Photo: Alison Tagert-Barone, National Park Service

Millions of people flocked to viewing sites like this one at Homestead National Monument in Nebraska to watch the 2017 total solar eclipse. The concentrated traffic created gridlock on roads across the country.

Total Solar Eclipse on August 21, 2017

Special Event with Coast-to-Coast Traffic Congestion

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The August 21, 2017, total solar eclipse was a special event unlike any other. Millions of visitors traveled to and from the narrow path of totality that extended across the United States, congesting the transportation network. Successfully managing traffic and parking was a major challenge for those who planned for and carried out the day's event management.

The millions of people drawn to locations along the eclipse path taxed limited transportation facilities, and traffic congestion was intense in many locations. Across the country, Interstate highways near the path of totality experienced traffic congestion shortly after the eclipse, with longer-than-normal travel times on Interstate highways. For example, travel from Casper, Wyoming, to Denver, Colorado—normally a 4-hour trip—took 10 hours or more. Traffic congestion on rural Interstate routes lasted for up to 13 hours after the eclipse.

Although transportation professionals have been conducting special-event traffic management for decades, this event was unusual. As the first total solar eclipse visible in the mainland United States since 1979, it was a very rare event and most agencies

Eclipse enthusiasts ride Amtrak's Southwest Chief from New Mexico to Missouri, near the path of totality. Amtrak ran several special trains tailored to the event.

Photo: Malcom K. Flickr

had no experience planning anything like it. Passing through 12 states from Oregon to South Carolina, the eclipse's path was linear in extent, with watchers concentrated around the centerline of the path. The event attracted enthusiastic eclipse watchers from around the world, called "eclipse chasers."

The eclipse lasted for a very short period—between 2 and 3 minutes for the length of totality—and although the arrival times of observers varied, their departure times were concentrated in a much smaller window. These factors combined to bring together large numbers of viewers and vehicles in small areas.

Forecasting traffic demand for this event was exceedingly difficult, but lodging facilities sold out a year in advance along much of the eclipse path—indicating that many areas would see huge influxes of people and vehicles. Some areas reached capacity and closed to inbound traffic before the eclipse even occurred.

Lessons Learned

Although the August 21, 2017, total solar eclipse was the first in the mainland United States in 38 years, the next eclipse is less than 6 years away—on April 8, 2024—and its path stretches from Texas to New England. The lessons learned in the 2017 eclipse can help transportation agencies better prepare for the 2024 eclipse. These findings include the following:

◆ **Huge numbers of viewers traveled to the path of totality**. The best estimate is that at least 5 million people traveled. See page 7 for more information on this estimate.

◆ **Almost all viewers traveled to the path of totality by motor vehicle**. Amtrak ran a special solar eclipse train from Chicago to Carbondale, Illinois. Some viewers flew via private or charter aircraft to airports within the path of totality. Although some small airports were concerned that they might run out of aircraft parking space, there are no known instances of this occurring. Some viewers flew commercial flights to nearby airports and drove to the path of totality. According to many anecdotes, seats on outbound flights from nearby commercial airports were unavailable after the eclipse.

◆ **Roadways experienced very little traffic congestion on the days leading up to totality**. The eclipse occurred on a Monday. Travel to the path of totality was spread over multiple days.

◆ **A major, immediate, post-eclipse exodus on Monday created traffic congestion on roadways leading away from the path of totality all across the United States**. The messaging used by many agencies was "arrive early, stay late." Although arrivals spread over multiple days, a large majority of eclipse watchers departed the same day. Some waited until Tuesday for their return trip; correspondingly, traffic levels were lower then. For example, the number of travelers heading south from eastern Wyoming to Colorado on Tuesday was 41 percent of the number of travelers on that route on Monday.

◆ **In the hours immediately following totality, almost every Interstate route passing through the**

path of totality showed red on Google Traffic maps. The screenshot from Google Traffic on page 9 was taken at approximately 3:30 p.m. EDT, about 45 minutes after the end of totality and well before the peak-period traffic congestion normally expected in the evening. Note that major urban areas outside the path of totality do not show traffic congestion.

◆ **On some Interstate routes, traffic congestion, slow speeds, and long travel times lingered for up to 13 hours after totality**. The headline at right, from the Lexington Herald-Leader in Kentucky, sums it up: "The rare eclipse was memorable. The ride home was something they want to forget."

◆ **Rural, nonfreeway routes also experienced significant traffic congestion, slow speeds, and long travel times**. An analysis by INRIX showed that four of the top five post-eclipse bottleneck locations, measured by duration and length of queue, were on nonfreeway routes. These four locations had congestion durations lasting from 7 to 15.5 hours; the maximum queue lengths at three locations ranged from 45 to 70 miles.

◆ **Evidence from three freeway locations, both urban and rural, showed that traffic flow on Monday afternoon degenerated to forced-flow, level-of-service-F conditions**. These facilities were not operating at anywhere near their capacity, which under ideal conditions is approximately 2,400 passenger cars per hour per lane. Average travel speed was about 20–30 mph and throughput was 1,000–1,500 vehicles per hour per lane.

◆ **Many state departments of transportation with roadways in the path of totality worked hard to minimize freeway lane closures for construction or maintenance**. If lane closures had not been minimized, congestion would have been much more severe.

◆ **Anecdotal and media accounts show that even some states not in the path of totality experienced increased freeway traffic congestion**. According to accounts, some nearby states allowed lane closures on August 21, causing congestion problems. The moral of the story is to prepare for increased traffic, even in areas far from the path of totality.

◆ **State transportation agencies worked hard on public messaging and communications**. Messages

Photo Courtesy Jonathan Upchurch

Western Kentucky Parkway eclipse traffic near Elizabethtown at 7:45 p.m. Monday, long after the eclipse ended. Steven Townsend Facebook post

STATE

The rare eclipse was memorable. The ride home was something they want to forget.

BY MIKE STUNSON
mstunson@herald-leader.com

August 22, 2017 11:37 AM
Updated August 23, 2017 12:08 PM

Photo: Jonathan Upchurch

A changeable message sign on I-15 in Utah warns of traffic delays related to the eclipse.

Cars crawl along I-15 in Idaho on the day of the eclipse.

Photo: Daniel Case, Wikimedia

about roadway safety—for example, "No Parking on Highway for Solar Eclipse" signs—were widespread, as were reminders to wear protective eyewear, expect traffic congestion, and to arrive early and stay late. These messages may have helped to spread out arrivals. These messages were displayed on changeable message signs and disseminated via other communication avenues. In 2024, stronger efforts to urge viewers to stay put and stay late can help deter the extreme post-eclipse peaking that occurred in 2017.

◆ **State and local agencies** deployed large numbers of service vehicles to respond to incidents and large numbers of flaggers and police to direct traffic at bottleneck locations.

◆ **To see the eclipse, viewers will position themselves at any location they believe to be legal**. These locations include highway rest areas, public lands, parks, and roadsides on lower-volume roads. Many venues were established to host eclipse viewers, including university stadiums, eclipse festivals, and parks. Vehicle parking is necessary at every location. Although rest facilities are not usually a transportation issue, viewers do need bathrooms wherever they choose to view the eclipse. Many transportation agencies deployed portable toilets at widespread locations.

◆ **The April 8, 2024, total solar eclipse may attract even greater interest than the August 21 event**. At the 2018 TRB Annual Meeting, an informal "show of hands" poll at a session on the August 21 eclipse asked two questions: 1) did you see totality on August 21 and 2) if so, are you intent on seeing

Photo: Eddie Yip, Flickr

Eclipse campers in Idaho. Although many public venues hosted organized gatherings, some viewers chose out-of-the-way locations. These had less traffic, but fewer facilities.

totality on April 8, 2024? Almost every person who raised their hand for the first question also raised their hand for the second question. Many first-time viewers will attend the 2024 eclipse because of what they heard from those who saw the eclipse in 2017. The event also will have a high number of repeat participants.

◆ **Most of the path of totality was cloud-free on August 21; in only a few locations, travelers were deterred by cloudy skies**. For the April 8, 2024, eclipse, planners need to assume that skies also will be clear and to prepare for large numbers of vehicles and people.

◆ **Attractions in and near the path of totality can expect high visitation on days before and after an eclipse**. For example, Yellowstone National Park had to close the entrance to Old Faithful and its 1,000-space parking lot on both Tuesday and Wednesday after the eclipse because the parking lot had filled.

◆ **For the April 8, 2024, event, border crossings between upstate New York and Canada and upper New England and Canada may be much higher than usual**. Canadians may want to enter New York to be closer to the centerline and to experience longer totality. Viewers on either side of the U.S.–Canada border may be searching for clear skies that are not available in their home country.

How Many People Traveled?

It was exceptionally difficult to predict the number of viewers who would travel to the path of totality. It had been 38 years since the last total solar eclipse on the U.S. mainland, so transportation agencies and others had no recent experience to draw upon.

A forecast model was created by Michael Zeiler, an employee of ESRI and the creator of the Great AmericanEclipse.com website. Using GIS tools, census data, and a road-network model of every street in the lower 48 states, Zeiler estimated that between 1.8 and 7.4 million people would travel to the path of totality. He also estimated the number of people who would travel to specific locations all along the path of totality.[1]

To document the actual numbers of people who traveled to the eclipse, the author of this article sought data from traffic-counting stations in Wyoming and Idaho. That data created a good estimate of actual numbers for those locations. Like all states, both Wyoming and Idaho have extensive networks of traffic-counting stations on the roadway system. The analysis utilized hourly traffic count data from selected dates before, after, and on August 21, 2017.

[1] Additional information on Zeiler's model can be found at www.greatamericaneclipse.com/statistics.

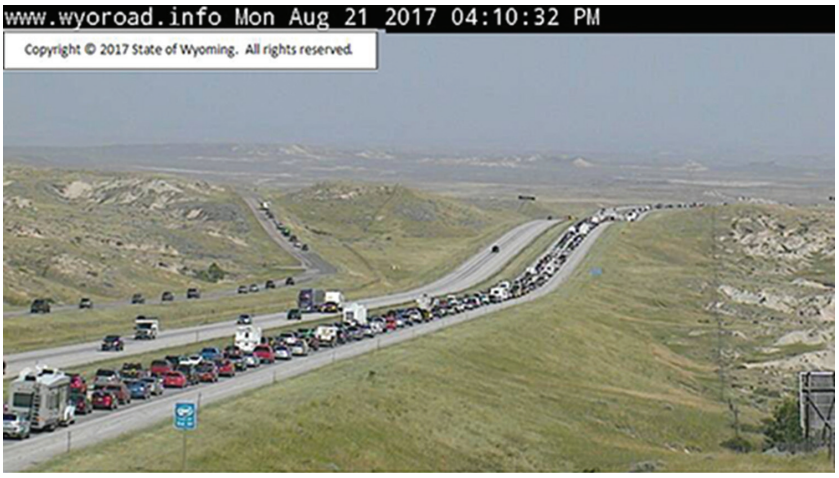


Photo: Wyoming DOT

A traffic camera captures the traffic congestion on I-25 on August 21, 2017.

Wyoming

The path of totality in Wyoming stretched from near Jackson in northwestern Wyoming to just north of Torrington in eastern Wyoming. Many eclipse observers traveled from the more-populated Front Range in Colorado (a population of more than 4 million) to points in eastern Wyoming. I-25 was the primary facility serving this population.

The author's analysis focused on post-eclipse traffic. Although a huge exodus occurred immediately after the eclipse, a significant number of eclipse viewers waited until the following day, Tuesday, August 22, to leave the eclipse path.

I-25 was the most heavily traveled route from the path of totality in eastern Wyoming to population centers along Colorado's Front Range. The generally east–west alignment of I-25 from Casper to Douglas to Glendo was located near the centerline of the path of totality. From Glendo, I-25 heads south toward Cheyenne and Colorado. All of I-25 is a four-lane

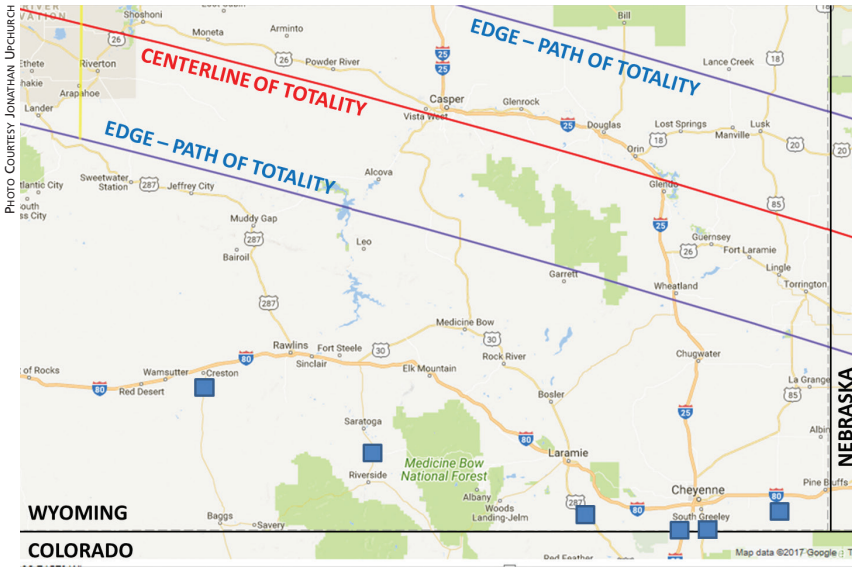


Photo Courtesy Jonathan Upchurch

Path of totality in eastern Wyoming and locations of traffic counting stations.

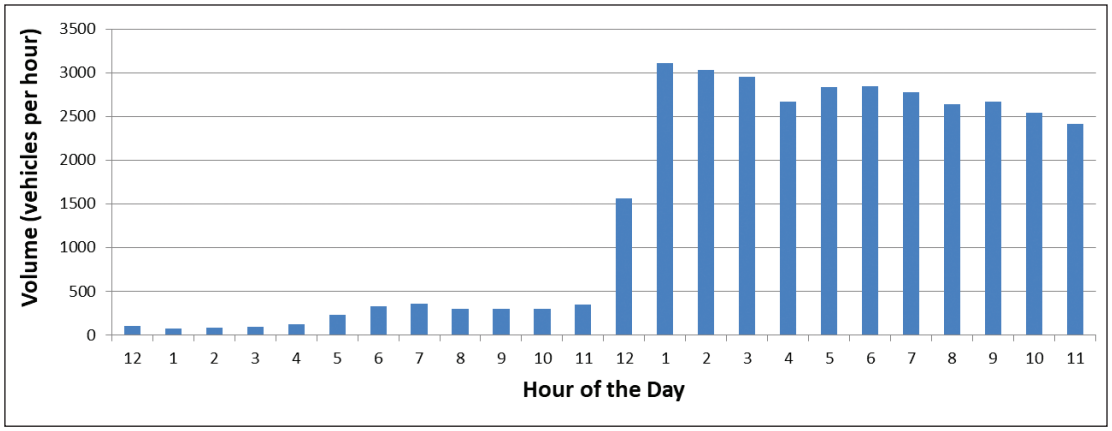


FIGURE 1 Southbound hourly traffic volume at I-25's Milepost 1 in Wyoming, August 21, 2017.

divided freeway, from Casper to Colorado.

Normally, the 278-mile trip from Casper to Denver on I-25 is approximately 4 hours driving time. After the eclipse on August 21, media commentaries and anecdotal accounts reported travel times of up to 10 hours from Casper to northern Colorado. A review of I-25 southbound traffic count data shows very heavy traffic volumes from noon until 1:00 a.m. the following morning. The traffic counting station at Milepost 1, 1 mile north of the Colorado–Wyoming state line, showed that volume jumped from 351 at 11:00 a.m., to 1,565 at noon, to 3,114 at 1:00 p.m. (Figure 1). Traffic volumes then declined slowly, to 2,303 vehicles per hour after midnight. Media accounts reported that traffic speeds from early afternoon to late night were very slow.

Using the Screenline A screenline is an imaginary line on a map that can be used to count traffic going from one side of the line to the other. A screenline was created covering the eastern half of Wyoming along the Wyoming–Colorado border, from Wyoming Route 789 on the west to the Nebraska border on the east. Unlike in the central and eastern United States, the roadway network in Wyoming consists of a small number of widely separated state highways. No other paved roadways offer alternative routes between these state highways. The roadway network is sparse and may lack the capacity for an event like the eclipse.

Traffic counts were available from six traffic-counting stations along this screenline at locations that would have captured almost all of the post-eclipse southbound traffic in the eastern half of Wyoming. Hourly traffic counts for the southbound direction, beginning at noon on Monday, August 21, and ending at 9:59 p.m. on Tuesday, August 22, were scrutinized.[2] This period captured the exodus of people headed south from the path of totality.

For each hour, the hourly count on August 21 was compared to the average of the hourly counts during the same hour on the preceding four Mondays and on the one following Monday, all acting as a baseline for comparison. August 22 hourly counts were compared in a similar way. Hourly counts, beginning at 10:00 a.m. on Monday, August 21, and ending at 10:00 p.m. on Tuesday, August 22, are depicted in red in Figure 2, which depicts the traffic volumes for all six traffic-counting stations combined. The baseline volumes on the comparison dates are shown in blue.

Analysis Southbound traffic counts on Monday (noon to midnight) were 48,275 vehicles higher than the baseline. Southbound counts on Tuesday (midnight to 9:59 p.m.) were 19,789 vehicles higher than

[2] Totality ended in eastern Wyoming at approximately 11:45 a.m. on Monday.

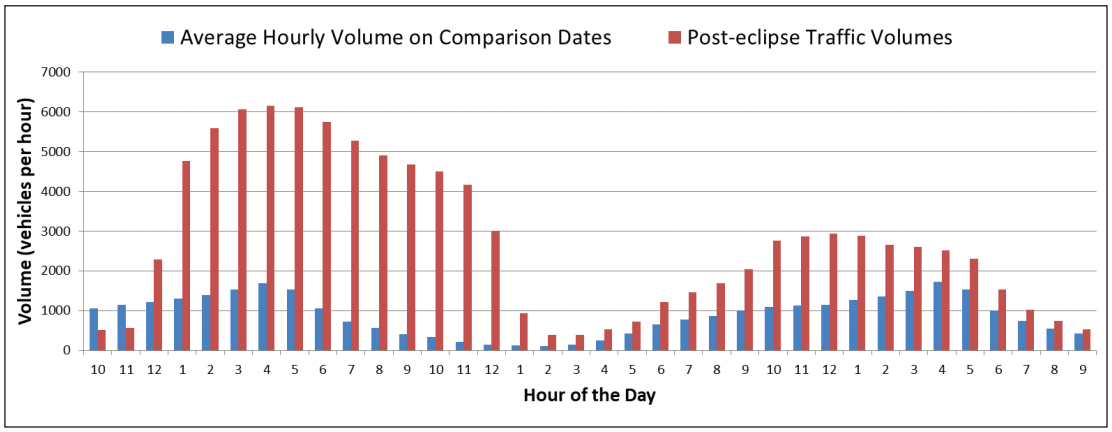


FIGURE 2 Southbound hourly traffic volume (red) in Screenline, Wyoming, August 21–22, 2017, versus comparison dates (blue).

the baseline. The combined total for both days was 68,063 extra vehicles—in other words, 68,063 more vehicles passed southbound from Wyoming to Colorado in the 34-hour period following the eclipse than would otherwise have been expected.

It is reasonable to assume that, for eclipse viewing, each vehicle would contain 3.0 persons. Three persons per vehicle × 68,063 vehicles = 204,190 persons who observed the eclipse in eastern Wyoming, coming from locations south of the Wyoming–Colorado border.

It is interesting to compare the above estimate of 204,190 persons with Zeiler's forecast. For the eastern half of Wyoming—the area captured by the traffic count data—Zeiler's high estimate was about 156,400. This included path-of-totality locations from Casper eastward to the Nebraska state line. Zeiler's estimate included visitors coming from both the north and the south, and included visitors from points north of the Wyoming–Colorado border that were not captured by the screenline analysis. Thus, the traffic count–derived estimate of 204,190 visitors greatly exceeds Zeiler's high estimate of 156,400.

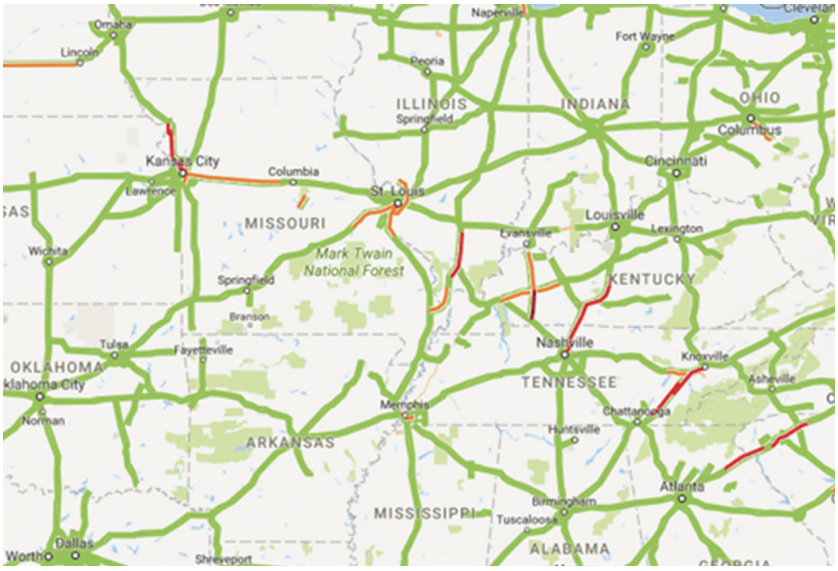
Idaho

A similar analysis was conducted for eastern Idaho, where I-15 brought travelers to the path of totality from the large population center of 2.4 million people along northern Utah's Wasatch Front.

The author's analysis—again based on traffic counts—estimated that 124,204 persons who observed the eclipse in eastern Idaho came from locations south of the Idaho–Utah border. Zeiler estimated that eclipse visitation to eastern Idaho would be between 70,000 and 280,000 persons. The actual, traffic count–derived visitation estimate of 124,204 falls within the range of Zeiler's high and low estimates. It should be noted, however, that Zeiler's estimate included visitors arriving from both the north and south as well as those who originated between the Idaho–Utah border and the path of totality.

Estimation of 2017 Viewing Total

The Wyoming and Idaho traffic counts provide two comparisons with Zeiler's estimates. In Wyoming, actual visitation was higher than Zeiler's high estimate. In Idaho, actual visitation was within the range of Zeiler's high and low estimates. If the Wyoming and Idaho experiences are representative of those of the other states—and noting Zeiler's estimate that nationwide, travelers to the path of totality numbered between 1.8 and 7.4 million—it is reasonable to conclude that at least 5 million people traveled to view totality.



Sections of red, showing slow traffic, in this Google Traffic screenshot on August 21, 2017, follow the path of the total solar eclipse across the Midwest and South.

Looking Ahead to 2024

Transportation professionals have been conducting special-event traffic planning and management for decades—athletic events such as the the Super Bowl, parades, holiday celebrations, and fireworks displays. The 2017 total solar eclipse was unlike any other special event, however. At 5 million participants, it was likely the largest special event in U.S. history. For comparison, 5 million people leaving the path of totality at once is like 71 sellout football games ending at the same time.

Several major population centers are located within a 3-hour drive of the path of totality of the April 8, 2024, solar eclipse. These include the metropolitan areas for Chicago (9.5 million); Houston (6.9 million); Toronto (6.4 million), Ontario, Canada; Boston (4.8 million); Detroit (4.3 million); St. Louis (2.8 million); Pittsburgh (2.3 million); and Cincinnati (2.2 million). Lessons learned from August 21, 2017—along with an understanding that viewers will travel in large numbers—can help transportation agencies be better prepared for the 2024 total solar eclipse.

Photo: Jonathan Upchurch

Eclipse totality.