicals; minerals; project cargo; and hazardous materials among others.

Missouri has more than 50 truck-to-rail transload terminals providing the exchange of bulk commodities between the road and rail networks. These exchanges can be direct or indirect and occur in different settings. Direct transloads occur adjacent to the railcar. Indirect transloads introduce dry and refrigerated warehouses or outdoor storage areas into the supply chain. These facilities are used to store and consolidate products between the unloading and loading from one mode onto another. Similarly, grains are stored in elevators during transloads, but are also increasingly being transloaded directly into international containers before being drayed to an intermodal ramp for export.

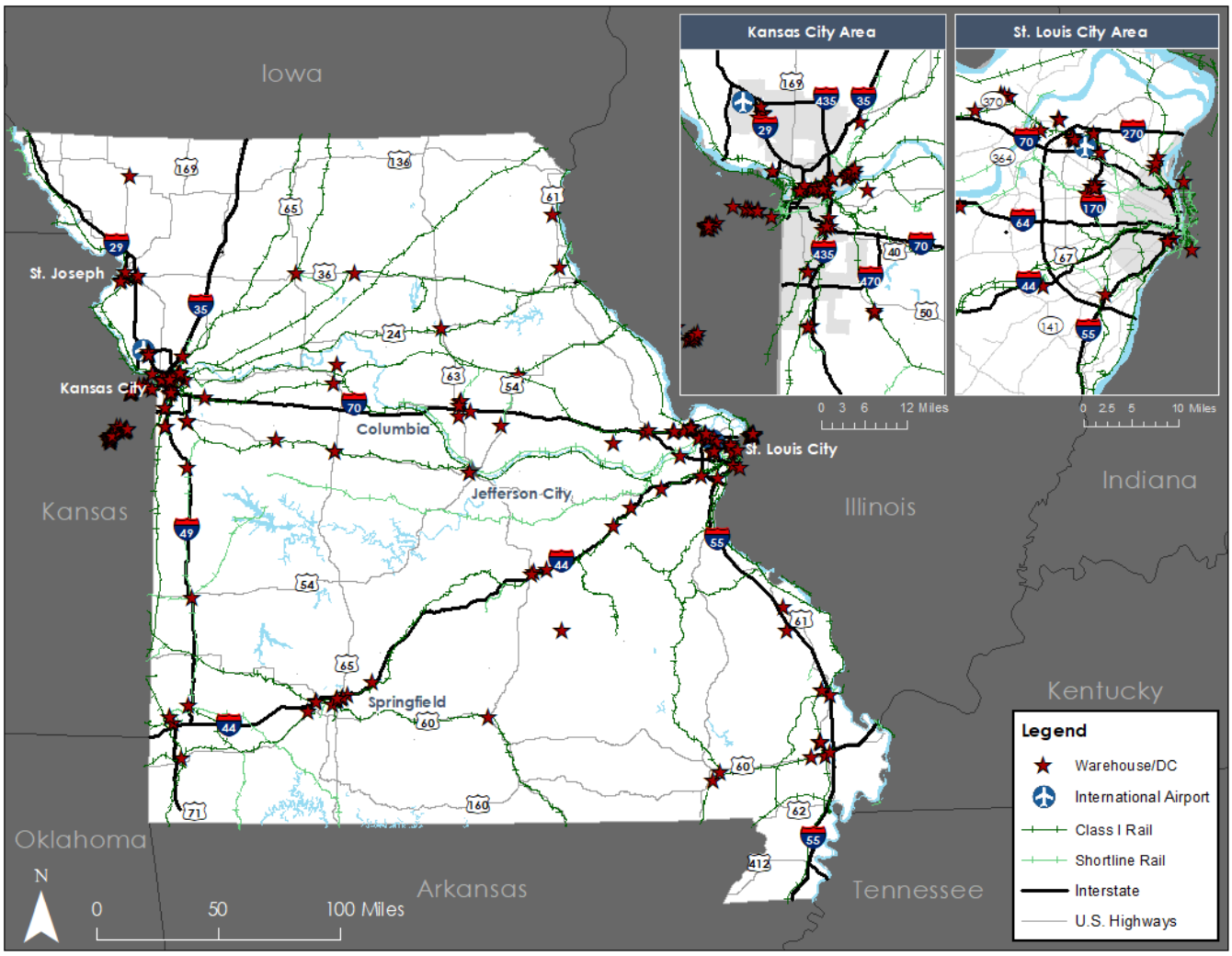
There are more than 120 river terminals in the state and more than 150 when including nearby terminals in Illinois and Kansas. These terminals transfer commodities between the inland waterway network and the road and/or rail networks. Roughly 120 of these marine transload terminals are located on the Mississippi River and 35 are on the Missouri River.

Freight moving by air is generally light in weight, high in value and requires fast transport. The road network is needed to cover the first and last miles of delivery, as is the case when transloading with the rail and waterway networks. Freight is either carried by aircraft dedicated solely to freight or in the 'belly' of passenger aircrafts. It requires sufficient ramp/apron area for loading and unloading operations, cargo staging and truck access. Often, adjacent land is needed to develop supporting services such as sorting facilities and consolidation centers that

drive volume through the airport. Air cargo volumes were recorded at five Missouri airports in 2019: Kansas City International, St. Louis Lambert International, Springfield-Branson International, Columbia Regional and Joplin Regional. MCI, STL and SGF are considered the state's largest air cargo facilities. With the recent and forecasted growth in e-commerce, air cargo is expected to experience similar high growth rates.

More than 220 major warehouses/distribution facilities were identified within close proximity to Missouri shippers with roughly 160 located within the state itself (Figure 7.6). Warehouses include storage facilities for dry and temperature-controlled products. Distribution centers include facilities utilized by manufacturers, wholesalers, retailers, third party logistics providers and package and parcel carriers like FedEx and UPS. Also included under distribution centers are the cross-dock facilities used by less-than-truckload carriers and the fulfillment centers operated by Amazon. By providing these storage and consolidation services to shippers, these facilities both attract and produce truck trips.

FIGURE 7.6 MAJOR WAREHOUSES AND DISTRIBUTION CENTERS

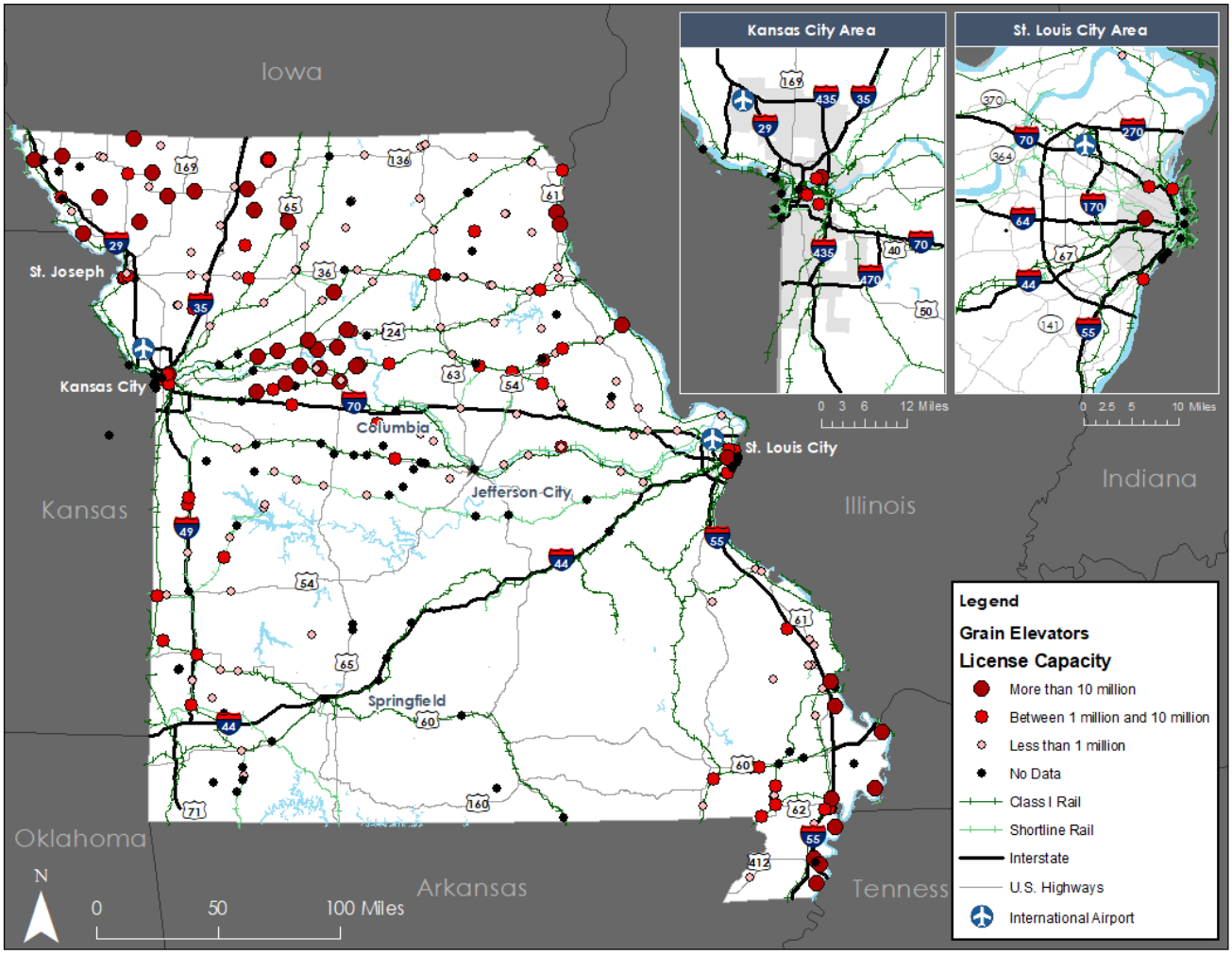


Source: MoDOT SFRP Freight Generator Dataset

Grain elevators allow for the aggregation and temporary storage of agricultural commodities before being processed on site or moved via truck, rail or river (Figure 7.7). Capacities at Missouri grain elevators range from 4,000 to nearly 100 million bushels on a license basis and 4,000 to more than seven million bushels on a location basis. Statewide, there are more than 270 grain elevators within the state and close to 300 within a close proximity of Missouri (Figure 7.8). The majority of these elevators are designed for storing grains while a handful of cotton warehouses are located in the southeastern portion of the state.

FIGURE 7.7 MISSOURI RAIL-SERVED GRAIN ELEVATOR

FIGURE 7.8 MISSOURI GRAIN ELEVATORS

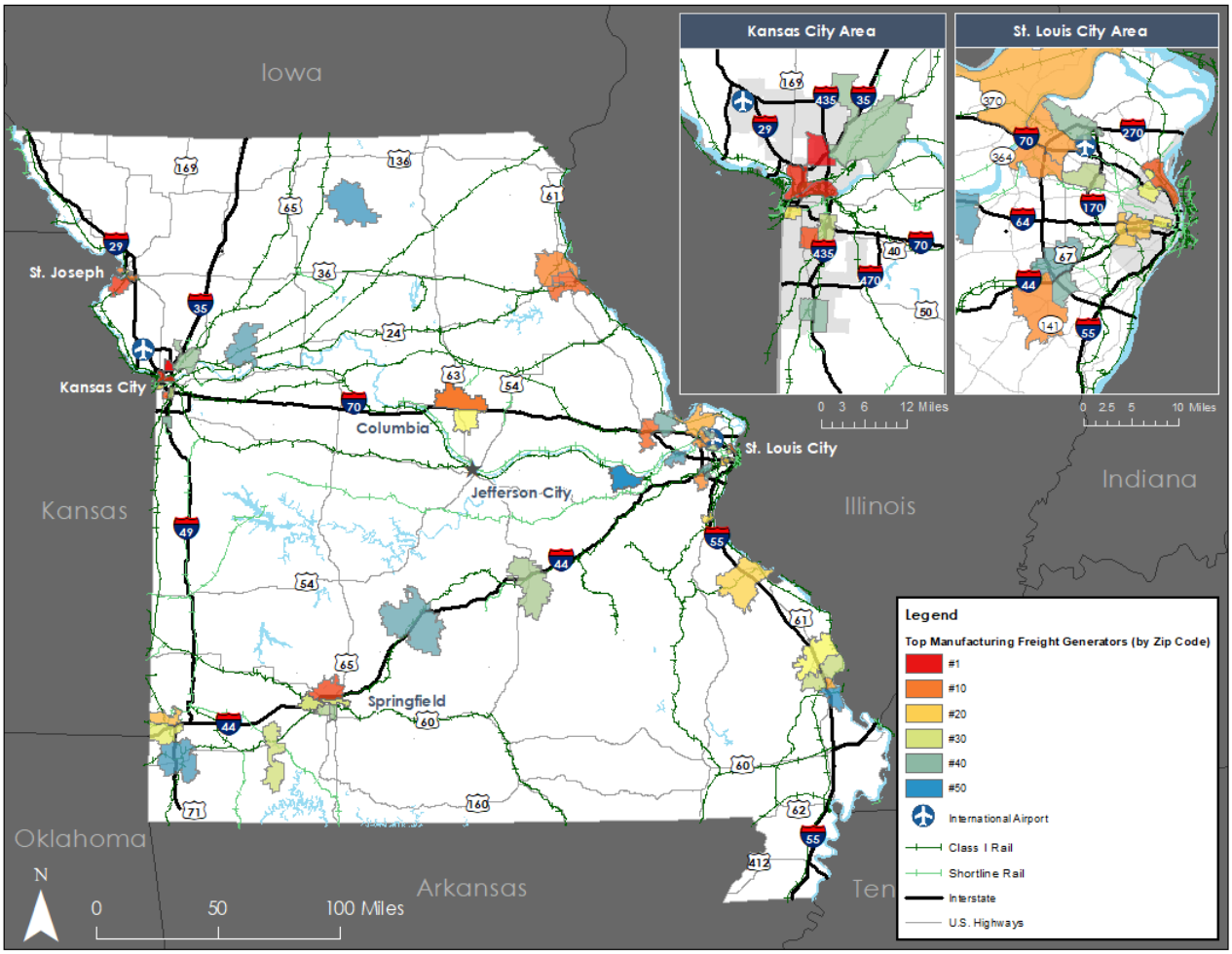


Source: MoDOT SFRP Freight Generator Dataset

Missouri manufacturers rely upon the multimodal freight network to efficiently bring inputs to their plants and deliver products to their customer's warehouses, distribution centers and retail locations and ultimately to consumers' homes in a cost-effective manner. Properly designing and maintaining the state's local first and last mile routes, highways, interstates and rail and river network access points is necessary to maintain a competitive advantage for the state's advanced manufacturing companies, energy solution providers and its 21st Century agricultural operations from lab to farm to table.

Figure 7.9 shows the state's top freight generating zip codes for manufacturers using the same methodology used to identify the state's top freight generators, as discussed in Section 7.1. As was the case with the total generation, concentrations of manufacturing activity are located adjacent to major highway corridors, Class 1 rail networks and along the Mississippi and Missouri Rivers. The heaviest concentration of freight generation by Missouri manufacturers are in the Kansas City and St. Louis metro areas, followed by other urban areas like St. Joseph, Springfield, Columbia and Joplin. Smaller communities like the Hannibal and Palmyra region, Cape Girardeau and Ste. Genevieve are also home to a number of manufacturers and associated freight generation. A number of rural communities included in the top 50 include Aurora, Lebanon, Milan, Rolla and Richmond.

FIGURE 7.9 TOP 50 MISSOURI MANUFACTURING FREIGHT GENERATORS



Source: IHS Freight Finder and Private Sector Bill of Lading Data

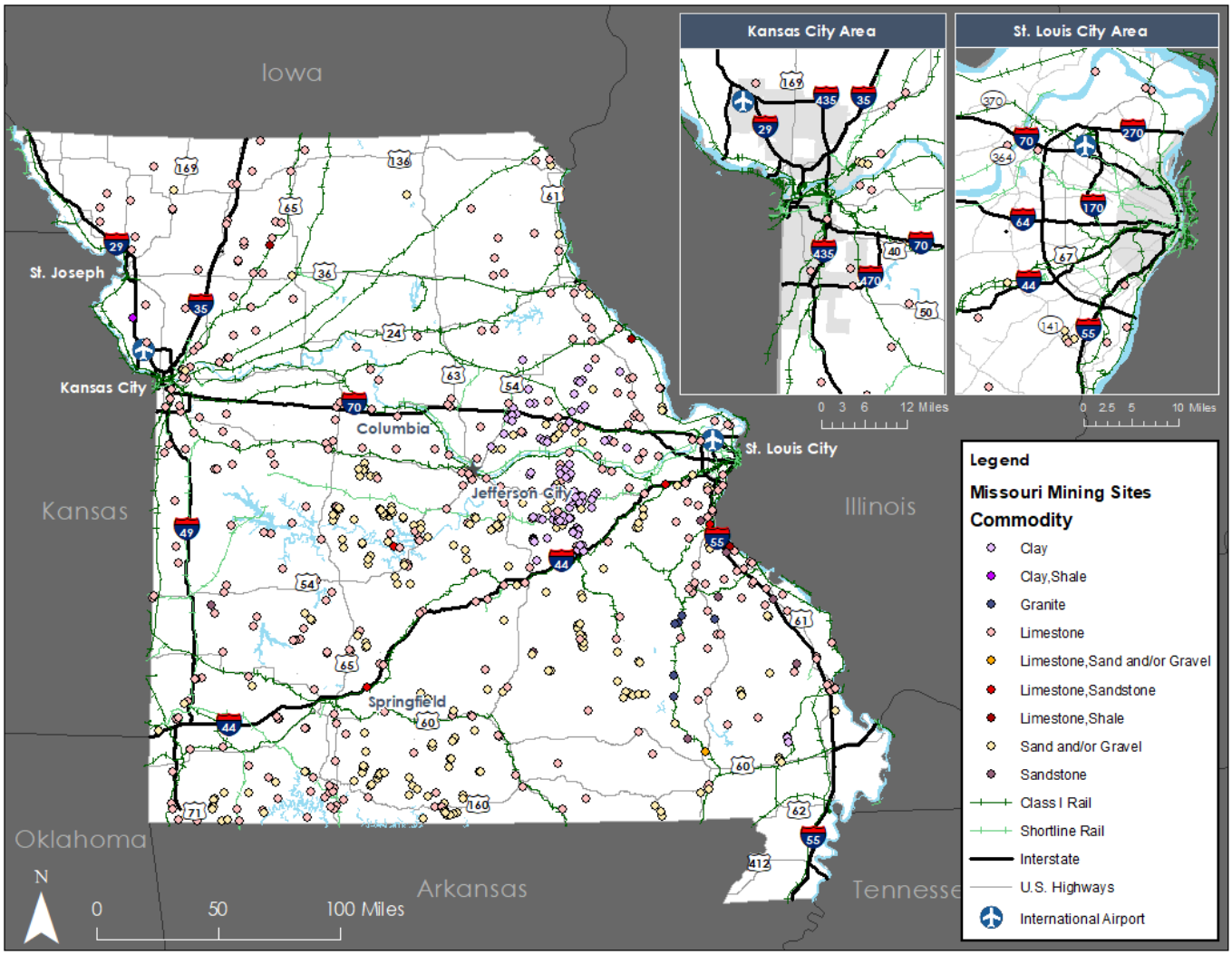
Missouri's Department of Natural Resources tracks both active open-pit and in-stream mines (Figure 7.10) within the state under the Missouri Mining Commission. Its data shows a total of 806 effective sites statewide. There are 590 active open-pit operations and 216 in-stream operations (Figure 7.11). Mining activities tend to produce freight volumes that far out-weigh the associated employment levels. The Commission data shows mining operations conducted for seven different materials:

- Clay
- Shale
- Granite
- Sandstone
- Limestone
- Gravel
- Sand

FIGURE 7.10 OPEN-PIT AND IN-STREAM MINING EXAMPLES

Source: Google Imagery

FIGURE 7.11 MINING SITES



Source: MoDOT SFRP Freight Generator Dataset

Missouri has a small oil extraction industry. The state produced a total of 84,830 barrels in 2019.[90] The majority of this production, roughly two-thirds of the total, was located near Kansas City in Cass County, while 12% of the state's 2019 total production was located in St. Louis County (Table 7.3). Production levels for Atchison County, Vernon County and Jackson County were under 10,000 barrels.

[90] Missouri Department of Natural Resources, Missouri Geological Survey, Geological Survey Program, 2019 Annual Oil Production Figures

TABLE 7.3 MISSOURI COUNTY OIL PRODUCTION

County	Production (BBLs)	Production Value ($)
Atchison	7,928	$367,750
Cass	58,363	$2,820,900
Jackson	3,555	$17,900
St. Louis	10,286	$516,000
Vernon	4,699	$231,250

Source: Missouri Department of Natural Resources

7.3 Freight Generators and the Multimodal Network

Intermodal connectors are corridors of public roads which link rail terminals, river ports and air cargo facilities to the National Highway System. Properly designed, maintained and operated connections to multimodal nodes facilitate the efficient and economically competitive movement of freight within supply chains by allowing shippers to leverage either the economies of scale from the water and rail networks or the speed and security of the air network for their long-haul moves and trucking to make the first and last mile trips to their front doors via the road network.

Missouri has nine multimodal facilities currently linked to the NHS by a designated intermodal connector (Table 7.4). Kansas City International Airport is connected to I-29 and I-435 by both Mexico City Avenue and Cookingham Drive while Springfield-Branson National Airport is connected to I-44 via MO-266 and Airport Boulevard. St. Louis' Lambert International Airport is served directly by existing NHS routes.

The Southeast Missouri Regional Port Authority is connected to I-55 by a four-mile corridor while the New Madrid County Port Authority is connected to I-55 by three miles of designated route. 7th Street serves as the intermodal connector for parts of the Port of St. Louis, but as is the case with Lambert International, portions of the Port of St. Louis are directly served by the NHS. NHS connectors to the nation's intermodal rail system includes a shared connection for the Kansas City Southern and Union Pacific ramps in Kansas City. Both of Norfolk Southern's Missouri-based intermodal ramps are connected to the NHS via two intermodal connectors.

TABLE 7.4 MISSOURI MULTIMODAL FACILITIES LINKED TO THE NATIONAL HIGHWAY SYSTEM

Facility	Route	Description
K.C. International Airport	MO-2A-01	From I-29/435 (ex 15): S 1.5 mi on Mexico City Ave to Air Cargo Facility on Paris Street
	MO-2A-02	From I-29 (ex 13)/I-435 (ex 36): W 1.8-2.4 mi on Cookingham Dr to Air Cargo Facility on Paris Street
Springfield-Branson National Airport	MO-3A	From I-44 (ex 72), a 2.9 mi corridor moving east along MO 266, north on Airport Boulevard to airport terminal.
SEMO Regional Port Authority	MO-5P	From I-55 (exit 91): Easterly 4.0 mi on Route AB to entrance to SEMO Port
Port of St. Louis	MO-17P	7th St. (I-55/44 to I-55)

Facility	Route	Description
New Madrid County Port Authority	MO-18P	From I-55 (ex 40): east 0.54 mile on Rte EE and 0.85 mile on Entrance Rd, north 0.52 mile on Port Authority Access Rd and 0.66 mile on Levee Rd and east 0.43 mile on County Rd 406 to terminal
Kansas City Southern, K.C. Intermodal Yard	MO-6R	South on Chouteau Frwy from Route 210 (shared connector with 7R)
Union Pacific, K.C. Intermodal Yard	MO-7R	From Route 210 intermodal connector: S 2.0 mi on Chouteau Trafficway to facility entrance on Gardner Ave
Norfolk Southern, K.C. Intermodal Yard	MO-8R-01	From I-29/35 (ex 6B): E 5.5 mi on Route 210 to facility entrance
	MO-8R-02	From SR 291: SW 4.5 mi on Route 210 to facility entrance
Norfolk Southern, St. Louis Intermodal Yard	MO-10R-01	From I-70 (exit 247): NE 0.3 mi on Grand, NW 1.5 mi on Hall to intermodal facility
	MO-10R-02	From I-270 (exit 34): SW 5.7 mi on Riverdale Dr and continuing on Hall Street to terminal

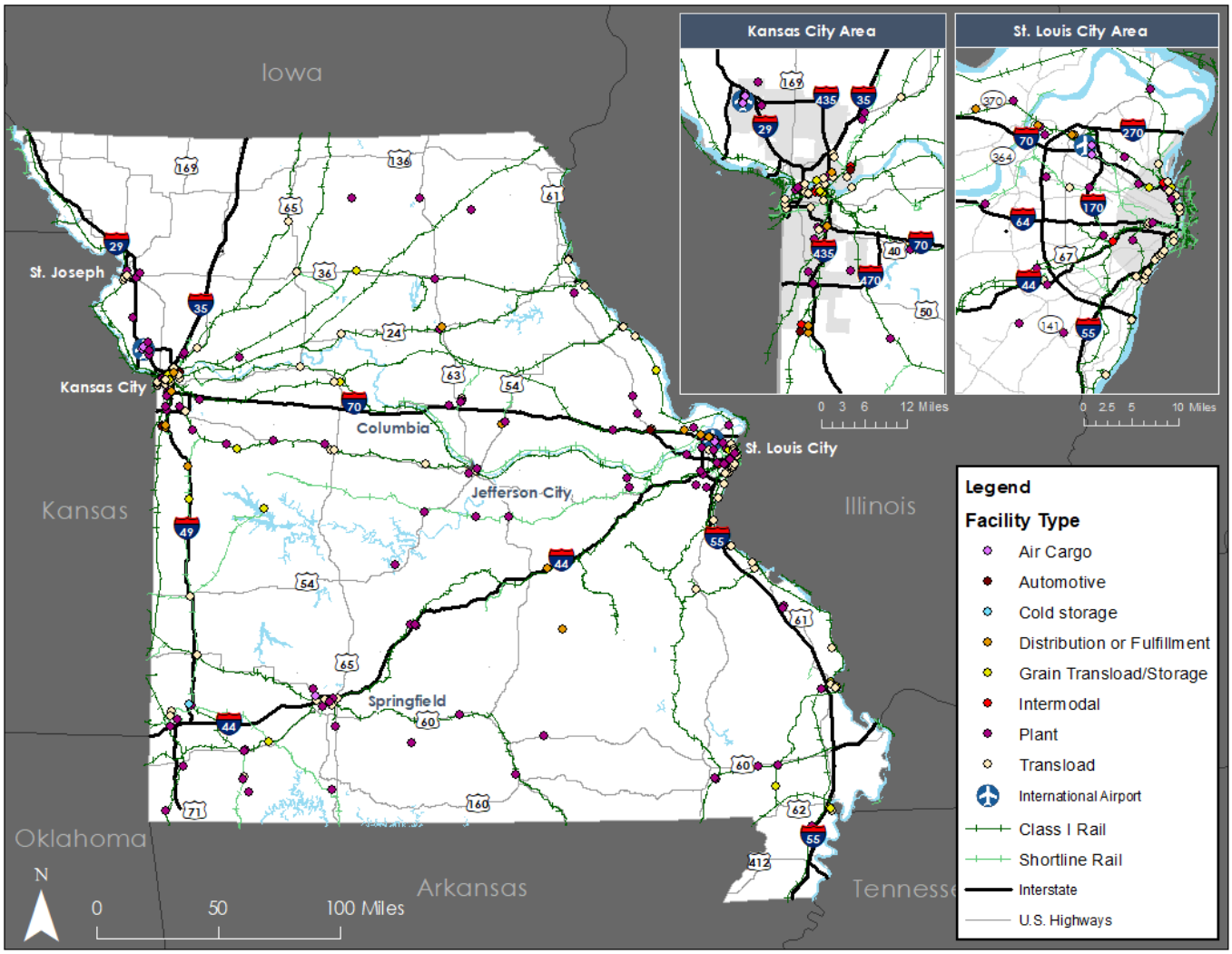
Source: U.S. DOT FHWA

Missouri's first/last mile routes provide a similar service as the NHS intermodal connectors in that they provide a connection between the state's major freight generators and the long-haul truck corridors. Unlike the NHS connectors however, these first/last mile connections are not under any designation by U.S. DOT. The Missouri State Freight and Rail Plan's first/last mile route inventory includes 250 major freight generators and more than 190 miles of non-NHS Highway Performance Monitoring System road segments. The locations of Missouri's major freight generators are shown in Figure 7.12.

The 250 major freight generators were identified in two ways. One, the facility was identified as being a multimodal freight facility during the inventorying efforts of the State Freight and Rail Plan. Examples from this process includes the state's intermodal ramps, air cargo facilities, river port terminals with rail access, truck-to-rail transload facilities, as well as grain elevators, distribution and fulfillment centers and rail-served warehouses. Other major freight generators were identified using the IHS Freight Finder dataset. Missouri business locations were included if they met one of the following criteria:

1. The location shipped more than 200,000 tons of freight per year
2. The location employed more than 400
3. The location had annual sales in excess of $300 million

FIGURE 7.12 MISSOURI FIRST/LAST MILE MAJOR FREIGHT GENERATORS



Source: MoDOT SFRP Freight Generator Dataset

7.4 Key Supply Chains and the Role of Facilities

Supply chain is the terminology most often applied to the network of human resources, organizations, information, physical assets, transport and technology responsible for moving a product from its inception to final consumption or end-user. Supply chains describe the process of turning raw materials into finished products and then getting them in to the homes and hands of final consumers. As the name implies there are often many links required to source, produce and deliver a product, especially when supply chains involve suppliers and buyers located across the globe.

Total Landed Cost, is an increasingly used business metric that refers to the sum of all costs associated with making and delivering a product. These costs include transportation, handling, packing, inventory, overhead, duties, taxes, tariffs, insurance and other fees. It is a common industry reference that up to 80% of a product's

landed cost can be attributed to physical supply chain network design, including initial facility location decisions. Supply chain design and the location of key facilities in relation to multimodal transportation networks often plan an integral role in the competitive nature of a state or regions businesses. In this section some of Missouri's key supply chains are examined in relation to the freight facilities that support them.

Agriculture Supply Chains

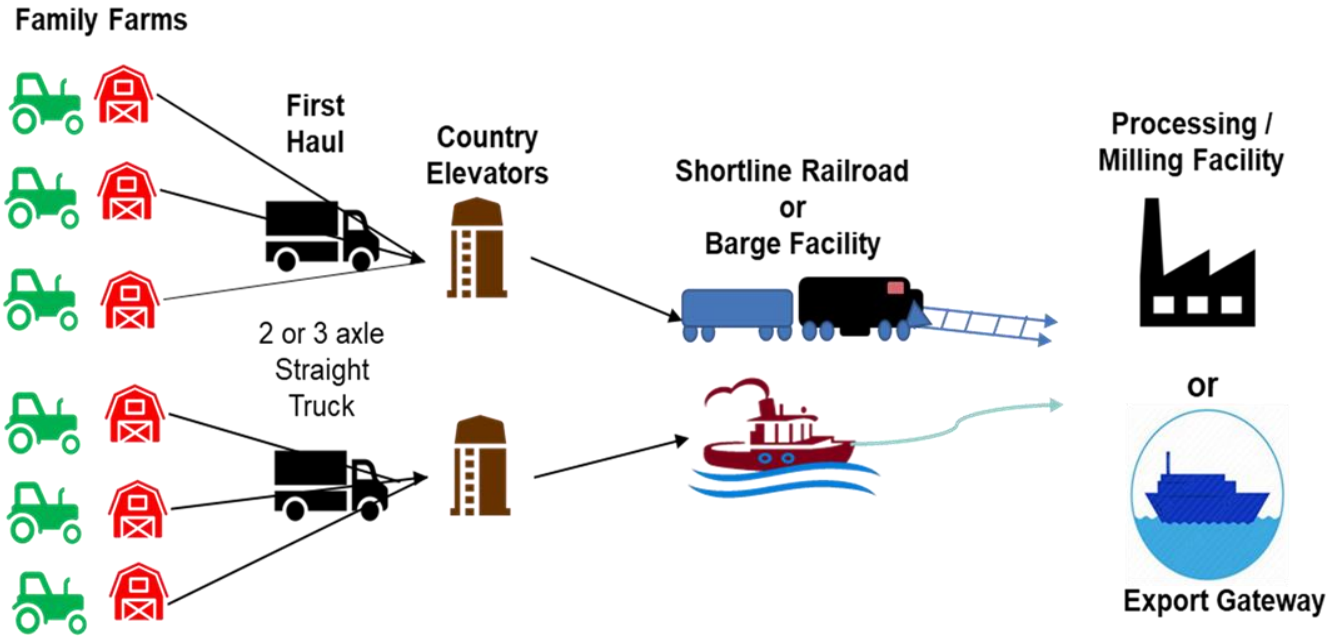
Elevators have been a staple of the grain producing regions of the American landscape since the mid-1800s as railroads developed networks to move grain from rural areas to urban processing and consumption markets. During the rail building boom in the latter half of the nineteenth century it was common for towns and grain elevators to be located every six to ten miles along rail lines in grain producing areas.[91] Traditionally, U.S. grains grown for export markets were assembled at elevators as a *"fungible"* commodity where all grains of the same type were mixed together without regard to how the crop was grown, i.e., what fertilizers or pesticides were applied. From these elevators rain was most often loaded into rail hopper cars and moved to coastal ports where the grain was transloaded into bulk cargo ships as shown in Figure 7.13.

As rural road networks developed around rail supported towns, the distance for the first haul from farm to elevator was typically short. usually less than 15 miles. Throughout the first half of the twentieth century, grain typically moved in two or three axle, single unit grain trucks and due to the relatively close spacing of elevators the typical capacity was based on the ability to load partial train sets of 20-40 rail cars.

After Congress authorized the maintenance of a 9-foot channels on both the Missouri and the Mississippi Rivers in the mid-1900s, barges also offered another alternative for moving grains to coastal port gateways for export.

[91] Barbara Krupp Selyem, *The Legacy of Country Elevators.* Accessed on line at: 2000springsummer_krupp.pdf (kshs.org). 11/

FIGURE 7.13 TRADITIONAL GRAIN EXPORT SUPPLY CHAIN

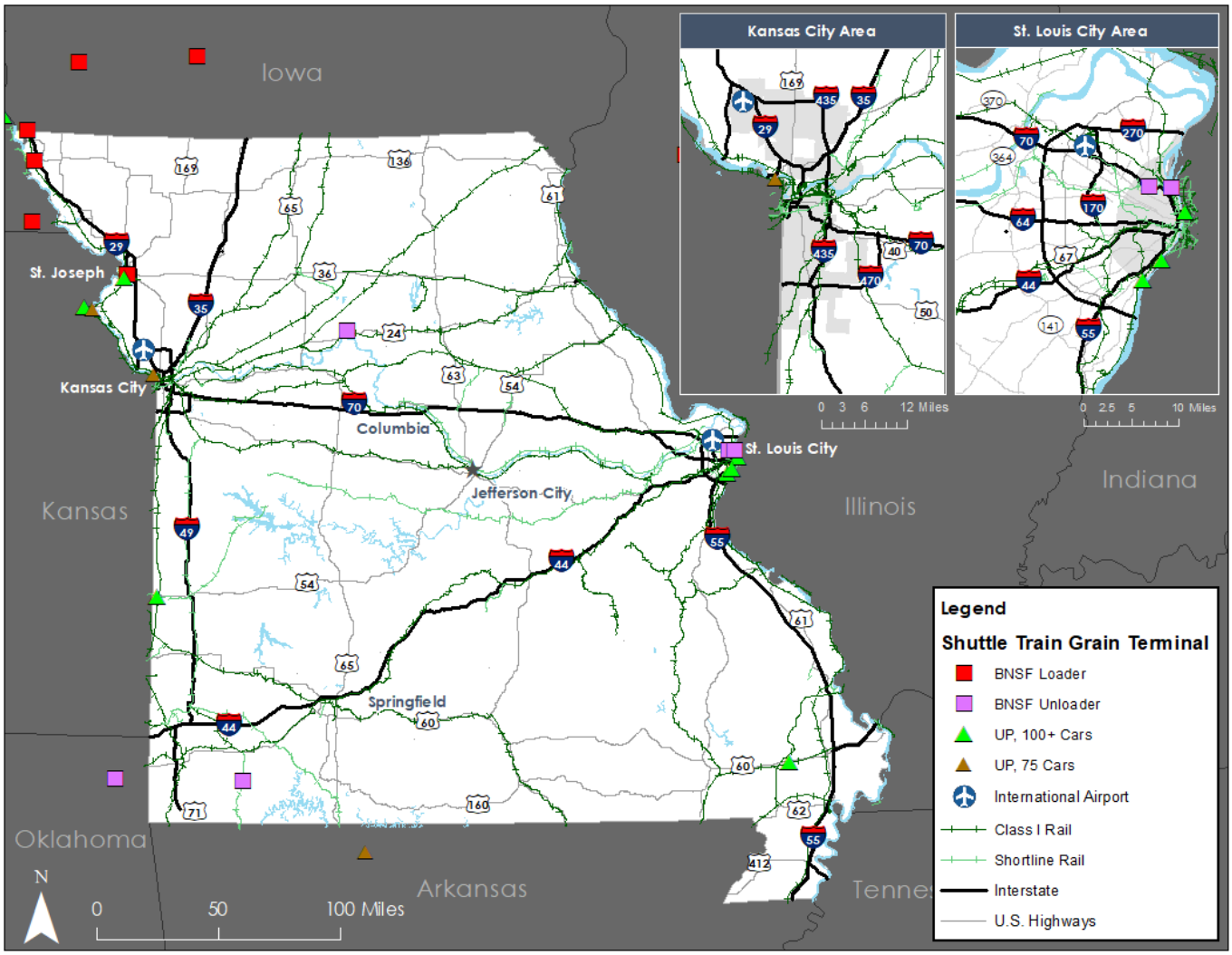


Source: Quetica

Following de-regulation of the railroad industry in the early 1980's, Class I railroads rationalized their networks, with many trunk lines sold-off or abandoned. As the focus of major railroads turned to optimizing mainline capacity and asset utilization, a number of unit train programs were instated for commodities like coal and grain. Unit trains typically haul bulk commodities from a single loading point to a single destination. Grain shuttle trains are typically 100-110 car unit trains comprised grain hopper cars weighing between 268,000 and 286,000 pounds. The typical shuttle train elevator is a high-capacity handling facility that can load a full unit train in 15 hours or less. Railroads offer the best transportation rates to shuttle train elevators, but they are also a major investment. Recently published research found that in 2013 shippers using shuttle train elevators saved 24% in total transportation costs, over non-shuttle train users; 22% of the total cost reduction was attributed to lower rail transportation costs.[92] The map in Figure 7.14 shows the location of shuttle train elevators in Missouri or bordering Missouri.

[92] Ndembe, Elvis, John Bitzan., North Dakota State University, *Grain freight elevator consolidation, transportation demand, and the growth of shuttle train facilities.* Research in Transportation Economics. Available online October 2018.

FIGURE 7.14 SHUTTLE TRAIN GRAIN FACILITIES



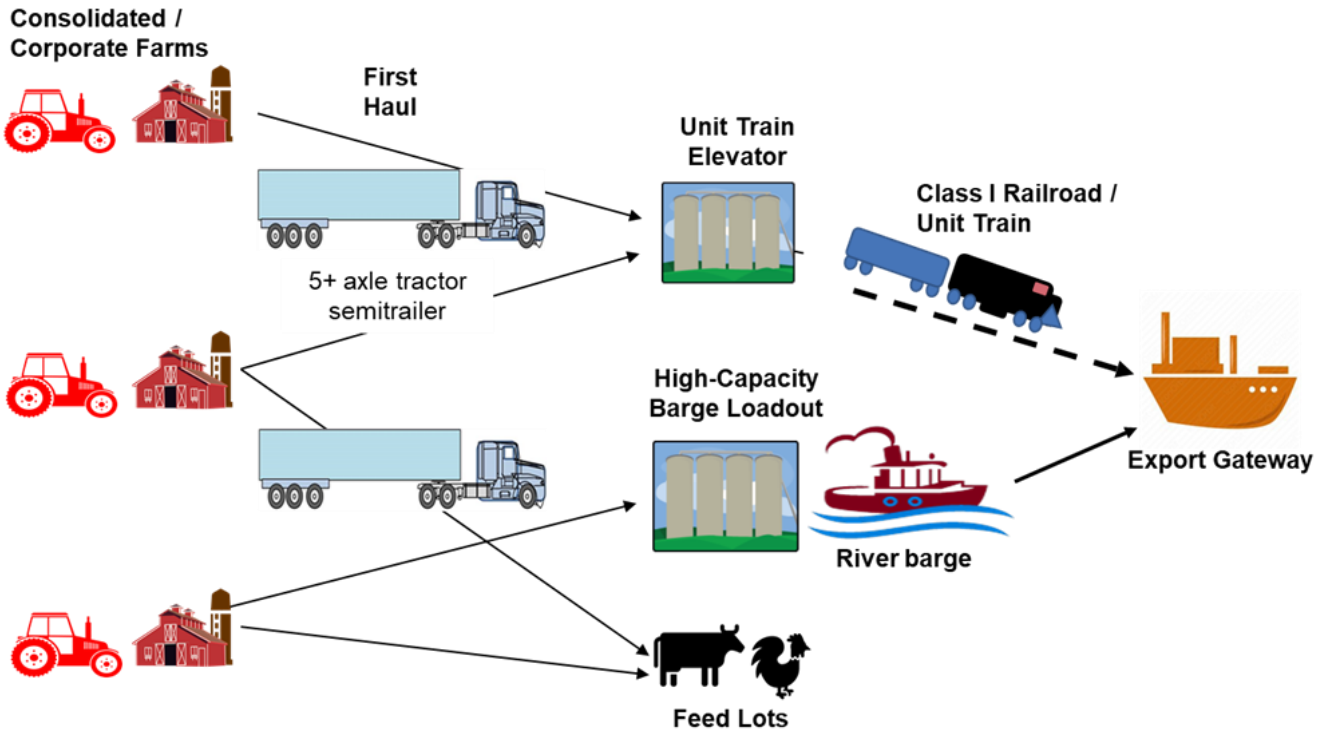
Source: MoDOT SFRP Freight Generator Dataset

During roughly the same time period that shuttle train programs emerged, another trend in American agriculture also impacted farm supply chains; the production of more and higher value products. Many farmer owned co-ops began taking on new venues like food processing, animal feeds and fuel. Turning corn into ethanol is one significant example of domestic value-added agriculture. This trend also extends to agriculture exports, examples include processed meats such as beef and poultry products or other produced grain products such as potato flakes and pasta. For a time the construction of ethanol plants exploded as tax incentives and emission mandates stimulated demand for the corn-based fuel. Farmers took advantage of this market as well. Figure 7.15 depicts the typical grain supply chain that has developed over the past several decades.

One of the significant impacts of these recent changes in agriculture supply chains has been the first haul from farm to facility has generally gotten longer and heavier. Two and three-axle grain single unit grain trucks have been replaced with farmer owned fleets of 5- and 6-axle tractor semitrailer fleets. Because shuttle train elevators are typically spaced 50-plus miles apart, the first haul to the elevator is often 50 miles or more.

The examination of emerging trends in Section 7.5 will explore emerging grain supply chains with a focus on identity preservation and product visibility.

FIGURE 7.15 CONTEMPORARY GRAIN SUPPLY CHAIN



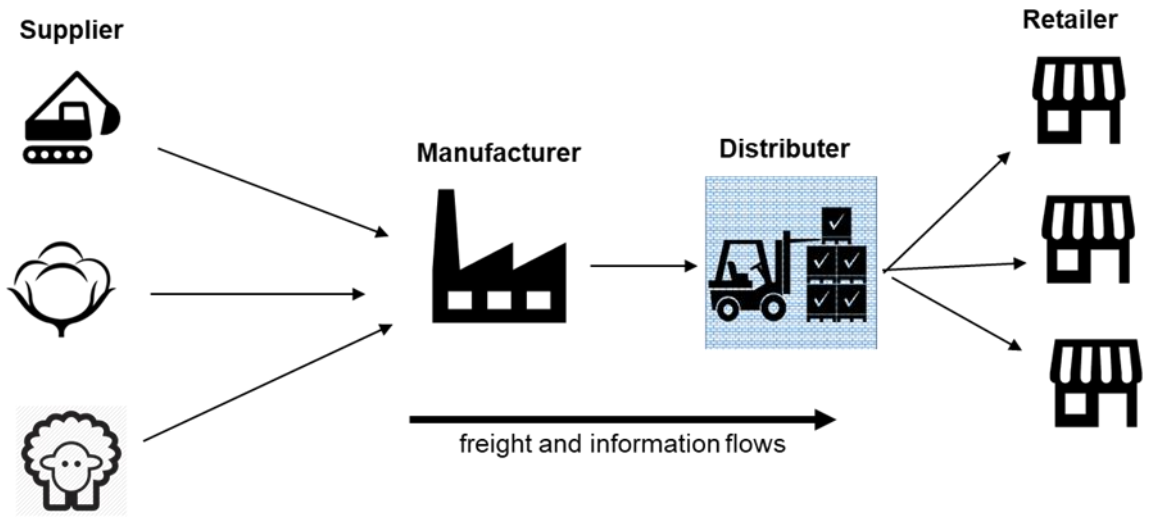
Source: Quetica

Retail and E-Commerce Supply Chains

Retail supply chains have undergone tremendous changes over the past several decades. While individual product supply chains vary, for decades the typical retail supply chain involves suppliers, original equipment manufacturers, distributors and retail stores. For most of the 20th Century, manufacturers and distributors "pushed" products into retail locations to stock inventories. The strategy around push supply chains was largely based on often slow and unreliable transportation networks. The logistics of push supply chains were driven by forecasts of predicted consumer demand. Products were produced and distributed in quantities sufficient to stock retail inventories at a level sufficient to meet predicted consumer demand in the coming weeks or months. When predictions were wrong, retailers could be left with high inventories of unsold goods or stockouts resulting in missed sales opportunities and unhappy customers.

A typical push retail supply chain is depicted in Figure 7.16. A key attribute of push supply chains is the largely one-way flow of both goods and information. Under push supply chain systems, distributor facilities tend to specialize on particular products or industries; e.g., apparel distributors, lumber distributors. Product inventories are most often stored at or near the retail facility.

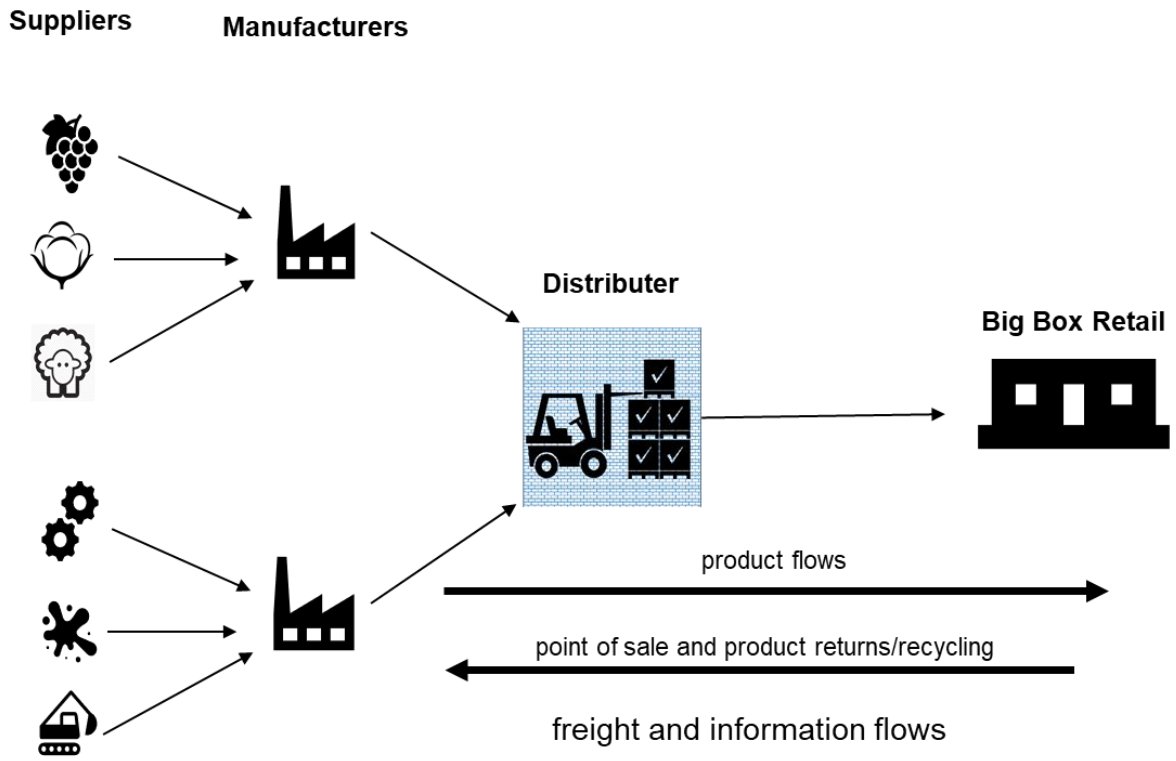
FIGURE 7.16 PUSH SUPPLY CHAIN - RETAIL



Source: Quetica

During the 1980s and 1990s, information technology began to play a much greater role in supply chain management. Point of sale customer data, where retailers could monitor consumer buying practices via data transmitted from the checkout counter back to manufacturers or distributors came into play. This reverse flow of customer sales data led to the evolution of *pull* supply chain management. Companies like Walmart revolutionized the retail market by developing supplier/production networks capable of replenishing product inventories on a largely as-needed basis. During this time the concept of *reverse logistics* also emerged as a means of handling unused, returned or recycled products. The key attribute of pull supply chain management is the two-way flow of information and freight. In this model inventories levels are greatly reduced as the various links in the chain communicate in real-time. This model places greater demands on distributors who handle a far broader variety of products from large “Big Box” retailers. Pull supply chain management lead to the development of regional distributions centers capable of handling a wide variety of products in large volumes. During this same period, large retail, manufacturing and transportation firms also began using large volumes of customer data to “optimize” the location of distribution and transload facilities to minimize costs in supply chain networks. Figure 7.17 depicts a simplified *pull* supply chain network.

FIGURE 7.17 PULL SUPPLY CHAIN - RETAIL



Source: Quetica

In recent years more and more consumers have turned to the internet to make retail purchases, due to the convenience and cost effectiveness of online shopping. While e-commerce has made steady gains in the past several years, the COVID-19 pandemic accelerated and already trending retail business model. Companies like Amazon and eBay, and even more traditional retailers like Walmart and Target are once again reinventing retail supply chains and *fulfilment center* warehousing facilities.

In 2019, Amazon opened a 855,000 square foot fulfillment center in St. Peters, Missouri a short distance from St. Louis: it was Amazon's first robotics fulfillment center.[93] The new facility employs 1,500 full time employees.

In the examination of emerging trends and issues the concept of fulfillment centers and their impacts on the retail supply chain will be discussed in greater detail.

Motor Vehicle Supply Chains

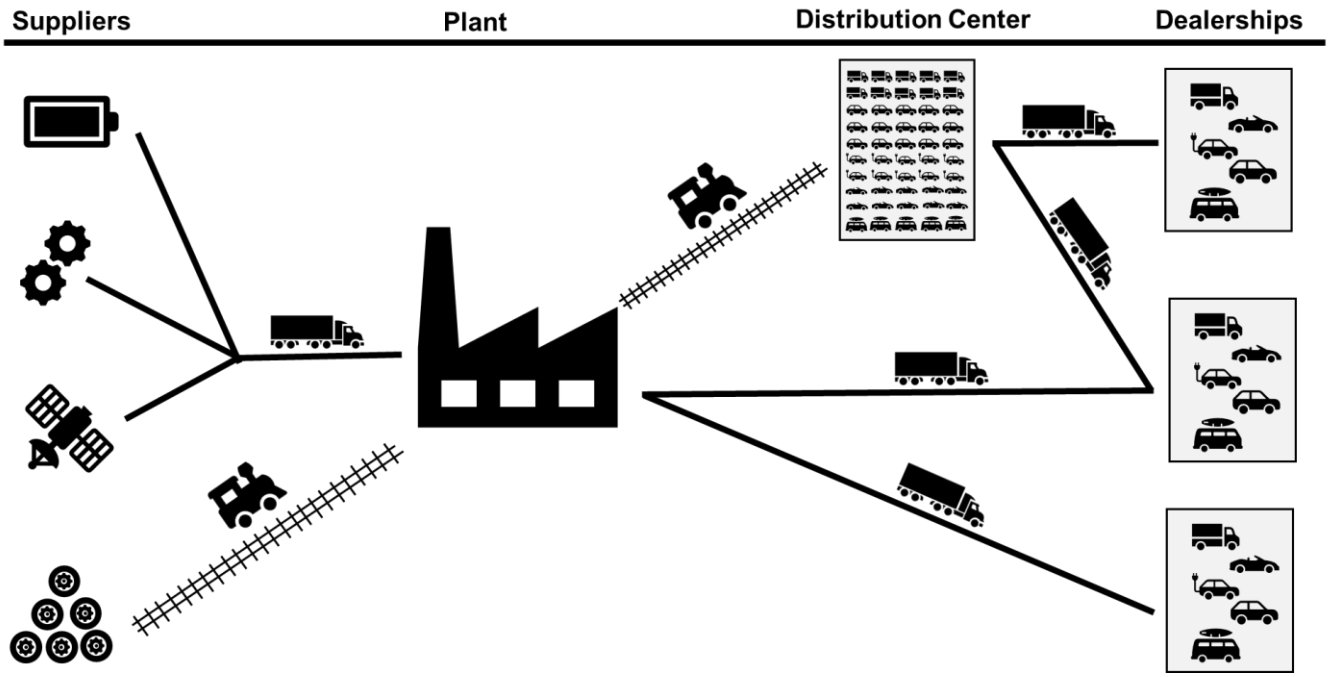
The automotive industry is a key advanced manufacturing supply chain in Missouri from the Ford and GM plants in the Kansas City and St. Louis metro areas to the large number of suppliers located statewide. These plants attract inputs from a wide variety of producers including electric and electronic equipment, plastics and rubber, structural metal products, batteries, engines, specialized glass and chemicals in the form of paint, coatings and adhesives

[93] Steph Kukuljan, *Inside Missouri's first Amazon fulfillment center.* St, Louis Business Journal. June, 26, 2019.

among others (Figure 7.18). As the automotive industry has matured, so has the make-up of its inputs. Electronic components were once limited to the starter, a radio and the electrical system to power windows and the like. However, connected and autonomous vehicles require components of a significantly higher level of sophistication. With image sensors, LiDAR and advance driver assistance systems on board, high-performance computers are needed to weave together multiple data streams in real-time and make decisions accordingly. Electric vehicles are having a similar impact where batteries are not only needed to start the vehicle, but also to power the drivetrain. Missouri manufacturers are at the forefront of this development.

The utilization of just-in-time manufacturing processes by motor vehicle producers require their production schedules to be tightly aligned with the deliveries of these inputs meaning disruptions to the delivery of any one input can negatively impact the entire process. Poor road conditions can result in damaged products being delivered to the plant while congestion can cause unexpected delays at the plant. Maintaining a state of good repair and appropriate levels of service across the multimodal network is needed for this process to be successful.

FIGURE 7.18 MOTOR VEHICLE SUPPLY CHAIN



Source: Quetica

7.5 Trends and Emerging Industries

From the data analysis and stakeholder outreach conducted in Missouri exploring major freight facilities, the most apparent trends in freight handling and storage facilities are they are becoming larger, more automated and more connected to the rest of the supply chain. Following are some specific industry trends and examples.

In the previous section the evolution of large high-capacity grain elevators is discussed. During discussions with facility operators the key trends are larger, faster, more autonomous and technology connected. For example, a new grain handling facility was noted that lies just across the border from St. Louis in Cahokia, Ill. Constructed for Louis Dreyfus Commodities in 2016, the *domesilo* in Cahokia is 127 feet in diameter and 99 feet tall (see Figure 7.19). The facility holds 18,000 metric tons of grain. The facility is a large loop track transload facility served by the Alton and Southern Railroad, providing access to six Class I railroads. This facility is filled and empty on a daily basis. The dome shape is marketed as having higher capacity with the same footprint as traditional cylindrical silos. In 2018, Continental Cement, with corporate headquarters in Hannibal, Mo., contracted for the construction of a drive-thru *domesilo*. The Continental facility was constructed in Memphis, Tenn. The facility takes in cement from barges and quickly loads trucks on a drive thru basis. New grain elevators are also increasingly technology connected: using wireless technologies companies can monitor issues like relative humidity inside the silo, grain moisture content, temperature and other metrics to ensure safe and stable storage.

FIGURE 7.19 LOUIS DREYFUS COMMODITIES DOMESILO IN CAHOKIA, ILLINOIS

Source: Photo Credit: Dome Technology

Over the past several decades urban population growth and point of sales data have driven larger regional distribution facilities to support the manufacturing and retail industries. However, during the past decade e-commerce emerged as the fastest growing business model in retail sales. While the growth of e-commerce was already expanding at a feverous pace, the COVID-19 pandemic accelerated online sales even more. The traditional retail warehouse is a facility used to store retail goods until they are delivered to the retailer; these facilities are typically owned by the retailer. A traditional warehouse might be described as a business-to-business distribution facility. A fulfillment center is a warehousing location that is typically operated by a third-party logistics provider, where goods are delivered directly to the consumer (i.e. business-to-consumer). Another difference is the space requirements: e-commerce supply chains require more than three times the distribution space required by traditional retail supply chains centered on brick-and- mortar distribution.[94]

While the size and throughput of freight facilities is generally increasing, there is an emerging trend toward nano-distribution sites that push warehoused goods closer to the customer in highly populated urban areas where space comes at a high cost. Vacant brick and mortar storefronts are being repurposed as delivery depots for businesses that have moved entirely online.[95]

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[94] "COVID-19 Special Report #6: Accelerated Retail Evolution Could Bolster Demand for Well-Located Logistics Space," Prologis, June 2020, https://www.prologis.com/logistics-industry-research/covid-19-special-report-6-accelerated-retail-evolution-could-bolster.

[95] Steve Weikal and James Robert Scott, *The Evolution of the Warehouse: Trends in Technology, Design, Development and Delivery.* NAIOP Research Foundation, October 2020. Pg. 5.

Both traditional warehouses and e-commerce fulfillment centers are becoming more automated. One reason is cost; while the initial investment in technology can be high, fully automated warehouses or fulfillment centers can operate 24/7. In 2019, e-commerce giant Amazon opened its first robotics fulfillment center in St. Peters, Mo. Robots are used to move goods within the 855,000 square foot facility. Even with the robotic automation the facility still employs 1,500 people. More than 4 million commercial robots will be installed in 50,000 warehouses by 2025, up from about 4,000 robotic warehouses in 2018, according to a report by ABI Research.[96]

Freight facility location decisions are increasingly driven by big-data and analytics. Supply chain optimization modeling has been a growing trend for several decades. In the most recent iteration of an annual survey of third-party logistics services conducted by Penn State University, 39% of shippers indicated that network modeling and optimization were capabilities they looked for in 3PL providers while 62% of responding 3PLs said they offer those capabilities.[97] Optimizing supply chain networks is a proven practice for reducing costs, improving competitiveness and raising profitability. Private sector transportation companies use supply chain optimization to design their networks, size facilities and determine the best transportation and inventory policies to move products at the lowest cost while maintaining customer service requirements. Many state and regional economic development programs use a variety of incentives, including tax breaks, no/low interest loans and other forms of subsidies to influence business location/expansion decisions. Yet, traditional business location incentives have been questioned over their ability to sustain long-term economic growth. Some public economic development agencies are now beginning to offer supply chain intelligence as a means of recruiting companies making facility location decisions. "*Data analytics are becoming increasingly important in locational decisions for industrial real estate. Analytics can help identify optimal placement of smaller distribution facilities for timely delivery to dense urban and suburban populations, as well as the best locations for multistate or multimarket distribution facilities."*[98] As the COVID-19 pandemic causes companies to consider reshoring critical supply chains to North America, the use of data analytics is likely to play an increasing large role in site location decisions.

The trucking industry is also rethinking its facilities and business models to address key industry issues like the driver shortages. One trend in new supply chain facilities is an expanding number of freight consolidation or cross-docking facilities. Recent industry interviews indicate that some trucking companies are focusing only on markets that they can service within a single 14-hour on duty / 11-hour drive time shift for a driver. To facilitate this business strategy, there has been recent growth in facilities to consolidate commodities moving in partial truckload, partial container load or less than truckload quantities. In addition to reducing the number of over-the-road long haul drivers, full truckload rates are substantially less when compared to less-than-truckload rates. A graphic representation of cross-docking is shown in Figure 7.20. Unlike less-than-truckload services where the trucking firm maintains an entire network of terminals and fleet of trucks, a cross-dock facility acts somewhat like a public utility that any shipper or trucking company can use. Cross-docking can be used in several logistics situations:

- ***Transportation cross-docking.*** Cross-docking is used to consolidate shipments from several suppliers (often in LTL batches) to FTL shipments, achieving economies of scale. Transportation companies sort and

[96] Greg Isaacson, "The Future of Industrial Real Estate," Commercial Property Executive, December 5, 2019, https://www.cpexecutive.com/post/the-future-of-industrial-real-estate/.

[97] Online access at: http://3plstudy.com/3plindex.php

[98] Steve Weikal and James Robert Scott, *The Evolution of the Warehouse: Trends in Technology, Design, Development and Delivery.* NAIOP Research Foundation, October 2020. Pg. 13.

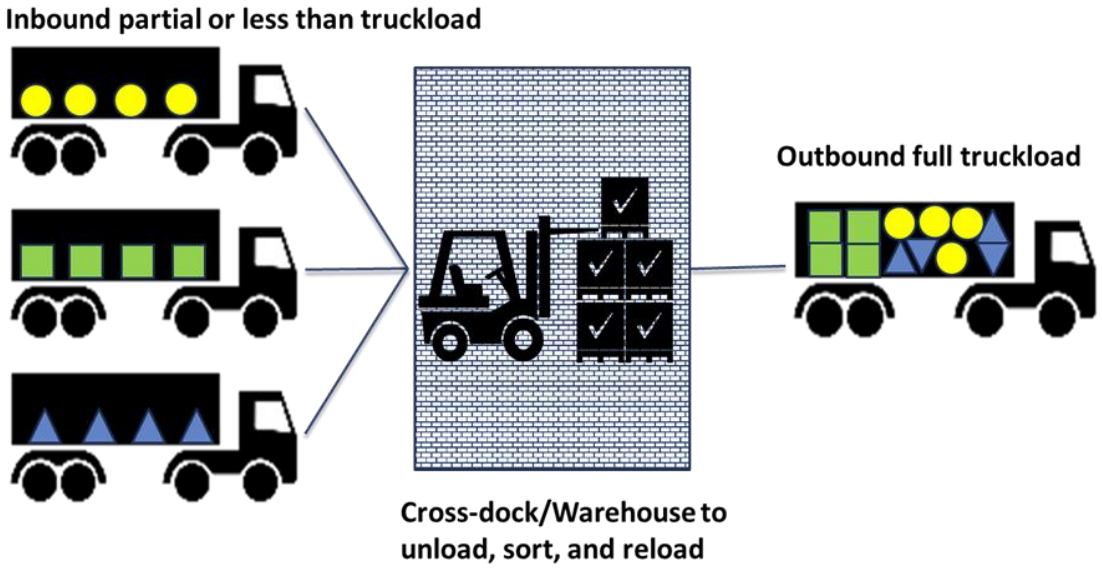
consolidate parcels and pallet loads based on geographic destination in the process. The cross-docking services can be provided by a pure cross-docking service provider or owned and operated by a trucking company to offer more competitive rates to shippers.

- ***Manufacturing cross-docking*.** Cross-docking is used for the receipt, consolidation and shipment of raw materials or component parts from many suppliers for TL shipments to a manufacturing plant.

- ***Distributor cross-docking*.** Multiple manufacturers ship merchandise to a common distributor's cross-dock facility. The distributor assembles or partially assembles products on a multi-SKU (stock keeping unit) pallet before delivery to the next receiver in the supply chain.

- ***Retail cross-docking*.** Products from multiple suppliers are received at a retailer's distribution center, moved across the dock and consolidated with other products bound for the same store. Wal-Mart delivers about 85% of its merchandises using a cross-docking system.

FIGURE 7.20 SCHEMATIC REPRESENTATION OF CROSS-DOCK FACILITY



Source: Quetica