MINNESOTA GO

Planning Minnesota's
Transportation Future

DISASTERS AND MAJOR EVENTS TREND ANALYSIS

CONTENTS

SUMMARY

Disasters, emergencies and major events can disrupt the transportation system with a variety of impacts. These include closures, detours, congestion, supply chain disruptions, crashes and risks to personal safety.

Traffic impacts from disasters and emergencies are typically reactive to the situation. However, MnDOT works closely with local agencies to minimize risks caused by unexpected events and build more resilient infrastructure. Major events are typically planned but they may still have negative effects on the transportation system, especially in small towns and rural areas. Major events require planning to manage the flow of people to and from the event and travel of people around the event area.

DISASTERS AND EMERGENCIES

Disasters and emergencies, such as severe weather, natural disasters and other emergencies, require a swift response to keep people, property, infrastructure and the environment safe. These events can cause short-term and long-term disruptions to the transportation system with closures, detours and safety issues. While disasters and emergencies are inherently reactive in nature, there is a lot of work that goes into designing resilient infrastructure and developing emergency response protocols to minimize and mitigate risks.

Climate change is also accelerating the frequency and intensity of severe weather events, requiring planning and design work to ensure resilient infrastructure that can withstand extreme events. Since 2000, rainstorms that used to be rare are now more frequent, with projections that these types of storms will increase in the future.[1] For example, from 1973 to 2020, there have been 16 mega-rain events in Minnesota, 11 of which occurred between 2000 and 2020.[2]

SEVERE WEATHER AND NATURAL DISASTERS

Severe weather events and natural disasters often arrive with little warning and can shut down the transportation system, leaving people stranded on the road, without a bus or forced to use alternative routes. MnDOT's Freeway Incident Response Safety Team (FIRST) team responds to highway incidents and can divert traffic, supporting the Minnesota State Patrol. For severe weather events where road closures are common (e.g., winter storms), many highway ramps are equipped with gate arms to physically close the highway to users. MnDOT also employs many tools to communicate changes in weather to travelers, like dynamic message signs, 511 travel information and live mapping, traffic cameras, speeds and live traffic information. The highway system also has designated rest areas that can be used during severe weather events for safe refuge. Table 1 summarizes these types of events, the potential impacts and response measures.

[1] "Climate Trends," MnDNR, accessed May 24, 2021, https://www.dnr.state.mn.us/climate/climate_change_info/climate-trends.html.
[2] "Historic Mega-Rain Events in Minnesota," MnDNR, accessed May 24, 2021, https://www.dnr.state.mn.us/climate/summaries_and_publications/mega_rain_events.html.

Table 1. Severe Weather and Natural Disasters in Minnesota

Types of events	Potential impacts	Response measures
Winter storm Flooding Tornado Fire Drought Excessive heat Debris flow/Landslide	Personal safety Road, rail, port and airport closures Road congestion/Long delays Detours Damage to infrastructure Crashes	Finding safe refuge Medical/Law Enforcement emergency response Freeway Incident Response Safety Team (FIRST) Road closures Emergency communications Dynamic message signs Ongoing traffic surveillance Emergency relief funding Detouring vehicular, transit, freight, non-motorized routes Repair/Replacement of infrastructure

LONG-TERM RESPONSES

Responses to these incidents can sometimes require long-term solutions including re-design and repair of infrastructure. MnDOT strives to design resilient infrastructure that can withstand the increased frequency and intensity of severe weather events. MnDOT has multiple research programs, studying topics such as pavement materials, to extend lifecycle, reduce costs and improve safety.[3] MnDOT also has ongoing programs and efforts to address climate and extreme weather events (Table 2). Aging infrastructure also requires more frequent maintenance and may be more likely to be impacted by severe weather events. See the Aging Infrastructure Trend Analysis and Climate Change Trend Analysis for more information on these topics.

[3] "Maintaining Minnesota's Highways: Maintenance Operations Research," MnDOT, accessed May 24, 2021, https://www.dot.state.mn.us/maintenance/research.html.

Table 2. MnDOT Efforts that Build Resilience to Climate and Extreme Weather by Program Area[4]

Program area	Examples
Planning	Slope Vulnerability Assessment and Stabilization Guide, Extreme Flood Vulnerability Assessment
Design and Environmental Review	Aquatic Organism Passage Guide, consideration of geomorphic design in floodplain culverts
Construction	Storm water and erosion control to protect assets, 2014 Flood Mitigation Program
Maintenance & Operations	Response salt management program, native and resilient plants, living snow fences, asset management
Emergency Response	State Aid betterment, Emergency Relief

CASE STUDY: HIGHWAY 210 IN NORTHERN MINNESOTA

In 2012, Highway 210 in Jay Cooke State Park was severely damaged after a storm. Mudslides and flooding washed out the roadway. The highway was closed for a few years while MnDOT surveyed the damage, redesigned and rebuilt the roadway. The re-built highway features 1,800 sensors above the roadway on the slope to detect soil movement and notify staff of potential issues.[5] Adding sensors allows staff to continually monitor the slope condition, address ongoing maintenance needs and respond quickly if unsafe conditions arise to keep people safe.

Figure 1. Highway 210 flooding damage (Photo Credit: Jim Sorenson)

[4] "Transportation Resilience: Current Practices and Opportunities for MnDOT," MnDOT, January 2020, https://www.dot.state.mn.us/sustainability/docs/resilience-report-2020.pdf.
[5] Dan Kraker, "5 years after flood, lone road through Jay Cooke state park reopens," MPR News, October 4, 2017, https://www.mprnews.org/story/2017/10/04/jay-cooke-state-park-bridge-reopens-after-flood.

OTHER TYPES OF DISASTERS AND EMERGENCIES

Non-natural disasters and emergencies range from nuclear disasters to power outages. These types of events require varying responses and impose varying threat levels to the public. MnDOT works closely with multiple agencies on emergency response protocols through the Minnesota Emergency Operations Plan.[6] The Minnesota Department of Safety is responsible for updating the plan. Events such as nuclear disasters, mass attacks and terrorism and hazardous materials incidents are rare. They are also typically isolated in a limited geographic area and the immediate response is focused on emergency aid, evacuating people and vehicles from the area and minimizing damage. Roads may be partially closed or fully closed as response teams assess the situation.

Cyberattacks using malware have a risk of causing intelligent transportation systems, such as dynamic message signs, to malfunction. This causes safety concerns and potential for congestion on the roadway. These types of events can be broader in geographic scope, more difficult to respond to for emergency response teams and longer in duration. MnDOT uses an Enterprise Risk Management framework to assess and manage security risks.[7] Additionally, as connected and automated vehicles become more prevalent, there will be an increasing need to protect the transportation system from cybersecurity threats. Safety and security, including protecting digital infrastructure and data, are areas of focus for Minnesota's CAV program as planning and preparation for connected and automated vehicles continues.

The recent COVID-19 pandemic is another example of a type of emergency that can affect transportation systems. Every part of the economy was disrupted. Lockdowns shifted consumption away from services and to durable goods. This rapid shift exposed vulnerabilities in an increasingly global supply chain with heavy reliance on foreign suppliers. This resulted in a mismatch in supply and demand that led to long wait times, price increases and system wide disruptions.[8] Impacts from the pandemic also extended beyond the economy and supply chain affecting overall traffic, transit ridership, walking and bicycling, safety and air quality.

MAJOR EVENTS

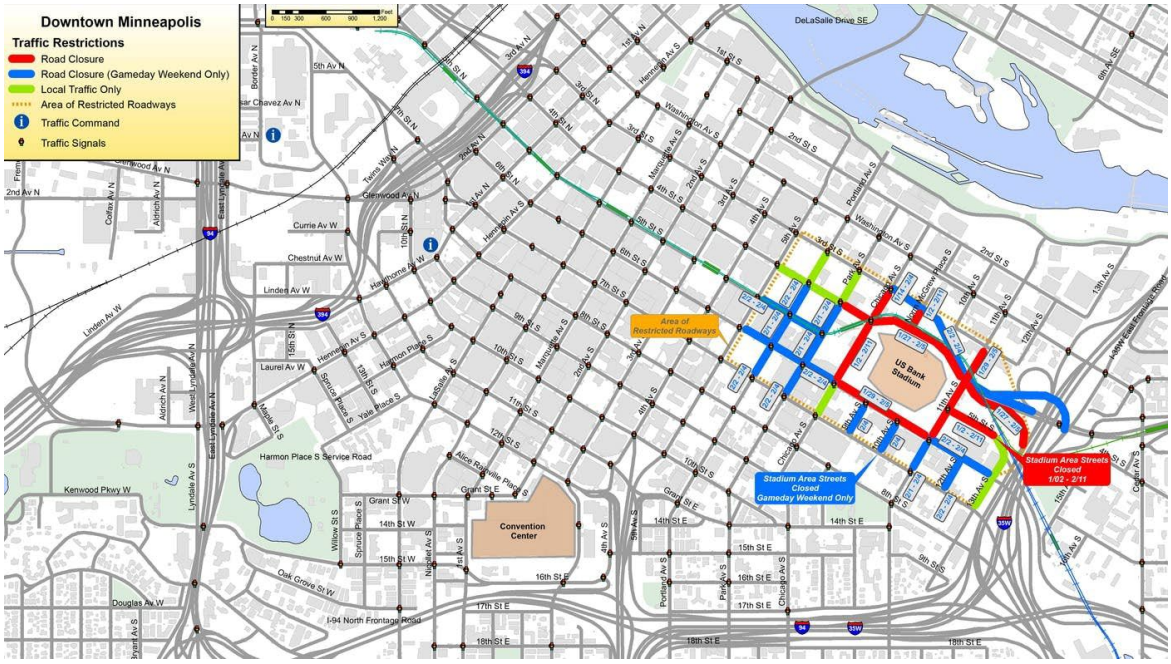
Major events across Minnesota bring communities together all year long and include fairs and festivals, entertainment, sporting events and large conferences or meetings. Major events are planned months in advance with coordination required across jurisdictions. Events like the Minnesota State Fair require coordination with the City of Minneapolis, the City of St. Paul, Metro Transit and other agencies to ensure that the transportation system operates with minimal disruption during the fair's duration. For example, Metro Transit runs special bus trips from park and ride lots throughout the seven-county metro area to encourage fair-goers to use transit and minimize congestion around the fairgrounds.

When the City of Minneapolis hosted the Super Bowl in 2018, several agencies worked together with NFL event planners to determine appropriate traffic management strategies to accommodate the millions of fans navigating

[6] "Maintenance Manual," MnDOT, November 10, 2015, https://www.dot.state.mn.us/maintenance/pdf/manual/chapter7emergency.pdf.
[7] National Academies of Sciences, Engineering, and Medicine, "Update of Security 101: A Physical Security and Cybersecurity Primer for Transportation Agencies" (Washington, DC: The National Academies Press, 2020), pp. 14-16.
[8] Santacreu, A. M. and LaBell, J. "Global Supply Chain Disruptions and Inflation During the COVID-19 Pandemic," Federal Reserve Bank of St. Louis, 2022, https://files.stlouisfed.org/files/htdocs/publications/review/2022/02/07/global-supply-chain-disruptions-and-inflation-during-the-covid-19-pandemic.pdf.

the city to various events around the downtown area. The city employed street closures, barricades and dynamic message board signs to manage traffic, including a gameday closure of two I-35W ramps. See Figure 2 for a map of the closures for the duration of the event. Nicollet Mall was closed to buses for the duration of the event to accommodate a Bold North pop-up event with winter sporting activities and entertainment.

Figure 1. Road closures during the Super Bowl in Minneapolis in 2018 (Source: City of Minneapolis)



Major events in smaller towns and rural areas often have resource constraints in planning and accommodating for an influx of people. Events like marathon races, music festivals and events at state parks can overwhelm the local transportation system even with careful planning. The transportation system itself is not built to accommodate a short-term increase in capacity in rural areas and small towns, so these events can lead to extended traffic congestion and higher risk for traffic crashes.

Road closures for planned major events can have negative impacts on emergency services and patient outcomes. In a study of 11 cities (including Minneapolis), researchers found ambulance transport times for Medicare patients experiencing heart attack or cardiac arrest were 32% longer on days when marathons occurred than days without marathons. Researchers also found higher 30-day mortality rates for Medicare patients experiencing heart attack or cardiac arrest on marathon days as compared to non-marathon days in these cities, though researchers were not able to confirm that delays in care due to road closures were responsible for this increased mortality. Researchers were unable to identify emergency response protocol discrepancies between cities that lead to different mortality outcomes.[9]

Protests are also a form of major event that may or may not include advance planning and coordination with agencies. Protests often occur on large streets and bridges, and at locations of community or historical

[9] Anupam B. Jena et al., "Delays in Emergency Care and Mortality during Major U.S. Marathons," New England Journal of Medicine 376, no. 15 (2017): pp. 1441-1450, https://doi.org/10.1056/nejmsa1614073.

significance.[10] The nature and mode of protest in the United States has undergone change in recent years, particularly in relation to racial justice and police brutality. Of the over 1,400 Black Lives Matter protests in the country between November 2014 and May 2015, over half shut down transportation infrastructure, a change from building-focused protests of earlier decades. Protests related to racial justice often focus on key transportation infrastructure to disrupt daily life and draw attention to the ways in which transportation systems oppress communities of color. Therefore, these protests often operate without formal governmental approval.[11] This shift in protest strategy has had impacts in the state of Minnesota. For example, in the seven-county metro area, I-94 and I-35W were closed by protesters demonstrating for racial justice after the murder of George Floyd in 2020. State highway patrol responded with diverting motor vehicle traffic from the freeway and closing ramps for the duration of the protests.

SPECIAL TRANSPORTATION NEEDS

Disasters, emergencies and major events require special transportation needs to respond to events and move goods and supplies to locations.

MOVING PEOPLE

Disasters, emergencies and major events affect a broad group of people who are responding to and/or supporting the event. Medical personnel, emergency responders, law enforcement, National Guard and others need to move quickly, and sometimes in large numbers, to respond to the event. For major events, beyond the attendees and performers, there are many staff required to put on an event, whether it's running security, serving food and beverages or janitorial work. All these people add passenger volume on the transportation system and sometimes require complex scheduling to manage shifts. For example, the Minnesota State Fair has approximately 2,300 fair-time staff.[12]

EFFECTS TO VULNERABLE POPULATIONS

Disasters, emergencies and major events can negatively affect many people and can particularly impact vulnerable populations. In the case of major events, the impacts often spread beyond just individuals participating in the event. Additional congestion, detours and transit routing changes can all add travel time and difficulty to trips. For vulnerable populations where travel and mobility are limited under normal circumstances, impacts from a disaster, emergency or major event can decrease a person's access to reliable transportation and can have potentially profound impacts.

MOVING GOODS

The movement of goods in response to a disaster or emergency requires use of Minnesota's freight system capacity. Just like the movement of people, goods need to be delivered quickly to support recovery efforts. The

[10] "Streets for Pandemic Response & Recovery: Streets for Protest," National Association of City Transportation Officials, August 19, 2020, https://nacto.org/publication/streets-for-pandemic-response-recovery/emerging-street-strategies/streets-for-protest/.
11 Emily Badger, "Why highways have become the center of civil rights protest," The Washington Post, July 13, 2016, https://www.washingtonpost.com/news/wonk/wp/2016/07/13/why-highways-have-become-the-center-of-civil-rights-protest/
[12] "Employment Opportunities," Minnesota State Fair, May 25, 2021, https://www.mnstatefair.org/get-involved/employment/.

Minnesota National Guard has been deployed over multiple years to respond to flooding on the Red River in Marshall County. In 2020, 20 soldiers were mobilized to support residents in the transportation of people, supplies and mail in the flooded town of Oslo, MN.[13]

Figure 2. Minnesota National Guard responding to flooding in Oslo, MN 2020 (Photo Credit: Minnesota National Guard)

RELATED TRENDS

- Aging Infrastructure
- Climate Change
- Health and Transportation
- General Transportation Safety
- Transportation Behavior

Minnesota's vision for transportation is known as Minnesota GO. The aim is that the multimodal transportation system maximizes the health of people, the environment and our economy. A transportation vision for generations, Minnesota GO guides a comprehensive planning effort for all people using the transportation system and for all modes of travel. Learn more at MinnesotaGO.org.

REVISION HISTORY

Date	Summary of revisions
April 2022	Original paper.

[13] "Minnesota National Guard Activated for Red River Flood Response," Minnesota National Guard, April 8, 2020, https://minnesotanationalguard.ng.mil/minnesota-national-guard-activated-for-red-river-flood-response/.