



UNIFIED RESPONSE TO NATIONAL TRANSPORTATION DISRUPTIONS

Successes and Gaps Observed
in Recent Transportation Disruptions

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Introduction

Transportation disruptions pose significant risks to the U.S. economy, homeland security, and defense by affecting the movement of food, energy, industrial goods, and personnel, and recent disruptions clearly demonstrate these risks. In May 2021, Colonial Pipeline suffered a ransomware attack that shut down its fuel flows for five days, resulting in fuel shortages that disrupted commerce and degraded defense capabilities across the southeastern U.S. In June 2023, a truck fire destroyed a section of Interstate 95 in Philadelphia, diverting traffic to secondary roads and other transportation modes until local authorities completed a temporary bridge a week later and restored full service a year later. In August 2023, Norfolk Southern suffered a major technology outage that disrupted the tracking and scheduling of its trains for a week, delaying freight deliveries across multiple U.S. industries. The far-reaching effects of these incidents necessitate further study and solutions so federal agencies can nimbly respond to future, inevitable transportation disruptions.

MITRE, through its multi-year investment in Unified Response and other activities, is examining transportation disruptions for opportunities to make national responses faster and more effective. This examination revealed that for events meeting Stafford Law thresholds, incident response and recovery are generally appropriate to local and regional natural disasters. However, particular with respect to transportation disruptions (especially those without a natural-disaster component), there is room for U.S. federal agencies to respond more quickly and with greater impact.

This report is intended to inform a federal government decision to implement policies and/or capabilities to facilitate unified planning, response, and recovery among agencies, state and local governments, and industry for transportation disruptions.

Problem Scope

A transportation disruption interrupts the normal flow of systems like roads, railways, air, and maritime routes. The U.S. is facing increasingly complex regional and national impacts from transportation disruptions given the social, economic, and other interdependencies across critical sectors. Causes include natural disasters, accidents, mechanical failures, labor strikes, or cybersecurity incidents, leading to delays, increased costs, and impacts on supply chains and commuters.^{1,2,3} Additionally, disruptions may occur in series or in parallel, making the responses more complicated. Responses to transportation disruptions require contributions of resources and capabilities from federal agencies; state, local, tribal, and territorial (SLTT) governments; and private sector organizations based on the breadth of impacts.

Approach

MITRE identified 14 transportation disruptions and analyzed them using publicly available material (Appendix A). This analysis included understanding and documenting the disruptions, their root causes, actions taken by responders that had a positive impact, and shortfalls in response actions that may have a potential negative effect in the near or long term. Disruptions between 2018 and mid-2024 were selected to ensure they embody the technologies and policies that would likely be in effect to manage transportation disruption responses over the next few years. The analyzed disruptions represent four historical types—System Technology Outages (Appendix B), Inoperable Localized Infrastructure (Appendix C), Regional Degraded Operations (Appendix D), and Service Interruptions due to Labor Strikes (Appendix E).

Existing Federal Emergency Management Agency (FEMA) frameworks, policies, and practices that guide responses to natural disasters and have the potential to be adapted to transportation disruptions were studied. These include FEMA's National Preparedness Goal,⁴ Threat and Hazard Identification and Risk Assessment (THIRA), Stakeholder

¹ Transportation Research Board. (2015). "Transportation Disruption: A Review of the Literature." *Transportation Research Record*

² U.S. Department of Transportation. (2020). "Transportation System Disruptions and Resilience." *Report on Transportation System Resilience*

³ Federal Emergency Management Agency (FEMA). (2018). "Transportation Disruptions: Understanding the Impact on Emergency Management." *FEMA Reports*

⁴ Department of Homeland Security. (2015). *National Preparedness Goal, 2nd Edition*.

Preparedness Review (SPR),⁵ and National Incident Management System (NIMS).⁶ The National Preparedness Goal outlines capabilities across five mission areas: prevention, protection, mitigation, response, and recovery. THIRA is a methodology to conduct a threat assessment and includes capability targets, which are measurable response actions. SPR is a process whereby communities assess their response against a capability target, such as through a cyber exercise or other means. NIMS is a set of principles that provides a systematic, proactive approach to guiding government agencies to work seamlessly in the event of an incident.

By analyzing recent transportation disruptions and applying FEMA's exemplar approach, this report aims to identify opportunities for faster, more effective national responses through coordinated actions among government organizations and the private sector.

Gaps in Unified Response

This report identifies three gaps in unified response during major transportation disruptions: 1) Guiding Federal Involvement, 2) Delivering the Operational Picture, and 3) Informing Response Actions. This section describes each unified response gap, existing frameworks and capabilities related to the gap, the need to address the gap, and example challenges experienced during historical disruptions.

Guiding Federal Involvement

Our nation needs the federal government to act faster and more decisively following major transportation disruptions to protect critical national interests, such as commerce, energy, medical supplies, food, and defense. The federal government is uniquely positioned and resourced to accomplish these functions. The role of SLTT governments and industry organizations is to ensure the safety and security of their communities by deploying first responders to control the initial disruption (e.g., put out fires, evacuate people). SLTT governments and industry are not positioned to assess and manage national impacts without federal leadership. To fulfill its role in stabilizing national interests, the federal government must consider how to more quickly activate its resources, better organize its multi-agency efforts, and coordinate with SLTT governments and the private sector.

The federal government does not consistently apply policies to guide rapid activation of its resources and capabilities and effective engagement to stabilize national interests following transportation disruptions.

The Stafford Act guides the federal government's rapid and effective engagement in responding to national disasters. When the Stafford Act is activated, FEMA leads the federal response to supplement resources from SLTT governments. However, the Stafford Act was not designed to apply to disruptions that primarily affect our transportation network and do not immediately threaten mass injuries or deaths.

A potential solution is a federal policy to define the federal government's response strategy to transportation disruptions, including decision criteria for when the federal government should engage and which agencies should respond in what roles. Federal policy and guidance that identifies response agencies and their lead or support roles can help resource, train, and equip each agency accordingly. Defined roles further inform how agencies prepare to interact with one another and with SLTT governments and industry organizations following a disruption.

Example Challenges during Historical Disruptions

- **Federal Decision to Engage:** Without a transparent decision process in place, the federal government decided to engage in stabilizing national effects related to the Colonial Pipeline ransomware shutdown and the rail labor strike, but not the I-95 Philadelphia bridge collapse, CrowdStrike Windows outage, or the Norfolk Southern software outage.

⁵ Department of Homeland Security. (2017). *National Incident Management System, Third Edition*.

⁶ Department of Homeland Security. (2018). *Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide- Comprehensive Preparedness Guide (CPG)*.

- *Agency Roles:* Following the Colonial Pipeline ransomware shutdown, a congressional hearing investigated why the Department of Energy (DOE) led the interagency response because, according to existing policy, the Cybersecurity and Infrastructure Security Agency (CISA) is responsible for coordinating federal efforts for critical infrastructure security (PPD-21) and cyber incident coordination (PPD-41). As another example, in preparing for the rail labor strike, the U.S. Department of Transportation (USDOT) led the federal response because the disruption was related to transportation, though the USDOT was not resourced, trained, and equipped accordingly and needed substantial augmentation from FEMA staff to execute the mission.
- *Federal Coordination with the Private Sector:* Resulting from *ad-hoc* communication processes, the federal government has limited insight and influence over transportation disruptions that take place among private infrastructure owners and operators, even for critical public lifelines, as seen in responses to the Norfolk Southern software outage, AT&T outage, and Custer, WA, derailment.

Delivering the Operational Picture

The immediate response to any incident is conducted by the local law enforcement and emergency responders. Initial communication and notification of the incident to appropriate federal authorities typically occurs, leading to a suitable federal presence at the incident site. However, recent historical events show that lack of up-to-date transportation system knowledge is common in the immediate aftermath of an incident. Moreover, while first responders do perform well with limited information in immediately responding to the disruption, they have neither the time nor the information to perceive the risk of any complex disruptions or events downstream of the incident.

Transportation infrastructure and operational use data are not accessible to inform effective actions that stabilize national interests following transportation disruptions.

MITRE envisions a transportation-oriented Common Operating Picture (COP), which would consist primarily of real-time and historical data on vehicle flows by mode along specific routes. Having such a COP could help unify the response in many ways. It would lay the foundation to maintain a national level asset that could track current flow patterns as well as the supply routes of various critical goods. When made readily available and layered with supply chain information, this COP could also lead to a different strategic viewpoint of the disruption in terms of knowing the risk of possible downstream effects and thus influence traffic management even in the initial hours of the response. The extensive study of various risks caused by disruptions along a route could be conducted and lead to better preparation among the federal government, SLTT levels, and private sector.

Example Challenges During Historical Disruptions

- *Bringing national resources to bear:* In the March 2024 I-695 Baltimore Key Bridge collapse, federal resources were marshalled quickly to supplement the response and facilitate the recovery. However, after the May 2021 Colonial Pipeline ransomware attack, operations were not resumed for six days, contributing to constraints in energy supply along the Eastern Seaboard and leading to lines at gas stations across the southeast U.S.⁷. Improved COP, including fuel trucking and fuel freight train capacity, might have helped the DOE and USDOT to more quickly reduce the fuel shortages. Additionally, sharing this information across all federal agencies (e.g., Federal Bureau of Investigation [FBI], Department of Homeland Security [DHS], CISA) may have laid the foundation for their expertise to be leveraged more readily.
- *Optimal use of alternate routes:* The June 2023 I-95 Philadelphia bridge fire required traffic to be rerouted across alternate routes for a little over a week. This led to increased traffic along alternate routes as well as increased use of commuter trains and carpooling. While a one-week recovery time is fast, a transportation-oriented COP could have helped transportation officials in Pennsylvania and New Jersey collaboratively route interstate traffic with less congestion and prioritize high-priority shipments as needed. Additionally, Philadelphia has obvious alternatives for freeway traffic that other locales may not have. Mirroring the work

⁷ <https://www.usatoday.com/picture-gallery/news/nation/2021/05/12/colonial-pipeline-shutdown-brings-long-lines-big-waits-gas-stations/5054762001/>

of the Eastern Transportation Coalition (tetcoalition.org) for other regions of the country, using common formats and analogous data feeds, would be helpful for both response and recovery planning for both infrastructure outages like the November 2023 I-10 Los Angeles bridge fire and for regional events such as Hurricane Michael in 2018 or the Midwest Floods in 2024.

- *Traffic congestion and constrained resources:* In August 2023, the Norfolk Southern software bug severely impacted the rail operator's scheduling and operations for several days. Downstream effects of this disruption included delays in passenger trains (e.g., Amtrak, Virginia Regional Express). Sharing an improved COP across government and the private sector could have helped the rail operators work collaboratively to find and use rail, highway, and truck alternatives for time-sensitive cargo and passengers.

Informing Response Actions

Our nation needs to respond to transportation disruptions by holistically considering multiple objectives and perspectives across life safety, security, the economy, defense, and other national interests. When managing transportation disruptions, SLTT governments and the private sector do not have the perspective to trade off competing objectives or the resources to act on them simultaneously. The federal government must lead response actions in coordination with SLTT governments and the private sector by facilitating joint analysis of these priorities, orchestrating response actions accordingly, and providing resources to complement ongoing efforts.

Existing guidance manages multiple systems, objectives, and trade-offs in the emergency management space. However, the guidance is not tailored to handle responses to transportation disruptions. Nevertheless, existing FEMA guidance that can inform responses to transportation disruptions includes the following:⁸

- *National Incident Management System (NIMS):* A unified framework for effective incident management and intelligence sharing across all mission areas to ensure national security.
- *Incident Command System:* A consistent framework for government, private, and nongovernmental organizations to collaboratively manage incidents of any type or complexity.
- *NIMS Intelligence and Information Sharing Guidance:* Aids personnel in managing all mission areas to ensure unified efforts and national security.

Government and industry have limited decision support aids available to assess and choose between courses of action in response to transportation disruptions.

Tailored decision support aids are needed to inform response options and actions for transportation disruptions. The federal government has a leadership role in tailoring these aids and developing methods for emergency responders to assess trade-offs and courses of action that satisfy national objectives from multiple perspectives. Such decision support aids can inform boots-on-the-ground first responders and strategic emergency operations personnel to understand the national interests at play and how the disruption and their response actions may impact them. Predictive decision support aids can also inform resilience planning in terms of risk analysis, mitigation, and investment prioritization. The federal government can use decision support aids tailored to transportation disruptions to identify and address the national priorities that SLTT governments and the private sector cannot.

Example Challenges during Historical Disruptions

- *Optimization of Response Actions:* Following the East Palestine Train Derailment in 2023, the decision to vent and burn the hazardous materials was determined to be incorrect and may result in health issues for exposed communities. During Hurricane Michael in 2018, necessary resources were unavailable to meet the demand for emergency assistance, communications, clean-up, and rebuilding infrastructure. The Colonial Pipeline ransomware shutdown is an example where industry and government independently acted, and a cohesive response did not occur. During the West Coast Wildfires in 2018, residents were

⁸ DHS FEMA, National Incident Management System Intelligence/Investigations Function Guidance September 2024 (Draft). https://www.fema.gov/sites/default/files/documents/nims_intel_invest_function_guidance_draft_20240925.pdf

informed to evacuate at the last minute, and the federal government funding assistance for recovery took over six months and was insufficient to cover the losses.

- *Predicting Cascading Impact:* The AT&T and CrowdStrike Windows outages crippled wireless service and the airline industry, respectively, demonstrating the impact of exploiting critical vulnerabilities to the transportation sector and national interests. As with the Denver and Dallas Global Positioning System (GPS) outages in 2022 and issues surrounding Position, Navigation, and Timing outages, responsibility remains diffused across federal agencies—such as CISA, the Federal Communications Commission (FCC), the military, the Department of Commerce, and the Federal Aviation Administration (FAA). The diffusion of responsibilities adversely impacts the understanding of how these disruptions affect national interests, coordinated investments and trade-offs in investments, and other actions to mitigate the negative impacts of these disruptions.

Summary

The analysis identified that today's emergency response guidance and practices aid personnel in making quick, high-stakes decisions with limited information. Using existing guidance and practices, first responders have a strong track record of managing dangerous situations while prioritizing safety. However, analysis detailed in this report reveals that transportation disruptions can have compounding factors that may escalate into complex national impacts, some of which are unprecedented and lack guidance and practices to stabilize them. Current guidance does not address stabilizing national impacts from transportation disruptions. The federal government can enhance response actions in these scenarios.

The analysis identified three critical gaps:

1. **Guiding federal involvement** - The federal government does not consistently apply policies to guide the rapid activation of its resources and capabilities and effective engagement to stabilize national interests following transportation disruptions.
2. **Delivering the operational picture** - Transportation infrastructure and operational use data are not accessible to inform effective actions that stabilize national interests following transportation disruptions.
3. **Informing response actions** - Government and industry have limited decision support aids available to assess and choose between courses of action in response to transportation disruptions.

Additional research is needed to address the gaps identified in this report.

Appendix A Evidence for Unified Response Gaps

Table 1 summarizes the historical transportation disruptions that demonstrated each of the three gaps identified in Section 0 of this report as follows:

- A solid orange square indicates a historical disruption exhibited gap as highlighted in the section Gaps in Unified Response.
- An empty orange square indicates historical disruption exhibited gap as cited in Appendix B through Appendix E.
- An empty gray circle indicates no evidence of this gap was found.

Table 1. Recent Disruption Responses that Demonstrated the Identified Gaps

Type	Historical Transportation Disruption	Gap 1: Guiding Federal Involvement	Gap 2: Delivering the Operational Picture	Gap3: Informing Response Options
System Technology Outages	Colonial Pipeline ransomware shutdown	■	■	■
	CrowdStrike Windows outage	■	○	■
	AT&T outages	■	○	■
	Denver and Dallas GPS outages	□	□	■
	Norfolk Southern software update	■	■	□
Inoperable Localized Infrastructure	East Palestine, OH, derailment	□	□	■
	Custer, WA, derailment	■	□	□
	I-95 Philadelphia bridge fire	■	■	□
	I-10 Los Angeles fire	□	■	□
	I-695 Baltimore Key Bridge collapse	□	■	□
Regional Degraded Operations	Hurricane Michael	○	■	■
	Midwest flooding	○	■	□
	West Coast wildfires	○	□	■
Service Interruptions due to Labor Strike	Rail labor strike	■	□	□

Appendix B Transportation Disruptions: System Technology Outages

A system technology outage refers to the unavailability of key technology resources that enable transportation operations. Characteristics of this type of outage include the following:

- The owner-operator of the technology resource is responsible for returning it to service.
- The federal government may have a role in providing resources to assist repairs, overseeing related safety implications, and managing downstream impacts (e.g., environmental, energy), among others.

B.1 Colonial Pipeline Ransomware Shutdown – May 2021

Event Summary: On 7 May 2021, the Colonial Pipeline Company shut down its pipeline system within an hour of discovering a ransomware attack at 5:00 am. The shutdown caused major disruptions to gas delivery up and down the East Coast, disrupting civilian transportation and airline operations. On 13 May 2021, Colonial Pipeline restarted its entire pipeline system and product delivery commenced to all markets.

Causal Factors: Ransomware attack.

Response: On 7 May, Colonial Pipeline shut down its pipeline network around 6:00 am to prevent the malware from spreading to its operational technology network which controlled pipeline operations. Colonial Pipeline contacted the FBI within hours of discovering the attack. CISA offered assistance with incident response, but Colonial Pipeline engaged a third-party incident response firm instead. On 8 May, Colonial Pipeline paid approximately \$5 million in ransom, of which the FBI later recovered \$2.3 million.

The federal government responded with a focus on avoiding potential energy supply disruptions to impacted communities, the U.S. military, and other facilities reliant on gasoline, diesel, jet fuel, and other refined petroleum products. The White House established an interagency response group to monitor and address the situation as swiftly as possible, consisting of DOJ (including FBI), CISA, DOE, Department of Defense (DOD), USDOT, Treasury, Federal Energy Regulatory Commission, Environmental Protection Agency (EPA), and White House Office of Management and Budget (WH OMB). The White House asked the DOE Energy Response Organization to coordinate with industry, interagency, and state partners, providing situational awareness, analysis of impacts, and supporting response efforts. The interagency group took the following actions:

- Issued a targeted one-week waiver allowing multiple states to temporarily use noncompliant fuel to boost available supply.
- Issued an “Hours of Service” waiver to provide greater flexibility to drivers transporting fuel.
- Launched an emergency effort to determine rail operators’ capacity to help transport fuel from ports inland and identify potential actions to enable this effort.
- Supported state efforts to allow higher weight limits for tank trucks.
- Initiated a survey of Jones Act-qualified vessels to begin the process of evaluating what assets are available in the Jones Act fleet to carry petroleum products within the Gulf, and from the Gulf up the Eastern Seaboard.
- Temporarily relaxed enforcement of pipeline operator qualification rules to allow for the use of emergency personnel that may be needed to assist in the partial manual return-to-service.
- Prepared to issue orders directing Colonial Pipeline to prioritize fuel for destinations, addressing critical supply shortages.
- Conducted regular outreach to state and local officials, Members of Congress, and impacted companies and retailers.
- Provided guidance on securing critical infrastructure.
- Published a cybersecurity advisory with specific mitigations to reduce the likelihood and impact of similar events.

- Held a stakeholder call with nearly 9,000 participants from across critical sectors.

On 13 May, Colonial Pipeline's network was restarted. On 8 June, a Congressional hearing reviewed the incident and the revealed gaps. It confirmed the Transportation Security Administration's (TSA) existing authority to require cybersecurity measures.

Positive Performance

- FBI coordination with Colonial Pipeline.
- Other government agency coordination with Colonial Pipeline through the FBI.
- Subsequent recovery of some ransom money.
- Coordination between federal and state agencies to facilitate fuel transport by freight truck - USDOT issued temporary waivers/suspensions of driver-fatigue regulations, state DOT issued temporary waiver/suspension of truck weight regulations.
- Following the disruption, TSA imposed the first mandatory cybersecurity requirements on pipeline owners and operators, requiring them to report breaches, designate cybersecurity coordinators, and self-assess their compliance with TSA security guidance.

Observed Shortfalls

- Six days elapsed between the shutdown and restart of pipeline operations.
- Colonial Pipeline acted to resolve this disruption mostly independently, accepting minimal support from the federal government. For example, Colonial Pipeline paid the \$5M ransom rather than working through an official investigation. As another example, Colonial Pipeline declined CISA's offer to help with incident response. CISA informed that "this was their right," but this reduced CISA's ability to manage this situation holistically and incorporate lessons learned into future protections and responses. As a third example, prior to the incident, TSA asked Colonial Pipeline on 13 occasions to participate in physical and cyber pipeline security assessments, and Colonial Pipeline repeatedly declined or delayed participation citing COVID-19. Following the disruption, CISA pledged to invest in and mature its voluntary partnerships with critical infrastructure entities.
- The federal government did not apply a defined process to identify the lead agency to address the disruption because the Federal government did not deem the attack a significant cyber incident, as defined by policy, despite its substantial impact. Instead, the White House appointed DOE as the lead agency for federal response to alleviate fuel shortages. According to PPD-21 and PPD-41, CISA is responsible for coordinating federal efforts to secure critical infrastructure with Sector Risk Management agencies like TSA, which oversees security for the pipeline sector.
- TSA and CISA did not have the resources and empowerment to ensure that the operators of pipelines and other forms of transportation harden and maintain their technology systems. Relatedly, the Congressional hearing revealed a sense that other federal agencies did not respect TSA's and CISA's experience and expertise to handle the disruption.
- CISA lacked sufficient visibility into cybersecurity risks to produce targeted guidance, share actionable information, and prioritize incidents that occur.

Organizations: Department of Justice (including FBI), DHS CISA, DOE, DOD, USDOT, Treasury, Federal Energy Regulatory Commission, EPA, and WH OMB. Colonial Pipeline Company and their third-party cyber response contractor.

Sources

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B.2 CrowdStrike Windows Outage – July 2024

Event Summary: On 19 July 2024, a wave of information technology outages swept across the globe, stalling internal and external Windows-based systems across a variety of industries.

The worst disruptions were on the first day, with American, United, and Delta flights grounded. Southwest reported not using CrowdStrike but having several critical systems affected anyway. Major airlines including American, United, and Delta cancelled thousands of flights. Delta alone valued the operational impact at half a billion dollars.

State and local dispatch services for 911 and first responders were slowed or offline. Federal field activities reported as “not affected,” but communications and information breakdowns at DOJ and HHS were reported as “significant.”

Causal Factors: CrowdStrike, a cybersecurity firm serving scores of companies worldwide, deployed a faulty software update that caused affected computers to freeze. This was not identified as a cyberattack or any other kind of malicious event.

Response Summary: Delta ultimately canceled around 5,000 flights over five days. Although Delta reported a return to normal operational reliability on July 25, major initiatives to reunite customers with luggage continued at all its hubs.

The White House initiated interagency coordination and communication with CrowdStrike. FAA air traffic control was not directly affected, but travel plans changed with flights cancelled then restored. Atlanta-Hartsfield airport implemented its crowd-control contingency plans because of extensive lines at check-in counters. Instead of printing signs, Atlanta-Hartsfield airport used white paper and markers.

Positive Performance

- One-day recovery times for American, United, and Southwest.
- Atlanta Hartsfield International Airport (ATL), and possibly other large airports, implemented contingency plans for crowd control to manage long lines at flight check-in area.

Observed Shortfalls

- Outages at airlines had a rippling effect on the air transport system.
- The contrast in recovery time between Delta (long) and other airlines (short) is notable.
- There was some public disputation between Delta and CrowdStrike, which may point to a lack of a coordinated response.
- For air transportation, residual effects (e.g., cancellations and delays) persisted for several days even though most airlines resolved their operational issues within a day.

Organizations: U.S. airlines, U.S. airports, White House, CISA, USDOT, DOJ, HHS, first responders

Sources

- Mitropoulos, Arielle. "American Airlines Issues Global Ground Stop for All Flights." *ABC News*, 17 July 2023, <https://abcnews.go.com/US/american-airlines-issues-global-ground-stop-flights/story?id=112092372>.
- "Aviation News Today" *AAAE.org*, American Association of Airport Executives, 21 August 2024.

B.3 AT&T Outages – 2023 and 2024

Event Summary: AT&T wireless service experienced several outages during 2023 and 2024. On 22 February 2024, the company's network went down for 125,000 devices across all 50 states and U.S. territories, leaving users unable to place calls, send texts, or access the internet for at least 12 hours. The outage blocked more than 92 million phone calls and more than 25,000 attempts to reach 911. On 4 June 2024, another problem prevented many AT&T customers from completing calls between carriers. On 23 August 2023, a network outage occurred in parts of Illinois, Kansas, Texas, and Wisconsin, failing to deliver 911 calls. On August 27, 2024, service was down for some customers throughout the day (~5 hours) due to a software issue. Most affected areas were Dallas, Charlotte, Los Angeles, Houston, Chicago, and New York City.

Causal Factors: The February incident began after AT&T implemented a network change with an equipment configuration error. The August incident resulted from a software issue.

Response Summary: Restoration of the February outage took up to 12 hours for some customers. While most of AT&T Mobility's subscribers were reconnected to the network within a few hours, traffic congestion from mass mobile device registrations prevented some subscriber devices from connecting to the network. Meanwhile, 911 was not reachable for many, and the outage stopped public safety personnel from using the First Responder Network Authority (FirstNet). AT&T prioritized the restoration of FirstNet before other services.

The FBI and DHS CISA looked into the AT&T outage to understand the cause. The White House issued a press briefing.

The FCC launched an investigation and fined AT&T nearly \$1 million. The FCC cited that network operators need to 1) adhere to their internal procedures and industry best practices when implementing network changes, 2) implement sufficient network controls to mitigate configuration errors so they do not escalate and disrupt network operations, and 3) have appropriate systems and procedures in place. The FCC reported that corrective actions were taken by AT&T to prevent a recurrence.

Positive Performance

- The FCC investigated if AT&T violated FCC rules.
- AT&T agreed to implement a three-year plan "to ensure future compliance with the FCC's 911 and outage notification rules" as part of the settlement with the FCC. Service providers have an obligation to transmit 911 calls and notify 911 call centers of outages in a timely manner.

Observed Shortfalls

- The FirstNet capability lacked redundancy as FirstNet devices operated by public safety users were not usable during the outage.
- AT&T notified FirstNet customers of the outage about one hour after it restored the service (which was also three hours after the outage began).
- AT&T did not adhere to its internal procedures and industry best practices when implementing network changes and did not implement network controls that mitigate configuration errors from disrupting network operations.

Organizations: FCC, AT&T, FBI, DHS CISA, White House.

Sources

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B.4 Denver and Dallas GPS Outages – January and October 2022

Event Summary: *Denver:* Starting on 21 January 2022, a GPS interference event occurred over a thirty-three-hour period in the vicinity of Denver International Airport (DEN) and Centennial Airport (APA). Interference was first detected by aircraft pilots and communicated to the Federal Aviation Administration (FAA) Air Traffic Control. Operators of surface traffic, rail traffic, communications towers, and other services using GPS timing signals also detected interference. A pilot reported a Traffic Collision Avoidance System (TCAS) error during this event.

Dallas: Starting on 17 October 2022, a GPS interference episode lasting 24 hours affected aircraft operations in a 40-mile radius of Dallas, including Dallas Love Field (DAL) and a closure of Runway 31L at Dallas Fort Worth International Airport (DFW). Some aircraft flying in the area were rerouted to areas where the GPS signal was known not to be disrupted. Aircraft on the ground in the affected region were also unable to receive reliable GPS readings. Operational effects lasted roughly an additional 20 hours after interference ended.

Causal Factors: *Denver:* A transmitter was positively identified as errantly broadcasting in the GPS L1 frequency. Some receivers within a line of sight of the transmitter experienced GPS signal disruption. The affected area covered approximately a 50-nautical-mile radius on the ground and spanned approximately 230 nautical miles from the interfering transmitter at flight levels up to approximately 36,000 feet.

Dallas: The root cause has not yet been determined. Fine-grained tracking of the interference suggested that military operations—the most common source of unintentional interference—did not play a role.

Response Summary: Several critical infrastructure sectors were degraded.

Denver: The FAA issued a Notice to Air Missions warning of the GPS interference. Ground-based industry users of the GPS/PNT services and others reported GPS interference to the United States Coast Guard (USCG) Navigation Center and the FCC Public Safety and Homeland Security Bureau. Many systems that detected the event had resilient alternate timing built in for backup or fail-over timing and experienced minor or no degradation of services. No accidents or injuries occurred because of the GPS interference incident.

Dallas: The FAA issued warnings to airspace users via the Automatic Terminal Information Service. The FCC’s Enforcement Bureau found and terminated the spurious transmission. After the interference was resolved, delays and reroutings continued for another day.

Overall: The presence of backup systems at the Denver and Dallas Fort Worth airports prevented any noticeable impacts on air travel despite each having experienced a disruption of GPS signals for 24 hours or more. By contrast, GPS interference at Tartu, Estonia caused scheduled air service to be cancelled until a GPS alternative was established. The International Civil Aviation Organization made an urgent call to action for its members “to address harmful interferences” to satellite navigation signals. The U.S. Cybersecurity and Infrastructure Security Agency (CISA) has been working with government and industry partners to increase resilience to GPS disruptions that could impact critical infrastructure operations.

Positive Performance

- Detection and information-sharing, at least in aviation, was fast and followed expected channels.
- The presence of backup systems at the Denver and Dallas airports prevented any noticeable impacts on air travel, despite each having experienced a disruption of GPS signals for 24 hours or more.
- Root cause investigation (using third-party resources in the case of Dallas) began quickly.
- The FAA and CISA were engaged in both instances. CISA “has prioritized” improving GPS interference detection and mitigation, and they are leading an interagency effort.
- The International Civil Aviation Organization made an urgent call to action to its members “to address harmful interferences” to satellite navigation signals.

Observed Shortfalls

- The interferences in Denver and Dallas lasted for 33 and 24 hours, respectively.
- The potential for another GPS outage with wider effect and longer duration seems present but unquantified.
- Responsibility for Position, Navigation, and Timing issues remains diffuse across federal agencies.

- CISA is coordinating the modeling of and response to GPS/PNT incidents.
- The FCC is legally responsible for ensuring transmitters don't trespass into unauthorized frequencies.
- GPS is a military-provided public (space) service.
- The Department of Commerce and FAA share responsibility for commercial space activities.

Organizations: FAA, FCC, USCG, CISA, DEN and DFW airports, ICAO.

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B.5 Norfolk Southern Software Update – August 2023

Event Summary: In August 2023, Norfolk Southern (NS), a key North American railroad operator, faced a major technology outage that severely disrupted its operations. This outage impacted businesses and individuals who depend on NS for freight transport, causing delays and inefficiencies across various industries.

Causal Factors: The root cause was a critical failure in NS's core IT systems due to a faulty software update from a third-party vendor. The defect was in the software that one of its vendors was using to perform maintenance on its data storage systems. NS's primary and backup systems became unresponsive at the same time. The update was made to one system and then automatically copied to the other system, allowing the defect to spread. The problem negatively impacted NS's positive train control system and freight yard operating system.

Response: NS shut down nearly 20,000 miles of track in the eastern U.S. The disruption lasted several days, varying by region and system component, and necessitated initial recovery efforts involving manual tracking and scheduling of trains and freight to mitigate immediate disruptions. Full restoration of normal operations took about a week, during which NS addressed the underlying technical issues and resumed regular scheduling and tracking.

Positive Performance

- The Federal Railroad Administration (FRA) assessed NS in March 2023, prior to the August disruption.
 - It included (1) an evaluation of NS's responses to prior FRA safety recommendations; (2) focused inspections and investigations designed to evaluate safety-critical elements of NS's operations; and (3) a safety culture review, including structured interviews (surveys) of NS employees.
 - The FRA recognized that NS has taken steps to be responsive to FRA recommendations and by implementing proactive safety measures. However, there are cases where NS continues to use minimum standards set by regulations as a benchmark for efficacy. FRA encouraged NS to advance its safety culture maturity by setting policies and procedures that incorporate proactive measures and continuous improvement goals. The FRA Safety Management Team and NS Leadership held weekly meetings to converse and follow up on the status of the implementation of the recommendations.

Observed Shortfalls

- NS demonstrated inadequate internal processes to robustly mitigate, and handle technology disruptions as follows:
 - Update and maintain software and IT infrastructure.
 - Manage its IT backup system.
 - Manage third-party vendors operating on its network.
 - Adequately communicate with customers and stakeholders during outages.
- The FRA and railroads have a regulatory relationship based on a culture of compliance that does not encourage the organizations to collaborate during disruption response.
- The FRA cited NS as doing the minimum necessary to ensure safety, with a focus on compliance only. The FRA also cited NS's training program was insufficient for safety purposes.

Organizations: Norfolk Southern, Association of American Railroads, Department of Transportation, Federal Railroad Administration.

Sources

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Appendix C Transportation Disruptions: Inoperable Localized Infrastructure

Transportation disruptions categorized as Inoperable Localized Infrastructure refer to disruptions to transportation infrastructure confined to a small area, like a road, railway, or pipeline. Characteristics of this type of outage include the following:

- The infrastructure owner-operator is responsible for the return to service.
- The federal government may have a role in providing resources to assist repairs, overseeing related safety implications, and managing national interests (e.g., environmental, energy), among others.

C.1 East Palestine, Ohio (NS) Derailment – February 2023

Event Summary: On February 3, 2023, a 150-car Norfolk Southern (NS), mixed-cargo freight train derailed in East Palestine, Ohio. Thirty-eight (38) of the cars derailed, five of which were carrying hazardous materials, including vinyl chloride and butyl acrylate.

Causal Factors: The National Transportation Safety Board (NTSB) final report found that a wheel bearing overheated. Tracksides devices to catch this hazard likely underreported the temperature. The model of tank cars involved (i.e., DOT-111) had already been found to be deficient and was scheduled for regulatory phase out by May 2029.

Response Summary: Authorities evacuated residents within a one-mile radius. NS's contractors conducted a controlled vent-and-burn to prevent a catastrophic explosion, but the burn released phosgene and hydrochloric acid into the atmosphere and over 16 states. The NTSB later determined that the vent-and-burn was unnecessary, a finding disputed by NS. The EPA monitored air and water quality, while local emergency services and the Ohio State Emergency Management Agency managed the initial response. Environmental cleanup and health monitoring continue. Long-term community recovery and potential regulatory changes are anticipated.

In May 2024, NS reached a \$310 million settlement with the federal government and a \$600 million settlement with residents and businesses affected by the derailment. In July 2024, NS reported its spending on this derailment to have exceeded \$1.7 billion.

Positive Performance

- On-site response to the incident was timely.

Observed Shortfalls

- Emergency response and monitoring plans were not sufficient to address incidents involving hazardous materials.
- Training was not sufficient for readiness for this type of incident (i.e., first responders handling hazardous materials and conducting controlled burns).
- Coordination was not sufficient between federal agencies (e.g., EPA, FEMA), state emergency management, and local authorities.
- There was a lack of timely, accurate, and transparent communication with the public, including regular updates about safety measures, environmental impacts, and health risks.
- Late deployment of federal resources and expertise may have negatively affected the initial response including involving FEMA and/or other federal agencies.
- NS demonstrated poor inspection and maintenance protocols.

Organizations / Stakeholders

Federal

- Secretary of Transportation

- Federal Railroad Administration
- Pipeline and Hazardous Materials Safety Administration
- Environmental Protection Agency (EPA)
- National Transportation Safety Board (NTSB)

State & Local

- State of Ohio
- Ohio State Emergency Management Agency
- Columbiana County Emergency Management Agency

Operators and Private Entities

- Association of American Railroads
- International Association of Fire Chiefs
- International Association of Fire Fighters
- National Volunteer Fire Council
- The Chlorine Institute
- American Chemistry Council
- Norfolk Southern Railway (NS)
- Oxy Vinyls, LP.
- Specialized Professional Services Inc. (note: NS contractor)
- Specialized Response Solutions (note: NS contractor)

Sources

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C.2 Custer, Washington (BNSF) Derailment – December 2022

Event Summary: The Custer, Washington rail derailment occurred on December 22, 2022, when a Burlington Northern Santa Fe (BNSF) Railway freight train derailed. Three of the ten derailed tank cars caught fire. The derailment caused significant disruption to freight services for about a week. There were no injuries. Approximately \$850,000 in damage was done to BNSF property, and an estimated 29,000 gallons of oil were lost.

Causal Factors: The FRA identified several causes, including unlocked coupler pins and closed angle cocks that prevented the emergency application of air brakes, non-compliance with federal requirements for securing key trains, BNSF's failure to inform employees about recent nearby vandalism, and possible vandalism immediately before the event.

Response Summary: The local Fire Chief immediately assumed the role of incident commander while working with the County Sheriff's Office and nearby oil refinery response teams. Local emergency services ensured public safety, including a ½-mile evacuation zone around the crash site for 5 hours, affecting nearby roads. Later in the day, a formal Unified Command structure was established with BNSF personnel, local fire and police departments, Washington Utilities and Transportation Commission (UTC) rail personnel, Washington Department of Ecology, a HAZMAT team, several local oil refinery response teams, and environmental contractors. Due to recent vandalism and tampering incidents along the BNSF Bellingham Subdivision, an FBI task force also responded. After the fires were out, the FBI closed the area to investigate. The next day, BNSF cleaned up and repaired operations. The National Transportation Safety Board (NTSB) investigated the cause and contributing factors of the derailment. The FRA provided oversight and technical support, ensuring safety protocols were followed in partnership with the Washington UTC.

Positive Performance

- The local Fire Chief immediately assumed the role of incident commander.
- Local emergency services set up an evacuation zone around the crash site until the fire was under control.
- After the immediate response, the engaged organizations established a formal Unified Command structure.
- After the fires were put out, the FBI investigated the crash site, followed by cleanup efforts.

Observed Shortfalls

- BNSF did not comply with operational safety regulations leading up to the disruption.

Organizations: BNSF, local fire, local police, Washington UTC, Washington Department of Ecology, a HAZMAT team, local oil refineries, environmental contractors, FBI, FRA, NTSB.

Sources

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C.3 I-95 Philadelphia Bridge Fire and Collapse – June 2023

Event Summary: On 11 June 2023, a vehicle fire under I-95 in Northeast Philadelphia caused a portion of the northbound lanes to collapse and damaged the southbound lanes. The driver of the vehicle passed away. There were no other injuries.

Causal Factors: The root cause was human performance. A tanker truck carrying flammable cargo flipped onto its side while going around a curve at high speed and then caught fire. Gasoline spilled out from an unsecured hatch on the top of the tanker. Extreme heat from the fire caused the road to collapse.

In 2022, the trucking firm issued a policy to its truck drivers requiring them to conduct pre-trip inspections of tanker manhole covers. The policy noted that manhole covers form a seal in case of a vehicle rollover and described an earlier incident in which a cover had been left unsecured, “allowing leakage and causing an environmental spill.”

Response Summary: Within hours of the crash, officials from USDOT were on the ground, supporting Pennsylvania officials in clearing the site and starting the rebuilding process. The USDOT’s Federal Highway Administration (FHWA) immediately released \$3 million to PennDOT as a down payment on the repair costs with additional funding planned. The funding was for maintaining emergency operations and detour routes for a structure that normally carries about 160,000 vehicles on average each day, the demolition of damaged structures, and emergency repairs to restore essential traffic. The federal government commitment of funds: 100% in first 200 days and 90% thereafter to rebuild. Union crews worked on rebuilding the area 24/7 including operating engineers, laborers, carpenters, cement finishers, teamsters, and ironworkers. The City of Philadelphia created a webpage to provide updates on progress (e.g., road closures and detours, share-a-ride carpooling program). Southeastern Pennsylvania Transportation Authority (SEPTA) added extra capacity and service as an alternative means of travel and offered complimentary parking at some train station lots. On 23 June 2023, PennDOT reopened six lanes on I-95 as a temporary fix. Within a year, the road was operating at normal capacity.

Positive Performance

- Immediate response to recover and an amazing immediate all hands on deck by union crews. The emergency declaration signed by Pennsylvania’s governor gave the ability to “replace the bridge in the speediest session possible.” Workers were able to deploy equipment and forces to begin demolition on the day of the fire. The asphalt and other special materials needed for the repair were delivered with police escorts.
- Temporary bridge available for use within 12 days.
- Support from the FHWA Emergency Relief program which provides funding to states, territories, tribes, and federal land management agencies for highways and bridges damaged by natural disasters or catastrophic external events. While funding is federal, projects are administered at the state level (state DOT). There is a partnership between states and the FHWA. There is one FHWA field office per state.
- An inspection of the area (prior to the fire) indicated that it was in good condition.
- SEPTA added additional train capacity to help people get around.

Observed Shortfalls

- No mention of an interagency federal effort among USDOT, DOC, U.S. Department of Agriculture (USDA), DOD, DHS, and others to assess and manage safety, commercial, and military impacts of the disrupted route until repairs were complete.

Organizations: PennDOT, White House, DOT-FHWA, City of Philadelphia, SEPTA, union workers.

Sources

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C.4 I-10 Los Angeles Bridge Fire – November 2023

Event Summary: On 11 November 2023, a fire shut down a key section of Interstate 10 in Los Angeles. An average of about 300,000 people drive on this 10-lane stretch daily.

Causal Factors: Suspected arson. Caltrans was leasing the land surrounding and under the roadway to a private company and the private company violated its lease by storing flammable materials under the roadway. The state transportation officials with responsibility for the Los Angeles area had already been investigating the I-10 bridge for months before the fire.

Response Summary: The California Governor proclaimed a state of emergency on the day of the fire (a Saturday). USDOT FHWA immediately made \$3 million in emergency relief funding available in response to a request by Caltrans to offset costs of emergency repair work. Caltrans conducted emergency operations, performing emergency repairs and continually assessing impacts, including structural damages and traffic operations. Caltrans emergency contractors worked 24/7 to clear hazardous materials and debris from the repair site ahead of schedule. Caltrans placed temporary supports, called shoring, next to damaged concrete pillars under the elevated freeway. Road traffic was restored within 8 days, way ahead of the initial 3-to-5-week estimates.

Positive Performance

- The California Governor proclaimed a state of emergency on the day of the fire (a Saturday).
- USDOT FHWA immediately made \$3 million in emergency relief funding available.
- Caltrans worked 24/7 to repair the roadway and completed work ahead of schedule.
- FHWA reminded other states they must follow federal requirements on how areas beneath and near critical highway infrastructure are used.
- The City of Los Angeles, in partnership with other government agencies and community-based organizations, hosted a Local Business Assistance Resource Center to offer affected businesses resources such as free consultations, low-interest loans, and other support services.

Observed Shortfalls

- State DOT did not perform the required annual roadway inspections. The Caltrans Office of the Inspector General (OIG) found the agency conducted its required annual inspections of lots under Interstate 10 only five times in 15 years and failed to fully document those inspections.
- State DOT did not sufficiently mitigate problems when identified. “Caltrans could have—and should have—done more to make this property safer for the motoring public who traveled above it,” according to the Caltrans OIG.
- USDOT did not provide oversight of the state DOT’s compliance with regulations. Caltrans violated federal requirements on how areas beneath and near critical highway infrastructure are used.
- No mention of the interagency federal effort among USDOT, DOC, USDA, DOD, DHS, and others to assess and manage safety, commercial, and military impacts of the disrupted route until repairs were complete.

Organizations: Caltrans, City of Los Angeles, White House, DOT, FHWA, laborers.

Sources

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C.5 I-695 Baltimore Key Bridge Collapse – March 2024

Event Summary: On 26 March 2024, Baltimore's Francis Scott Key Bridge collapsed into the Patapsco River where it feeds the Chesapeake Bay. The Dali, a cargo ship, crashed into it. Officials were able to prevent cars from driving onto the bridge just before the accident. Around 20 people are reported to have been on the bridge at the time of its collapse, including the eight construction workers who plummeted into the river below. Six of them died.

The collapse of the bridge blocks the shipping channel and severs the I-695 freeway (the beltway around Baltimore). The port, which the channel serves, is important for the northeastern U.S., handling about 10% of shipping traffic. The port is particularly important for wood (39% of northeast ports' imports), construction machinery (31%) and steel/aluminum (20%) sectors. Eleven million vehicles used the bridge annually. The next nearest major ports are located in Wilmington, DE and Philadelphia, PA.

Causal Factors: The cargo ship lost power around 1:24 am and was unable to turn away from the bridge pilons. It crashed into the bridge pilons around 1:30 am. There is currently no indication that the vessel operators intentionally hit the bridge. A contributing factor was that the pilons were known to be under-designed but had yet to be retrofitted.

Response Summary

- **Response:** Police worked quickly that morning to halt traffic on the bridge before the collision. Two construction workers were rescued from the water.
- **Restoration:** On the day of the event, the federal government announced that it will provide all the support needed to fix the bridge. Plan, estimated cost between \$1.7 billion and \$1.9 billion:
 - Temporary workaround: Opened additional channels that support some of the traffic. Always evaluating contingencies.
 - June 2024: Channel reopened fully
 - 2025: Bridge rebuilding to begin
 - Autumn 2028: Replacement bridge planned to open.
 - Greater goal: Restore the entire marine transportation system (MTS), getting a 50-foot channel and revitalizing the port's economy as more tugs and barges would be able to haul through the Patapsco channel.

Positive Performance

- Communications about the issue led to stopping auto traffic to the bridge moments before the accident, saving many lives.
- Removing the sunken vessel and restoring the channel seem to have been executed smoothly.
- The plans to restore the bridge and overall shipping seem to be proceeding smoothly.

Observed Shortfalls

- Four years to restore the bridge may be fast for construction but a long time for the local communities.
- Safety of ship systems and of operations near and around structures:
 - Processes to ensure safe operation before leaving ports. The Dali experienced apparent electrical issues before leaving the port, and the ship's crew was aware of the issues and understood that they would be addressed in the future.
 - Under-design of the bridge and pylons for the traffic that passes through it was a known issue.

Organizations: Key Bridge Response Unified Command is led by the USCG, U.S. Army Corps of Engineers (USACE), Maryland Department of the Environment, Maryland Transportation Authority and Maryland State Police, and local churches.

Sources

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Appendix D Transportation Disruptions: Regional Degraded Operations (Natural Disasters)

These disruptions are natural disasters for which the federal response was led by FEMA.

D.1 Hurricane Michael – October 2018

Event Summary: Hurricane Michael, a Category 5 hurricane, struck the Florida panhandle, resulting in 57 fatalities and additional injuries, disruption to essential services (i.e., power outages, water, transportation, and communications), and large-scale displacement of residents due to damage to homes and businesses. The damage was estimated at \$25 billion.

Causal Factors: Hurricane.

Response Summary: FEMA took immediate action, coordinating disaster relief by deploying search and rescue teams, providing financial aid, and managing logistics for relief supplies. The Florida Division of Emergency Management played a crucial role in coordinating the initial response, allocating resources, and supporting local efforts in partnership with FEMA. USACE focused on debris removal and repairing infrastructure to restore essential services. The American Red Cross provided temporary shelters and emergency aid to displaced residents. Local emergency management agencies managed on-the-ground response efforts, including emergency services, evacuations, and community support.

Within 24 to 48 hours, search and rescue operations and initial aid distribution were well underway. Over the next few days, utilities were being restored and debris was cleaned up. Within two weeks from landfall, rebuilding infrastructure began and there was a partial resumption of rail and transportation services. Within six months, most major infrastructure, including roads and utilities, was mostly restored. Rail services gradually returned to normal. By late 2019 most areas were fully recovered.

Positive Performance

- Effective local emergency response coordination.
- FEMA and state agencies experienced effective coordination with each other and with local agencies.
- State and local agencies experienced rapid activation and deployment of their resources (e.g., shelters, aid distribution centers).
- FEMA's Interagency Recovery Coordination Group worked with the state of Florida and the designated counties and their communities to help identify and coordinate financial and other resources to meet needs beyond what FEMA, the state, and other programs can cover.
- USACE focused on debris removal and infrastructure repair. The After-Action Report indicated efficient debris removal and repairs, and effective collaboration and mobilization of resources.

Observed Shortfalls

- FEMA experienced delays in the distribution of aid. FEMA recommended improved logistics for aid distribution.
- FEMA observed difficulties in meeting the surge in demand for emergency assistance. FEMA recommended better pre-storm preparedness and resource management.
- Local agencies experienced challenges communicating with state and federal agencies. Local government recommended enhancing communication channels with state and federal entities. FEMA also observed issues with communication among agencies and recommended enhanced communication systems.
- Florida agencies experienced difficulties in resource distribution, logistical coordination, and strain on state resources due to the scale of the disaster. The state recommended improved pre-disaster planning, better integration of state and local response strategies, and enhanced logistical support systems.

- Infrastructure damage led to difficulties accessing affected areas. Local government recommended strengthening local emergency plans and improving infrastructure resilience.
- USACE cited challenges in coordinating and delays in cleaning up areas with a lot of debris.

Organizations: FEMA led 25+ additional federal agencies (DOD, USCG, Customs and Border Protection, DOT, FCC, DOI, USACE, DOA, Department of Labor (DOL), National Oceanic and Atmospheric Administration) Florida Division of Emergency Management leading 28 additional state agencies, local emergency management agencies, American Red Cross.

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D.2 Midwest Flooding – June 2024

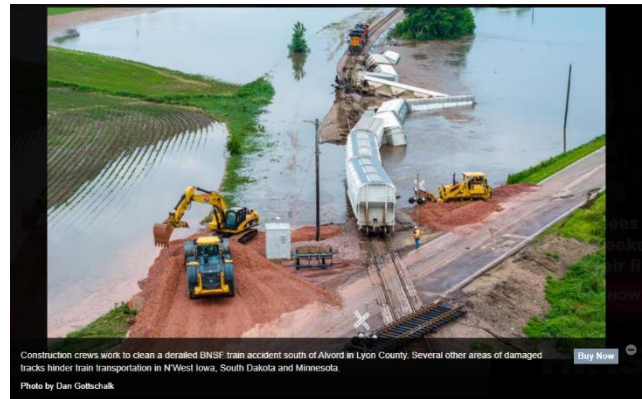
Event Summary: Record-setting floods hit parts of Iowa (IA), South Dakota (SD), Nebraska (NE), and Minnesota (MN), covering buildings up to their rooftops, shutting down major roads, and disrupting basic services like electricity and drinking water. The Big Sioux River crested at 45 feet, over 7 feet higher than the previous record. In Iowa, over 350 residences sustained major damage or were destroyed and another 1,600 sustained minor damage or were affected in some manner. Thousands of people were evacuated. Deaths were reported in IA and SD. Floods destroyed a power substation, swept structures downstream, caused a BNSF train to derail near Alvorde in Lyon County (see photo), and forced its way around the Rapidan Dam in MN, risking the dam’s failure (see photo). BNSF lost a bridge over the Big Sioux River between IA and SD: “That is the main bridge going into IA that a lot of commodities and different materials move on throughout the state,” said SD Governor. “That’ll impact us for many, many months to come.” Several roads and highways closed for five or more days, including Interstate 29 between Loveland, IA to Omaha, NE and Highway 12 in IA. The rural county roads across the area were affected by the storm path, and subsequent flash-flooding. Early estimates were that hundreds of secondary county roads could be washed out or unable to sustain traffic.

Causal Factors: Flooding was triggered by drought conditions followed by a long duration rainfall capped off by an unusual weather pattern that brought torrential rainfall on 22 June 2024.

Response Summary: State agencies activated their emergency management resources and managed public safety, including issuing warnings, closing affected roads, ordering evacuations, opening shelters, helping people flee, performing high water rescues, and upgrading downstream levees. The Iowa Department of Homeland Security and Emergency Management (HSEM) worked with emergency management coordinators across the state and with agencies and organizations including the Iowa DOT, Iowa Health and Human Services, Iowa National Guard, Iowa Department of Administrative Services, Iowa Utilities Board, National Weather Service, American Red Cross, and Iowa Disaster Human Resources Council. Iowa named the director of the HSEM to coordinate response with comparable functions of the federal government and political subdivisions of the state. The Iowa DOT coordinated flood response with vital transportation stakeholders including cities, counties, railroads, airports, and public transit providers. Local non-profits and volunteers contributed to cleanup efforts and provided shelters and supplies.

USACE implemented its flood risk management plan, including activating its emergency operations center to coordinate response efforts and establishing contact with state, tribal and local leaders, and emergency managers. USACE leadership coordinated with governors, mayors, and the Offutt Air Force Base commander and initiated a daily stakeholder call to communicate as widely and transparently as possible about the evolving conditions and actions being taken. They also disseminated real-time information using social media platforms. USACE personnel used boats and helicopters to surveil conditions along the river using orthographic photo and lidar to inform decisions to protect lives and property. USACE also managed water levels in the river’s reservoirs to prevent gate overtopping while avoiding exacerbating flooding downstream. As floodwaters receded, USACE shifted to recovery, conducting damage assessments, identifying levee areas in need of repair, and coordinating with local authorities to prioritize and plan reconstruction efforts.

The White House declared a major disaster in IA, SD, MN, and NE and appointed FEMA to coordinate Federal recovery operations. The disaster declaration provided access for state, tribal, and eligible local governments and



Iowa Train Derailment ([Image Source](#))



Dam Overtake in MN ([Image Source](#))

certain private nonprofit organizations to funds for emergency work and repair or replacement of damaged facilities, and for residents and businesses to apply for FEMA recovery aid. The Small Business Administration (SBA) offered loans to small businesses. The U.S. Department of Health and Human Services monitored the water and environmental health. Infrastructure rebuilding started in September 2024 with the federal government providing funds.

Railroad infrastructure owners and operators, BNSF, and Union Pacific monitored conditions across their rail networks and executed recovery operations as needed, including monitoring river heights and bridge conditions, closing impacted rail lines, rerouting trains, and repairing tracks damaged by heavy rains and flooding. For the BNSF derailment outside Alford, BNSF crews completed work within five days to repair damage and remove debris. The local sheriff shared that the BNSF quickly fixed other washed-out railways. The railway bridge from Sioux City, IA to Sioux Falls, SD remains closed with an expected repair timeline of one month.

Positive Performance

- States made available all state departments and area agencies' resources to meet the needs of this emergency.
- As flood waters receded, officials communicated with the public about bridges and pavement inspections to ensure they are safe to use: "Please keep in mind that transportation infrastructure such as roads, bridges, and railroads may be owned by different jurisdictions or private entities. Each owner may handle recovery efforts in their own way."
- Within 12 hours, USACE teams deployed to monitor the integrity of dams, reservoirs, and federally managed levees. USACE engineers used sophisticated modeling tools to predict and respond to changing conditions.
- Overall, the Missouri River mainstem dam system and federally managed levee systems performed as designed with no breaches, no overtopping, and minimal damage considering the situation.
- USACE leveraged lessons learned from the 2019 floods to restore damaged infrastructure and repair and reinforce levees as soon as possible to strengthen resilience in long-term flood mitigation measures.
- The White House declared a major disaster in IA, SD, MN, and NE and appointed FEMA to coordinate Federal recovery operations.
- In the weeks following the Midwest flooding, the White House announced [new actions to protect workers and families from the impacts of extreme weather](#).
- Railroads quickly fixed washed-out railways.

Observed Shortfalls

- Coordination efforts appear redundant. In addition to leadership and communication provided by state and federal emergency management officials, USACE coordinated with governors, mayors, and the Offutt Air Force Base commander and initiated a daily stakeholder call to communicate about the evolving conditions and actions being taken.
- Local emergency responders do not appear prepared for possible disaster scenarios. A local Fire Marshal said, "It's just been difficult to predict what's going to happen when [water] levels are this high when we have no history with it."
- Recovery does not adequately address long-term costs following the disruption. For example, there are costs of disrupted supply chains when major roads are inundated or washed out, raising prices for consumers and perhaps lowering job security in transportation and shipping-related industries. The damage is sending costs of infrastructure maintenance upward.
- Recovery does not adequately address long-term environmental impacts following the disruption. For example, the pools of livestock manure that spilled waste and bacteria into the Mississippi and Missouri River basins; the threat that high waters made room for invasive carp to migrate north; the risk that nutrients washed from cropland will fuel larger algae blooms and contaminate drinking water wells.

Organizations: Local government agencies and first responders, state departments of homeland security and emergency management, additional state agencies (USDOT, Health and Human Services, state National Guard, Utilities), National Weather Service, American Red Cross, White House, FEMA, SBA, USACE, railroad infrastructure owners and operators (BNSF and Union Pacific).

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D.3 West Coast Wildfires – July 2018

Event Summary: The 2018 wildfire season was the deadliest and most destructive wildfire season on record in California, with a total of over 7,500 fires burning an area of over 1,670,000 acres, the largest area recorded in a single season. Over 40,000 structures were severely damaged or destroyed. An estimated 96 people died.

In mid-July to August 2018, a series of large wildfires erupted across California, mostly in the northern part of the state, including the destructive Carr Fire and the Mendocino Complex Fire. In November 2018, another batch of large, destructive fires including the Woolsey Fire and the Camp Fire, which killed at least 85 people. The Camp Fire destroyed more than 18,000 structures, becoming both California's deadliest and most destructive wildfire on record. Containment varied. Start months and durations are shown below for key fires:

- Ranch Fire (Mendocino Complex Fire) (July 2018): 161 days
- Carr Fire (August 2018): 38 days
- Camp Fire (November 2018): 17 days
- Woolsey Fire (November 2018): 57 days

Causal Factors: Dry conditions and high winds made the fires very difficult to contain and extinguish. Fires started from failed utility equipment, among other problems that had been identified as vulnerabilities that were not fixed.

Response Summary: Nearly ten thousand firefighters battled the fires. California's statewide Emergency Operations Center and its Regional Emergency Operations Centers worked 24/7 to manage shelter operations, debris removal, impacts on schools, fire and law enforcement mutual aid, disaster assistance and long-term recovery needs.

States of emergency were declared in Los Angeles, Ventura, and Butte counties just before 8 November 2018. State and federal agencies were strategically co-located and worked around the clock to coordinate resources, assist survivors, and help local communities begin the long road to recovery. The State Operations Center coordinated with local, state and federal emergency response officials to address emergency management needs. On 11 November 2018, the Governor joined leaders of the Governor's Office of Emergency Services, CAL FIRE, California Highway Patrol, and California National Guard to provide an update on firefighting efforts at the State Operations Center. President Trump declared a national disaster on 13 November 2018, providing direct federal assistance to further support the impacted communities within 24 hours of the California Governor's request.

FEMA and federal partners aided in mission assignments for specialized resources and capabilities. For example, the DOD provided pilots and support to the California Military Department to gather information and assess fire impacts. The EPA helped collect household hazardous waste in the impacted counties.

FEMA approved \$814,164 through the Individual & Households Program. The U.S. SBA helped businesses, private non-profit organizations, homeowners, and renters fund repairs or rebuilding efforts and cover the cost of replacing lost or disaster-damaged personal property. The 57-member Disaster Survivor Assistance field team reached out to survivors and visited shelters to assist survivors with their registrations. Federal Disaster Unemployment Assistance benefits were also made available for workers who lost jobs or had their work hours substantially reduced as a result of the wildfires.

Positive Performance

- Long-term recovery plans have been established:
 - FEMA established a long-term community recovery office in Paradise to take a holistic, long-term view of critical recovery needs and coordinate the mobilization of resources at the federal, state and community levels.
 - State and federal agencies strategically co-located and worked around the clock to coordinate resources, aid survivors, and help local communities begin the long road of recovery.
- Logistical support centers for relief efforts:
 - The State's Emergency Operations Center near Sacramento worked a 24/7 response and recovery operation with hundreds of emergency managers, subject matter experts and representatives from

dozens of state and federal agencies. It moved massive amounts of supplies to logistical support centers established in affected communities to support relief efforts.

- Food, shelter and support while rebuilding
- The Watershed Emergency Response Team identified moderate to high-risk flooding and debris flow to segments of State Highway 70 and Union Pacific Railroad and local access roads and coordinated with the infrastructure owners to further evaluate them.

Observed Shortfalls

- Residents evacuated with a moment's notice and some never received the orders.
- Community lifelines were not operational: cell towers and phone systems failed to operate. Power was out in many places.
- Disaster Aid was slow to arrive as more than 7 months passed after the Camp Fire before Congress approved more than \$2.4 billion in Community Development Block Grant – Disaster Recovery (CDBG-DR) funds for California and other impacted areas, further delaying the recovery.

Organizations: FEMA, National Weather Service, Unified Command (CAL FIRE, Butte County Sheriff Department, Paradise Police Department, USFS), California DOT, California Department of Corrections and Rehabilitation, California Highway Patrol, California Office of Emergency Services, California Conservation Corps, Butte County, City of Chico, Santa Clara County Fire Department, Verizon Wireless.

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Appendix E Transportation Disruptions: Service Interruptions due to Labor Strike

This disruption was handled by Congress.

E.1 Rail Labor Strike – November 2022

Event Summary: In November 2022, 150,000 U.S. freight railroad workers were close to striking over claims about grueling schedules and poor working conditions after nearly three years of negotiations. The union contracts include workers at Union Pacific, BNSF, CSX, Norfolk Southern Corp, and Kansas City Southern. The 3-year negotiation featured a national mediation board, a presidential emergency board, and tentative agreements signed by all 12 union presidents in September and still members from four (of 12) unions voted not to ratify the tentative agreements. In accordance with the Railway Labor Act, cooling off periods were scheduled to expire on 9 December, allowing for either side to take “self-help” actions (e.g., lock-out, strike).

Rail moves close to 40% of the U.S.’s long-distance trade and a strike could cost the U.S. economy \$2 billion a day, according to the Association of American Railroads, disrupting travel, commutes, and the shipment of commodities and other goods across the country. The strike could have impacted 30% of freight, halt passenger rail, and caused 750,000 job losses and a recession.

Causal Factors: The rail unions were planning to strike over pay and ongoing grievances about the working conditions like schedules that do not allow for sick leave, routine visits to the doctor, or tending to family emergencies.

Response Summary: Congress has the power under Article I, Section 8 of the Constitution to regulate interstate commerce, and the Supreme Court has ruled that that includes the authority to intervene in railway labor disputes that threaten trade across state lines. In September, the Biden administration issued recommendations to settle the dispute and imposed a “cooling off” period. On November 15, when it became increasingly clear that a negotiated settlement would not be achieved, the White House established a Unified Coordination Group (UCG) to refine national risk assessments and coordinate interagency efforts relating to crisis/consequence management. Consistent with PPD-44, the White House expressed an intention to designate DOT as Lead Federal Agency (LFA) with FEMA in direct support. Although the White House did not officially designate DOT as LFA, domestic planning and response commenced, and agencies assumed the planned roles.

The UCG established a Core team consisting of senior response officials and deputy level participants from USDOT, FEMA, National Economic Council (NEC), National Security Council (NSC), DOL, and other Executive Office of the President (EOP) staff functions (e.g., labor, Office of Public Affairs (OPA), Office of Legislative Affairs (OLA)). The UCG also established a Fusion Cell to serve as the ‘engine’ that collected and shared interagency reports, maintained situational awareness, produced senior leader briefs, conducted future planning, evaluated existing authorities, and produced other analysis and reports as required. The UCG Fusion Cell was created from elements of the USDOT Transportation Operations Center with essential FEMA augmentation, and further augmented by liaisons from other government agencies (e.g., USDOT, USDA, FDA, EPA, DOD, DOL, DOC, DHS, HHS, Surface Transportation Board (STB)). The UCG established four lines of effort:

1. Facilitate a negotiated contract settlement between management and labor (Lead: DOL)
2. Facilitate a Congressionally enacted contract settlement (Lead: White House Office of Legislative Affairs (OLA))
3. Coordinate Domestic Preparedness Response (Lead: USDOT with FEMA).
4. Communications (manage expectations with stakeholders) (Lead: White House).

In December 2022, the U.S. Senate voted 80 to 15 to impose a tentative contract deal reached in September on the unions representing 115,000 workers, who could have gone on strike on December 9. President Biden signed the legislation on December 2, ending the threat of a national U.S. railroad strike.

Positive Performance

- The Federal government stepped in to avoid the strike.

- The White House initiated a UCG to refine national risk assessments and coordinate interagency efforts relating to crisis/consequence management.

Observed Shortfalls

- Most federal agencies, including USDOT, are not adequately resourced or prepared to lead a whole of government response capable of addressing consequences of this magnitude (such as if there was a rail strike).
- Presidential Policy Directive (PPD) 44 (Implications for Domestic Incident Management) does not include broad evaluation criteria to consider the scope and scale of consequence management efforts to identify the best suited Lead Federal Agency for the scenario.
- The USG lacks a standard Knowledge Management approach to share information across multiple agencies in support of domestic crisis response operations.
- Programs are not currently in place to train, exercise, and certify agencies expected to assume Lead Federal Agency responsibilities.
- Tentative agreement reached months later in December 2022 to thwart strike that would have occurred on Dec 9, 2022. Tentative agreement did not include short-term sick days and remains a contention point.

Organizations:

- USDOT, FEMA, NEC, NSC, DOL, and other EOP staff functions (Labor, OPA, OLA)
- Congress and White House
- Class I Railroads: Union Pacific, BNSF, CSX, Norfolk Southern Corp, and Kansas City Southern, Amtrak

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