SFRP

State Freight & Rail Plan

Freight and Rail Impacts

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Introduction

The Missouri freight transportation network encompasses railroads, highways, bridges, ports, waterways and airports, which can face significant threats from extreme weather. Certain weather events can substantially damage and disrupt the freight network, impacting the infrastructure needed to move goods or stalling the State's economy by preventing goods and services from reaching intended markets. Tornadoes, extreme flooding and winter storms are a few examples of weather hazards that may cause safety issues and operational disruptions. Road closures, railroad shutdowns, port congestion and flight delays are examples of disruptions that impact the economy by increasing delays and imposing safety risks.

Freight transportation is essential to the movement of goods across the country, but its impact extends far beyond logistics and economics. As volume of trucks, trains, barges and planes increases, impacts to the neighborhoods and wildlife also increase. Expansion of infrastructure reduces wildlife habitats and the buffers between it and residents. Freight impacts to the environment can include increased particulate matter in the air, increased noise levels and increased intensity for stormwater runoff carrying debris and chemicals into the water system.

Recognizing the cost of the extreme weather's impacts to freight movement and the potential impacts of freight movement on the surrounding environment, Congress incorporated provisions in 49 USC 70202 requiring analysis of these elements in state freight plans. On Jan. 12, 2023, the United States Department of Transportation (USDOT) published the USDOT State Freight Plan and State Freight Advisory Committee F (the Guidance) identifying the minimum requirements for state freight plans to meet the new statutory requirements from the Infrastructure Investment and Jobs Act (IIJA).[1] The Guidance was effective March 8, 2023.

The Guidance requires each plan to include quantifiable goals and strategies to decrease:

- The severity of impacts of extreme weather and natural disasters on freight mobility
- The impacts of freight movement on local air pollution.
- The impacts of freight movement on flooding and stormwater runoff
- The impacts of freight movement on wildlife habitat loss

[1] USDOT, "State Freight Plan and State Freight Advisory Committee Guidance," issued January 12, 2023, https://www.transportation.gov/mission/office-secretary/office-policy/guidance-state-freight-plans-and-state-freight-advisory.

The plan must include discussion of existing baseline conditions including reference to recent related events such as extreme weather, natural disaster, flooding, runoff, changes in air quality, siting of freight facilities in or near wildlife areas or population centers and consideration of anticipated impacts to freight transportation as a result of climate change and extreme weather related and flooding events and impacts of freight emissions and increasing freight volumes on communities and wildlife.

This chapter discusses the impacts of severe weather on the freight system by looking at the resilience of the Missouri Department of Transportation's (MoDOT) freight network. Freight resilience emphasizes an adaptable freight system that maintains operations and recovers rapidly from disruptions caused by extreme weather events. For infrastructure to withstand weather events, engineering designs/materials or the location of new infrastructure placement is important. Recovery from disruptions can include an initial emergency response as well as managing subsequent recovery actions, such as the emergency procurement of a downed bridge to expedite the delivery of materials for reconstruction. Mitigating impacts from weather hazards on the freight network is vital to improve safety and reduce impacts on the overall freight economy. **Figure 1** demonstrates damage that can occur to critical infrastructure from extreme weather events like flooding.

Then the chapter examines more closely the impacts Missouri's freight transportation system has on the human and wildlife environments. Use of zero emissions equipment, implementation of quiet zones, grade separations and stormwater management techniques can reduce these freight impacts.

Figure 1 – 2019 Flooding Washes Out a Section of U.S. Route 136

Background

Reliability is key in freight movement. States strive to operate resilient transportation networks that can endure and adapt to disruptions such as extreme weather, aging infrastructure, economic shifts and changing freight demands to maintain reliability for users. Missouri's 2022 State Freight Rail Plan reflected this focus through a multimodal strategy that integrated freight and passenger systems while prioritizing infrastructure durability, network redundancy and long-term adaptability. As part of its planning and project delivery processes, MoDOT routinely evaluates each location for safety, functionality, corridor consistency and potential impacts from extreme weather and resilience concerns. In 2018, MoDOT conducted a statewide assessment of National Highway System (NHS) facilities affected by natural disasters that required permanent repairs. This effort was expanded in 2020 with updates to the Transportation Management System (TMS), which now tracks all disaster-impacted locations across NHS and other routes.[2] These evaluations help MoDOT identify vulnerabilities and guide investments that strengthen the freight network's resilience.

Source: MoDOT

[2] MoDOT, "National Highway System Transportation Asset Management Plan", published June 2022, https://www.modot.org/sites/default/files/documents/Federal%20Transporation%20Asset%20Management%20Plan_508Compliant.pdf

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2022 Missouri State Freight and Rail Plan

The 2022 State Freight and Rail Plan (SFRP or the Plan) was the State's first integrated, multimodal blueprint designed to optimize multimodal freight and passenger rail.[3] Resilience was a central pillar throughout the 2022 SFRP, with specific attention to Missouri's ability to withstand and adapt to dynamic challenges such as supply chain disruptions, natural disasters, economic shifts and evolving transportation demands. The 2022 SFRP identified resilience as critical in both freight and passenger systems, emphasizing infrastructure durability, redundancy in networks and adaptability for future trends such as renewable energy and near-shoring. It's resilience strategy also focused on supporting the continuity of essential goods movement and passenger service, particularly in response to vulnerabilities exposed by the COVID-19 pandemic and anticipated energy transitions.

The 2022 SFRP proposed infrastructure improvements like universal crossovers and additional main lines to prevent bottlenecks and improve network redundancy. By embedding environmental, operational and economic resilience into all aspects of freight and rail planning, the 2022 SFRP positioned Missouri to thrive in an uncertain future. The key pieces of resilience from the 2022 SFRP are:

Equity and Environmental Resiliency: Support Equity and Environmental Resiliency of the multimodal freight and passenger rail.

- Support opportunities for alternative fueling infrastructure.
- Support expanded multimodal freight and passenger rail service as a part of an overall state energy conservation policy to protect Missouri travelers and shippers from the adverse mobility and economic impacts of expected increases in future transportation energy costs.
- Support expanded multimodal freight and passenger rail service as a means of reducing carbon emissions and fuel consumed per ton and per passenger mile and increasing the system's resiliency and redundancy against extreme weather events.
- Increase passenger rail accessibility to low-income, elderly and special needs groups who have limited access to auto and other modes.

Economy: Support economic growth and competitiveness in Missouri through strategic improvements to the multimodal freight network and passenger rail system.

- Enhance resiliency and develop redundancy for the multimodal freight and passenger rail system to increase reliability in moving passengers and freight.

[3] MoDOT, "2022 Missouri State Freight and Rail Plan", published May 2022, https://www.modot.org/2022-state-freight-and-rail-plan-documents.

By embedding resilience into its planning framework, Missouri joins other states in developing tailored strategies to address regional challenges. For example, California emphasizes smart technology and disaster preparedness, while Illinois focuses on connectivity and weather-resilient infrastructure. These diverse approaches offer valuable insights into how resilience can be integrated across different freight systems. MoDOT's commitment to reviewing and updating its infrastructure data confirms that resilience remains a central consideration in future investments. Through these efforts, Missouri continues to enhance its freight network's ability to withstand disruptions and support long-term economic growth.

MoDOT 2023 Carbon Reduction Strategy

In Nov. 2023, MoDOT published its Carbon Reduction Strategy (CRS) that was developed in coordination with the metropolitan planning organizations and the regional planning councils.[4] This strategy is focused on the goals of the IIJA Carbon Reduction Program (CRP) which provides funding for a wide variety of eligible projects geared toward reducing transportation carbon dioxide emissions from on-road highway sources. It focuses on three areas:

- **Energy Management:** reduce Missouri's energy footprint by implementing new technologies such as smart lighting and electrification infrastructure.
- **Non-motorized Transportation:** provide people the opportunity to walk or bike to nearby destinations by constructing new and improved non-motorized facilities.
- **Traffic Flow Improvement:** promote better fuel economy through signal and intersection optimization projects that reduce delays and improve traffic flows.

Strategies aligned with freight movement include:

- Expanding the use of roundabouts to reduce idling vehicles,
- Linking additional traffic cameras to traffic management centers that monitor congestion and incidents for more rapid response to traffic disruptions
- Projects that separate motor vehicles from pedestrians and bicycles.

[4] MoDOT, Carbon Reduction Strategy, published November 2023, https://www.modot.org/sites/default/files/documents/MoDOT%20CRS_web.pdf.

MoDOT Freight Network and Weather Hazards

MoDOT's multimodal freight transportation network serves as a critical hub for national and international commerce. This network of interconnected roadways supports the State's economy and links Missouri to major national trade routes. Missouri facilitates freight movement through major highway corridors such as I-70 and I-44, Class I railroads and vital inland ports along the Missouri and Mississippi Rivers. However, the State's extensive infrastructure investment faces disruption threats from extreme weather events such as flooding, winter extremes, heat waves and severe storms. These events can disrupt operations across all freight modes by compromising rail integrity, damaging bridges, disrupting river navigation and hindering logistics center operations. MoDOT actively monitors these risks, implements strategies to reduce their impact and prepares itself to respond effectively when disruptions occur.

Missouri's central location in the United States (U.S.) and its diverse freight assets make it a key link in the national supply chain. Evaluating how extreme weather affects state freight systems is essential for maintaining performance and building long-term resilience. Though not discussed in detail here, the possible disruption of freight movement due to seismic risks from the New Madrid and other fault lines should also be considered.

Source: MoDOT

MoDOT incorporates weather-related changes into its life cycle planning to enable its infrastructure remains reliable over time. With most locations seeing major projects every eight to nine years, the risk of needing premature replacements due to non-performance issues is reduced. This approach allows MoDOT to focus on strategic investments that consider both current and future severe weather challenges. Through planning, MoDOT strengthens the freight network's ability to withstand and adapt to evolving environmental conditions.

Weather Hazards

Weather hazards are natural events that create risks to human life, the environment and property. Common weather hazards in Missouri include tornadoes, flooding, severe thunderstorms, winter storms, cold waves, heat waves, droughts and wildfires. These events can be extremely dangerous and develop quickly with little warning. Not only can these hazards affect human life and the environment, but they can also impact freight infrastructure such as the rail and highway network, bridges, alternative transportation, stormwater management, inland waterways, airports, pipelines and intermodal facilities. This section lays out the most common weather hazards that affect the Missouri Freight Network at the time of writing. As weather patterns shift and change, future weather hazards may be added or removed from this list. In **Appendix I**, **Figures 1-7** demonstrate the location of weather events in the state and how those events relate to the location of critical infrastructure.

Tornadoes

- Tornadoes disrupt transportation systems by impacting operations, damaging infrastructure and lowering overall efficiency.
- Missouri is highly tornado prone, with more than 2,500 tornadoes since 1950. Peak months of tornado occurrence are April through June.[5]
- The 2011 Joplin Tornado, rated an EF5 on the Enhanced Fujita scale, was Missouri's deadliest tornado. It caused catastrophic destruction, requiring an immediate highway clean-up effort, a massive disaster relief freight response and utility reconstruction, impacting freight routes for weeks.

Flooding

- Flooding severely disrupts infrastructure, shutting down highways, railways, bridges and ports, triggering widespread logistical and economic disruptions.
- Repeated widespread flooding events, including the historic 1993 and 1995 Midwest floods and more recent events, resulted in closure of airports, water ports and long distances of highways and rail lines which all require subsequent rebuilding.[6&7]
- Even minor floods can interrupt operation of multiple freight modes, resulting in supply chain delays.

[5] U.S. National Weather Service, NOAA, "Months of Peak Tornado Occurrence," accessed October 15, 2025, https://www.weather.gov/cae/tornadobymonth.html.

[6] D.J. Hagerty, A.C. Parola, and T.E. Fenske, "Impacts of 1993 Upper Mississippi River Basin Floods on Highway Systems," Transportation Research Record 1483 (1995): 32-37, https://onlinepubs.trb.org/Onlinepubs/trr/1995/1483/1483-004.pdf

[7] Joanna Marsh, FreightWaves, "Midwest Floods Stymie Rail Operations," March 21, 2019, https://www.freightwaves.com/news/railroad-midwest-floods-stymie-rail-operations.

Severe Thunderstorms

- The high winds, tornadoes, hail, lightning and intense rainfall associated with thunderstorms delay shipments, stranded vehicles and cause costly infrastructure damage.
- Thunderstorms, a frequent and disruptive force statewide, are becoming more common and extreme. In 2024, a severe storm in St. Louis set a record for the most rain in a 24-hour period. It caused flash flooding that shut down transportation systems and stranded vehicles. At least a dozen St. Louis metro bus routes were out of service for the morning commute, with only limited restoration by 9 a.m. The same storm caused flooding in multiple counties southwest of St. Louis.[8] In all, five Missourians were swept to their deaths by the storm's fast-rising floodwaters.[9]

Winter Storms

- Winter weather events can significantly disrupt ground and air transportation systems by impairing visibility, reducing traction, damaging infrastructure and straining maintenance and operational capacity.
- In Missouri, winter weather has repeatedly halted freight and passenger movement, such as the 2011 snowstorm that prompted the first statewide closure of I-70 and an hours-long closure of the Kansas City International Airport.[10] **Figure 2** shows the impacts of cold weather on river barge traffic.

Figure 2 – A Mississippi River Towboat and Coal Barge in Icy Waters During a St. Louis Winter

Source: MoDOT

[8] Kate Grumke, Lacretia Wimbley and Sarah Fentem, St. Louis Public Radio, "At least two dead after flash flooding throughout St. Louis area on Election Day," published November 5, 2024, https://www.stlpr.org/news-briefs/2024-11-05/record-breaking-rainfall-flash-flooding-st-louis-election-day.

[9] Associated Press, "Missouri Flash Floods Blamed for Five Deaths, Including Two Poll Workers," published November 6, 2024, https://weather.com/news/weather/news/2024-11-06-deadly-flash-floods-in-missouri-on-election-day.

[10] NOAA, "February 1-2, 2011 Blizzard and Record Snowfall Event," accessed October, 15, 2025, https://www.weather.gov/eax/feb012011.

Cold Waves

- Cold waves are extended periods of extreme cold, often caused by Artic air masses, leading to sudden temperature drops and freeze-related damage.
- These events can severely impact infrastructure, causing bridge joint failures, rail fractures and river ice jams.

Heat Waves

- Heat waves in Missouri are becoming more frequent and intense, with periods of extreme heat and high humidity.[11]
- Extreme heat conditions can cause heat-related illnesses, droughts, wildfires and significant stress on infrastructure, including power grids and pavement buckling.

Drought

- Droughts are prolonged periods of below-average rainfall, often exacerbated by high temperatures. Extreme drought can lead to water shortages and harm to agriculture and ecosystems in the form of reduced crop yields and increased risk of wildfires.
- Extended dry periods can also limit barge transportation on major rivers, threaten municipal water supplies and reduce hydropower generation.[12]
- In 2023, Missouri experienced its seventh driest growing season since 1895, with widespread drought conditions caused by low rainfall and high temperatures across an eight-month span.[13]

Wildfires

- Although less frequent than in western states, wildfires in Missouri pose a serious threat, especially during dry months with high temperatures and strong winds.
- Most wildfires are the result of human activity and can damage property, harm wildlife and endanger public health.
- In March 2024, Missouri experienced its first-ever fire disaster, with more than 200 wildfires burning more than 15,000 acres, including a major outbreak in mid-March that heavily impacted the Ozarks.[14]

[11] Frankson, Rebekah, Kenneth E. Kunkel, Sarah M. Champion, and Brooke C. Stewart., NOAA National Centers for Environmental Information, “Missouri State Climate Summary,” 2024, https://statesummaries.ncics.org/downloads/Missouri-StateClimateSummary2022.pdf.

[12] NOAA National Integrated Drought Information System, “National Conditions Missouri”, accessed October 15, 2025, https://www.drought.gov/states/missouri.

[13] University of Missouri. College of Agriculture, Food and Natural Resources, Missouri Climate Center, “2023 was likely Earths warmest year on record, Missouri’s third drought during growing season also defined 2023,” January 11, 2024, http://climate.missouri.edu/news/arc/jan2024a.php.

[14] Bassler, H. (2025, June 17). “Worst-case scenario”: St. Louis meteorologists warn of Missouri’s worsening wildfire disasters, KSDK, https://www.ksdk.com/article/news/local/missouri-wildfire-disasters-are-coming-meteorologists-warn-to-prepare/63-5eb0f06f-be95-4ce6-9cac-3888238f8bec.

Freight Transportation Network

Weather hazards pose significant risks to Missouri’s freight and transportation systems, leading to widespread delays, cancellations, infrastructure damage and increased operational costs. Given Missouri’s central location and its vital role as a national freight hub, the impacts to the economy from freight disruptions reach far beyond the State.

The freight transportation network is complex and highly interconnected, supporting the movement of goods across broad distances. It relies on a combination of transportation modes such as railroads, highways, inland waterways, airports, pipelines and intermodal facilities. These modes contribute to the efficiency and reliability of freight logistics while interacting to meet the diverse needs of industries, businesses and consumers. Rather than operating independently, these

modes are interconnected in ways that allow freight to move efficiently. This multimodal approach enables flexibility in routing, cost-effectiveness in shipping and reliability in delivery. Intermodal facilities enhance this system by allowing goods to transfer seamlessly between modes, strengthening the overall performance of the network.

Each transportation mode, rail, highways, bridges, inland waterways and ports, airports, pipelines and intermodal facilities, faces distinct risks that can affect the overall functionality and resilience of the freight network. Understanding the specific function and vulnerabilities of each mode is essential for improving system preparedness and response to enable continued flow of freight.

Rail

- Missouri is a central hub for freight rail, hosting more than 3,700 miles of track.
- Class I railroads, including Burlington Northern Santa Fe (BNSF), Canadian Pacific Kansas City (CPKC), CSX, Norfolk Southern (NS) and Union Pacific (UP) connect the state to national economic hubs and international ports of entry.
- Class III railroads, also known as short lines, are important first and last mile connections between industrial areas and the Class I railroads, reducing congestion on Missouri’s highways.
- Critical rail hubs like Kansas City and St. Louis are the second and sixth largest freight rail hubs in the country, playing a vital role in national and international freight movement.

Rail yards, intermodal facilities and bridges are particularly vulnerable to flooding, heat-related rail deformation and severe storms.

Highway Network and Trucking Corridors

- Missouri is intersected by major highways, including I-70, 44, 49, 55, 29 and 35, which serve as key state and national freight corridors.
- St. Louis, Kansas City and Springfield are major nodes for trucking and logistics.
- Highways serve as critical access to all modal freight hubs.
- Truck parking facilities, highways and bridges need protection from extreme weather events and stormwater flooding.

Inland Waterways and Ports

- The Missouri River (M70 and M29) and Mississippi River (M35 and M55) are major arteries for waterborne freight movement moving between the agricultural Midwest and the Gulf for international shipments.
- The St. Louis regional port accounts for 21% of the Upper and Mid-Mississippi River freight flow.
- Vulnerabilities include fluctuating river levels, sediment buildup in channels and harbors and infrastructure damage from storms both at the ports and to the rivers' navigation control structures.

Airports

- St. Louis Lambert International Airport (STL), Springfield-Branson International Airport (SGF) and Kansas City International Airport (KCI) are critical components for high-value and time-sensitive freight cargo.
- Extreme weather risks that contribute to delays include heat damage to runways, disruptions from severe wind and rainstorms and icing on plane wings.

Pipelines

- Missouri has an extensive network of pipelines transporting oil, natural gas and other products.
- Access to pipeline terminals is a critical component of the network.
- Pipelines are susceptible to erosion, flooding and damage from shifting soil due to extreme weather events.

Intermodal Facilities

- Key intermodal terminals in Kansas City, St. Louis and other locations facilitate the transfer of goods between rail, truck and waterways.
- These facilities face risks from extreme heat, flooding and storm damage

Table 1 outlines the potential impacts of various weather hazards on Missouri's freight and transportation infrastructure.

Table 1 – Weather Hazard Impacts on Missouri's Freight System

	Rail	Highways and Trucking Corridors	Bridges	Inland Waterways and Ports	Airports	Pipelines	Intermodal Facilities
Tornado	Tracks blocked by debris; wind damage to rail infrastructure. Possible damage to cargo, railcars and locomotives	Debris blocks roads; structural damage to signage and barriers. Vehicle and cargo damage possible	Structural damage from wind; erosion from flash floods	Debris and outages disrupt cargo flow; fallen trees block access	Aircraft and terminals are vulnerable to wind damage	Debris impact and wind pressure may rupture pipelines	Structural damage to cranes, buildings; system shutdowns. Possible vehicle, container and cargo damage
Flooding	Track washouts; foundation erosion	Road erosion and collapse; vehicle sweep risk in deep water	Scouring weakens piers and footings; water pressure damages joints	Eroded banks, damaged docks and disrupted navigation channels. Risk of facility closure	Water intrusion impacts runway surfaces and access roads. Risk of facility closure	Eroded soil exposes or shifts buried pipelines	Rail washouts and road closures break multimodal links
Severe Thunder-storms	Track bed erosion; electrical and signal system failure	Washed-out roads; power outages disable signals and crossings. Possible cargo damage	Wind and water stress structural elements	Container loss; unsafe operating conditions for workers	Lightning and wind cause infrastructure damage	Voltage surges and flying debris can damage components	Flooding and outages disrupt operations
Winter Storms	Cold cracks rails and stiffens components; snow/ice reduce traction	Icy roads reduce driver control; increased maintenance needs	Brittle failures and freeze-thaw cracking	Ice buildup halts barge traffic	Ground handling disruptions due to snow and ice	Cracking and leakage from pipe freezing and contraction	Worker safety protocols trigger shutdowns

	Rail	Highways and Trucking Corridors	Bridges	Inland Waterways and Ports	Airports	Pipelines	Intermodal Facilities
Cold Waves	Rail fractures; frozen cables disrupt signals	Freeze-thaw cycles degrade pavement, subgrade. Possible cargo damage	Stress from material contraction causes cracking and joint damage	Possible cargo damage from extreme cold	Equipment performance impacted by extreme cold	Freezing can block or rupture pipes	Truck engines or systems may fail to start
Heat Waves	Rail deformation and buckling (“sun kinks”); overheated signals	Pavement buckling and rutting of pavement	Thermal expansion stresses bridge joints and decks	Cargo spoilage risk increases; cooling requirements intensify	Runway surface softening	Pipe expansion stresses joints; soil shrinkage shifts support	Thermal stress impacts infrastructure reliability
Drought	Rail deformation and buckling. Risk of embankment fires started by sparks	Soil shrinkage can destabilize embankments, cuttings and pavement substructure	Shrinking soils shift bridge foundations	Low water restricts barge drafts and narrows navigation channels	Runway degradation from heat	Soil desiccation shifts pipes, increasing risk of leaks	Soil shrinkage and settlement may stress infrastructure
Wildfires	Track damage from heat; reduced visibility from smoke. Possible structure and equipment loss	Road closures from smoke; heat damages pavement; signpost loss risk. Possible structure and equipment loss	Buckled steel and cracked concrete from high heat	Erosion increases from vegetation loss; clogged drainage. Possible structure and equipment loss	Smoke disrupts air traffic visibility and routing. Possible structure and equipment loss	Heat may deform pipes; ash contaminates water systems	Air quality and visibility impair operations. Possible structure and equipment loss

Freight Impacts on the Environment and Society

Efficient, reliable freight transportation is essential to the nationwide movement of goods and supports jobs, availability of consumer products and quality of life amenities. However, its impact extends far beyond logistics and economics as increasing freight activity can contribute to concerns from communities near the freight facilities. The movement of diesel-powered trucks, trains and cargo equipment contributes to airborne particulate matter, affecting air quality, while the design of freight infrastructure can disrupt drainage patterns and lead to water issues. Over time, these conditions can affect public health and reduce property values. As a result, strategies to reduce these impacts while supporting the continued movement of goods must be considered.

A range of solutions is available to address these challenges to increase the environmental sustainability of the freight systems. The use of zero-emissions equipment at freight facilities can help reduce diesel emissions, improving air quality and public health. In rail corridors, the establishment of quiet zones and the use of wayside horns and rail-highway grade separations can significantly reduce noise pollution without compromising safety. Meanwhile, the growing demand for truck parking has prompted the exploration of potential solutions such as real-time parking information systems, new facility development and the repurposing of existing infrastructure to reduce trucks parking on highway ramps and shoulders, as well as neighborhood streets. These practices aim to address the safety, regulatory and operational challenges truck drivers face when designated parking is unavailable. These solutions improve safety and efficiency and also help protect the quality of life for nearby communities, representing a shift toward more sustainable, efficient and community-conscious freight infrastructure.

Community Impacts

Missouri’s freight transportation network, while vital to citizens’ well-being and the commercial health of the State, can impact communities and wildlife habitats through its contributions to air and noise pollution, safety concerns and soil and water contamination.

Air

Diesel-powered vehicles and equipment are a source of emissions at the local level, affecting areas that are near highways, river ports, rail yards, transload facilities and distribution centers. When motors idle, they release emissions, increasing local exposure to tiny particles and droplets such as soot and smoke. Trucks most often idle in traffic and

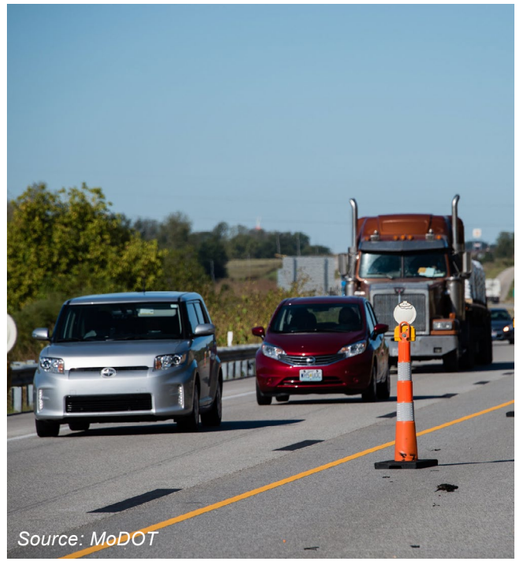
at loading docks. Locomotives idle mostly at loading docks and while awaiting maneuvers in siding tracks and rail yards. Among the effects of vehicle emissions is the formation of ozone, which affects air quality. **Figure 3** shows a sign warning drivers about poor air quality.

Air freight impacts local air quality in communities that are near cargo airports. Aircraft emissions are released during landing, takeoff and idling. Although the volume of air freight emissions is less overall than that of rail or trucks, the emissions per ton of freight are comparable and also impact regional air quality.

Marine freight can affect local air quality, specifically in port communities. At inland waterways emissions originate from ships, diesel-powered equipment, trucks and trains that support cargo movement.

Figure 3 – Ozone Forecast Messaging

Source: MoDOT



Source: MoDOT

Noise and Vibration

The noise from freight traffic can disrupt sleep and affect individuals' stress levels. Vibration caused by the movement of vehicles and locomotives can impact nearby buildings and infrastructure, leading to structural issues.[15]

Traffic Congestion and Safety

Growing demand for goods and services—including doorstep delivery of consumer products—increases the average traffic rate on Missouri's roads. Increasing numbers of passenger and commercial vehicles can slow the flow of traffic and increase the number of potential conflicts.

[15] Ardian, Alan Riski Rio, Dewi Handayani, and Ahmad Marzuki. 2025, "A Review: Vibration Caused by Transportation," Engineering Proceedings 84, no. 1: 42, https://doi.org/10.3390/engproc2025084042.

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Stormwater Runoff and Flooding

Freight facility surfaces such as concrete, asphalt and rooftops are mostly impermeable. These prevent water infiltration and, during significant rain events, can increase surface runoff volume and speed. Stormwater can quickly overflow drainage systems, especially in urban areas. Deluges and the resulting runoff can lead to flash flooding in and around freight hubs, can cause erosion and lessen water quality.

Freight infrastructure can disrupt natural drainage patterns where roads, terminals and buildings were not designed with high water volumes in mind. Soil compaction, caused by the use of heavy equipment and large trucks, can also reduce soil permeability, resulting in flooding. Excess water might flood adjoining or low-lying areas due to the lack of flood protection and resilient infrastructure. Runoff from freight areas can wash contaminants such as deicing chemicals, hydrocarbons from lubricating fluids and heavy metals from tires, brakes and engine wear into watersheds.[16]

Source: MoDOT

Strategies to Enhance Freight Transportation Resilience

Increased resilience can enhance the efficiency and reliability within Missouri's freight transportation network in the face of major weather disruptions and aging infrastructure. **Table 2** describes targeted goals and strategies that can result in a more adaptable freight system that maintains uninterrupted movement of goods, strengthens reliability of corridors and supports economic competitiveness. By focusing on future planning strategies, MoDOT can mitigate risks and minimize the disruptions on the freight network statewide. Enhancing freight resiliency can protect Missouri's role as a key national freight hub and support long term economic growth.

[16] U.S. Environmental Protection Agency (EPA), National Pollutant Discharge Elimination System, "Stormwater Discharges From Transportation Sources," last modified January 10, 2025, https://www.epa.gov/npdes/stormwater-discharges-transportation-sources.

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Table 2 – Goals and Strategies to Enhance Freight Transportation System Resilience

SFRP Goal	Strategy
Stewardship Maintain current assets and services we have today	Prioritize long-term maintenance for critical freight assets. Incorporate risk planning and resilience needs into transportation planning processes Design freight infrastructure to resist damage under physical stress. Strengthen secondary highways and bridges to operate as detour routes for all traffic, including standard commercial motor vehicles.
Safe Work to enhance safety of the transportation system for all users	Identify safe, publicly owned locations for truck parking use when major freight corridors are unexpectedly closed due to weather or other incidents.
Prosperous Boost the economy through transportation investments	Coordinate across state and local agencies and modes to unify resilience efforts statewide.
Connected Improve mobility and connect communities through expanded multimodal choices	Identify alternative routes for freight assets which are more vulnerable to extreme weather disruptions. Install signage and real-time traffic alert systems to guide freight vehicles through congested areas and provide alternate routes for standard size and weight vehicles when delays occur.
Reliable Ensure efficiency and reliability in the transportation network	Prioritize critical freight needs, transportation assets and modal connections for rapid emergency response. Harden vulnerable freight assets to extreme weather and seismic events. Stage alternative commercial vehicle route signage - for trucks of legal dimension and weight – at locations for quick installation during detour events.
Innovative Integrate emerging technologies to make our transportation system prepared and future-ready	Integrate technologies to track infrastructure conditions, detect disruptions, and support timely freight operation decisions. Implement technology to simulate and monitor infrastructure performance, enabling proactive maintenance and informing design decisions. Include outlier vehicles such as oversized and/or overweight vehicles in assessment and design decisions.

Strategies to Enhance Freight Transportation Resilience

Table 3 describes goals and strategies in the SFRP that will mitigate freights impacts on the environment and society.

Table 3 – Goals and Strategies to Mitigate Freight Impacts

SFRP Goal	Strategy
Stewardship Maintain current assets and services we have today	Support implementation of Quiet Zones on freight rail lines adjacent to residential areas to reduce noise and improve quality of life while maintaining freight service.
Safe Work to enhance safety of the transportation system for all users	Support implementation of zero emission freight equipment. Encourage truck parking facilities to be included in industrial economic development projects to reduce unauthorized parking on shoulders, ramps and near residential areas.
Prosperous Boost the economy through transportation investments	Identify potential road-rail grade separation locations on freight routes to reduce idling and noise. Support rail access to industrial development areas to encourage freight traffic efficiency.
Reliable Ensure efficiency and reliability in the transportation network	Support installation of automation and idle reduction standards at modal hubs to reduce idling and increase capacity. Consider roundabout installation near freight hubs to reduce truck idling. Expand CCTV locations connected to traffic management systems to increase rapid response for traffic disruptions and backups
Connected Improve mobility and connect communities through expanded multimodal choices	Support existing intermodal hub locations and identify potential additional sites to encourage efficient movement of freight and reduce idling from backup queue.
Innovative Integrate emerging technologies to make our transportation system prepared and future-ready	Support installation of intelligent highway-rail at-grade crossing technology that adjusts traffic signals and notifies commercial vehicles when an alternative crossing should be used. This reduces idling from backup queues. Continue to monitor other states' experiences with truck parking information systems that provide virtual information to drivers regarding available authorized parking locations.